May 9, 2015

Dorrance H. Hamilton Building
1001 Locust Street

Sidney Kimmel Medical College
Thomas Jefferson University
Philadelphia, PA 19107
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<td>A Survey of Naloxone Use in Hospital Personnel as an Assessment of Safety</td>
<td>Steven W. McGrath MD</td>
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<td>Jaime L. Baratta MD</td>
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<td>OR-2</td>
<td>Histopathological Observations in the Brains of Children Exposed to Inhalational Anesthetic Agents: A Retrospective Autopsy-Based Study</td>
<td>Leigh A Stevens, MD, MBA</td>
<td>Drexel University College of Medicine/Hahnemann Hospital</td>
<td>Michael S. Green DO</td>
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<td>OR-3</td>
<td>Comparison between the risk falls after Total Knee Arthroplasty with use of femoral nerve block versus adductor canal block</td>
<td>Sean Antosh MD</td>
<td>Hospital Of The University of Pennsylvania</td>
<td>Nabil Elkassabany MD MSCE</td>
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<td>OR-4</td>
<td>The Role of Ethnicity in Liver Transplantation Thrombotic Complications</td>
<td>Venkataraman Iyer, MD</td>
<td>Penn State Hershey Medical Center</td>
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<td>OR-6</td>
<td>Retrospective Analysis Of Pain Management In Patients Undergoing Pancreatectoduodenectomy And Liver Resection</td>
<td>Babatunde Afitiaka, MD</td>
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<td>Sonia Vaida, MD</td>
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<td>Sedation Strategies For Procedures In The Cardiac Electrophysiology Laboratory</td>
<td>Julie E. DeVore, DO, MPH</td>
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<td>Providers’ Perceived Barriers To Quality</td>
<td>Christian Lauver MD</td>
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<td>Matthew McClain MD</td>
<td>Penn State Hershey Medical Center</td>
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<td>Hypoalbuminemia more than Morbid Obesity is an Independent Predictor of Complications after Total Hip Arthroplasty</td>
<td>Daniel Abraham, MD</td>
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<td>Retrospective Analysis Of Rib Fractures: Epidemiology, Associated Morbidity and Risk Factors</td>
<td>Brian Hertzberg MD</td>
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<td>Innovative Health Systems Projects</td>
<td>Mansoor M. Aman, MD</td>
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<td>Optimization of Ventilation During Laparoscopic Surgery Using a Lung Simulator Model</td>
<td>Emily J. MacKay, DO</td>
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<td>David M. Maguire MD</td>
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<td>Zev Noah Kornfield, MD</td>
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<td>Jacob T Gutsche MD</td>
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<td>CRNA Billed-to-Staffed Hours as a Measure of Operating Room Efficiency Across a Large Multi-Hospital Health Care System</td>
<td>Andrius Giedraitis, MD, MBA, MSE</td>
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<td>Mark Hudson, MD, MBA</td>
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<td>Incorporating an OR Performance Report Card into Personal Effectiveness Evaluation in a Large Anesthesiology Training Program</td>
<td>Andrius Giedraitis, MD, MBA, MSE</td>
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<td>Evaluation of Neurological Outcomes after Interscalene Nerve Block for Ambulatory Shoulder Surgery</td>
<td>Keith Vogt, MD for Gaurav Rajpal, MD</td>
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<td>Marc B. Royo MD, MBA</td>
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<td>Amanda Lukof, MD</td>
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<td>Ian Yuan, MD</td>
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<td>Practice Patterns and Impact of Tidal Volume During One-Lung Ventilation on Outcome in Patients Undergoing Esophagectomy</td>
<td>Patrick Hackett, MD</td>
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<td>Murat Kaynar, MD</td>
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<td>Gerhardt Konig, MD</td>
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<td>Jonathan H. Waters, MD</td>
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<td>Prescribing Patterns of Discharge Pain Regimen for Patients Undergoing Common Surgical Procedures</td>
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<td>Use of Skeletal Muscle Relaxants in the Postoperative Period</td>
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<td>Emergency Department Pain Management in Cognitively Impaired Versus Cognitively Intact Older Adults with Hip Fracture</td>
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<td>FIBTEM is More Sensitive than EXTEM and Kaolin-TEG in Detecting Fibrinolysis: Part II of a Prospective Comparative Study Between ROTEM® vs. TEG® in Liver Transplantation</td>
<td>Ezeldeen Abuelkasem, MD, MSc</td>
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<td>Tetsuro Sakai, MD</td>
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<td>Thrombocytopenia as etiology of bleeding associated with veno-venous ECMO</td>
<td>Ronak Shah MD</td>
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<td>Retrospective Review of Pediatric Cardiac Tumors Between 1986-2014 at The Penn State Milton S. Hershey Medical Center</td>
<td>Natalya N.M. Riek, DO, MS</td>
<td>Penn State Hershey Medical Center</td>
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<td>Jansie Prozesky, MB, ChB</td>
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<td>Distinct Effects of Propofol and Methohexital at Individualized Dosages on Seizure Induction and Seizure Duration During Electroconvulsive Therapy</td>
<td>Mehreen Iqbal, MD</td>
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<td>Michael H. Entrup, MD, and Dietrich Gravenstein, MD</td>
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<td>The Impact of Severity and Duration of Hypotension on Outcomes Following Out-of-Hospital Pediatric Cardiac Arrest</td>
<td>Elizabeth K. Lavreriere, MD, MPH</td>
<td>Hospital Of The University of Pennsylvania</td>
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<td>Alexis A. Topjian, MD, MSCE</td>
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<td>OR-35</td>
<td>Talk Is Cheap: A Half-Day Retreat For Improving Communication Between Surgeons And Anesthesiologists</td>
<td>JA Leckie MD</td>
<td>Penn State Hershey Medical Center</td>
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<td>Julie Vuong, MD</td>
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<td>OR-36</td>
<td>Optimization of ultrasound probe positioning during endotracheal tube placement confirmation in the cadaveric model.</td>
<td>Sokpoleak So MD</td>
<td>University of Pittsburgh Medical Center</td>
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<td>Steven L. Orebaugh MD</td>
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<td>OR-37</td>
<td>Advance Directives and Operating: Room for Improvement?</td>
<td>Rachel Hadler, MD</td>
<td>Hospital Of The University of Pennsylvania</td>
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<td>Fleisher LA, MD</td>
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<td>OR-38</td>
<td>The effect of CPAP simulation and training on operator proficiency</td>
<td>Corey Herman, MD</td>
<td>Thomas Jefferson University</td>
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<td>David Maguire MD</td>
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## CASE REPORTS

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<td>Bronchoscopy for Biopsy of Large Hilar Mass Compressing Carina and Superior Vena Cava</td>
<td>James Lincoln MD</td>
<td>Drexel University College of Medicine</td>
<td>Mario Drexel University College Gonzalez DO</td>
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<td>“Pop” on Induction; An Unanticipated Complete Airway Obstruction In A Child for Dental Surgery</td>
<td>P. Saththasivam, MD</td>
<td>Drexel University College of Medicine</td>
<td>Yuri Shevchenko, MD</td>
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<td>Neurologic complications after bariatric surgery</td>
<td>Marlene Barnhouse, MD, PhD</td>
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<td>Anita Gupta, DO, PharmD</td>
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<td>Goltz Syndrome: A Dermatologic Urgency Turned into an Airway Emergency</td>
<td>Sadie Smith, MD</td>
<td>Penn State Hershey Medical Center</td>
<td>Kavita Gadkho, MD, Dimitri Guvakov, MD</td>
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<td>Tension Pneumothorax During Elective Tracheotomy</td>
<td>Kevin Funez, MD</td>
<td>Penn State Hershey Medical Center</td>
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<td>Intraoperative use of Point of Care Ultrasonography (POCUS) for Stat Cesarean Delivery with Refractory Hypoxemia</td>
<td>Nicholas J Schott MD</td>
<td>University of Pittsburgh Medical Center</td>
<td>Susan McEiroy, DO</td>
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<td>Presumed S1 Transforaminal Epidural Steroid Injection-Induced Reactivation of Herpes Zoster Along The Corresponding Dermatome.</td>
<td>Brandon Rein DO</td>
<td>Penn State Hershey Medical Center</td>
<td>Julia Caldwell MD, Vitaly Gordin MD</td>
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<td>CR-8</td>
<td>Unilateral Approach To Neurolytic Superior Hypogastric Plexus Block For Chronic Pelvic Pain Associated With Cancer</td>
<td>Kathryn Price, MD</td>
<td>Allegheny Health Network</td>
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<td>Ultrasound-Guided Transversus Abdominis Plane Block For The Treatment Of Postoperative Pain Following Iliac Crest Bone Grafting</td>
<td>Kathryn Price, MD</td>
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<td>Rafik Tadros, MD</td>
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<td>A Case Of Cutaneous Manifestations Of Granulomatosis With Polyangiitis And Steroid Induced Skin Atrophy Resulting In A Significant Skin Laceration Intraoperatively After Routine Iv Access</td>
<td>Emily Penick, MD for Rano Faltas MD</td>
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<td>A Novel Approach To The Management Of Parsonage-Turner Syndrome</td>
<td>Emily Penick, MD for Rano Faltas MD</td>
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<td>Methemoglobinia induced by benzocaine spray</td>
<td>Christopher Hoffman DO</td>
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<td>Pramood Kalikiri MD</td>
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<td>Autotriggering caused by cardiogenic oscillation during pressure support mechanical ventilation</td>
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<td>Quantification of Supraglottic Edema in Epiglottitis and the Role of Video Laryngoscopy</td>
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<td>Epidural Anesthesia for Renal Transplant in a Patient with Severe Pulmonary Disease</td>
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<td>Stress Cardiomyopathy in Liver Transplant</td>
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<td>Anesthetic Management of Cesarean Section in a Parturient with Heterotaxy Syndrome and Severe Mitral Stenosis, a Case Report</td>
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<td>Novel Use of Pharmacogenetic Testing in the Identification of CYP2C9 Polymorphisms Related to NSAID-Induced Gastropathy</td>
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<td>Repeated Cardioplegic Arrest of Donor Allograft During Orthotopic Heart Transplant</td>
<td>Natalia Martinez Acero, MD</td>
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<td>Modified nasal trumpet for airway management of a patient with undiagnosed obstructive sleep apnea undergoing an awake craniotomy</td>
<td>Uzung Yoon, MD</td>
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<td>Management of Hepatopulmonary Syndrome Post Liver Transplant</td>
<td>Amanda Lukof, MD</td>
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<td>Elia Elia, MD; Yoogoo Kang, MD</td>
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<td>Maternal Cyclical Tachycardia During Labor: A Sign of Hypovolemia</td>
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<td>Pneumothorax after trigger point injections – Is it really as rare as we think?</td>
<td>Neha M. Soares MD</td>
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<td>Subcutaneous emphysema and pneumo-mediastinum secondary to pyriform sinus perforation during an emergent intubation attempt</td>
<td>Neha M. Soares MD</td>
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<td>Anesthetic considerations for a large, long-standing, symptomatic traumatic diaphragmatic hernia repair.</td>
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<td>Saket Singh, MD</td>
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<td>Hospital of the University of Pennsylvania</td>
<td>Krzysztof Laudanski MD PhD</td>
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<td>Matthew M. Corriveau, MD</td>
<td>Geisinger Medical Center</td>
<td>Michael H. Entrup MD</td>
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<td>An Incidental Finding of Cleft Palate—A Case Report</td>
<td>Anish Sethi DO</td>
<td>Temple University Hospital</td>
<td>D. Kim MD</td>
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<td>Arrhythmia During Transversus Abdominis Plane Block With EXPAREL</td>
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<td>Milena Pilipovic, MD</td>
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<td>Michael S. Thompson, DO</td>
<td>University of Pittsburgh Medical Center</td>
<td>Theresa A. Gelzinis, MD</td>
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<td>Dynamic Airway Collapse Masquerading as Esophageal Intubation?</td>
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<td>Drexel University College of Medicine</td>
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<td>The Perioperative Management Of An Adult Patient With A Symptomatic Mediastinal Mass</td>
<td>Bradley Hammond, DO</td>
<td>Temple University Hospital</td>
<td>Cherrie Erkmen, MD, Scott Schartel, DO</td>
</tr>
<tr>
<td>CR-40</td>
<td>Amniotic Fluid Embolism – A surviving case</td>
<td>Manish Shah MD</td>
<td>Penn State Hershey Medical Center</td>
<td>Sonia Vaida MD, Anita Malhotra MD</td>
</tr>
<tr>
<td>CR-41</td>
<td>Delayed Onset of Horner’s Syndrome after a Stellate Ganglion Block in a patient with Complex Regional Pain Syndrome – Case Report</td>
<td>Manish Shah MD</td>
<td>Penn State Hershey Medical Center</td>
<td>Julia Caldwell, MD</td>
</tr>
<tr>
<td>CR-42</td>
<td>Extracorporeal Membranous Oxygenation (ECMO) as Support for Hemophagocytic Lymphohistiocytosis (HLH)</td>
<td>Rachel Hadler, MD</td>
<td>Hospital of the University of Pennsylvania</td>
<td>Krzysztof Laudanski, MD</td>
</tr>
<tr>
<td>CR-43</td>
<td>The Use Of A Continuous Infusion Of Intravenous Heparin To Treat Intracardiac Thrombosis During Liver Transplantation</td>
<td>Caroline Protin, MD</td>
<td>Penn State Hershey Medical Center</td>
<td>Dimitri Bezinover, MD</td>
</tr>
<tr>
<td>CR-44</td>
<td>Fontan physiology with situs inversus for laparoscopic cholecystectomy</td>
<td>Vishal Patel MD</td>
<td>Drexel University College of Medicine</td>
<td>Nagaraj Lingaraju MD</td>
</tr>
</tbody>
</table>
A Survey of Naloxone Use in Hospital Personnel as an Assessment of Safety

Steven W. McGrath MD¹, Jaime L. Baratta MD², Kishor Gandhi MD MPH CPE³, Eugene R. Viscusi MD²

1. Department of Anesthesiology, Thomas Jefferson University Hospital, 2. Jefferson Medical College, Thomas Jefferson University, 3. Department of Anesthesiology, University Medical Center of Princeton

Introduction

Naloxone is an opioid antagonist used for treatment of opioid induced respiratory depression or overdose and can be titrated to effect. Excessive dosing in chronic opioid users precipitates withdrawal symptoms ranging from tachycardia or hypertension to pulmonary edema or death¹. Usage typically occurs in urgent situations, potentially with inexperienced administrators. We aim to assess the knowledge base for naloxone use in an academic setting from a variety of healthcare providers to determine their ability to use it effectively and safely. Deficiencies will be evaluated for initiatives to ensure safe naloxone use.

Methods

Participants were given a 12 question survey, each with a targeted learning objective containing basic knowledge about naloxone. The survey assessed basic domains of pharmacology, clinical use and safety. It was administered to departments of Anesthesiology, Surgery and Medicine, including medical students, nurses, residents and practicing physicians. Questions addressed concentration, dosing, side effects, and indications. We defined greater than 70% correct as passing on the knowledge domain. Data were sorted/analyzed by chi-square analysis with department, position and training as variables.

Results

163 surveys completed: 40 medical students, 30 anesthesia residents, 16 anesthesia attendings, 18 CRNAs, 24 medicine residents, 18 surgical residents and 12 PACU nurses (Table 1). Surprisingly, 50% of responders would administer naloxone before assisting ventilation. Three groups had more than 60% of participants achieve a passing grade (Figure 1). After survey completion all groups felt less comfortable using naloxone (Table 1). Those who identify as comfortable or greater with naloxone use prior to the survey only scored significantly better on one of nine questions in the survey (Table 2). Only 20% of medicine residents received a passing score and just 17.5% of medical students.

Discussion

Opioids are the primary analgesic used in most hospitals. Respiratory depression is a significant opioid adverse event. Patients on opioids are managed by surgical and medical teams
who are the primary responders during emergencies. Two groups, Anesthesiology attendings and residents received a passing score. 20% of medicine residents and 44% of surgical residents received a passing score, many may be using naloxone without proper education. Those more comfortable with knowledge of naloxone did not perform much better than those less comfortable.

Conclusions

There are significant knowledge gaps in the appropriate use of naloxone that may lead to improper usage. There is a need for targeted education on naloxone. Anesthesiology residents and attendings appear to be more knowledgeable and could be key in further educational initiatives.

References

1 Barash Et al. Clinical Anes. 2009
## Table 1: Survey responses to question domain according to groups

<table>
<thead>
<tr>
<th>Category</th>
<th>Medical Students n=40</th>
<th>Anesthesiology Department</th>
<th>PACU Nurses n=12</th>
<th>Medicine Residents n=24</th>
<th>Surgical Residents N=18</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=30</td>
<td>n=18</td>
<td>n=16</td>
<td></td>
<td></td>
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<tr>
<td>Comfort with knowledge of treatment of opioid overdose (Pre-survey)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than comfortable</td>
<td>23 (57.5)</td>
<td>19 (63.3)</td>
<td>17 (56.4)</td>
<td>16 (100)</td>
<td>9 (75)</td>
<td>12 (66.7)</td>
</tr>
<tr>
<td>Comfortable or greater</td>
<td>17 (42.5)</td>
<td>17 (94.4)</td>
<td>3 (25)</td>
<td>6 (25)</td>
<td>6 (33.3)</td>
<td>&lt;0.01</td>
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<tr>
<td>Domain 1: Appropriate Response to opioid overdose:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 3</td>
<td>10 (25.6)</td>
<td>18 (60.0)</td>
<td>13 (72.2)</td>
<td>8 (66.7)</td>
<td>8 (32.0)</td>
<td>14 (77.8)</td>
</tr>
<tr>
<td>Domain 2: Pharmacology of Naloxone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 4</td>
<td>27 (69.2)</td>
<td>28 (96.6)</td>
<td>14 (77.8)</td>
<td>14 (87.5)</td>
<td>6 (50.0)</td>
<td>16 (88.9)</td>
</tr>
<tr>
<td>Question 5</td>
<td>9 (22.5)</td>
<td>11 (61.1)</td>
<td>9 (56.3)</td>
<td>7 (58.3)</td>
<td>3 (12.0)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Question 9</td>
<td>6 (15.4)</td>
<td>20 (66.7)</td>
<td>12 (70.6)</td>
<td>7 (63.6)</td>
<td>6 (25.0)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Domain 3: Safe Administration of Naloxone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 6</td>
<td>16 (40.0)</td>
<td>18 (60.0)</td>
<td>15 (83.3)</td>
<td>12 (80.0)</td>
<td>8 (66.7)</td>
<td>7 (38.9)</td>
</tr>
<tr>
<td>Question 7</td>
<td>6 (15.0)</td>
<td>11 (36.7)</td>
<td>4 (23.5)</td>
<td>9 (56.3)</td>
<td>5 (45.5)</td>
<td>&lt;0.05</td>
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<tr>
<td>Question 8</td>
<td>16 (41.0)</td>
<td>21 (70.0)</td>
<td>12 (75.0)</td>
<td>7 (58.3)</td>
<td>8 (32.0)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Question 10</td>
<td>24 (60.0)</td>
<td>20 (66.7)</td>
<td>7 (38.9)</td>
<td>10 (62.5)</td>
<td>4 (33.3)</td>
<td>12 (80.0)</td>
</tr>
<tr>
<td>Question 11</td>
<td>29 (78.4)</td>
<td>24 (80.0)</td>
<td>15 (83.3)</td>
<td>15 (93.8)</td>
<td>8 (66.7)</td>
<td>10 (62.5)</td>
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<tr>
<td>Level of comfort of knowledge after survey</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Less than comfortable</td>
<td>32 (80.0)</td>
<td>16 (53.3)</td>
<td>5 (27.8)</td>
<td>4 (25.0)</td>
<td>6 (50.0)</td>
<td>14 (82.4)</td>
</tr>
<tr>
<td>Comfortable or greater</td>
<td>8 (20.0)</td>
<td>14 (46.7)</td>
<td>13 (72.2)</td>
<td>12 (75.0)</td>
<td>6 (50.0)</td>
<td>3 (17.6)</td>
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</table>

N (%), P value based on Pearson’s Chi-Square analysis
Table 2: Univariate Analysis measuring comfort of knowledge with various domains

<table>
<thead>
<tr>
<th>Domain 1:</th>
<th>Comfortable (or greater) with knowledge of naloxone for opioid overdose (N=111)</th>
<th>P Value</th>
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</thead>
<tbody>
<tr>
<td>Appropriate Response to opioid overdose:</td>
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<tr>
<td>Question 3</td>
<td>98 (88.3)</td>
<td>0.001</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>Domain 2:</td>
<td></td>
<td></td>
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<tr>
<td>Pharmacology of Naloxone:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 4:</td>
<td>82 (75.2)</td>
<td>0.237</td>
</tr>
<tr>
<td>Question 5:</td>
<td>41 (36.9)</td>
<td>0.091</td>
</tr>
<tr>
<td>Question 9:</td>
<td>52 (47.7)</td>
<td>0.094</td>
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<tr>
<td>Domain 3:</td>
<td></td>
<td></td>
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<tr>
<td>Safe Administration of Naloxone</td>
<td></td>
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<tr>
<td>Question 6:</td>
<td>67 (60.9)</td>
<td>0.156</td>
</tr>
<tr>
<td>Question 7:</td>
<td>40 (36.4)</td>
<td>&lt;0.01</td>
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<tr>
<td>Question 8:</td>
<td>59 (53.6)</td>
<td>0.370</td>
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<tr>
<td>Question 10</td>
<td>64 (58.7)</td>
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<tr>
<td>Question 11</td>
<td>85 (78.7)</td>
<td>0.857</td>
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<tr>
<td>Comfortable or greater with knowledge of treatment of opioid overdose after survey</td>
<td>63 (56.8)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Figure 2: Comparing the scores of each question of those clinicians who identified themselves as comfortable to extremely comfortable with naloxone to those less than comfortable with naloxone use and their response to key questions in the survey. Pearson’s Chi Square analysis was used to determine p-value. N =111 ; Number in quotations is percentage answered correctly.
Abstract Submission PARRC

**Title:** Histopathological Observations in the Brains of Children Exposed to Inhalational Anesthetic Agents: A Retrospective Autopsy-Based Study

**Presenter/Affiliation:** Leigh A Stevens, MD, MBA
Drexel University College of Medicine/Hahnemann Hospital University

**Author(s):** Michael S. Green DO, Mansoor Aman MD, Leigh Stevens MD, Kirtanaa Voralu MSc, Poovendran Saththasivam MD, George Mychaskiw DO, Christos D Katsetos MD PhD

**Introduction:**
Six million children undergo anesthesia annually. Understanding the effects of inhalational anesthetics on the human brain is an emerging public health concern. Numerous animal models demonstrate neuronal damage resulting from anesthetic exposure in the developing brain. These studies have shown a relationship between anesthetic exposure and brain hypoxia, neurodegeneration and apoptosis. Most studies performed to date on children have had a neuropsychological slant yielding mixed results. Our study compares histopathological findings in post-mortem pediatric brain tissue specimens with and without exposure to inhalational anesthetic agents.

**Objective:**
Compare histopathological changes in post-mortem pediatric brain tissue specimens with and without exposure to inhalational anesthetic agents

**Methods:**
Retrospective chart review of ninety four autopsy reports (archived files from 2003-2011 Department of Pathology and Laboratory Medicine, St. Christopher’s Hospital for Children) as well as patient demographics, medical history, and anesthetic history was compiled. Forty Four patients with documented brain hypoxia/ischemia were excluded. Fifty patients were divided into exposure (n=26, 52%) and non exposure groups (n=24, 48%). Exposure group was defined as patients who underwent any procedure which exposed them to inhalational anesthetic agents (desflurane, sevoflurane, isoflurane, halothane, or nitrous oxide). Exposure group was analyzed further by examining the type of anesthetic agents administered. The autopsy results examined the presence of twelve different histopathological parameters reflecting morphologic changes in thirteen regions of interest in the central nervous system.

**Results:**
Out of the 94 patients, 50 patients were used for analysis. Patients were divided into two groups: exposure to anesthetics (n = 26, 52%) and no inhalational anesthetic exposure (n = 24, 48%). No statistical difference was noted when comparing gender and the presence of other co-morbidities,
except the exposure group had a history of malignancy (n=9, 34.6%) versus non-exposure group (n=1, 4.2%). Mean age at death in the exposure group was 23 days (SD = 48) while the non-exposure group was 9 days (SD = 20). Prematurity was more prevalent in the non-exposure group.

The mean number of times a child was exposed to an inhalational agent was 3 with a mean anesthetic duration time of 452 minutes (SD = 512 min). Sevoflurane was administered to all patients at some point during their anesthetic management while desflurane was given to half the patients (n=13, 50.0%). Intravenous anesthetic agents dispensed during the anesthetic were reviewed and showed no statistically significant differences.

Gliosis, which was confirmed in the original autopsy studies by immunohistochemical staining for glial fibrillary acidic protein (GFAP), was more prevalent in the exposure group (n = 48) compared to the non-exposure group (n = 20) (p < 0.05). Remaining histopathological findings were not statistically significant.

**Conclusions**

Anesthetic neurotoxicity is not well understood. To date, there is no tangible evidence of anesthetic neurotoxicity in humans. Our analysis demonstrates histopathological brain changes in children with anesthetic exposure not seen in the non-exposed group. Gliosis was the only statistically significant finding in postmortem brain samples of patients with anesthetics exposure. Our findings confirm and extend previous reports a trend for gliosis in different cortical and subcortical brain regions after anesthetic exposure.

**References:**


Figure 1. The number of histopathologic observations in each brain region as reported in 50 autopsy reports from SCHC (2003-2011).

- **Brain regions**: Cerebrocortical, White Matter, Medulla, Periventricular leptomeninges, Pons, Hippocampus (CA1), Hippocampus (CA4), Amygdala, Thalamus, Hypothalamus, Subthalamus, Basal Ganglia, Brainstem, Cerebellum, Spinal cord.

- **Observations**:
  - A: Anesthesia Group
  - N: No Anesthesia Group

Figure 2. Comparisons of histopathologic observations of 50 subjects exposed to anesthesia and not exposed to anesthesia.

- **Histopathologic Observations**:
  - Spinal cord
  - Cerebellum
  - Brainstem
  - Basal Ganglia
  - Subthalamic nuclei
  - Hypothalamus
  - Thalamus
  - Amygdala
  - Hippocampus (CA1/A)
  - Hippocampus (CA1)
  - Parahippocampal gyrus
  - Subiculum
  - White Matter
  - Cerebrocortex

- **Observations**:
  - A: Anesthesia Group
  - N: No Anesthesia Group
Comparison between the risk falls after Total Knee Arthroplasty with use of femoral nerve block versus adductor canal block

Sean Antosh MD, Moustafa Ahmed MD, Charles Nelson MD, Craig Israelite MD, Ignacio Badiola MD, Lu F. Cai MD, Rebekah Williams BS, Christopher Hughes, Edward R. Mariano, MD, MAS, Nabil Elkassabany MD MSCE, Jiabin Liu MD PhD

Introduction:
Adductor canal block (ACB) has emerged as an appealing alternative to femoral nerve block (FNB) that produces a predominantly sensory nerve block by anesthetizing the saphenous nerve. Studies have shown greater quadriceps strength preservation with ACB compared to FNB, but no advantage has yet been shown in terms of fall risk. The Tinetti scale is used by physical therapists to assess gait and balance, and total score can determine a patient’s fall risk. We designed this study to test the primary hypothesis that FNB results in a greater proportion of “high fall risk” patients postoperatively using the Tinetti score compared with ACB.

Materials and Methods:
With IRB approval and informed consent, patients undergoing primary unilateral TKA were offered enrollment in this double-blinded, randomized trial over four months at Penn Presbyterian Medical Center. Patients received either an ACB or FNB block (20 ml of 0.5% ropivacaine) with catheter placement (8 ml/hr of 0.2% ropivacaine) in the setting of multimodal analgesia. Continuous infusion was stopped in the morning of POD#1 prior to starting physical therapy (PT). On postoperative day (POD) 1, PT assessed the primary outcome using Tinetti score for gait and balance. Patients were considered to be high risk of falling if they scored <19. Secondary outcomes included: manual muscle testing (MMT) of the quadriceps muscle strength, time to up and go (TUG), and ambulation distance on postoperative day 1 and 2. The quality of postoperative analgesia and the quality of recovery were assessed with American Pain Society patient outcome questionnaire Revised (APS-POQ-R) and Quality of Recovery-9 (QOR-9) questionnaire, respectively.

Results:
Sixty-two patients were enrolled in the study (31 ACB and 31 FNB). Patient characteristics were similar between the two groups. No difference was found in the proportion of “high fall risk” patients on POD 1 (21/31 in the ACB group versus 24/31 in the FNB group, P=0.7) or POD 2 (7/31 in the ACB versus 14/31 in the FNB group, P=0.06). The average distance of ambulation during PT and TUG were similar on POD 1 and 2. There was an advantage in MMT on POD 1 in the ACB group (P=0.001); however no difference was found by POD 2 (P>0.99). There were no other differences in postoperative outcomes.

Discussion:
Although ACB results in greater preservation of quadriceps muscle strength, there appears to be no reduction in fall risk or functional outcome benefits when compared to FNB. Factors other than quadriceps muscle strength likely contribute to patients' falls and should be addressed through education and training in a well-defined fall prevention program.
References:
The Role of Ethnicity in Liver Transplantation Thrombotic Complications

Presenter/Affiliation: Venkataraman Iyer, MD/ Department of Anesthesiology, Penn State Hershey Medical Center, Hershey, PA

Authors: Venkataraman Iyer, Vernon Chinchilli, Khaled Iskandarani, and Dmitri Bezinover

Introduction

Thrombotic complications following orthotopic liver transplantation (OLT) are associated with increased morbidity and mortality. After primary liver non-function, hepatic artery thrombosis is the next major cause of liver graft failure. While various factors can contribute to this complication, we specifically investigated the association between the transplant recipient's ethnicity and subsequent perioperative thrombotic complications. In this retrospective study, we performed statistical analyses of United Network for Organ Sharing (UNOS) data to study the role of ethnicity in OLT-related thrombosis.

Objective

To analyze UNOS data (time interval 1993-2012) and determine correlations between ethnicity and OLT thrombotic complications.

Methods

We analyzed OLT performed from 1993-2012, a total of 119,663 cases (114,886 deceased donors and 4,777 live donors). The breakdown for each ethnic group was: a) White, N=85,869, b) Black, N=16,544, c) Hispanic, N=13,604, d) Asian, N=2,342, e) Multiracial, N=690, f) American Indian/Alaska Native, N=375, and g) Native Hawaiian/Pacific Islander, N=239.

Additionally, for the time interval 2000-2012 (78,466 OLT cases), statistical analysis was performed to determine associations between perioperative thrombotic complications and the following autoimmune and oncologic conditions: a) hepatocellular carcinoma (HCC) (n=3,597), b) HCC and cirrhosis (n=5,237), c) primary biliary cirrhosis (PBC) (n=6,916), and d) autoimmune cirrhosis (n=6,027). The UNOS data related to thrombotic complications included 1) portal vein thrombosis (n=4,901), and 2) vascular thrombosis other than portal vein (n=3,296).

Results

There was no difference in the incidence of thrombotic complications between ethnic groups for either deceased or live donor OLT (p > 0.05). Significantly higher proportions of vascular thrombosis at the time of OLT were found for patients with PBC (21.8% vs. 16.1% (without PBC), p=0.03). Significantly higher proportions of portal vein thrombosis were found for: 1) patients with HCC (7.2 % vs. 6.0% (without HCC) \( p = 0.017 \)); and 2) patients with both HCC and cirrhosis (6.9 % vs. 6.0% (without HCC and cirrhosis), \( p = 0.013 \)). Statistical analysis was performed stratifying the data for patients who received a transjugular portosystemic shunt (TIPS). Patients who had autoimmune cirrhosis, and had a TIPS, had a significantly higher incidence of portal vein thrombosis compared to those without a diagnosis of autoimmune cirrhosis (14. 9% vs. 6.7% respectively, \( p =0.0074 \)).

Conclusion

Our primary finding was that there is no discernable correlation between recipient ethnic groups and the incidence of perioperative thrombotic complications. Additional findings were that OLT patients with HCC and PBC, as well as patients with autoimmune cirrhosis and history of TIPS, are at an increased risk of perioperative thrombotic complications. These findings can guide us in focusing our investigation of possible modifiable factors that could improve OLT thrombotic complications.
RETROSPECTIVE ANALYSIS OF PAIN MANAGEMENT IN PATIENTS UNDERGOING PANCREATICODUODENECTOMY AND LIVER RESECTION

Authors: Julia Caldwell, MD, Babatunde Afilaka, MD, Caitlyn Moss, MS II, Dmitri Bezinover, MD, PhD, Sonia Vaida, MD, Khaled Iskandarani, MPH

Presenter: Babatunde Afilaka, MD

Department of Anesthesiology, Penn State Hershey Medical Center

Background: Although many advances have been made in understanding the physiology of pain, adequate post-operative pain control still remains a challenge. In the United States, approximately 80% of patients experience severe pain after surgery, and 50% of patients do not feel that they achieved effective analgesia. Post-operative pain is considered a major co-morbidity, and can lead to complications including myocardial ischemia, pulmonary infections, and decreased immune function. Moreover, patients with higher levels of post-operative pain tend to have longer hospital stays, leading to higher medical costs and lower levels of patient satisfaction. This is particularly a concern in major abdominal surgeries, such as liver resections and pancreaticoduodenectomies (Whipple procedures).

Objectives: The primary objective of our study was to test the hypothesis that patients undergoing a liver resection experience less post-operative pain than those undergoing a Whipple procedure. The secondary objective was to assess patient characteristics and demographics to determine what factors affect differences in pain experienced post-operatively.

Methods: This was an IRB-approved retrospective chart review, which included all patients who underwent either a Whipple procedure or a liver resection at the Penn State Hershey Medical Center between 01/01/2010 and 06/30/2013 and had both a general anesthetic and thoracic epidural. Information documented included: demographics, American Society of Anesthesiologist (ASA) status, body mass index (BMI), total opioid use, pain scores, and length of stay (LOS) in both hospital and Intensive care unit (ICU). Univariate summary statistics and frequencies were analyzed for all variables of interest. The Wilcoxon two-sample test, Student’s t-test, and Chi-square test were used as appropriate to determine where significant differences existed between the two patient groups. A p-value of <0.05 was used to indicate significance. Predictors of opioid administration were also assessed using a multivariate analysis.

Results: The medical records of 159 patients were reviewed; 80 underwent a Whipple procedure and 79 underwent liver resection. There were no significant differences between the groups in pain scores measured, however, there was a significant difference in total opioids administered; patients in the Whipple procedure group received significantly more opioids (p-value=0.0017). There was no significant correlation between amount of opioids administered and total LOS. While there were no differences in PACU/ICU LOS between the two groups, the Whipple procedure group had a significantly higher average total LOS (8.7 days) than the liver resection group (average total LOS=7.0, p-value=0.03).

Conclusions: Patients undergoing a Whipple procedure received significantly more opioids than liver resection patients and also had a significantly higher average total LOS. These results support our hypothesis that patients undergoing liver resection experienced less pain than those undergoing a Whipple procedure. This may be due to the type and extent of surgical incision, use of retractors, etc. This finding is important to clinical practice, as higher doses of opioids are associated with higher risk for adverse drug reactions including postoperative ileus, decreased cognitive function, respiratory depression, and even death. In addition, adverse reactions from opioids are known to increase LOS, cost of treatment, likelihood of readmission, and mortality.

References:


3. European Journal of Anaesthesiology / Volume / Issue 11 / November 2002, pp 780-788Copyright © 2002 European Society of AnaesthesiologyDOI: http://dx.doi.org/10.1017/S0265021502001266 (About DOI), Published online: 16 August 2002 Anaesthesia for elective liver resection: some points should be revisited. C. Lentschener and Y. Ozier


ORIGINAL RESEARCH: SEDATION STRATEGIES FOR PROCEDURES IN THE CARDIAC ELECTROPHYSIOLOGY LABORATORY
Julie E. DeVore, DO, MPH, Anne Kamarchik, MD, Samir F. Saba, MD, Raveen R. Bazaz, MD, Kathirvel Subramaniam, MD. University of Pittsburgh Medical Center.

Introduction

Procedures in the cardiac electrophysiology laboratory (EPL) are associated with a high incidence of adverse events. Excessive sedation, airway intervention, or conversion to general anesthesia was reported in 40% of patients in one study. A recent study reported a 19% respiratory and a 17% cardiac complication rate among 269 ASA physical status 3 and 4 patients calling for more research on sedation in the EPL. Only one previous study of 34 patients has evaluated propofol versus dexmedetomidine in patients undergoing EPL procedures with dexmedetomidine showing better hemodynamic and respiratory stability.

Objective

Our goal was to compare three common sedation techniques utilized in the cardiac EPL for differences in patient pre-operative demographics and co-morbidities, intra-operative vasopressor use, and cardiac or pulmonary adverse events during or after the case.

Methods

A retrospective chart review of outpatients scheduled for an EP Lab procedure under anesthesiologist directed sedation between 9/2012 and 9/2014 was done after approval from institutional quality improvement committee. Patients who received propofol alone, propofol and dexmedetomidine, or propofol and ketamine were included in the study, as they are the three most common sedation strategies practiced. Patients in all three sedation strategies received midazolam and fentanyl as required. Data recorded included patient demographics and co-morbidities, sedation and vasopressor medication administration during the procedure, and adverse events intra-operatively or post-operatively. Adverse events recorded included requirement for assisted ventilation, endotracheal intubation, unanticipated admission, excessive post-procedure sedation, pain, nausea and hypotension. Statistical analysis was carried out using STATA 13.0 software and P<0.05 was significant. Frequency data was analyzed by Chi-square test and continuous outcomes analyzed by Kruskall Wallis test as the data were not normally distributed.

Results

Of the 200 patients analyzed, 17 patients were excluded for extraneous medication administration and administration of multiple sedation agents (more than 4). A statistically significant difference was found for patient age and history of congestive heart failure (CHF) between the three sedation strategies. No other differences were found between the three groups with regards to other pre-operative characteristics and comorbidities (Table). No aspiration or cardiac arrest events were documented. Other adverse events such as airway interventions, total dose of vasopressors required to maintain blood pressure, and intra- and postoperative adverse events (pain, sedation, hypotension, nausea, unanticipated admission and PACU/hospital stay) were similar between the three groups. Total dose of propofol infused was similar in all three groups.

Conclusions

All three sedation regimens were equally efficacious and safe for EP laboratory procedures in this retrospective study of limited patient population. Further data collection is underway and will likely reveal some interesting findings.
Table
* Values expressed as mean +/- standard deviation
** Values expressed as median (interquartile range), others n (%)

References

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<th>Propofol (n = 98)</th>
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Outcomes

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PROVIDERS’ PERCEIVED BARRIERS TO QUALITY

Presenter: Christian Lauver MD, Department of Anesthesiology, Penn State Hershey Medical Center, Hershey, PA

Authors: Christian Lauver MD, Kayla Knuf BS, Renee Doll MD, Verghese Cherian MD, Julia Caldwell MD

Introduction: Quality measures are utilized with the expectation that healthcare providers can implement actions to improve or maintain a measurable level of quality care\textsuperscript{1,2,3}. Insight into what precludes or diminishes quality in healthcare is lacking\textsuperscript{4,5}. Individual providers can provide insight regarding the barriers they perceive in providing quality care. For this study we focused on anesthesia providers (Attending and Resident Anesthesiologists, and Certified Registered Nurse Anesthetists (CRNAs)) at the Penn State Milton S. Hershey Medical Center. We hypothesized that anesthesia providers would have a few salient areas perceived as barriers by a majority of anesthesia providers; that junior providers (1-2 years experience) would be more likely than non-junior providers (>2 years experience) to see time pressure as a barrier; and that more experienced (managerial/quality improvement experience or >5 years practice experience) providers were less likely to perceive healthcare processes as barriers compared to providers with less experience.

Objective: To better understand what providers see as barriers to quality. We think that this information can be used to implement change and improve care.

Methods: We conducted a survey consisting of demographical information and a series of questions to define and weigh an individual provider’s perceived barriers to quality. Participants were given the opportunity to define additional barriers, explain their responses, and offer ideas for improvement.

Results: In this observational pilot study, 52 participants’ responses were analyzed overall and as demographic subgroups. The most cited barriers were “I do not know how the quality measures are monitored” (61%) and “I do not have a summary of quality measures” (56%). Non-junior providers cited time pressure as a barrier 36% of the time compared to junior providers 26% (p=0.19). More experienced (practice or managerial) providers cited healthcare processes as barriers less frequently than providers with less experience. Specifically, providers with >5 years experience agreed to “Frustration with the system” 22% of the time vs. 44% for those with less than 5 years experience (p=0.07)

Conclusions: In our study group of anesthesia providers, a major barrier to quality is provider’s knowledge of what the measures are and how they are monitored. This barrier to quality care can be addressed by instituting an educational program for providers about the quality measures. Another barrier to quality highly reported by non-junior providers was time restraints. Dedicating protected time to addressing quality measures may change this as a barrier to quality. Those with more practice and managerial experience likely have more involvement in creation and implementation of healthcare processes which may be the reason they tended to perceive healthcare processes as a barrier less than those with less practice or no managerial experience. Although our results did not reach statistical significance, the trend toward a difference between groups, coupled with a small sample size suggests clinical significance. This study provided some insight into provider perceived barriers to quality; we think that further study into specifics of these barriers could be used to remove these barriers and provide more quality based care at our institution.

References


3. Leape LL, Berwick DM. Five years after “to err is human”: what have we learned?. *JAMA*. 2005;293;19:2384–90.


NOCICEPTIN CONCENTRATION IN SYNOVIAL FLUID AND PLASMA IN PATIENTS UNDERGOING PRIMARY TOTAL KNEE ARTHROPLASTY: A PROSPECTIVE PILOT STUDY

Authors
Matthew McClain M.D.
Julia Caldwell M.D.
Nancy Ruth Jarbadan B.S.
Thomas Verbeek M.B., Ch.B.

Presenter
Matthew McClain M.D. – Penn State Hershey Department of Anesthesiology

Background
Nociceptin, an endogenous neuropeptide with similar structure to classic opioids, is involved in a variety of systemic modulatory responses. Research continues to elucidate nociceptin’s various functions, especially as they pertain to pain modulation. Osteoarthritis, a chronic neuroinflammatory condition, appears to have both pro- and anti-inflammatory processes possibly linked to nociceptin. There is, however, debate as to whether nociceptin is present in human synovial fluid, with some studies indicating its presence and others its absence. Clarifying the presence of nociceptin in synovial fluid of inflamed joints may improve the understanding and management of osteoarthritis.

Objective
The objective of this pilot study was to determine whether nociceptin is present in the synovial fluid of osteoarthritic knees, and to measure its concentration in blood and synovial fluid.

Methods
Institutional Review Board approval was received prior to initiation of the study and written informed consent was obtained from all participants. Patients with osteoarthritis who were undergoing primary total knee arthroplasty were enrolled. Patients who had prior joint arthroplasty at the current surgical site and/or joint or systemic infections were excluded. Two blood samples were obtained: the first during IV placement and the second five minutes after the thigh tourniquet was deflated. A sample of synovial fluid was aspirated from the knee joint after skin incision. Each of the patients had their procedure performed by the same orthopedic surgeon and all samples were collected following a standardized study protocol. All samples were assayed for nociceptin using a commercially available EIA kit.

Results
A total of 20 patients with ages ranging from 50 to 73 were included in this study. We were able to demonstrate the presence of nociceptin in the synovial fluid and blood of all the patients. The concentration range in synovial fluid was 7.68 to 71.07 pg/ml, with a mean level ± 24.46 ± 16.89 pg/ml. The mean blood level pre-induction was 48.07 ± 31.89 pg/ml, and the mean blood level post-tourniquet deflation was 42.79 ± 27.63 pg/ml.

Conclusion
We were able to demonstrate the presence of nociceptin in the synovial fluid of patients undergoing total knee arthroplasty for osteoarthritis. These data can be used as a foundation for future studies.

References:


3 Neither nociceptin nor its receptor are present in human synovial fluid or tissue. Kumar, Smart, Mason, McKnight, Rowbotham, Lambert. British Journal of Anaesthesia. 1999. September 83(3):470-1.
TITLE: HYPOALBUMINEMIA MORE THAN MORBID OBESITY IS AN INDEPENDENT PREDICTOR OF COMPLICATIONS AFTER TOTAL HIP ARTHROPLASTY

Jason D. Walls, Daniel Abraham, Charles Nelson, Atul Kamath, Nabil Elkassabany, Jiabin Liu

ABSTRACT

BACKGROUND and AIMS:
Health care reform is directing clinical practice towards improving outcomes and minimizing complications. Preoperative identification of high-risk patients and modifiable risk factors present opportunity for clinical research. In patients undergoing total hip arthroplasty (THA), there is a link between preoperative nutritional status and perioperative morbidity and mortality. However, this association has only been established with limited publications and using mostly low powered studies. This study aims to further solidify the link between preoperative nutritional disorders and perioperative complications by reviewing a large national database.

METHODS
A total of 49,475 total hip arthroplasty patients were identified from National Surgical Quality Improvement Program between 2006 and 2013. We compared morbidly obese patients (BMI >= 40 kg/m²) and non-morbidly obese patients (BMI 18.5-40 kg/m²). We also compared patients with hypoalbuminemia (serum albumin < 3.5 g/dL) against those with normal albumin. We analyzed data on 22 complications as reported in the NSQIP database and developed three composite complication variables, including any infections, cardiac/pulmonary complications, and any major complications. For each complication, multivariable logistic regression analysis was used to evaluate its association.

RESULTS
The final cohort included 49,475 entries, including 3,580 subjects with BMI > 40 kg/m² and 45,895 subjects with BMI 18.5-40 kg/m². There were 1,122 patients with serum albumin < 3.5 g/dL and 23,116 patients with albumin >= 3.5 g/dL. Obesity was only found to associated with risk of superficial incisional surgical site infection (OR:2.02 {1.36-3.02}) and composite “any infection” complication (OR:1.42 {1.05-1.93}). Patients with hypoalbuminemia carried a 5.94-fold higher risk of mortality when compared to the group with normal albumin (OR: 5.94 {3.07-11.48}). The patients with hypoalbuminemia experienced a significantly higher incidence of complications in all three composite complication variables (any infections, cardiac/pulmonary complications, and any major complications).

CONCLUSIONS
Our study demonstrates that hypoalbuminemia is a significant risk factor for mortality and major morbidity among total hip arthroplasty patients, while morbid obesity was only associated with an increased risk of superficial surgical site infection. This study further emphasizes the relationship between poor preoperative nutritional status and morbidity and mortality following THA. This review is the largest to date to show this association and gives impetus for future studies to determine the role of preoperative nutritional evaluation and optimization. Moreover, further investigation is needed not only to confirm our findings, but also to test the hypothesis that modifying hypoalbuminemia preoperatively could improve morbidity and mortality.
References:
Abstract Title: RETROSPECTIVE ANALYSIS OF RIB FRACTURES: EPIDEMIOLOGY, ASSOCIATED MORBIDITY AND RISK FACTORS

Presenter/Affiliation: Brian Hertzberg MD, Department of Anesthesiology, Penn State Hershey Medical Center, Hershey, PA

Authors: Brian Hertzberg MD, Kristen Berger BS, Aldis Siltumens BS, Sanjib Adhikary MD, Julia Caldwell MD

Introduction: Rib fractures are prevalent (noted in 4-12% of trauma admissions) and can have significant associated complications and sequelae (i.e., pneumothorax, flail chest, pneumonia, and even death). This has raised the question of how the presence of rib fractures affects mortality and morbidity, as well as what is the epidemiological nature of rib fractures. Various studies have attempted to examine these questions, but results have varied and no clear consensus has emerged. Mortality rates of 3-13% for rib fracture patients have been reported, with higher mortality rates associated with more fractures (1). Pre-existing disease has been related to mortality of patients with rib fractures, and rib fracture injury also has been linked to significant longer-term morbidity related to pain and disability (2).

Objective: Our objective was to explore the epidemiological characterization and management of rib fractures at an academic level 1 trauma center that is in a very unique rural area with an ethnically homogeneous population.

Methods: After IRB approval was received, the medical records of patients who presented to the Penn State Hershey Medical Center Emergency Department during the years of 2010-2012, with multiple (≥2) rib fractures were retrospectively reviewed. The number of fractures, co-morbidities, demographics, treatment, pain level, hospital and ICU length of stay were documented. Descriptive statistics and multivariate logistic regression analysis were completed.

Results: A total of 921 patients met the criteria for review: they were 66% male and 34% female, with 5.6% belonging to an ethnic minority. Pneumothorax was a common complication (25.1%, 232/921) and was associated with a higher number of fractures (OR =1.20, CI 1.12, 1.28)) and a younger age (OR = 0.98, CI 0.97, 0.99). Pneumonia was also associated with a high number of fractures (OR= 1.21, CI = 1.08, 1.36.) A tendency to develop chronic pain was associated with pain medication given in the ER: 100% of patients who developed chronic pain after rib fracture received opioid pain medication upon presentation. Additionally, a higher pain score on presentation was associated with developing chronic pain (OR =1.35, CI= 1.11, 1.63). Rib fracture patients who did not develop chronic pain, had an average pain score of 6.3 +/-2.6, while those who did develop chronic pain, had an average pain score of 8.0+-/ 2.2. Higher pain scores from rib fractures were also positively associated with female gender (p=0.001) and non-white status (p=0.05), but negatively associated with older age (p<0.0001) and presence of other fractures (p=0.03).

Conclusions: Specific complications of rib fractures such as pneumothorax, pneumonia and chronic pain were associated with certain risk factors including age at presentation, gender, and presence of other fractures. By reviewing the associated factors, treatment, complications and demographics, our understanding is improved and can be used to facilitate and improve care.

References:

**INNOVATIVE HEALTH SYSTEMS PROJECTS**  
Michael Green¹, Mansoor M. Aman¹, Mark Woodland²  
Drexel University College of Medicine- Department of Anesthesiology¹, Department of Obstetrics & Gynecology²

**Background:** Residency programs struggle with the systems-based practice and improvement competency promoted by the Accreditation Council for Graduate Medical Education¹,². The development of Innovative Health Systems Projects (IHeLP) was driven by the need for better systems-based initiatives at an institutional level. Our objective was to develop a novel approach that successfully incorporates systems-based practice in our Graduate Medical Education (GME) programs, while tracking our impact on health care delivery as an academic medical center.

**Methods:** We started the IHeLP program as a ‘volunteer initiative’ in 2010. A detailed description of the definition, development and implementation of the IHeLP program, along with our experience of the first year, is described. We developed a model that would incorporate all aspects of patient care, research and medical education, while meeting the educational outcome needs of our trainees. The focus is more on establishing a database that tracks our impact on health care delivery. Projects are reviewed and evaluated by program directors on an annual basis. In our department we found it was most suitable for the program director to discuss projects with residents during biannual scheduled meetings. Once learning objectives are met and the project deemed acceptable they are forwarded to the program coordinators for inclusion into the institutional database. At the culmination of each academic year the vice-dean receives a summary of all projects that were submitted. Projects that led to institutional change are discussed in GME meetings. Residents, fellows and faculty mentors all played an important role in establishing the foundation of this initiative. Following the positive response, we have now incorporated IHeLP into all curricula as a graduating requirement.

**Results:** A total of 123 residents and fellows, representing 26 specialties, participated. We reviewed 145 projects that addressed topics ranging from administrative and departmental improvements to clinical care algorithms. The projects by area of focus were: patient care – clinical care, 38 per cent; patient care – quality, 27 per cent; resident education, 21 per cent; and a cumulative 16 per cent among pharmacy, department activities, patient education, medical records and clinical facility.

**Discussion:** Programs in the past have used various strategies for teaching SBP³,⁴. The most commonly reported were didactics, grand round presentations, discussion in journal clubs and reflective analysis¹⁰. Our approach to the integration of this competency has been much more independent when compared with those described. Time and financial constraints are often cited as the most important barrier when implementing any aspect of the outcome project¹¹. IHeLP has proven successful because of the minimal set-up required and its flexibility in incorporating IHeLP in the busy schedules of faculty members and residents.

**Conclusion:** We are pleased with the results of our first year of incorporating a systems-based improvement program into GME programs. This initiative has promoted scholarly activity and faculty mentorship, has improved aspects of patient care and safety, and has led to the development of many practical innovations.

**References:**


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**Projects Per Area of Focus**

- Patient Care – actual clinical care: 38%
- Patient Care – quality of care: 27%
- Resident Education: 21%
- Medical Records: 5%
- Department Activities: 1%
- Clinical Facility: 1%
- Other - Patient education: 4%
- Program Activities: 2%
- Pharmacy: 1%
OPTIMIZATION OF VENTILATION DURING LAPAROSCOPIC SURGERY USING A LUNG SIMULATOR MODEL

Emily J. MacKay, DO1, Michael D. Stubna, PhD1, Richard H. Epstein, MD2, Marc C. Torjman, PhD2, David M. Maguire MD2

1: Thomas Jefferson University Hospital, Philadelphia, PA
2: Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, PA

Introduction

Minimally invasive laparoscopic and video-assisted surgery is replacing open procedures with increasing frequency. As a consequence, patients who may have been at too high risk previously for an open procedure, due to comorbid cardiopulmonary disease, are becoming candidates for surgery. Because these less invasive approaches involve insufflation of the abdominal or thoracic cavity with carbon dioxide, a strategy involving increased minute ventilation must be undertaken to avoid hypercapnia. On average, insufflation associated with abdominal laparoscopic surgery decreases static lung compliance by 50% and increases resistance by 80%; simulation scenarios were chosen to reflect typical respiratory physiologic parameters in such cases. The objective of this study was to investigate ventilatory strategies during simulated laparoscopic surgeries, using a variable compliance and resistance lung simulator. The goal being to determine the maximum minute ventilation while maintaining a peak airway pressure between 30-35cm H2O, ideally, less than 30cm H2O.

Methods

Equipment used were an Apollo anesthesia machine (Dräger, Telford, PA) and an ASL 5000 lung simulator (IngMar Medical®, Pittsburgh, PA).

Nine scenarios were simulated: all combinations of lung compliance (C) of 10, 15, 20 (mL/cm H2O) and lung resistance (R) of 5, 7.5, 10 (cm H2O/L/second). For each of these scenarios, 72 different ventilator configurations were run: all combinations of tidal volume (TV) of 500, 600 (mL); inspiratory to expiratory ratio (I:E) of 1:1, 1:2.5; ventilator mode of volume mode (VOL) and AutoFlow mode (AUTO) (AutoFlow alters the inspiratory flow pattern; it changes from the constant flow, typical of volume controlled ventilation to a decelerating flow patter usually associated with pressure controlled ventilation. respiratory rate (RR) of 14 to 30 breaths per minute BPM)), in increments of 2. During each run, the lung simulator recorded respiratory parameters including peak airway pressure, (PPeak) (cm H2O) and inspiratory tidal volume (InspVT) (ml). Effective minute ventilation (MV) was calculated as RR * InspVT (L/min).

Results

For each scenario, we investigated the relationship between MV and PPeak as a function of ventilator configuration (Fig. 1). Across all scenarios and ventilator configurations, using AUTO mode significantly reduced PPeak by 2.70 ± 0.14 cmH2O, and significantly reduce MV by 0.58±0.05 L/min when compared to using VOL mode (p < 0.01). In the lowest compliance scenarios (C=10), while in AUTO mode, using I:E=1:1 was found to significantly increase the maximum achievable MV by 1.21 ± 0.62 L/min without significantly increasing the maximum PPeak when compared to using I:E=1:2.5 (p < 0.02).

Conclusions

In general, choosing the optimal ventilator mode to use for any case depends on many factors, including but not limited to: lung compliance, lung resistance, the minimum allowable minute ventilation, and the maximum allowable peak airway pressure. In simulations of laparoscopic surgery cases, we found that using AUTO mode can be an effective way of reducing peak airway pressure (although at the expense of reducing minute ventilation). In extremely low compliance scenarios, using AUTO mode can result in severely limiting the maximum achievable minute ventilation, but this limitation can be mitigated by using I:E=1:1.
Images and References

References:

3. Dräger Apollo ventilator manual. [http://www.draeger.com/sites/enus_us/Pages/Hospital/Apollo.aspx](http://www.draeger.com/sites/enus_us/Pages/Hospital/Apollo.aspx)
**Title:** COMPARING VENO-VENOUS ECMO SCORING SYSTEMS’ ABILITY TO PREDICT IN-HOSPITAL MORTALITY IN PATIENTS WITH SEVERE ARDS

**Presenter/Affiliation:** Zev Noah Kornfield / University of Pennsylvania

**Author(s):** Zev Noah Kornfield MD, Andrew E Ochroch MD, Yianni JG Augoustides MD, Ronak Shah MD, Jacob T Gutsche MD

**Introduction:** ECMO is regularly considered for patients with severe respiratory failure, and utilization of ECMO is increasing at a rapid rate in the United States. Publication of the CESAR trial in 2009 followed by several reports describing excellent outcomes from ECMO in patients with pandemic influenza A (H1N1) have greatly increased world-wide enthusiasm for veno-venous (V-V) ECMO for severe ARDS (1, 2). ECMO is associated with a high morbidity, mortality, and cost. Risk stratification is important to inform families and practitioners of the potential for survival in this intensive salvage therapy. There are currently 5 published risk stratification scores that have not been subjected to extensive external validation.(3-7) We attempted to validate these scoring systems using retrospectively collected data in our patients receiving V-V ECMO for ARDS. The PRESERVE Score uses 6-month survival post-ECMO (4) while ECMOnet, RESP and Roch et al use in-hospital mortality after VV ECMO implementation as an end point (5-7).

**Objective:** To compare the ability of the known ECMO risk scoring systems to predict in- hospital survival in patients with severe ARDS.

**Methods:** After receiving institutional review board approval, data from the medical records of all patients placed on V-V ECMO for ARDS over a 6-year period between June 14, 2008 to August 9, 2014 in the University of Pennsylvania Health System were retrospectively collected. Data was collected and analyzed from a total of 58 patients who were placed on VV ECMO in order to obtain the variables necessary to calculate scores for the four outcome scoring systems of interest(4-7). Once these scores were calculated the investigators analyzed the ability of these scores to predict in-patient in our patient set.

**Results:** Logistic regression revealed no significant relationship between any of the studied scoring systems and in-hospital survival (Table 1). Scores did not significantly change when only H1N1 subjects were included (Table 2).

**Conclusions:** The current scoring systems did not predict in-hospital mortality in our VV-ECMO sample. Further study is needed to develop an effective VV-ECMO scoring system to accurately predict in-hospital survival rates.
Table 1.

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Table 2.

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CRNA BILLED-TO-STAFFED HOURS AS A MEASURE OF OPERATING ROOM EFFICIENCY ACROSS A LARGE MULTI-HOSPITAL HEALTH CARE SYSTEM

Authors: Andrius Giedraitis, MD, MBA, MSE\textsuperscript{1}, Trent Emerick, MD\textsuperscript{1}, David Nelson, MD, MBA\textsuperscript{1}, Mark Hudson, MD, MBA\textsuperscript{1}

\textsuperscript{1}Department of Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA

Introduction: The current health care climate mandates efficient management of costs to assure sustainability of hospital economics. One metric to assess efficiency of resource utilization in the operating room (OR) is the CRNA billed-to-staffed hours percentage. This metric represents the percentage of time CRNAs are engaged in billable activity and can be used as a proxy of overall OR efficiency. In a multi-hospital health care system that utilizes a standardized staffing model for CRNAs, this measure can serve as a comparative metric for the system and aid in the identification of best practice OR management models and sites with opportunity for improvement.

Objective: Our aim was to use the CRNA billed-to-staffed hours metric in identifying best practice OR management models, which could subsequently be translated to less efficient UPMC hospitals and lead to significant cost savings.

Methods: CRNA billed-to-staffed hour percentages were obtained for 13 hospitals within the UPMC system for fiscal year (FY) 2013, FY 2014, and FY 2015 YTD. Demand (number of CRNA staffed hours from FY 2014) was also obtained for each hospital. 60\% was used as the target CRNA billed-to-staffed hours mark from 7am to 3pm. Best practice hospitals were identified using CRNA billed-to-staffed hours greater than 60\% in FY 2013. These best-practice approaches were then shared among other hospitals during quarterly system-wide surgical services meetings. A line graph was created to show the change in CRNA billed-to-staffed hours from FY 2013 to FY 2015 YTD. $82 was used as the average CRNA cost per hour for calculation.

Results: The target of 60\% CRNA billed-to-staffed hours was exceeded by 5 of 13 hospitals by FY 2015 YTD; only 2 hospitals exceeded this threshold in FY 2013. No sub-threshold hospital increased this percentage beyond 60\% between FY 2014 and FY 2015 YTD, as all 5 hospitals that exceeded 60\% accomplished this between FY 2013 and FY 2014. The overall improvement between FY 2013 and FY 2015 YTD amounted to a total of $1,600,590.25 in cost savings. However, $1,116,128.40 in additional cost savings would have been achieved if each hospital increased their CRNA billed-to-staffed hours percentage to a minimum threshold of 60\%.

Discussion: In our large, multi-hospital health care system, overall OR efficiency can be gauged by CRNA billed-to-staffed hours due to the Department of Anesthesiology’s consistent staffing methodology. To improve overall resource efficiency, providing expectations for this metric and targeting sites and services with low utilization can be effective. As a comparative metric, CRNA-billed-to-staffed hours has allowed us to identify opportunities for progress and change OR processes that have led to improved resource utilization. For example, by identifying locations and times when CRNAs are poorly utilized, changes in staffing have been implemented; offsite coverage has been consolidated, staffing patterns have changed, and allocation of ORs has been addressed. We have utilized this metric as a starting point to help identify inefficiencies in resource allocation, and it has demonstrated significant achievable savings. Furthermore, these savings are compounded with improved efficiency of hospital resources.
INCORPORATING AN OR PERFORMANCE REPORT CARD INTO PERSONAL EFFECTIVENESS EVALUATION IN A LARGE ANESTHESIOLOGY TRAINING PROGRAM

Authors: Andrius Giedraitis, MD, MBA, MSE\(^1\), Trent Emerick, MD\(^1\), David Nelson, MD, MBA\(^1\), Mark Hudson, MD, MBA\(^1\)
\(^1\)Department of Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA

Introduction: Demand for objective data in gauging physician performance is growing. The Milestone Project by the ACGME has also increased awareness of the need for accurate assessment tools of residents. One measure in allowing for performance assessment and comparative analysis is an OR Performance Report Card, which compares a provider’s average outcomes, first case start times, and other common performance metrics against peer providers. Such a tool can be utilized by department managers for accurate assignment of anesthesiologists, while residents may use it to evaluate areas that require further skill development.

Objective: Our aim was to develop a tool by which attending and resident anesthesiologists alike could assess their performance relative to peers and identify areas for improvement.

Methods: Operating room performance improvement metrics were retrospectively tabulated for university hospital anesthesiologists and a select group of residents in a twelve-month period between October 2013 and September 2014. Cases were only included if they were non-urgent and non-emergent and took place in a surgical or obstetric operating room at a large, multi-hospital health system. Data in the report card includes patient demographics, outcomes measures (average length of stay, in-hospital mortality), first case on time start percentage (using an anesthesia ready time of 7:30am), anesthesia start to wheels in time, wheels in to anesthesia ready time, anesthesia ready to incision time, and incision closure to wheels out time; each data point was compared to a subset of peers (anesthesiologists or residents) who perform similar cases. Report cards were then distributed to anesthesiologists and residents for personal analysis.

Results: Each resident/anesthesiologist is compared to their peers for various efficiency metrics in numerous surgical specialties. Demographics and outcome data, including average length of stay, is also reported for each resident/anesthesiologist.

Discussion: This Performance Report Card is a novel evaluation tool for resident assessment. The report card may also be used to make personnel assignments based on the providers that are most efficient for a given surgical procedure. The report card succinctly provides resident performance measures, which highlight areas of relative strength and weakness. In a survey of our residents, 88% of those responding stated they were interested in receiving personal effectiveness data, and 92% stated they would use these reports to change their practice.\(^1\) For instance, could poor resident wheels in to anesthesia ready times in orthopedic cases be a result of deficient neuraxial blockade skills? Could this time be subsequently compared to the number of previous blocks performed to assess for correlation? Further development of the resident report card could include data on patients’ early postoperative health, including multidimensional assessments of pain, physical independence, emotional state, and psychosocial support. Ultimately, such data will lead to improved practice, resulting in both decreased costs and improved patient care.

References:
1. Lim, K, Hudson M, Metro D. Designing an Anesthesiology Residency Personal Effectiveness Feedback System Using Qualitative Analysis of Resident Survey
OR-18

Responses. Presented at The Society for Education in Anesthesia (SEA) 2014 Annual Spring Meeting, Conference, Boston, MA.
EVALUATION OF NEUROLOGICAL OUTCOMES AFTER INTERSCALENE NERVE BLOCK FOR AMBULATORY SHOULDER SURGERY

Gaurav Rajpal, MD¹; Megan Helen Cortazzo, MD²; Michael Kentor, MD³; Steven L. Orebaugh, MD⁴

¹Resident Anesthesiology, Department of Anesthesiology; ²Assistant Professor, Department of Physical Medicine and Rehabilitation; ³Assistant Professor, Department of Anesthesiology; ⁴Professor, Department of Anesthesiology, UPMC Mercy/Southside Surgical Center, Pittsburgh, Pennsylvania, 15203, USA

ABSTRACT

Introduction:

Reports of post-operative neurological symptoms after interscalene nerve block for shoulder surgery have revealed an incidence as high as 14% (1). Some of these studies were performed before the availability of ultrasound guidance, and others have used relatively high volumes of local anesthetic solutions (1-5). We prospectively followed 300 patients who underwent ultrasound-guided interscalene block with relatively low volumes of local anesthetics, to determine rates of neurologic symptoms at 10 days and 30 days after surgery.

Methods:
After IRB approval, we enrolled 300 patients scheduled for ambulatory shoulder surgery with a pre-operative single injection interscalene block, followed by propofol/ketamine sedation in the operating room. Excluded were pediatric patients, ipsilateral pre-existing neurologic abnormality, and other contra-indications to peripheral nerve blockade. Interscalene blocks were performed with ultrasound guidance, with or without the use of peripheral nerve stimulator, utilizing 15-20 ml of either 0.5% bupivacaine, or a mixture of bupivacaine/mepivacaine (in patients with obstructive sleep apnea). Patients were contacted by phone at 10 days to inquire about any residual neurological symptoms outside of the immediate surgical region. For those with neurologic symptoms, a follow-up phone call was made at 30 days to identify patients with persistent neurological symptoms, who were subsequently evaluated with electromyography, and any other indicated diagnostic studies.

The primary outcome is frequency of neurologic symptoms at 10 days after surgery. Secondary outcomes include the incidence of symptoms at 30 days, duration of the neurological symptom, correlation to a particular surgical type or block characteristic (such as repeat attempt at nerve block, paresthesia, or needle re-directions), and results of examination/EMG for those with persistent symptoms.

Results:
All 300 patients have been contacted by phone at 10 days. The incidence of postoperative neurological symptoms at 10 days is 4.8%. Only one patient (0.3%) had persistent symptoms at 30 days. Neurological symptoms included numbness, transient tingling and paresthesias. The patient with persistent neurological symptom at 30 days was found to have altered sensation at the tip of index finger and a normal EMG study.

Discussion:

We found low incidence of persistent neurologic symptoms in this population. While incidence rates in the era prior to ultrasound were considerably higher (1), our data is consistent with that of Liu, et al, who reported a 0.6% incidence of persistent neurologic symptoms at four weeks (6). These results underscore the potential of ultrasound guidance to reduce persistent neurologic symptoms.

References:

1. Borgeat A. Anesthesiology 2001; 95: 875-890
3. Fredrickson M. Anaesthesia 2009; 64:836-841
MINIMAL TRACHEAL DEPTH OF A TUBE EXCHANGE CATHETER DURING EXCHANGE OF SUPRAGLOTTIC AIRWAY DEVICES FOR ENDOTRACHEAL TUBES

Presenter/Affiliation: Shawn M. Falitz, MD/ Department of Anesthesiology, Penn State Hershey Medical Center, Hershey, PA

Authors: Shawn M. Falitz, MD, John Picard, Priti G. Dalal, MD, Sonia J. Vaida, MD and Arne O. Budde, MD

Introduction: Supraglottic Airways (SGAs), as airway rescue devices, are often used by pre-hospital providers. Hospital clinicians tasked with airway management frequently have to exchange a SGA for a secure definitive airway, such as an endotracheal tube (ETT). Multiple techniques have been described for the exchange of SGAs for ETTs. A fiber optic (FOB) facilitated endoluminal exchange technique, using an intubating catheter (IC), has been reported. One of the disadvantages of this technique is the possible inadvertent expulsion of the IC, resulting in loss of airway control. We hypothesized that there is a minimal depth that the IC needs to be inserted into the trachea to accomplish a successful exchange.

Objective: The objective of this study was to determine the minimal depth that the IC must be inserted into the trachea for the safe exchange of a SGA for an ETT.

Methods: Following IRB approval and informed verbal consent, 30 anesthesia providers experienced in fiber optic intubation were recruited for the study. Using an airway simulation mannequin, participants attempted to exchange a SGA (i.e. the laryngeal tube, LT) for an ETT (internal diameter 7.5 mm), using a FOB and an IC (i.e. the Aintree catheter). The depth of insertion of the IC was noted by the investigator by using a FOB inserted through the nares and advanced to the level of the vocal cords. Successful intubation was confirmed via FOB visualization. Participants were randomized into two groups: 1) standard group: exchanges were performed using the standard ETT, and 2) modified group: exchanges were performed using a standard ETT that was shortened by 2 cm. Each participant made 5 intubation attempts. Data collected included demographics, time to insertion of the ETT, and depth of insertion of the IC immediately prior to ETT advancement. Primary outcome variables were depth of insertion and time to insertion. Data was compared using the Mann-Whitney Rank Sum test. A p value <0.05 was considered statistically significant.

Results: Of the 30 participants, 16 were randomized to the standard group and 14 to the modified group. The demographic and experimental data are as shown in Table 1. Overall, there was no statistical difference in the time to insertion or the mean depth of insertion of the IC between the 2 groups. The mean depth of insertion of the IC during exchange with a laryngeal tube over a fiber optic scope was approximately 7 cm. Shortening the ETT by 2 cm, did not affect the time, depth, or success rates using the IC exchange technique.

Conclusion: All observed IC expulsions occurred during LT removal, thus, further studies may be useful to evaluate this technique in clinical practice.

Table 1. Study data.

<table>
<thead>
<tr>
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<th>Standard group n=16 (80 trials)</th>
<th>Modified group n=14 (70 trials)</th>
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<tr>
<td>Age, y (mean ± sd)</td>
<td>41.7 ± 10.3</td>
<td>43.8 ± 14.11</td>
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<td>Sex, M:F</td>
<td>12:4</td>
<td>8:6</td>
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<tr>
<td>Experience, years</td>
<td>10 ± 8.4</td>
<td>15.8 ± 14.1</td>
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<tr>
<td>Depth of insertion, cm (mean ± sd)</td>
<td>6.9 ± 2.4</td>
<td>7 ± 2.4</td>
<td>p=0.916</td>
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<tr>
<td>Time to insertion, seconds (mean ±sd)</td>
<td>77.9 ± 48.4</td>
<td>92.7 ± 61.2</td>
<td>p=0.115</td>
</tr>
<tr>
<td>Success rate (%)</td>
<td>98.7%</td>
<td>94.3%</td>
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IMPLEMENTATION OF A PERIOPERATIVE ENHANCED RECOVERY PATHWAY FOR ELECTIVE COLORECTAL SURGERY

Authors: Marc B. Royo M.D., M.B.A., Scott A. Falk M.D., Najjia N. Mahmoud M.D., Lee A. Fleisher M.D.
Department: Department of Anesthesiology and Critical Care, Hospital of the University of Pennsylvania

Introduction:
With published morbidity rates upwards of 40% in elective colorectal surgery, many widely practiced perioperative care principles for this patient population are being challenged\(^1,2\). One multidisciplinary care model with mounting evidence of clinical effectiveness is the Enhanced Recovery After Surgery (ERAS) pathway. Standardizing pre-, intra-, and postoperative interventions aimed at accelerating recovery, ERAS protocols demonstrate success in reducing postoperative complications and the average hospital length of stay associated with elective colorectal surgery\(^3,4\).

For the anesthesiologist, Enhanced Recovery pathways aim to target specific practices of preoperative fasting recommendations, analgesic techniques, nausea and vomiting prophylaxis and perioperative fluid administration.

Objective:
To implement a multidisciplinary clinical care pathway for patients undergoing elective colorectal surgery using current best evidence.

Methods:
Following a literature review of current ERAS consensus guidelines, a clinical care pathway for elective colorectal surgery was designed and introduced across our institution’s perioperative setting. Anesthesia providers were offered clinical suggestions for intra- and postoperative (post-anesthesia care unit) management that focused primarily on opioid-sparing analgesic techniques and relative fluid restriction.

Post-intervention data pertaining to patient demographics, fluid administration and length of stay were compared to all elective colorectal surgery cases performed during the 2011-2012 academic year at the Hospital of the University of Pennsylvania.

Results:
Seventy-seven patients have received their perioperative care in alignment with our institution’s enhanced recovery pathway to date. Comparisons were made to 139 patients who underwent elective colorectal surgery during the 2011-2012 academic year. Mean intraoperative crystalloid administration decreased from 9.9 mL/kg/hour to 5.1 mL/kg/hour in the post-intervention group \((p < 0.001)\). Average length of stay decreased from 6.7 days to 5.6 days \((p < 0.01)\) following the institution of the pathway.

Discussion:
The implementation of an enhanced recovery pathway for elective colorectal surgery was associated with a significant decrease in intraoperative crystalloid administration and hospital length of stay. Although early in our institution’s adoption of this care model, our findings demonstrate that a standardized pathway that frames ERAS guidelines as clinical recommendations is efficacious in minimizing inter-provider practice variability. The observed decreased length of stay suggests the ERAS model as a potential force to drive value for both patients and health systems.

References:

**Table 1. Patient Demographics**

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<td>Male (%)</td>
<td>46.8</td>
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<td>ASA Physical Status (mean)</td>
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**Table 2. Outcomes**

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<tr>
<td>Crystalloid Administration (mL/kg/hr)</td>
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<tr>
<td>Length of Stay (days)</td>
<td>6.7 ± 2.9</td>
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**Figure 1. Crystalloid Administration by Temporal Cohort (mL/kg/hr)**

**Figure 2. Length of Stay - "Traditional Care"**

**Figure 3. Length of Stay - "ERAS"**
THE PORTABLE GLOSTAVENT: SPEED OF ASSEMBLY AND SUCCESSFUL VENTILATION FOR NAÏVE OPERATORS

Presenter: Jacob Benrud, MD, Department of Anesthesiology, Milton S. Hershey Medical Center
Authors: Jacob Benrud, MD, Julie Vuong, MD, Shannon Grap, MD, Allison Weinstock, MS2

Introduction
Much of the world lacks resources to allow use of modern complex anesthesia machines in clinical practice. Furthermore, developing or disaster-stricken areas often lack basic resources such as compressed gases or electricity. The portable Glostavent (GV) offers a self-contained solution to provide anesthesia in environments as mentioned above, while not relying on availability of supplemental oxygen or electricity. 1 Draw-over anesthesia machines such as the GV have been utilized by military personnel and developing countries for years; however, interest in the portable version of the GV has increased for use in medical missions, where equipment may be unfamiliar.

This research focuses not on the merits of the portable GV itself but rather if anesthetists without experience with this machine would be able to read basic instructions provided by the manufacturer with the machine, assemble, and successfully ventilate a mannequin within a given period of time. By demonstrating success of quick assembly and use of the portable GV by naïve operators, we will further demonstrate its utility for use in medical mission trips and austere environments.

Objective
The study objective was to determine if naïve operators can successfully assemble and ventilate a mannequin with the portable GV after a 10 minute self-taught instructional period and 10 minute simulation session using only the standard manufacturer-provided instructions.

Methods
30 study subjects, anesthesia residents and faculty currently in practice, were anticipated to participate. Each participant was screened to ensure they were naïve to the portable GV. They were allowed 10 minutes to familiarize themselves with the machine and instructions, without any input from the evaluator. After this period they were timed to successful assembly including ventilation, within a maximum time frame of 10 minutes. At the end of this period they were asked to fill out a questionnaire.

Results
Thus far, 18/30 subjects have completed the study. All but one have successfully assembled the portable GV during the second 10 minute period, although 5/18 were unable to put the machine together during the initial learning period. So, all but one were able to learn from their mistakes and succeed with proper assembly and ventilation of the mannequin. The average time for initial learning was 372 seconds (6 minutes, 12 seconds) and the average time for successful assembly during the second “real time” period was 94 seconds (1 minute, 33 seconds), excluding the one participant who failed during both periods.

Conclusion
While our study is not yet complete, we have very encouraging results regarding the ability of the average practicing anesthesiologist to assemble a new anesthesia machine built for austere and challenging environments. It appears that even if an anesthesiologist has difficulty with self-learning, given a second chance nearly everyone can successfully assemble and utilize a precious life-saving machine for operative use. When our study is fully finalized, we will be able to assess more if the years of anesthesia practice correlate with faster times to either self-learning or to successful assembly and use for giving anesthesia.

References
COMPLICATIONS OF INTRA-ARTERIAL CHEMOTHERAPY

Ian Yuan, MD, MEng; Robert Machnicki, MD; Amanda Lukof, MD; Marc Torjman, PhD
Thomas Jefferson University Hospital

Introduction
Intra-arterial chemotherapy (IAC) is a relatively new treatment for retinoblastoma that selectively targets chemotherapy at the ophthalmic artery, thus avoiding many of the complications associated with systemic chemotherapy. While under general anesthesia for IAC, cardiopulmonary events such as bronchospasm and bradycardia have been noted, with rates of up to 24% reported in the literature\(^1\). Although these events are thought to be an autonomic reflex reaction, the exact mechanism is unknown.

Objective
The goal of this retrospective, observational study is to quantify the incidence of these cardiopulmonary events during IAC. A secondary goal is to identify surgical or anesthetic factors that may correlate with these events to help decrease occurrences of these events in the future.

Methods
With IRB approval and parental consent, pediatric patients undergoing IAC were recruited for this study. After inhalation induction and IV access, intubation was accomplished with a standard list of IV medications including: fentanyl (1mcg/kg), glycopyrrolate (0.01mg/kg), rocuronium (1mg/kg), and dexamethasone (0.5mg/kg). Two puffs of albuterol are administered through the endotracheal tube post-intubation. Patients were maintained at greater than one MAC of sevoflurane. Standard ASA monitors were used in addition to arterial blood pressure from the femoral sheath. Timestamps were applied to the electronic anesthetic record to mark the catheter entry of the ophthalmic artery, the start and end of chemotherapy drug injection, and if a cardiorespiratory event occurred. These cardiorespiratory events were defined as \(\geq 20\%\) change from baseline in any of the following: increase in peak inspiratory pressure, decrease in tidal volume, decrease in heart rate, or decrease in blood pressure. If intravenous epinephrine or additional albuterol was necessary, the event was considered severe.

Results
Intraoperative data from 51 IAC procedures in 26 patients were analyzed. Cardiorespiratory events that met the criteria defined above occurred in 8 cases from 6 patients, indicating an incidence of 15.69%. There was no significant difference in age or weight in the group that developed bronchospasm. (Table 1). Table 2 summarizes the correlation between prematurity, reactive airway disease, tobacco exposure, and previous IAC treatments.

Conclusions
The group who developed bronchospasm had statistically similar age and weight to the group without bronchospasm. Furthermore, there is no correlation between prematurity, reactive airway disease, and tobacco exposure to the development of bronchospasm. All 6 patients who developed bronchospasm had prior IAC treatment, suggesting a correlation between previous IAC treatment and the incidence of bronchospasm \((p = 0.0149)\). Since this is a preliminary analysis of an ongoing study, statistical results should be interpreted with caution until more data is collected. Future work will focus on identifying other factors that may contribute to bronchospasm, such as lack of premedication and the temporal correlation between cannulation of the ophthalmic artery and the onset of bronchospasm.
Table 1

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Table 2

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<tr>
<td>N=</td>
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<td>6</td>
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<tr>
<td>Tobacco exposure</td>
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<td>Previous IAC treatment</td>
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References

**Practice Patterns and Impact of Tidal Volume During One-Lung Ventilation on Outcome in Patients Undergoing Esophagectomy**

Presenter: Patrick Hackett, MD

Patrick Hackett, MD1; Justin Tawil, MD; Timothy Olsen, MS; Erica Coffin, MD; Poleak So, MD; Derek Lauter, MD; Sean Dechancie, DO; Steven Whitehurst, MD; A. Murat Kaynar, MD, MPH

1Resident, Department of Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

**Abstract Type:** Original research project

**Introduction:** Substandard ventilator management, allowing excessive tidal volumes (VT) and peak airway pressures (PAP) have been shown to have significant deleterious effects on patient outcomes.1-4 Unfortunately, standard ventilator strategies for one-lung ventilation (OLV) have not been clearly described in the literature.

**Objectives:** We aimed to determine the impact of ventilator management strategies during one-lung ventilation (OLV) on short- and long-term outcomes. Furthermore, we sought to determine the current practices of anesthesia providers in a large academic, quaternary-care center.

**Methods:** We collected data on 252 patients who received OLV during minimally invasive esophagectomy. The variables included demographics, medical history and ventilator settings including tidal volume (TV), positive end expiratory pressure (PEEP) and peak inspiratory pressure. We extracted from medical records 7- and 30-day outcomes including the rates of pneumonia, ventilator days, sepsis, septic shock, and death. Chi-square was used to compare outcomes and a p value <0.05 was significant. We also surveyed residents in anesthesiology, certified registered nurse anesthetist, and anesthesiologist regarding their current practices during OLV, including TV and PEEP.

**Results:** Patients ventilated during OLV using a TV <6 ml/kg showed lower rates of sepsis and septic shock (p=0.016 and 0.024, respectively). Ninety-nine anesthesia providers completed our survey. Less than half (42.62%) of anesthesia staff report providing PEEP of 5 cmH2O. Furthermore, while the majority (68.85%) of providers administer a TV of 4-6 ml/kg, only 19.67% calculate their patients ideal body weight (IBW).

**Conclusions:** TV of less than 6 ml/kg and PEEP of 5 cmH2O during OLV showed fewer rates of sepsis and septic shock. Unfortunately, survey results suggest current practices are not consistent with what the data describe as potentially protective OLV strategies. Furthermore, while most provide appropriate ml/kg TV, most do not calculate the patients IBW, which can lead to a falsely elevated TV administration.

**References:**

1. Gama de Abreu M et al. One-lung ventilation with high tidal volumes and zero positive end-expiratory pressure is injurious in the isolated rabbit lung model. *Anesthesia and Analgesia*. Sept 2002;96:220-228
BLOOD VOLUMES DISCARDED WITH SURGICAL SPONGES

Gerhardt Konig1, Andrew Hosford2, Siddarth Satish2, Jonathan H. Waters1

1. Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, United States.
2. Gauss Surgical, Inc., Los Altos, United States

Introduction:
When making estimates of intraoperative blood loss, the anesthesiologist must estimate the amount of blood contained within suction canisters, surgical sponges, surgical drapes, and on the operating room floor. Quantitative measurements of the blood contained within surgical sponges are rarely made. The objective of this study was to make quantitative measures of the volume of blood contained within surgical sponges at the end of common surgical procedures.

Methods:
Prospective cohort study of the Hb content of surgical sponges. Consecutive cesearean section (C/S), abdominal (GI), hysterectomy, liver resections, and total hip replacement (ortho) surgeries were enrolled. Total blood volume contained within each sponge used during the surgical case was measured and totaled for the surgical case using a previously validated visual-algorithm system(1,2). Cases were grouped by type, and reported as mean, standard deviation (SD), median, 25th percentile, 75th percentile, and interquartile range (IQR).

Results:
A total of 68 surgical cases were enrolled (30 C/S, 12 GI, 7 hysterectomy, 7 liver, 12 ortho). The mean volume of blood for C/S were 369mL, SD 198mL, median 312mL (245mL, 454mL, IQR 209mL). The mean volume of blood for GI cases were 205mL, SD 202mL, median 121mL (57mL, 287mL, IQR 231mL). The mean volume of blood for hysterectomies were 102mL, SD 62mL, median 112 (55mL, 144mL, IQR 89mL). The mean volume of blood for liver resections were 426mL, SD 275mL, median 460mL (229mL, 534mL, IQR 305mL). The mean volume of blood for total hip replacements were 84mL, SD 112mL, median 53mL (40mL, 65mL, IQR 25mL).

Conclusions:
There is a significant amount of blood contained within surgical sponges at the end of surgery in many common surgical procedures. An accurate estimated blood loss for the surgery should include a measure of the blood contained within the surgical sponges removed from the field.

References:
PREScribing Patterns of Discharge Pain Regimen for Patients Undergoing Common Surgical Procedures

Presenter: Brian Lai, M.D., Department of Anesthesiology, Jefferson University Hospital, Philadelphia, PA

Authors: Brian Lai, M.D.; Eugene Viscusi, M.D.; Ashwin Rangavajjula, M.D.

Introduction: Pain control is a major concern of most patients undergoing surgery. Pain can be relieved using multiple drugs and multiple techniques, otherwise known as a multimodal analgesia. The ideal discharge pain regimen achieves the goal of analgesia with minimal side effects. Opioids are still a primary treatment for postoperative pain. Opioids are associated with troubling and often dose limiting side effects. Furthermore, excessive postoperative opioid prescribing may contribute to availability of opioids for abuse and diversion. The goals of this study were to: 1) determine which opioids were being prescribed postoperatively and in what quantity and duration, 2) determine the pattern and prevalence for use of non-opioid analgesics. In order to narrow the scope of the study and reduce confounding variables, five common surgical procedures were chosen as a focal point of this study (Hip Replacements, Laparoscopic Cholecystectomies, Hysterectomies, Tonsillectomies, and Knee Replacements)

Methods: Following IRB approval, a retrospective data query of discharge analgesia prescriptions at a university tertiary care center for five surgical procedures was performed using data between the years 2011 and 2012.

Results: Approximately 50 patients from each of the five common surgical procedures were included. The summary of the results are found in Tables 1 and 2.

Conclusions: Opioid combination agents remain the most commonly prescribed oral analgesics upon discharge following surgery. The use of multimodal analgesia is supported by acute pain guidelines, and the orthopedic surgeons and gynecologic surgeons at our institution embrace it while the ENT and general surgeons still prescribe opioids as a primary treatment for postoperative pain. Our data also suggests that at our institution, only a moderate quantity of opioid is prescribed limiting the risk of exposure and diversion. Further prospective studies are warranted to determine what patients actually consume of their discharge prescriptions.
<table>
<thead>
<tr>
<th>Case Type</th>
<th>Number of Cases</th>
<th>Most Commonly Prescribed Medication</th>
<th>Percentage of Patients Receiving Drug</th>
<th>Mean Number of Tablets Prescribed or ml Prescribed</th>
<th>Calculated Duration of Prescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Replacements</td>
<td>57</td>
<td>Tramadol 50 mg</td>
<td>88%</td>
<td>40</td>
<td>5-10 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydrocodone-APAP 7.5-325 mg</td>
<td>82%</td>
<td>40</td>
<td>3-7 days</td>
</tr>
<tr>
<td>Laparoscopic Cholecystectomy</td>
<td>52</td>
<td>Oxycodone-APAP 5-325 mg</td>
<td>87%</td>
<td>33</td>
<td>2-6 days</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>51</td>
<td>Ibuprofen 600 mg</td>
<td>92%</td>
<td>49</td>
<td>12 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oxycodone-APAP 5-325 mg</td>
<td>61%</td>
<td>32.5</td>
<td>5-8 days</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>50</td>
<td>Oxycodone-APAP 5-325 mg Solution</td>
<td>36%</td>
<td>306 ml</td>
<td>5-8 days</td>
</tr>
<tr>
<td>Knee Replacements</td>
<td>50</td>
<td>Hydrocodone-APAP 7.5-325 mg</td>
<td>90%</td>
<td>40</td>
<td>3-7 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tramadol 50 mg</td>
<td>86%</td>
<td>40</td>
<td>5-10 days</td>
</tr>
</tbody>
</table>

* NOTE the duration of medication was estimated using the parameters in the described prescription and assumed that patients were not taking them PRN but exactly as prescribed. Using these assumptions, the number of pills consumed per day was determined and that was divided into the total number of pills to estimate the duration of the prescription.

Table 1: Most Commonly Prescribed Discharge Medication for Different Surgical Procedures with Mean Number Quantity Dispensed and Calculated Duration of Prescription

<table>
<thead>
<tr>
<th>Case Type</th>
<th>% Patient Receiving Multimodal Analgesia</th>
<th>% Patient Receiving Combination Products (ie: Oxycodone-APAP)</th>
<th>% Patient Receiving Opioids Only including Combination Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Replacements</td>
<td>84%</td>
<td>86%</td>
<td>9%</td>
</tr>
<tr>
<td>Laparoscopic Cholecystectomy</td>
<td>10%</td>
<td>94%</td>
<td>92%</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>92%</td>
<td>75%</td>
<td>8%</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>12%</td>
<td>62%</td>
<td>56%</td>
</tr>
<tr>
<td>Knee Replacements</td>
<td>90%</td>
<td>92%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Table 2: Percentage of Patients Receiving Multimodal Analgesia vs. Combination Products vs. Opioid Only Regimens
USE OF SKELETAL MUSCLE RELAXANTS IN THE POSTOPERATIVE PERIOD

Presenter: Brian Lai, M.D., Department of Anesthesiology, Jefferson University Hospital, Philadelphia, PA
Authors: Brian Lai, M.D.; Eugene Viscusi, M.D.; James Harrop, M.D.

Introduction: Opioids remain the primary management for postoperative pain frequently as a monotherapy. However, postoperative pain is a mixed pain experience with components that include nociceptive neuropathic, visceral, and spasmatic and spastic contributions. Postoperative pain following spine surgery frequently includes patient complaint of muscle spasms. Hence, a multimodal approach is warranted. Skeletal muscle relaxants are sometimes incorporated into the postoperative pain regimen following major surgery for relief of primary myalgias. Yet, their contribution to pain relief is not well understood. This review was taken in order to summarize the evidence surrounding common skeletal muscle relaxants during the postoperative period. We examined mechanism of action, role in postoperative pain management, dosage and administration, limitations on its usage, drug abuse and dependence liability, and key clinical studies regarding safety and efficacy were explored.

Methods: The skeletal muscle relaxant drugs commonly utilized in the United States (baclofen, carisoprodol, cyclobenzaprine, diazepam, tizanidine, metaxalone, methocarbamol, and ophenadrine citrate) were reviewed (Table 1). A PubMed search using each of the drugs as a Mesh criterion was performed and additional restrictions including English language, clinical trials, and drug as a supplementary concept were placed on the search (Table 2). The articles that resulted from this automated search were individually reviewed for those specific to the drug and the postoperative period.

Results: 73,000 articles were reviewed as outlined in the methodologies section and only two articles met the inclusion criteria. The only drugs with detailed literature evidence for usage during this period are diazepam and baclofen with one article for each drug.

Discussion: Skeletal muscle relaxants may be an adjunct to opioid therapy that can aid in treating pain that has is described as “muscle tightness” or muscle spasms. The relative lack of information available on these agents guiding usage in general makes clinical application challenging. There is sparse if any data for most agents in the post-operative period. Skeletal muscle relaxants are commonly used following major spine surgery and may have a benefit in a multimodal analgesic pathway when muscle spasms are present. There is currently little evidence to guide our use of specific drugs or dosing regimens. These agents have known adverse events including sedation and impairment of respiratory function particularly in combination with opioids hence these drugs should be used judiciously.

Conclusions: There is limited evidence for the usage of skeletal muscle relaxants in the postoperative spine surgery period. None the less, these agents remain widely used by some surgical specialties particularly spine with clinical benefit. Given the potential for significant adverse events particularly in combination with opioids, prospective clinical studies are clearly warranted.

References:
Tizanidine hydrochloride capsule package insert. Morgantown, West Virginia: Mylan Pharmaceuticals, Inc.
EMERGENCY DEPARTMENT PAIN MANAGEMENT IN COGNITIVELY IMPAIRED VERSUS COGNITIVELY INTACT OLDER ADULTS WITH HIP FRACTURE

Pieczynski LM, Rudnick D, Perrin B, Neuman MD

Department of Anesthesiology and Critical Care, Perelman School of Medicine at the University of Pennsylvania

Introduction: Hip fractures represent a common, painful injury affecting over 320,000 older adults in the US each year (1). Approximately 19% of hip fracture patients have pre-existing cognitive dysfunction, and past investigations have found pain related to hip fracture to be relatively undertreated among patients with and without impaired cognition (2). For example, a 2000 study found that hip fracture patients with dementia received one-third the amount of morphine sulfate equivalents (MEQ) as cognitively intact patients (3). A 2006 study found that only 64% of patients with hip fractures received any analgesics while in the emergency department (ED) (4).

Objective: We examined pain assessments, administration of opioid and non-opioid analgesics, and timing of medication administration in the ED in patients with and without cognitive impairments. We hypothesized that older adults with dementia receive less opioid analgesia, experience longer times until pain assessment and longer wait times before receiving analgesia.

Methods: We identified all patients aged 50 or older treated for intertrochanteric, femoral neck, or subtrochanteric fractures at two major urban academic medical centers between November 1, 2012 and November 1, 2013. We excluded patients who transferred from another hospital, who presented with multiple traumatic injuries, or sustained hip fracture during their hospitalization. Data were collected from hospital electronic medical records into a standard chart abstraction form by three trained reviewers (LP, DR, BP). We used descriptive statistics to characterize the distributions of variables in our sample, and used Fisher’s exact test and the Wilcoxon rank-sum test. We compared patients with and without cognitive impairment in terms of the fractions receiving opioid and non-opioid analgesics, and the time to pain assessment and first analgesic administration.

Results: Our sample included 90 patients, 25 of whom had cognitive dysfunction. The median age of patients in our sample was 88 and 79 for demented and cognitively intact patients, respectively (p<0.001). 76% of demented patients received opioid analgesia in the ED, while 89.2% of non-demented patients received opioids (p=0.177). 20% of demented patients versus 4.6% non-demented patients received non-opioid analgesics (p=0.035). Cognitively intact patients received 0.8 morphine milligram equivalents (MEQ) per hour compared to 0.5 MEQ per hour in the demented patients (p= 0.006). There was no significant difference in the length of time the demented versus non-demented patients spent in the ED, which was 373 (median 311) versus 385 (median 326) minutes respectively (p=0.558). There was no difference in time to first pain assessment, with 13 minutes (median 9) and 14 minutes (median 8) respectively (p=0.430). There was a trend towards a delay to treatment in the dementia group, with 136 minutes (median 89) versus 69 (median 36) minutes to first analgesic administration (p=0.085). We observed similar results when we restricted our sample to individuals aged 80 years or more.

Conclusions: Our findings demonstrated that patients with cognitive impairments receive less total and per-hour opioid analgesia after hip fracture. Patients with dementia are more likely to receive non-opioid analgesia. When compared to previous studies, we found a higher overall fraction of patients receiving analgesia for hip fracture, but still identified differences in treatment between those with a pre-existing diagnosis of dementia. Demented patients receive significantly more non-opioid analgesia, but the overall use of these adjuvants remains low.

References:
### Table 1
Patient Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Dementia (N=25)</th>
<th>Cognitively Intact (N= 65)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age (IQR)</td>
<td>88 (82, 92)</td>
<td>79 (68, 87)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Women</td>
<td>17 (29.8%)</td>
<td>40 (70.2%)</td>
<td>0.632</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>15 (60%)</td>
<td>36 (55.4%)</td>
<td>0.913</td>
</tr>
<tr>
<td>African American</td>
<td>10 (40%)</td>
<td>24 (36.9%)</td>
<td></td>
</tr>
<tr>
<td>Latino</td>
<td>0</td>
<td>2 (3.1%)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>3 (4.6%)</td>
<td></td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>3 (12%)</td>
<td>39 (60%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>22 (88%)</td>
<td>26 (40%)</td>
<td></td>
</tr>
<tr>
<td>Fracture type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Femoral neck</td>
<td>10 (40%)</td>
<td>28 (43.1%)</td>
<td>0.854</td>
</tr>
<tr>
<td>Intertrochanteric</td>
<td>12 (48%)</td>
<td>27 (41.5%)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>3 (12%)</td>
<td>10 (15.4%)</td>
<td></td>
</tr>
<tr>
<td>Length of stay</td>
<td>6 (4,7)</td>
<td>7 (5,9)</td>
<td>0.295</td>
</tr>
<tr>
<td>(median, IQR)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: IQR: Interquartile range

### Table 2
Pain and Analgesic Prescribing Practices in the Emergency Room

<table>
<thead>
<tr>
<th></th>
<th>Dementia</th>
<th>No Dementia</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number receiving opioids (%)</td>
<td>19 (76%)</td>
<td>58 (89.2%)</td>
<td>0.177</td>
</tr>
<tr>
<td>Total MEQ (median, IQR)</td>
<td>2.5 (1.5, 6)</td>
<td>6 (2.7, 12)</td>
<td>0.003</td>
</tr>
<tr>
<td>Average MEQ/hr (median, IQR)</td>
<td>0.5 (0.19, 0.67)</td>
<td>0.8 (0.47, 2.1)</td>
<td>0.006</td>
</tr>
<tr>
<td>Number receiving non-opioid analgesia</td>
<td>5 (20%)</td>
<td>3 (4.6%)</td>
<td>0.035</td>
</tr>
<tr>
<td>ED length of stay (med, IQR)</td>
<td>373 (311, 491)</td>
<td>385 (326, 536)</td>
<td>0.558</td>
</tr>
<tr>
<td>Time to first pain assessment (med, IQR)</td>
<td>13 (9, 30)</td>
<td>14 (8, 24)</td>
<td>0.430</td>
</tr>
<tr>
<td>Time to first pain med administration (med, IQR)</td>
<td>136 (89, 218)</td>
<td>69 (36, 177)</td>
<td>0.085</td>
</tr>
</tbody>
</table>

IQR: Interquartile range

### Table 3
Pain and Analgesic Prescribing Practices in the Emergency Room- Stratified by Age

<table>
<thead>
<tr>
<th>PATIENTS AGE &gt;80</th>
<th>Dementia</th>
<th>No Dementia</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number receiving opioids (%)</td>
<td>16 (72.7%)</td>
<td>29 (90.6%)</td>
<td>0.136</td>
</tr>
<tr>
<td>Total MEQ (median, IQR)</td>
<td>2 (0, 4)</td>
<td>6.0 (2.6, 8.3)</td>
<td>0.011</td>
</tr>
<tr>
<td>Average MEQ/hr (median, IQR)</td>
<td>0.5 (0, 0.67)</td>
<td>0.74 (0.43, 1.24)</td>
<td>0.016</td>
</tr>
<tr>
<td>Number receiving non-opioid analgesia</td>
<td>5 (22.7%)</td>
<td>2 (6.3%)</td>
<td>0.107</td>
</tr>
<tr>
<td>ED length of stay (median, IQR)</td>
<td>366.5 (304, 491)</td>
<td>398 (328, 507.5)</td>
<td>0.408</td>
</tr>
<tr>
<td>Time to first pain assessment (median, IQR)</td>
<td>13 (9, 30)</td>
<td>15.5 (10, 24.5)</td>
<td>0.950</td>
</tr>
<tr>
<td>Time to first pain med administration (median, IQR)</td>
<td>137 (89, 218)</td>
<td>65 (34, 168.5)</td>
<td>0.084</td>
</tr>
</tbody>
</table>
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Abstract

FIBTEM IS MORE SENSITIVE THAN EXTEM AND KAOLIN-TEG IN DETECTING FIBRINOLYSIS: PART II OF A PROSPECTIVE COMPARATIVE STUDY BETWEEN ROTEM® VS. TEG® IN LIVER TRANSPLANTATION

Ezeldeen Abuelkasem, MD, MSc¹, Kenichi A. Tanaka, MD, MSc², Shu Yang Lu, MD¹, Raymond M. Planinsic, MD¹ and Tetsuro Sakai, MD, PhD¹. ¹Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, United States and ²Anesthesiology, University of Maryland Medical Center, Baltimore, MD, United States.

Body:

Background: Liver transplantation (LT) is frequently associated with fibrinolysis, which ROTEM® and TEG® can detect at the bed-side in a timely manner. However, no study has demonstrated which modality and channel is more suitable for detecting fibrinolysis.

Materials and Methods: This is the second part of an IRB-approved, prospective, observational study comparing ROTEM and TEG in isolated adult LTs [1]. ROTEM® (EXTEM, INTEM, FIBTEM, and APTEM) and TEG® (kaolin-TEG) were simultaneously performed using arterial blood samples at the eight time points during LT: at induction of general anesthesia, 60 minutes after skin incision, 10 and 45 minutes after portal vein clamp, 15 minutes prior to graft reperfusion, and five, 30, and 90 minutes after graft reperfusion. Fibrinolysis was diagnosed per the manufacturers’ definition (maximum lysis>15% in ROTEM® or Lysis30>8% in TEG®). The incidence of fibrinolysis was compared among channels using McNemar’s test.

Results: Thirty seven consecutive LT recipients completed the study (median age was 56 years old; 28 males [75.6%]; median MELD score was 18; eight live donor LTs [21.6%]). Among 296 possible measurement points, 250 underwent the final analysis: 46 measurement points were excluded due to missing one of any of the channels. Fibrinolysis was identified in 87 points (34.8%) of 250 measured points: kaolin-TEG detected 19 (21.8%), EXTEM detected 38 measurements (43.7%), and FIBTEM detected 84 (96.6%) in 87 fibrinolysis incidents (Fig-1). Each channel was significantly different (p<0.001) than the others. In each fibrinolysis detection by ROTEM® channels, the corresponding APTEM demonstrated normalization of the fibrinolysis parameter.

Conclusions: FIBTEM in ROTEM® is more sensitive than EXTEM and kaolin-TEG in the diagnosis of fibrinolysis in LTs.

Reference: 1) Abuelkasem E, et. al. Liver Transplantation 2014;20;Supple P-14
Fig-1: Bar chart showing of fibrinolysis (expressed as percentage of positive lysis out of total number of measurements) identified by each channel.

Disclosure Information:

**Author Name:** Ezeldeen Abuelkasem

No financial relationships to disclose

**Author Name:** Kenichi A. Tanaka

Dr. Tanaka has served as a consultant for Tem International (Munich, Germany), Grifols Biologicals (Barcelona, Spain), and Octapharma (Vienna, Austria), and has previously received research support from CSL Behring (Marburg, Germany); none of the companies were involved in the manuscript preparation.

**Author Name:** Shu Yang Lu

No financial relationships to disclose

**Author Name:** Raymond M. Planinsic

No financial relationships to disclose

**Author Name:** Tetsuro Sakai

No financial relationships to disclose
THROMBOCYTOPENIA AS ETOLOGY OF BLEEDING ASSOCIATED WITH VENO-VENOUS ECMO

Authors: Ronak Shah MD, Rebecca Speck PhD, MPH, Rebekah Williams, Yianni JG Augoustides MD, Zev Noah Kornfield MD, Jacob T Gutsche MD

Introduction
For critically ill patients who fail standard treatment modalities, extracorporeal membrane oxygenation (ECMO) may serve as a temporary bridge to recovery. Currently veno-venous (V-V) ECMO is indicated for cases of acute respiratory failure including pneumonia, failing lung transplant, traumatic lung injury, status asthmaticus and adult respiratory distress syndrome (ARDS), the last of which is the most common indication for veno-venous ECMO.1,2,3 ECMO is associated with a high morbidity and mortality and warrants further investigation to reduce the risk of this salvage therapy.

Bleeding complications are very common in patients on ECMO due to coagulopathy. Systemic anticoagulation is usually initiated to prevent circuit thrombosis. In addition, coagulopathy is thought to be secondary to continuous activation of platelets that adhere to surface fibrinogen, which is activated by the ECMO circuit.4 Platelet activation results in aggregation and clumping which ultimately lowers the systemic platelet count. Thrombocytopenia while on ECMO places the patient at risk for serious bleeding complications.5 Since heparin is the most common systemic anticoagulant used while patients are maintained on ECMO, heparin-induced thrombocytopenia may also cause a reduction in the platelet count. The appropriate platelet count threshold to transfuse platelets to prevent bleeding complications is currently unknown. The purpose of this study is to stratify risk of bleeding complications associated with a reduced platelet count.

Objective
To determine if platelet count is a contributing factor in bleeding complications and overall morbidity and mortality associated with veno-venous ECMO patients.

Methods
After receiving institutional review board approval, data from the medical records of all patients placed on V-V ECMO for acute respiratory failure between June 14, 2008 to August 9, 2014 in the University of Pennsylvania Health System were retrospectively collected. In patients with a bleeding complication, the lowest documented platelet count was noted in the previous 24 hours. In all other patients, the lowest platelet count while on ECMO was documented. Statistical analysis was performed to evaluate the risk of bleeding associated with thrombocytopenia and the platelet count thresholds of 100, 75, and 50 were evaluated for bleeding risk.

Results
Data was collected and analyzed from a total of 75 patients who were placed on V-V ECMO for acute respiratory failure including bleeding complications. The mean age of the patients was 46 and 61% were male. Twenty-five of the 75 patients had documented bleeding complications in their medical record. There was no association between platelet count and bleeding complications. Reduction in platelet count below the thresholds of 100, 75 and 50 was not found to increase risk for bleeding complications (p <0.01).

Conclusion
In our retrospective analysis, a reduced platelet count did not statistically contribute to bleeding complications. Further studies will be required to evaluate the risk of bleeding complications associated with thrombocytopenia.
References


RETROSPECTIVE REVIEW OF PEDIATRIC CARDIAC TUMORS BETWEEN 1986-2014 AT THE PENN STATE MILTON S. HERSHEY MEDICAL CENTER

Natalya N.M. Riek, DO, MS and Jansie Prozesky, MB, ChB
Department of Anesthesiology, Penn State Hershey Medical Center, Hershey, PA.

Introduction:

Cardiac tumors are extraordinarily rare in the pediatric population. According to autopsy studies, the prevalence of primary cardiac tumors in children is estimated to be 0.00017-0.28%. The incidence of cardiac tumors during fetal period was estimated at 0.14%. (1-3) Most tumors in children are benign with rhabdomyomas being the most common types in both infants and children while cardiac myxomas are the most common benign primary tumors in adults. (4-5) It is reported that cardiac rhabdomyomas present in close association with Tuberous Sclerosis. (6) We retrospectively analyzed all pediatric surgically-treated cardiac tumor cases at The Hershey Medical Center between 1986-2014.

Methods:

IRB approval was obtained to conduct this review. The Penn State Hershey Medical Center medical records of all pediatric patients with diagnosed and resected primary or secondary cardiac tumors from 1986 to 2014 were reviewed. Data collected included: patient demographics, presentation, surgical procedure, tumor type by histological identification, postoperative complications, associated Tuberous Sclerosis diagnosis, and survival rate.

Results:

Seventeen cases of intracardiac masses were reported. Three cases were excluded from the analysis, (one case of cardiac vegetation, one case of cardiac thrombus, and one case of unidentified mediastinal mass). From 1986 through 2014, fourteen pediatric patients (8 males and 6 females) who underwent diagnosis and resection of primary or secondary cardiac tumors were identified. Thirteen cases were identified as primary cardiac tumors and one case of secondary cardiac tumor. All patients underwent either complete or partial resection. The age of patients ranged from 1 day to 15 years. Twelve patients presented with primary benign tumors. Of these, 3 were teratomas, 3 myxomas, 2 rhabdomyomas, 2 fibromas, and 2 haemangiomas. One patient presented with primary metastatic fibrosarcoma and one patient presented with secondary metastatic Wilms’ tumor, both patients underwent suboptimal palliative resection. Eleven patients experienced no immediate post-operative complications; two patients required prolonged mechanical ventilation and ICU stay (neither experienced immediate postoperative mortality). One patient was later diagnosed with tuberous sclerosis. All patients survived at least one month following resection.

Discussion:

Short-term survival was favorable in all patients; however, we were not able to report on long term survival due to the lack of or loss of follow up data. Except for prolonged mechanical ventilation in two patients with multiple significant comorbidities, there were no significant complications reported postoperatively. There was associated tuberous sclerosis diagnosis in one patient, reflective of current literature reporting a high association of this disorder with cardiac rhabdomyomas.
References:

DISTINCT EFFECTS OF PROPOFOL AND METHOHEXITAL AT INDIVIDUALIZED DOSAGES ON SEIZURE INDUCTION AND SEIZURE DURATION DURING ELECTROCONVULSIVE THERAPY

Resident: Mehreen Iqbal, MD

Advisors: Xianren Wu, MD, Michael H. Entrup, MD, and Dietrich Gravenstein, MD

Affiliation: Geisinger Medical Center, Danville, PA

Introduction Electroconvulsive therapy (ECT) is one of the most common procedures that requires general anesthesia. Several anesthetic protocols, utilizing drugs with distinct pharmacological profiles, appear to be sufficient and safe to mask the electrical activity and the subsequent myoclonic movements. Previous studies were conducted to define and compare the effects of anesthetics during ECT. The results showed that methohexital was associated with a lower seizure threshold, while propofol had a more favorable hemodynamic response and recovery. The dosages of methohexital and propofol in those studies were standardized to meet the criteria of the research. Clinically, the dose of anesthetic drugs could vary widely among patients and through the course of ECT treatment. Therefore, the studies of “standardized dosage” may not necessarily be clinically relevant. It remains unclear if the choice of anesthetic agents makes any difference in the long-term outcome of these patients.

Methods We retrospectively identified the patients who received propofol in May 2014 or methohexital in Oct 2014 for ECT treatment. The following data were collected: dosage of induction agent, the energy needed to induce seizure, the electroencephalogram (EEG) seizure duration, and motor seizure duration. To avoid bias, the analysis was conducted in two ways: Treatment-based analysis, which considered every treatment data for final analysis, and Case-based analysis, which used only an average of each parameter from each patient over that period time. The Student t-test was used for group comparison.

Results Twenty-seven patients (mean age 53.5± 14.2 years old) underwent 86 treatments using propofol (1.61±0.37 mg/kg, range 1.08-2.67mg/kg) as an anesthesia induction agent. Seventeen patients received methohexital (1.06±0.34 mg/kg, range 0.56-1.9 mg/kg) for induction. Treatment based analysis: The energy needed for seizure induction was significantly higher in the group receiving propofol for induction (59.0±24 with propofol vs 43.9±20.9 with methohexital, p<0.05). The motor seizure duration (14.8±10.2 sec for propofol vs 31.4±45.0 sec for methohexital, p<0.01) and EEG seizure duration (36.7±11.6 sec for propofol vs 50.4±25.0sec for methohexital, p<0.01) were significantly shorter when propofol was used for induction. Similar results were found in the case-based analysis (data not reported here).

Discussion ECT is an effective therapy which requires repetitive procedures. To obtain optimal results, it is necessary to carefully tailor the dosages of anesthetics agents according to individual responses to electrical stimulation and recovery. Our data indicate that for desired seizure duration and timely recovery, dosages of propofol or methohexital varied widely from patient to patient. Over the treatment course, the change in dosages for the same patient was minimal after initial adjustment. The distinct ECT profiles suggest that methohexital might be a preferable agent when given in a clinically relevant dosing pattern.

THE IMPACT OF SEVERITY AND DURATION OF HYPOTENSION ON OUTCOMES FOLLOWING OUT-OF-HOSPITAL PEDIATRIC CARDIAC ARREST

Elizabeth K. Laverriere, MD, MPH. University of Pennsylvania Anesthesiology Residency Program

Authors: Elizabeth K. Laverriere, MD, MPH, Sarah Sanchez, Benjamin French, Ph.D., Robert A. Berg, MD, Alexis A. Topjian, MD, MSCE

Introduction: Pediatric out-of-hospital cardiac arrest (OHCA) incidence is 8.04/100,000 person-years, and survival ranges from 6-13%. Post-cardiac arrest syndrome (PCAS) is in part comprised of post-cardiac arrest myocardial dysfunction and a systemic ischemia/reperfusion response, which can lead to hypotension. Following in- and out-of-hospital adult cardiac arrest hypotension is associated with worse survival to discharge, with evidence that treatment of hypotension may improve outcomes.

It has recently been demonstrated that there is an association between early post-arrest systolic hypotension and increased in-hospital mortality and worse neurologic outcome among children from a multi-center post-cardiac arrest database. Further characterization of the extent and time course of hypotension in the post-ROSC (return of spontaneous circulation) period following resuscitation from pediatric cardiac arrest provides an opportunity for improved understanding of the PCAS and the impact of inotropic and vasopressor support on improving survival and neurologic outcomes.

Objective: To characterize the severity and duration of post-resuscitation hemodynamic derangements and vasopressor support following successful resuscitation from out-of-hospital pediatric cardiac arrest and to examine the association of post-ROSC hypotension with morbidity and neurologic outcomes.

Methods: This study was approved by the IRB. Fifty-four children who suffered an OHCA between November 2012 and December 2014 will be analyzed. Patients were included if they were ages 0 to 18 years, received chest compressions for ≥ 2 minutes, had ROSC ≥ 20 minutes, and survived to admission to the pediatric intensive care unit. Data was extracted from charts, including hourly blood pressures, heart rates, and vasopressor dosing for the first 72 hours after arrest. Blood pressures will be standardized for gender and age and dichotomized as hypotension (<5%ile) vs. absence of hypotension (>5%ile). Cuff blood pressures were used unless arterial line blood pressures were available. Extent and duration of hypotension in the post-arrest period will be analyzed as an area under the curve until resolution of hypotension or death. We will assess the severity of hypotension’s association with mortality and neurologic and functional outcomes. A severity score for hemodynamic support will be calculated using the vasoactive-inotropic score.

Pre-arrest variables, arrest characteristics, post-resuscitation care, outcomes, and cause of death have been prospectively collected and will be included in the analysis. Multivariable analyses will be used to control for potential confounders when evaluating the association between: 1) post arrest hypotension and mortality, 2) post-arrest hypotension and neurological outcome (by Pediatric Cerebral Performance Categories), and 3) post-arrest hypotension and functional outcomes (measured by the pediatric functional status scale).

Results: We have collected data on 54 children who suffered an out-of-hospital cardiac arrest and survived to ICU admission. 60% survived to discharge. It has been feasible to collect this data from the medical record and it is in the process of being analyzed for presentation in May 2015 at PARRC.
OR-34

References:


TALK IS CHEAP: A HALF-DAY RETREAT FOR IMPROVING COMMUNICATION BETWEEN SURGEONS AND ANESTHESIOLOGISTS

Presenter: JA Leckie MD, Department of Anesthesiology, Penn State Hershey Medical Center

Authors: JA Leckie MD, E Kenning MD, DC Han MD, J Vuong MD, JM Eckert DO, J Moyer BS, J Swierczynski BS

Introduction: Fourteen years after the publication of the Institute of Medicine’s *To Err is Human: Building a Safer Health System*, reducing medical errors to improve patient safety remains at the forefront of the medical community’s agenda. The operating room represents a high risk clinical environment where patient safety relies heavily on timely and effective interprofessional communication. Residency training is a time when one of the earliest and most enduring impacts can be made in this regard. In a previous study, Cleveland Clinic demonstrated that a teambuilding exercise developed teamwork and leadership skills among residents of their Internal Medicine residency program1. To our knowledge, the effect of a teambuilding retreat between different clinical departments has yet to be explored.

Objective: We hypothesized that even in a period of significant time and financial constraint, a multidisciplinary retreat involving Surgery and Anesthesiology residents could have a positive and measurable impact on communication between these specialties.

Methods: A core group from the Departments of Anesthesiology and Surgery, as well as a corporate consultant who specializes in communication styles, organized a half-day off-site retreat for residents of these two departments. The retreat included a didactic session whereby residents assessed their individual communication styles, identified associated aids and barriers to communication, and learned skills to overcome these barriers. The didactic session was followed by a “low-ropes challenge course” requiring the implementation of their learned communication skills. To evaluate the impact of the retreat, residents completed anonymous surveys before and after the retreat in which they indicated their likelihood to communicate with other health care providers in various clinical scenarios.

Results: A group of 50 residents from both specialties participated in the retreat. Total cost for the event was $114 per resident. Based on survey responses, residents who participated were more likely to communicate with other health care providers in clinical settings after the retreat relative to before the retreat (p = 0.048). When stratified by specialty, Anesthesiology residents were more likely to communicate after the retreat (p = 0.044) whereas Surgery residents were also more likely to communicate after the retreat (although not to statistical significance). Fifty-nine percent of participants considered the information presented to be useful and 92% of participants felt that their communication skills improved because of the didactic session. When asked specifically if they thought the retreat made them more likely to communicate with other health care providers, greater than 70% of participants did not perceive that the retreat had any effect.

Conclusion: Our study suggests that a short focused event for residents of different specialties can have a positive impact on interprofessional communication. Depending on available time and resources, an interdisciplinary retreat can be executed with substantial positive outcome and relevant implications for patient safety.

References:
OPTIMIZATION OF ULTRASOUND PROBE POSITIONING DURING ENDOTRACHEAL TUBE PLACEMENT CONFIRMATION IN THE CADAVERIC MODEL.

Tiffany K. Lonchena MD 1, Sokpoleak So MD 2, Jim W. Ibinson MD 3, Steven L. Orebaugh MD 4

University of Pittsburgh Medical Center
Department of Anesthesiology
Pittsburgh, Pennsylvania

1 Resident, Department of Anesthesiology
2 Resident, Department of Anesthesiology
3 Professor, Department of Anesthesiology
4 Professor, Department of Anesthesiology and Critical Care Medicine

Introduction
Confirmation of accurate endotracheal tube (ETT) placement in the airway is paramount in critically ill patients, particularly in those who have undergone cardiac arrest or when carbon dioxide detection is unavailable. Ultrasonography has been suggested as a possible means of ETT placement confirmation. Limited investigations have shown a high sensitivity of this modality for detection of endotracheal intubation in both the living and cadaveric model; however, optimum ultrasound probe placement has not been established.1,2 Using the cadaveric model, we sought to compare the ability to detect ETT placement by ultrasound appearance at three levels of probe placement over the upper airway.

Materials and Methods
Utilizing five lightly-preserved cadavers, we performed three sets of ten intubations in each specimen with realtime ultrasound visualization of ETT passage at three levels: thyroid cartilage, cricothyroid membrane, and suprasternal notch. A single provider performed all cadaveric intubations, while two separate experienced airway providers positioned and interpreted the ultrasound imaging in real time. Movement within the tracheal rings was used as an indication of passage of the ETT through the airway. The ultrasound interpreters graded each intubation on a visualization scale of 0 (no movement), 1 (subtle movement), 2 (clear movement), 3 (pronounced movement).

Results
At the level of the thyroid cartilage, tracheal intubation was unable to be detected in 60% (18/30) of ultrasound visualizations, with a median visualization scale of 1 (subtle movement). At the level of the cricoid cartilage, the visualization scale improved to a median of 2 (clear movement) with 30% (9/30) intubations unable to be visualized (0 = no movement). At the level of suprasternal notch, 100% of the tracheal intubations were visualized on ultrasound, with a median score of 3 (pronounced movement).

Discussion/Conclusion
In comparing ultrasound detection of ETT placement at three levels of the upper airway in the cadaveric model, our results clearly indicate that visualization was superior at the level of the
suprasternal notch with 100% of intubations detected and strong visualization scores.

References
Original Research
ADVANCE DIRECTIVES AND OPERATING: ROOM FOR IMPROVEMENT?

Presenter/Affiliation: Rachel Hadler/Hospital of the University of Pennsylvania
Author(s): Hadler RA, Neuman MD, Fleisher LA, Raper S.

Introduction: Surgeons and anesthesiologists are frequently called upon to perform procedures upon critically ill patients with advanced directives. We assessed the attitudes of attending and resident surgeons and anesthesiologists at our institution regarding their understanding of and practice around the application of consenting critically ill patients with advance directives in the operating room.

Objective: To elucidate training and practice patterns around care of critically ill surgical patients with advanced directives at our institution.

Methods: Participants attended an interdisciplinary Grand Rounds in which a surgeon-expert discussed a technique by which surgeons can re-frame surgical outcomes in critically ill patients. A multidisciplinary panel, comprised of two surgeons, one anesthesiologist, and a palliative care physician then discussed a series of cases with audience participation. Participants were invited to complete a survey discussing their own practice patterns with regards to surgical/perioperative care in elderly/ill patients. The 13-item survey included questions on individual training and practice in performing informed consent and advanced directives as well as assessing understanding of institutional policy regarding suspension of do not resuscitate orders for surgical procedures. Responses were scored on a 5 point Likert scale. Statistical analysis was performed in Excel.

Results: 69 of the 137 surveys disseminated were collected (response rate 50%). All groups of respondents reported that they had received minimal training with respect to discussing advance directives with surgical patients (16% of whole group, with similar means in sub-groups). Attending surgeons were more likely than any other group of practitioner to confirm the presence/absence of an advance directive before taking a patient to surgery. All respondents reported that they believed that critically ill, elderly patients very frequently came to the operating room without discussion of advance directives or how the scheduled procedure might be concordant with their goals of care. All four groups believed that discussions between surgeons and anesthesiologists regarding the congruence of a procedure with a patient’s stated goals of care happened very infrequently; residents in both the surgical and anesthesia groups were more likely to perceive a value in these conversations. (Table 2) There was concordance among respondents that they would rarely, if ever, decline to perform/participate in a procedure for someone with an advance directive limiting care in place; however, there was significant variance between groups in reported practice with regards to management of DNR orders in the operating room. The majority of anesthesia and surgery attendings reported that they would treat DNR orders as though they were suspended in the operating room under all circumstances, whereas less than half of all residents endorsed this management strategy (Table 3). This discrepancy could reflect different levels of medicolegal sophistication as well as perhaps different perception of patient rights at the end of life. Pennsylvania law states that DNR orders are uniformly suspended in the operating room unless patients specify other management preferences.

Conclusions: At our institution there has been minimal training and discussion of appropriate application of advanced directives and do not resuscitate orders in the critically ill surgical population. Training level appears to significantly influence interpretation of a variety of factors influencing care of the critically ill, including surgeon-anesthesiologist communication and application of do not resuscitate orders in the operating room.

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Tables:

Table 1: Respondent Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Anesthesia Resident</td>
<td>26</td>
<td>37.7</td>
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<tr>
<td>Anesthesia Attending</td>
<td>19</td>
<td>27.5</td>
</tr>
<tr>
<td>Surgery Resident</td>
<td>11</td>
<td>15.9</td>
</tr>
<tr>
<td>Surgery Attending</td>
<td>9</td>
<td>8.6</td>
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<tr>
<td><strong>Total</strong></td>
<td>69</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Perioperative practice surrounding advance directives. Responses are means of Likert-scaled scores. 1= least frequent/ disagree strongly, 4= very frequent/ agree strongly

<table>
<thead>
<tr>
<th></th>
<th>Anesthesia Resident</th>
<th>Anesthesia Attending</th>
<th>Surgery Resident</th>
<th>Surgery Attending</th>
<th>Other</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss acute/ life-threatening events in procedural consent</td>
<td>3.15</td>
<td>3.42</td>
<td>3.36</td>
<td>3.63</td>
<td>3.67</td>
<td>3.34</td>
<td>0.018</td>
</tr>
<tr>
<td>Confirm the presence of advance directive preoperatively</td>
<td>1.89</td>
<td>2.36</td>
<td>2.09</td>
<td>2.75</td>
<td>2.75</td>
<td>2.20</td>
<td>0.29</td>
</tr>
<tr>
<td>Frequency with which pts come to OR w/o discussion of impact of surgery</td>
<td>4.35</td>
<td>4.36</td>
<td>4.36</td>
<td>4.0</td>
<td>4.67</td>
<td>4.32</td>
<td>0.008</td>
</tr>
<tr>
<td>Would ever decline to provide care for pt with AD limiting care</td>
<td>2.28</td>
<td>2</td>
<td>2.81</td>
<td>2.11</td>
<td>3</td>
<td>2.29</td>
<td>0.16</td>
</tr>
<tr>
<td>Would discussion preop between surgeons and anesthesiologists re: goals of surgical care be helpful</td>
<td>3.5</td>
<td>3.21</td>
<td>3.35</td>
<td>2.88</td>
<td>3.75</td>
<td>3.33</td>
<td>0.009</td>
</tr>
<tr>
<td>How often does this discussion happen?</td>
<td>1.88</td>
<td>2</td>
<td>1.81</td>
<td>1.67</td>
<td>1.75</td>
<td>1.87</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Table 3: Management of DNR status in the OR

<table>
<thead>
<tr>
<th></th>
<th>Suspend DNR</th>
<th>Suspend DNI; Respect DNR</th>
<th>Respect DNR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia residents</td>
<td>44.4%</td>
<td>40.7%</td>
<td>14.1%</td>
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<tr>
<td>Anesthesia attendings</td>
<td>73.7%</td>
<td>10.5%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Surgery residents</td>
<td>45.5%</td>
<td>45.5%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Surgery attendings</td>
<td>77.8%</td>
<td>11.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Other</td>
<td>33.3%</td>
<td>33.3%</td>
<td>33.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>56.5%</td>
<td>28.9%</td>
<td>14.4%</td>
</tr>
</tbody>
</table>

References:
THE EFFECT OF CPAP SIMULATION AND TRAINING ON OPERATOR PROFICIENCY

Quigley G, Yuan I, Herman C, Torjman M, Maguire D
Department of Anesthesiology, Sidney Kimmel Medical College, Thomas Jefferson University

Introduction: Laryngospasm is an uncommon but serious complication of general anesthesia. Published laryngospasm management protocols recommend using continuous positive airway pressure (CPAP) early in the treatment of laryngospasm. This pilot study investigated the ability of a CPAP part-task trainer (CPCP-PTT) to evaluate and train anesthesia providers to perform CPAP.

Methods: After IRB approval, members of the Anesthesiology Department at Thomas Jefferson University Hospital (faculty, residents, and CRNAs) were recruited. The CPAP PTT consisted of an Apollo anesthesia machine, ASL 5000 Lung Simulator programmed to replicate a spontaneously ventilating adult patient under inhalation anesthesia, and evaluation software created by the study team to analyze CPAP proficiency. Subjects were first given a 3-minute baseline test on the CPAP PTT. This was followed by an instructional session and time to practice CPAP on the PTT. A second 3-minute post-training test was given to evaluate their progress after additional training. Results were processed and analyzed using customized software to determine proficiency in performing CPAP.

Acceptable performance criteria were defined as follows: The provider should maintain CPAP within a target pressure range within two standard deviations of the expert performance (94.3%±7.1) for at least 80% of the 3 minute trial period and the provider must minimize the occurrence of inspiratory pressure loss (IPL), defined as airway pressure less than 8 cmH2O (lower limit of the CPAP goal). The proficiency criterion for IPL was set as inspiratory pressure loss occurring less than one out of every 10 breaths.

Results: 27 subjects completed the baseline and post-training tests. The mean percent of time the subjects were able to maintain target pressure for the baseline and post-training test were 67.7±12 and 82.0±15.2 seconds, respectively. One-way ANOVA showed a significant improvement in performance between the two sessions (P <0.001). The percent of inspiratory loss was 3.1% for the baseline and significantly decreased to 0.9% (p=0.019) for the post-training test. The Friedman analysis also determined that there was a significant difference between the baseline and post-training tests for acceptable time in target (p=0.007), acceptable inspiratory loss (p=0.018) and overall proficiency (p=0.07) (Figure).

Discussion: This pilot study describes the setup of a part-task trainer (PTT) that can be used to practice CPAP. The post-training test showed a significant increase in the percentage of participants who satisfied the criteria for CPAP proficiency. The CPAP PTT system may be an effective task trainer valuable tool in improving the CPAP skills of clinicians.
Percent of subjects who are within acceptable range of pressure, inspiratory loss, and overall proficiency.

Acceptable time in target, \( p = 0.007 \), Acceptable inspiratory loss, \( p = 0.018 \), Overall proficiency, \( p = 0.007 \)

References:
7. Stanford School of Medicine Center for Immersive and Simulation-Based Learning: Part-task Physical Trainers. ; May 1, 2014: http://cisl.stanford.edu/what_is/sim_modalities/phys_trainers.html
BRONCHOSCOPY FOR BIOPSY OF LARGE HILAR MASS COMPRESSING CARINA AND SUPERIOR VENA CAVA

James Lincoln M.D., Velvet Patterson M.D. and Mario Gonzalez D.O.
Department of Anesthesiology & Perioperative Medicine, Drexel University College of Medicine

CASE discussion:
A 65 year old female
PMHx: 70-pack-year active smoker, HTN, DM, CAD, OSA, GERD, CHF (EF 5-10%), Pulm HTN (mPAP 37), Severe COPD Diagnosed with chest tumor 1 year ago. Lost to follow up.

• Admitted for COPD exacerbation with SOB and orthopnea.
  • CXR showed large mediastinal mass
  • CT chest showed 10x8x7cm hilar mass with significant compression of R mainstem bronchus and carina also markedly compressing SVC and hilar vasculature
  • Bronchoscopy for biopsy of mass
  • Scheduled in cardiac OR with CT surgery present. Multi-disciplinary case discussion prior to procedure.
  • Awake technique. Glyco 0.2mg for secretions, 2mL Nebulized lidocaine 4%, Lidocaine nasal pledgets (by pulmonologist)
  • Anxiolysis with 2mg midazolam, 20mg ketamine. Tolerated well.
  • Bronch: 100% R bronchial occlusion, 80% L bronchial occlusion

Hospital Course
• Biopsy result: Large B-Cell (Non-Hodgkin) Lymphoma
• Palliative radiation therapy begun after family discussion
• Post-Op day 14: Pt developed severe R lung atelectasis. Worsening SOB, PEA arrest -> withdrawal of care

Discussion:
1. Anterior mediastinal tumors can cause severe airway and vascular compromise, which is often exacerbated by general anesthesia or use of muscle relaxant
2. Evaluation of Risk:
   • Sx of airway compromise (dyspnea, orthopnea) suggest risk of airway compromise
   • Mass effect on the heart or SVC can cause syncope and edema of head/neck
   • Appropriate testing can including CT imaging, Echocardiography, and lab studies

• Approach to Biopsy:
   • Biopsy under local anesthesia is preferred whenever possible.
   • General anesthesia (GA) for biopsy procedure can produce diminished lung volumes and other adverse effects without the benefit of tumor removal.
   • GA should only be undertaken following comprehensive pre-operative evaluation and patient-centered discussion
   • Careful preparation for “Plan B” if there is distal airway or circulatory compromise
     • Adequate vascular access, rigid bronchoscopy, tracheobronchial stenting, Extracorporeal membrane oxygenation (ECMO)
Conclusion:
- This case highlights the anesthetic risks associated with anterior mediastinal mass procedures.
- Patients presenting with such tumors should be approached with caution even by experienced providers.

References:
“POP” ON INDUCTION; AN UNANTICIPATED COMPLETE AIRWAY OBSTRUCTION IN A CHILD FOR DENTAL SURGERY

P. Saththasivam, MD, Konstantinos Pilidis, Y. Shevchenko, MD

Department of Anesthesiology
St Christopher’s Hospital for Children, Hahnemann University Hospital, Drexel University College of Medicine, Philadelphia, PA

We report a case of unanticipated complete airway obstruction during induction for dental rehabilitation surgery in our center.

A five-year-old male, weighing 19kg with no past medical history presented with extensive dental caries. The case was planned for dental rehabilitation under general anesthesia. The preanesthetic evaluation and physical exam were normal. Patient was premedicated with oral midazolam 10mg before taken to the operating room.

In the operating room, standard ASA monitors were applied and mask induction with 8% sevoflurane in 70% nitrous oxide and 30% oxygen was started. Spontaneous respiration was maintained and after obtaining peripheral IV, several drops of oxymetazoline were instilled into each nostril. Patient was switched to 100% oxygen and ventilation was assisted and then taken over by manual bagging. After several uneventful breaths, the ventilation suddenly became extremely difficult while patient was not making any respiratory effort. Propofol 2mg/kg intravenous was given and two men mask ventilation was attempted without visible chest movement.

Succinylcholine 20mg intravenous was given, and after a few attempted positive pressure ventilation breaths with PIP of 30-40, a distinct ‘pop’ was felt and ventilation became very easy with equal bilateral chest movement, good end tidal CO2 waveform and rapidly increasing saturation from 80’s to 100%

Direct laryngoscopy with Miller blade size 2 was done to reveal cloth like material wrapped around the laryngeal inlet with vocal cords visible. The foreign body was extracted carefully using Magill forceps. Thereafter, nasal intubation was done on the right nostril with 5.0 uncuffed nasal RAE (leak test at 18 mm H2O). The case then proceeded uneventfully with successful awake extubation at the end of the case.

Upon completion of the case, the patient’s mother was specifically asked about the history of a nasal foreign body. She recalled taking the child to the pediatrician several weeks ago for right nostril nasal discharge, and she was told her child had an “ear infection” and was treated with oral antibiotic while the pediatrician dismissed any other evaluations. The mother denied any possibility of the foreign body being introduced in the nose by anybody but the child himself.
Discussion

The incidence of airway foreign body in children is around 0.6% of all total foreign bodies.(1) Children at age of 3-4 years old are most common to have foreign bodies because of the strong curiosity in nature, strong oral tendency and absence of molar teeth.(2) Prior et al has reported a similar incident where a 1.8 x0.9 x 0.5 cm plastic key of a calculator obstructing the glottis in a four year old boy during blind nasal intubation for dental procedure. (3)

We hypothesized that the bag mask ventilation might have dislodged the foreign body causing partial airway obstruction or even incited laryngospasm, which then responded to our initial therapy. Besides that, in a child with craniofacial abnormality, arytenoid prolapse should also be considered as total airway obstruction on induction of anesthesia.(4)

Unexpected airway obstruction during induction is a real possibility that could result in intraoperative death. Airway mishap is every pediatric anesthesiologist dreaded dream. Even though thorough history and physical examination was performed, the presence of foreign body this child was completely missed and unsuspected.

Reference

Picture 1
The foreign body right after extricated from the patient that that looked like a piece of gauze.

Picture 2
The same material after it was spread out measuring 3cm x 0.5cm.
NEUROLOGIC COMPLICATIONS AFTER BARIATRIC SURGERY

Marlene Barnhouse, MD, PhD, CA-3
DUCOM, Hahnemann University Hospital

Introduction:
Neurologic complications after bariatric surgery are relatively common and well described due to the increasing numbers of procedures and the vast prevalence of obesity in the US. Deficits are commonly seen with thiamine, vitamin B12, folate, vitamin D, vitamin E, and copper deficiencies. Common side effect with these nutritional deficiencies vary and can include, among others, polyradiculoneuropathy, polyneuropathy, optic neuropathy, encephalopathy, and myelopathy. We discovered unexplained neurological complications, despite B1 and B12 replacement therapy, in one of our patients s/p bariatric surgery. We encourage the idea that more research needs to be done to find out whether the surgical alteration during gastric bypass surgery could be responsible for negative neurological symptoms and outcomes e.g. secondary to over treatment with vitamins (hypervitaminosis) vs a compromised uptake of thiamine/B12 with impaired utilization of dietary thiamine/B12.

Case Description
The patient is a 35yo F with PMH significant of morbid obesity, anxiety, depression, dumping syndrome, and polyneuropathic pain syndrome, s/p gastric bypass surgery done at an outside facility (2011) without any other known triggers. She presented in 4/2013 with sudden onset of s/s, w/ weakness, seizure like activities, ataxia, L eye apraxia and blurry vision, and was diagnosed with thiamine deficiency. Replacement therapy with thiamine and B12 initially led to improvement of her symptoms. However, in 11/2013 she suffered from suddenly worsening symptoms w/ left sided weakness, and inability to walk. In 3/2014 she had a new crisis with increased level of pain, here first was noted decreased DTR b/l LE and 2+ b/l UE, likely 2˚ to dietary deficiency. Further evaluation resulted in unimpressive laboratory markers for serology, cerebrospinal fluid, protein electrophoresis, toxicology including lead, zinc, copper. MRI of the spine also did not reveal any acute pathology. During her work-up her symptoms continued to worsen. In 4/2014 she developed seizures, thought to be likely 2˚ to withdrawal of pain medication (UDS was negative). In 7/2014 she had multiple ER visits, and again admission to our Neurology service for polyneuropathic pain exacerbation w/ intractable pain, worsening of muscle spasms, muscle weakness, and deep bone pain. Diagnostic testing revealed anemia and leucopenia, without thrombocytopenia. Vitamin B12, folate, and methylmalonic acid levels were all normal. Other infectious and inflammatory serologic markers were negative for inflammation, and findings of a spinal fluid examination were normal. Serum copper and ceruloplasmin levels were low normal 82mcg/dl. Only abnormalities were TSH 0.165 uIU/ml(nl 0.39-5.6), and persistently (since onset of symptoms) elevated B1 (thiamine) at 50.1, 233.9, and 110nmol/l (nl 8.1-32.9) and B12 1,314 and 1,317pg/ml (nl 108-914) aldolase 8.1 (nl 1.2-7.6). She is currently still on disability without complete resolution of her symptoms with remaining weakness, chronic pain, muscle spasms controlled with home meds: percocet 5/325mg q4h, baclofen 20mg po TID, Lyrica 100mg po TID, topamax 50mg BID, Amitriptyline 75mg poqpm, Celexa 10mg po qPM.

Theory: possible hypervitaminosis B1 as cause for neurological symptoms??? Or –possible impaired diatary thiamine utilization after gastric bypass surgery.... even if it does reach the cells, further exacerbating the thiamine deficiency.
GOLTZ SYNDROME: A DERMATOLOGIC URGENCY TURNED INTO AN AIRWAY EMERGENCY

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Authors: Sadie Smith, MD, Kavita Gadhok, MD, Dimitri Guvakov, MD

Introduction
Goltz syndrome, also known as focal dermal hypoplasia, is a rare X-linked dominant multisystem syndrome presenting with cutaneous, skeletal, dental, ocular, central nervous system and soft-tissue abnormalities. This case report discusses an adult male patient with Goltz syndrome, with only a transient history of snoring, noted to have laryngeal papillomas upon direct laryngoscopy.

Case Description
A 38 year old, obese, Caucasian male with Goltz syndrome presented for elective surgery for removal of a papillomatous left thigh mass. Mask ventilation required two hands due to his body habitus, however no signs of airway obstruction were noted. Direct laryngoscopy revealed a grade 2a laryngeal view, and the vocal cords were noted to be pulled to the right by a mass at the base of the tongue (Fig.1). A Glidescope was then used to expose a large, friable papillomatous mass at the right tongue base. After successful intubation, the thigh mass removal was completed, and ENT was consulted for evaluation of the unusual laryngeal mass. The tongue/tonsillar lesion was debrided in order to obtain a more clear view of the larynx and vocal cords. However, the epiglottis and surrounding soft tissues were noted to be moderately edematous. The patient was left intubated to safely allow laryngeal swelling to subside. He was extubated and discharged the following day. The pathological report for the debrided mass was interpreted as papillary lymphoid hyperplasia, which is consistent with the histologic description of Goltz syndrome. At a follow up clinic visit with ENT one week later, the patient was breathing well, with no areas of concern for residual or recurrent pharyngeal disease.

Discussion
Goltz syndrome is known to have variable manifestations involving ectodermal and mesenchymal tissues with a broad phenotypical presentation. The most common areas affected are the central nervous system, eyes, craniofacial, dentition, skeletal system and skin; however the cardiovascular, gastrointestinal and reproductive systems can also be involved to a lesser extent. The skin features are the most common and are essential for the diagnosis. A prominent characteristic is the occurrence of papillomas arising from the skin and mucous membranes. However, involvement of the laryngeal mucosa is rare. Goltz syndrome is a rare X-linked dominant disorder that is lethal in males. Only 10% of cases are males, due to somatic mosaicism. Symptoms may include dysphagia, dyspnea, and snoring. The patient’s snoring had improved recently, which could suggest part of the mass may have dislodged during sleep.

Airway compromise from oral and laryngeal papillomas is one of the major unexpected anesthetic implications of Goltz syndrome. The only symptom our patient exhibited for possible airway compromise was a transient history of snoring. In addition to a thorough history and physical exam, pre-operative spirometry and airway examination may be beneficial, especially in symptomatic patients. Induction of anesthesia with spontaneous ventilation techniques as performed in other cases of known airway lesions (e.g. tonsillar abscess and laryngeal carcinoma) may be suggested as an anesthetic technique in patients with Goltz syndrome.

References
The large fungating mass coming from the base of the right tongue obstructs the view of the epiglottis and vocal cords (Figure 1A). After manipulation of the glidescope, the mass was seen to be pulling the vocal cords to the right (Figure 1B).
Case Report Abstract

TENSION PNEUMOTHORAX DURING ELECTIVE TRACHEOTOMY

Presenter/Affiliation: Kevin Funez, MD., Department of Anesthesiology, Penn State Hershey Medical Center, Hershey, PA

Authors: Kevin Funez, MD. Melina Varner, MD.

Introduction:
Tracheotomy (trach) is a common procedure for ventilator-dependent patients who are unable to be weaned and the ultimate life-saving procedure for difficult airways. Although it is the most secure airway that can be had, it does not come without its complications. In this case we discuss an 83 year-old trauma patient who sustained multiple injuries after a motor vehicle accident (MVC) with extrusion through the windshield into oncoming traffic. The patient was intubated on the scene and for the duration of his stay in the surgical intensive care unit (SICU) he was unable to be weaned off mechanical ventilation. A decision was made to perform an elective tracheotomy.

Case Description:
During the intraoperative course, the surgical team had difficulty placing a tracheotomy tube, and after the third attempt, the patient’s already increased peak airway pressures were elevated further. The patient became unstable and shortly after went into pulseless electrical activity (PEA) arrest. ACLS was performed until a diagnosis of tension pneumothorax was made. A right-side chest tube was placed with confirmation of air rush after placement. Immediately after transfer back to the SICU, a chest x-ray showed diffuse subcutaneous emphysema across the entire right chest which worsened over the next few days. This all resolved over the next few weeks and the patient was discharged to a long-term acute care (LTAC) facility.

Discussion:
The incidence of pneumothorax during tracheotomy has been estimated to be 4% to 9%. There are a few points to consider during this case that could have caused the tension pneumothorax. The patient was brought to the OR with already high peak airway pressures. There was difficulty in placing the initial 8.0mm trach, which could have lacerated the posterior wall of the trachea; however, one would expect a much more septic, unstable outcome. Having to replace the endotracheal tube (ETT) each time a failed trach placement occurred could also be another contributing factor. Worsening subcutaneous emphysema has been reported in other cases with posterior tracheal wall laceration, but this could also have resulted from high airway pressures pushing air into the subcutaneous layers around the trach that was open for quite some time. Rapid diagnosis and intervention is required in order to stabilize the patient with a tension pneumothorax and should be at the top of your differential diagnosis list when dealing with instability or PEA arrest during tracheotomy.
References:


INTRAOPERATIVE USE OF POINT OF CARE ULTRASONOGRAPHY (POCUS) FOR STAT CESAREAN DELIVERY WITH REFRACTORY HYPOXEMIA

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Introduction: A 30-year-old, 131kg, BMI 43, G6P5 female at 24 weeks gestation presented with complaints of headache, hypertension and blurry vision. She was diagnosed with superimposed pre-eclampsia (SIPE) on chronic hypertension. An obstetrical emergency was called due to fetal heart rate decreasing to a nadir of 40bpm within 20 minutes of arrival. The patient was taken for an emergent cesarean delivery.

Case Description: Prior to induction of anesthesia, the SpO2 was 92% on 6L O2 facemask and then 93% on 100% mask preoxygenation. A rapid sequence induction was conducted with a successful intubation using a videolaryngoscope with end tidal CO2 confirmation and bilateral breath sounds. Oxygen saturation during laryngoscopy decreased to 80%. Immediately after intubation, SpO2 dropped to 71% on 100% fio2. The patient was manually ventilated manually with PEEP 10-20cm H2O and was given Albuterol endotracheally. However, ventilation and oxygenation did not improve. The oxygen saturation remained between 71-80% using manual ventilation. Peak airway pressure ranged from 25-38mmHg while attempted machine ventilation. At that time, the differential diagnosis included bronchospasm, pneumothorax, pulmonary edema, cardiogenic congestive heart failure, hemothorax, atelectasis and pneumonia. In order to assist in diagnosing and planning further anesthetic treatment, a portable point-of-care ultrasound (POCUS) device was brought into the operating room. Using the Focused Assessed Transthoracic Echocardiography (FATE) protocol, windows obtained suggested that the patient had a small pericardial effusion, left ventricular hypertrophy and gross pulmonary edema as illustrated by multiple “b-lines” in pleural view. Given the findings, 1:1 crystalloid replacement was undertaken rather than the traditional 3:1 replacement for crystalloid to blood loss ratio. The patient’s SpO2 slowly improved and by the end of the surgical procedure, the patient’s SpO2 was between 88-91%. Re-imaging of the pleural views revealed improvement of interstitial pulmonary fluid. The patient remained intubated for the entire procedure and post-operatively. A chest radiograph postoperatively confirmed ongoing pulmonary edema and equivocal pleural and pericardial effusions. A transthoracic echo obtained on postoperative day 1 further supported the diagnosis. The patient was extubated on POD 2 and eventually discharged home. The patient was scheduled for follow-up care.

Discussion: Peri-operative POCUS was used to help aid in a diagnosis of an emergent cesarean delivery with ongoing hypoxia. Multiple disciplines including obstetrics, anesthesia and critical care were able to visualize her problems and collaborate with plan for management and post operative care.

Conclusion: The use of POCUS helped intraoperative and postoperative care in a critically ill surgical patient. Further study to broadening obstetrical anesthesia use of POCUS is required.

References:
PRESumed S1 TRANSFORAMINAL EPIDURAL STEROID INJECTION-INDUCED REACTIVATION OF HERPES ZOSTER ALONG THE CORRESPONDING DERMATOME.

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Authors: Brandon Rein D.O., Bunty Shah M.D., Julia Caldwell M.D., Vitaly Gordin M.D.

Introduction: Varicella-zoster virus (VZV) is a neurotropic virus that has the unique ability to remain latent for years after a primary infection. Ultimately, this can lead to the clinical condition of Herpes Zoster, also known as shingles. This virus primarily targets afferent sensory neurons, and can remain dormant in the sensory dorsal root ganglia. Reactivation of this latent infection, within the dorsal root ganglia can lead to axonal transport, resulting in shingles. Motor neuron involvement has even been reported in 0.5-31% of cases of Herpes Zoster, even though afferent sensory neurons are affected most often [1]. Key characteristics of this condition include neuralgic pain and segmental or radicular vesicular lesions. Lifetime incidence is approximately 10% to 20% of the population [2].

Case Description: We present a case of a 52 year-old female who developed a herniated L5-S1 disk, with left leg weakness and numbness, and associated with bowel and bladder dysfunction. Subsequently, she underwent successful left-sided L5-S1 diskectomy, but complained of persistent pain, weakness, and paresthesias.

A left-sided S1 transforaminal epidural injection with local anesthetic and corticosteroid was performed in this patient without technical difficulty.

Within 2-3 days after the procedure, the patient reported the development of a vesicular rash in the S1 dermatome as highlighted in Figure 1. A diagnosis of shingles was made, she was started on gabapentin, and the rash eventually resolved.

Discussion: A literature search revealed multiple case reports of reactivation of VZV following surgeries as well as interventional pain procedures. However, in many of these case reports, there was no clear relationship between the target level of intervention, and the resultant dermatomal lesions [3]. This case is unique in that the VZV lesion that developed was observed only in the dermatome corresponding exactly to the target level of pain intervention. We feel that this case lends credence to the theory that mechanical trauma to the dorsal root ganglion may be responsible for reactivation of dormant VZV [4].

References:

Figure 1. Development of a left-sided vesicular rash in the S1 dermatome following a left-sided S1 transforaminal epidural injection.
UNILATERAL APPROACH TO NEUROLYTIC SUPERIOR HYPOGASTRIC PLEXUS BLOCK FOR CHRONIC PELVIC PAIN ASSOCIATED WITH CANCER

Author[s]: Kathryn Price, MD [presenter] and Till Conermann, MD

Affiliation: Allegheny Health Network

Introduction: Neurolytic superior hypogastric plexus blockade [SHPB] is a safe and effective technique for pain relief for cancer-associated chronic pelvic pain. SHPB reduces opioid consumption, improves quality of life, and decreases initial and long term pain scores. Though several approaches can block the bilateral superior hypogastric plexuses, medical literature has not focused on the efficacy of a single, unilateral approach to pelvic pain management.

Case Description: A 44-year old female presented with intractable chronic rectal pain secondary to metastatic cervical cancer. She underwent total pelvic exenteration complicated by small bowel obstruction progressing to perianal fistula development. Pain was a throbbing, burning quality localized in the pelvic region. For one year, her pain was managed on progressively increasing opiate therapy producing debilitating side effects with prolonged usage. Following evaluation, she initially underwent a diagnostic ganglion impar block which provided minimal relief. She was then amenable to a diagnostic SHPB and consented to the classic bilateral posterior approach. She was prepped, draped and positioned prone in the standard fashion. During consultation her left-sided complaints recently increased compared to the right, hence the procedure began on the left. Needle position and adequate spread along the sympathetic chain was confirmed under fluoroscopy. Ten milliliters 0.25% ropivacaine was injected. The patient was very satisfied to receive immediate reduction in her bilateral pain complaints by 50% with treatment of the left-side only. Per patient preference for the quickest, least invasive approach, a unilateral technique was pursued two weeks later for the therapeutic SHPB. Eight milliliters 7% aqueous phenol was slowly injected followed by nine milliliters preservative-free saline. The patient tolerated both procedures well without complications.

She received approximately 50% reduction in symptoms immediately following the therapeutic SHPB. After one week, she significantly decreased her dilaudid PCA requirements and was more functional at home. She continued to have excellent pain control for two further months.

Discussion: This case report indicates that a unilateral approach to superior hypogastric plexus blockade can adequately deliver significant relief for bilateral pelvic pain secondary to metastatic cervical cancer. Cross-communication between the left and right superior hypogastric plexuses likely contributed to the bilateral reduction under the unilateral approach. Literature supports that the left superior hypogastric plexus may be more highly innervated and hence may offer more pain relief if a unilateral approach is preferred or required. Patient preference for a less invasive approach, time constraints or anatomical barriers presents limitations to the standard bilateral approach. Future studies should investigate pain management utilizing a unilateral vs bilateral approach as well as differences between left versus right-sided approach to SHPB.

References:
SELECTION OF THE OPTIMAL COMBINED GENERAL-REGIONAL ANESTHETIC TECHNIQUE IN A COMPLEX PATIENT UNDERGOING VASCULAR SURGERY

Author[s]: Kathryn Price, MD [presenter] and Rafik Tadros, MD

Affiliation: Allegheny Health Network

Introduction: Patients presenting for lower extremity vascular surgery oftentimes have comorbidities which make optimizing the anesthetic plan challenging. Regional anesthesia poses several benefits including improved hemodynamic stability, decreased catecholamine surges, sympathectomy, and decreased side effects from systemic medications. This case report offers insight into medical decision making necessary to create an appropriate anesthetic plan for complex patients with numerous medical concerns and anatomical limitations undergoing an above the knee amputation.

Case Description: A 66-year-old female with extensive medical history including ESRD on hemodialysis, diabetes, atrial fibrillation, COPD, and peripheral vascular disease presented with a non-healing ulcer requiring a right-sided above the knee amputation[AKA]. Previously, she underwent a right-sided metacarpal amputation from ulcers secondary to poorly managed diabetes. Numerous hemodialysis catheter placements and removals were required earlier and she exhausted all access points in the upper extremities resulting in placement of a right groin AV graft. Ischemia to the right lower extremity secondary to steal phenomenon from the graft prompted a below the knee amputation[BKA] initially. The non-healing BKA wound led to her planned AKA. Given limited hemodialysis access options, the surgical team declined replacement of the hemodialysis catheter.

Considering the anatomical barriers and need to preserve functioning of the hemodialysis graft, a combined general-regional anesthetic plan was developed. A sciatic block with catheter placement for continuous usage intra- and post-operatively addressed posterior analgesia for the lower extremity, while a lumbar plexus block adequately covered anterior and medial aspects. Femoral block and catheter placement was considered, but posed a greater risk of destruction or infectious complication to the AV graft.

Preoperatively, a right-sided sciatic block was performed with an injectate of 12 milliliters of 0.5% ropivacaine mixed with 12 milliliters preservative-free saline. The same composition was used for the right-sided lumbar plexus blockade. Anatomical landmarks and spread of local anesthetic was confirmed under ultrasound-guidance prior to catheter placement, respectively. No complications were noted.

The patient was intubated with a LMA and anesthetic maintenance with 0.5 MAC sevoflurane in conjunction with continuous infusion of the sciatic and lumbar plexus catheters. She required minimal opiate requirements intraoperatively. In recovery, she received a single bolus of 10 milliliters of 0.25% ropivacaine to her respective catheters and required a single dose of 50 mcg fentanyl. Later in her course, she was transitioned to a dilaudid PCA for further breakthrough pain.

Discussion: In patients undergoing lower extremity amputation, peripheral nerve blocks and neuroaxial anesthesia has proven effective in diminishing postoperative pain. This combined general-regional anesthetic technique allowed for this complex patient to receive adequate analgesia during and after her procedure with minimal opiate requirements and volatile anesthetic exposure. Our regional anesthesia selection of the lumbar plexus block minimized infection by avoiding proximity to the hemodialysis sheath and preserved graft vascularity.

References

ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK FOR THE TREATMENT OF POSTOPERATIVE PAIN FOLLOWING ILIAC CREST BONE GRAFTING

Author[s]: Kathryn Price, MD [presenter] and Rafik Tadros, MD

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Introduction: Iliac crest bone grafting [ICBG] is commonly used for a variety of reconstructive surgical procedures. Patients can have severe pain from harvesting which is often worse than the primary site of operation. Intercostal nerves [T11, T12] and the iliohypogastric nerve [L1, L2] innervate the iliac crest and overlying skin. A transversus abdominis plane [TAP] block effectively anesthetizes T6-L1 which can reliably supply pain control for ICBG. Growing evidence supports TAP block as a feasible technique for postoperative analgesia following ICBG, however, it is not currently common practice. This case series provides further support of TAP block efficacy in improving postoperative pain relief after ICBG.

Case Description: Patient one was a 61-year old female with osteopenia and a left distal radius and ulna fracture undergoing an open reduction internal fixation [ORIF] with ICBG harvesting. She consented for a preoperative left-sided supraclavicular block and TAP block.

Patient two was a 51-year old male with a history of hypertension, diabetes, CAD, COPD presenting with a left clavicular non-union. He was scheduled for a left clavicular ORIF with ICBG and underwent a left-sided interscalene and TAP block prior to surgery.

The TAP procedure performed for both patients was identical. Premedication of 2 mg midazolam and 50 mcg fentanyl was provided. Standard monitors were applied with a small bolus of Lactated Ringers solution. Patients were prepped, draped and placed supine. Identification of pertinent anatomical sites was performed under ultrasound guidance. A 21-gauge needle in-plane with a short-axis view was used for puncture. Twenty milliliters of 0.5% ropivacaine [with 4 mg dexamethasone additive] was injected into the fascia between the transversus abdominis and internal oblique muscles. Circumferential spread was confirmed with ultrasound. Patients were tested using cold alcohol wips and blunt needles for adequate sensory blockade using their contralateral side as a control. Appropriate sensory blockade was achieved. No complications occurred.

Patient one was intubated using induction agents of propofol and rocuronium with sevoflurane for maintenance. No further intraoperative opiates were required. Postoperatively, she received a total of 50 mcg fentanyl twice for minimal pain at the primary surgical site [3/10 on the verbal numeric pain scale].

Patient two was intubated with induction agents of 50 mcg fentanyl, propofol, and succinylcholine. Sevoflurane was used for maintenance and no further opiate therapy was utilized intraoperatively nor immediately postoperatively.

Discussion: Inadequately controlled postoperative pain leads to unanticipated or prolonged hospitalization, decreased satisfaction and adverse clinical outcomes. These cases demonstrate ICBG site pain was successfully treated via TAP blockade. Patients required minimal opioid usage contributing to decreased side effects, earlier functionality and reduced hospitalization. Ultrasound-guidance allowed for direct visualization and quick, effective spread of local anesthetic without complications. Procedure time less than 10 minutes makes this technique easily incorporated perioperatively. Additional RCTs are necessary to confirm efficacy and identify long-term benefits.

References:


A CASE OF CUTANEOUS MANIFESTATIONS OF GRANULOMATOSIS WITH POLYANGITIS AND STEROID INDUCED SKIN ATROPHY RESULTING IN A SIGNIFICANT SKIN LACERATION INTRAOPERATIVELY AFTER ROUTINE IV ACCESS

Rano Faltas MD, Suzanne Huffnagle, DO
Sidney Kimmel Medical College of Thomas Jefferson University Hospital

Introduction:
Certain skin conditions may increase the likelihood of loss or complications regarding IV access. Such conditions include vasculitides with skin involvement, and effects on skin from chronic medication usage.

Case Report:
A 78-year-old female patient presented for a decompression and fusion from L3-L5. Her past medical history was pertinent for Wegner’s granulomatosis. On the day of surgery, her physical examination revealed skin thinning and fragility. IV access was obtained using 16 gauge needles in the dorsum of both hands. A STATlock® IV Universal Stabilization Devices with Tegaderms were applied to secure the IVs. During the case both IV sites were evaluated and no abnormalities were noticed. Just prior to returning the patient to the supine position, a small amount of blood was noticed beneath the Tegaderm. Removal of the Tegaderm revealed a 1.3 by 1.3cm laceration at the IV site without infiltration of the IV. The IV was subsequently removed and the area and sutures were required to establish proper wound closure. Post operatively the patient mentioned that she had sustained a skin laceration following establishment of IV access in the past during a prior hospitalization. We postulated that the skin tear happened during positioning but was not noticed when the hand was inspected after positioning. It might also have resulted from mild tension on the IV tubing which may have pivoted on the StatLock® and caused the large caliber 16G IV to shear through the exceedingly thin skin.

Discussion:
Granulomatosis with polyangitis is a systemic autoimmune vasculitis. This disease is most notably seen in both the respiratory and renal systems, but it can manifest as cutaneous involvement. Leukocytoclastic vasculitis is the most common cutaneous pathologic pattern of skin involvement. Chronic glucocorticoids therapy is one of the primary therapies for cutaneous manifestations, but it can also cause cutaneous side effects. The most frequent and irreversible side effect is skin atrophy (2, 3). This can result in problems with establishing and maintaining peripheral intravenous access for such patients undergoing surgical procedures (7). In this population, pressure over the tip of the cannula may easily tear the vessel wall (8). Four factors that individually predisposed our patient to the complication she sustained were: her exceedingly thin skin, her age, the cutaneous manifestations of her Granulomatosis with polyangiitis, and the chronic steroid therapy her autoimmune vasculitis required.

Conclusion:
Special care is advised preoperatively when planning anesthesia for patients with significant skin conditions. Patients should be interviewed and asked about previous skin injuries with minor traumas. Care should be taken not only to provide proper padding to prevent skin injuries. When possible, IVs should be inserted away from diseased skin areas. Also, if IVs are to be inserted on diseased areas of the skin, a StatLock® device may not be the best option. Excessively diseased skin may tear with minor shear stresses applied on the device. If it is not possible to stay away from diseased skin, the option of obtaining central access should be weighed and discussed with the patient after the risks and benefits are explained.
References

A NOVEL APPROACH TO THE MANAGEMENT OF PARSONAGE-TURNER SYNDROME

Rano Faltas MD, David K. Garas MD Eugene R. Viscusi MD

Introduction:
Parsonage-Turner Syndrome (brachial plexus neuritis) is a rare, often idiopathic condition, which presents with the acute onset of severe, continuous unilateral pain in the upper extremity, often extending to the trapezius, upper arm, forearm, and hand.

Case Report:
A 35-year-old male presented to the emergency room of an outside hospital with a four-day history of severe left upper arm and shoulder pain. Recent medical history included recently resolved gastroenteritis along with a history of chronic lumbar pain. The extremity pain was associated with weakness and loss of sensation in the affected extremity. Medical therapy was initiated at an outside hospital for suspected Parsonage-Turner Syndrome, including prednisone, gabapentin, ketorolac, oxycodone ER, and lidocaine patch. The pain remained refractory and thus the patient presented to our institution where Acute Pain Management Service discontinued prednisone and augmented his multimodal analgesic approach with patient controlled analgesia and alternative opioid pharmacotherapy along with IV ketamine infusion, escalated gabapentin doses, and duloxetine therapy at which point the patient began to experience relief. The patient was hospitalized throughout the course of his pain management as a result of the degree of his uncontrolled pain. By day 15, the patient was weaned off of ketamine, and by day 17 he had experienced marked improvement and relief of symptoms.

Discussion:
While conventional management of Parsonage-Turner Syndrome includes therapy consisting of corticosteroids, long-acting opioids, and NSAIDs, this case offers an adjunct therapy of IV ketamine infusion along with other antineuropathic agents in the treatment of brachial neuritis that is refractory to standard treatment measures.

Conclusion:
Parsonage-Turner Syndrome remains a difficult condition to diagnose and manage, and a number of treatment modalities have been attempted to accelerate the onset of pain relief and initiate the recovery period. Our institution demonstrated that the administration of IV ketamine may be a novel approach to the treatment of PTS when titrated and administered promptly.
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METHEMOGLOBINEMIA INDUCED BY BENZOCAINE SPRAY

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Introduction  
Methemoglobin arises when the ferrous (Fe2+) iron moiety of the heme group within hemoglobin is converted to the ferric (Fe3+) state. This occurs in the setting of oxidative stress, and converts the heme group into a non-oxygen binding state. Two pathways correct for methemoglobin by reducing the oxidized heme group. The major mechanism is reduction via cytochrome b5 reductase, accounting for 95% of this process. The minor pathway utilizes NADPH methemoglobin reductase; while this enzyme is responsible for 5% of native activity, its effect can be substantially increased by methylene blue. Methemoglobin levels increase when these pathways are exhausted or when methoglobin production abnormally increases. The latter occurs when exogenous substances or their metabolites are potent oxidizers that induce excessive methemoglobin formation. Local anesthetics enhance methemoglobin formation as much as 1000-fold mainly through the oxidizing activity of their metabolites. A breakdown of symptom presentation to corresponding minimal methemoglobin values can be found in Figure 1. If allowed to continue unrecognized and untreated, significant morbidity and mortality can result from tissue hypoxia. We report an episode of methemoglobinemia during post-operative use of benzocaine spray.

Case Presentation  
A 27 year-old woman underwent a low anterior resection, completed under general anesthesia with no relevant complications. Recovery was complicated by an episode of ileus on post-operative day 6, necessitating nasogastric tube placement. On day 7, the patient’s oxygen saturation decreased to 82% and she reported headache, drowsiness, and abdominal pain. The patient was tachypneic with a respiratory rate at 22-25 breaths per minute. Unchanged on 100% non-rebreather, an arterial blood gas sample yielded chocolate brown colored blood. The blood gas results included a methemoglobin level of 47%. Upon further investigation, a resident left a bottle of benzocaine spray at the bedside to assist in the patient’s tolerance of the nasogastric tube. The patient admitted to using the spray 4 times over a 5-hour period and estimated each spray to be 2 seconds in length. The patient received 120mg IV methylene blue and 3 hours later yielded a similar blood gas except for a methemoglobin level of 1.3% with resolution of prior symptoms.

Discussion  
As it is indicated in Figure 1, severe symptoms including coma, syncope, and respiratory compromise can present in the percentage of circulating methemoglobin seen in this case. This was a 20% benzocaine spray (200mg/mL) with text on the package insert that 1 mL can aerosolize in 3-4 seconds. The recommended dose on the spray's package insert is a 0.5 second spray up to 4 times daily and that "spraying in excess of 2 seconds is contraindicated." As previously mentioned, the patient sprayed the bottle 4 times at 2 seconds each spray. The spray, when used as indicated, delivers about a 30mg dose. Keeping in mind that benzocaine toxicity is reported at 100mg, the patient was delivering as high as 100mg doses with each spray attempt. Quick recognition and evaluation of the patient’s complaints allow for this case to be an effective teaching tool instead of something more catastrophic. Effective communication between clinicians and patients is a simple means to reduce exposure to cases where simple mistakes cause significant outcomes.
Figure 1: Minimal methemoglobin value associated with various signs and symptoms5


AUTOTRIGGERING CAUSED BY CARDIOGENIC OSCILLATION DURING PRESSURE SUPPORT MECHANICAL VENTILATION

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Introduction
The inclusion of pressure support ventilation in the anesthesia machine offers a valuable tool for cases where neuromuscular function and/or spontaneous breathing is preserved. Utilizing pressure support ventilation in the operative setting allows effective oxygen exchange in patients otherwise unable to produce sufficient tidal volumes due to motor fatigue, respiratory co-morbidities, or excessive anesthetic. The Brimacombe et al study provides evidence that pressure support improves work of breathing, tidal volumes, and oxygen saturation when using the laryngeal mask airway. Spontaneous breathing also allows for titration of anesthetic and narcotic medication based on respiratory rate and tidal volumes observed. We report an unusual episode of triggered breaths due to cardiac oscillations instead of inspiratory effort during pressure support ventilation.

Case Presentation
An 82 year-old man presented for a transurethral resection of a bladder tumor. Induction with propofol and placement of a laryngeal mask airway was uneventful. Initially inadequate tidal volumes led to the implementation of 5cm H₂O pressure ventilation using a Datex-Ohmeda Avance. It was at this point that while vital signs were stable, the patient’s respiratory rate was 32 breaths/minute with tidal volumes around 300mL. Suspicion arose after narcotic dosing did not alter the breathing pattern, and the ventilator was switched to manual breathing without support. The capnograph displayed cardiac oscillations seen in Figure 1. Rapid inefficient breaths were ruled out after increasing the inspiratory pressure trigger, which prevented these oscillations from triggering breaths when the pressure support was turned back on. The patient returned to a rate of 12 breaths/minute with adequate tidal volumes after two doses of 0.04mg Naloxone. The patient maintained his own respirations and further pressure support was not needed. The remainder of the case was uneventful on manual/spontaneous mode and the patient emerged and was extubated without complications.

Discussion
Pressure support settings function via inspiratory flow sensors in the limbs of the breathing circuit. Cardiac oscillations significant enough to produce inspiratory flow fluctuations may produce autotriggering. The potential for inappropriate triggering can be found in patients with elevated cardiac output or venous pressure combined with low pulmonary vascular resistance. This is a reported occurrence that can lead to dangerous outcomes if not recognized. Our patient was truly apneic at the time, and the autotriggered respiratory pattern led to inappropriate administration of narcotic to the extent that reversal was required. Autotriggering can be ruled out by either placing the ventilator back in spontaneous mode or by increasing the required inspiratory flow rate trigger. Educating anesthesia providers regarding this circumstance allows for recognition and correction of the miscue.
Fig. 1 Photograph showing autotriggering during pressure support ventilation

References


QUANTIFICATION OF SUPRAGLOTTIC EDEMA IN EPIGHLOTTITIS AND THE ROLE OF VIDEO LARYNGOSCOPY

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Introduction: Epiglottitis is a rare and serious condition in the adult population with a prevalence of about 0.6-2.9 in 100,000. Most of the literature has been presented in ENT and ID journals, with little focus on diagnosis and airway management. Here, we present a case study discussing the use of video laryngoscopy in this capacity.

Case Description: A 43 year old woman presented with acute respiratory distress. She had a temperature of 103 Fahrenheit, excessive salivation, was sitting in the tripod position, and was taken to the OR immediately for airway management. Surgery was present if a surgical airway became necessary, and general anesthesia induced using propofol. She was easy to mask ventilate, rocuronium given, and video laryngoscopy attempted. The patient was successfully intubated on the second attempt with a 6.5 ETT, each time using a pediatric fiberoptic scope to evaluate placement. During the entire process, the patient maintained a SaO2 of 99%. A picture was taken of the supraglottic tissue seconds after intubation using video laryngoscopy showing severe edema (Fig 1). Each day following intubation, the patient’s supraglottic tissue was examined by video laryngoscopy, and the images compared. On the third day, the edema decreased by 50%, and the patient was extubated with no complications (Fig 2).

Discussion: Here, we demonstrate the usefulness of video laryngoscopy to determine the severity of the airway and to guide management. The accepted gold standard for epiglottitis diagnosis is direct supraglottic visualization as the oropharynx is notoriously misleading. While not all adults require intubation, literature has recommended that in severe airway distress defined as: more than 50% obstruction of the laryngeal lumen, drooling, strider, cyanosis, presence of an epiglottic abscess, or sitting in the 'tripod' position, the patient should be immediately intubated, as the majority of mortality of epiglottitis occurs from hypoxia. We also demonstrate that in epiglottitis, fiberoptic techniques can be successfully used in conjunction with video laryngoscopy. Finally, we show that video laryngoscopy daily offers a clear comparative tool in monitoring edema, and determining an appropriate time to extubate in this patient population. A large number of complications are shown in literature to be secondary to prolonged hospitalization and intubation. By a quantitative analysis, we were able to extubate more quickly in order to reduce our patient’s risk for these complications. We propose video laryngoscopy as an objective way to diagnose, intubate, and follow the course of treatment by quantifying daily edema in epiglottitis.
References:

Fig 1:

Fig 2:
Epidural Anesthesia for Renal Transplant in a Patient with Severe Pulmonary Disease

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Abstract:
Renal transplantation is traditionally performed under general endotracheal anesthesia, however in rare circumstances may be done utilizing regional anesthesia. We present a unique case of a patient undergoing renal transplantation with severe lung disease. The degree of pulmonary dysfunction raised concern for intubation and ventilator associated morbidity. The transplant was performed completely under epidural anesthesia with intravenous sedation. Although the use of epidural anesthesia alone is controversial in renal transplantation due to potential difficulties associated with platelet dysfunction, inadequate anesthesia, patient comfort, optimizing surgical conditions, and the potential need for urgent airway management, we present a case where epidural anesthesia was successfully used for renal transplantation without general anesthesia.

Introduction:
Renal transplantation was first successfully performed in 1954 by Dr. Joseph Murray. It has since developed into an increasingly common procedure that improves quality of life and long-term survival in patients with end-stage renal disease (ESRD), and is a more cost effective option than hemodialysis. Patients undergoing renal transplantation present unique problems affecting every organ system. Renal transplantation is usually performed under general endotracheal anesthesia. However, in recent years regional anesthesia has been explored as an alternative. Continuous epidural anesthesia has been used for renal transplantation since 1990. Other forms of neuraxial anesthesia such as a spinal or combined spinal-epidural have been used in some circumstances, with or without accompanying general anesthesia.

We present a case of a patient undergoing renal transplantation for ESRD, with a history of severe combined immunodeficiency (SCID). SCID is an inherited defect in B and T lymphocytes causing severe immunocompromise. Patients are more susceptible to severe infections beginning at an early age due to a non-functioning immune system. When diagnosed early, a bone marrow transplant can treat the disorder. Left untreated, patients may die before one year of life.

Due to markedly decreased lung function resulting from recurrent pneumonia and bronchiectasis, and concern for prolonged postoperative intubation after general endotracheal anesthesia, it was decided to perform the renal transplant under epidural anesthesia and intravenous sedation.

Case Description:
R C Jr is a 40 year old male with a past medical history significant for ESRD, SCID and hypertension who underwent kidney transplantation in June of 2014. His ESRD is presumed to be focal segmental glomerulosclerosis (FSG) however never biopsied. He was anuric on hemodyalsis three times a week for 7 years, thus prompting renal transplant which was from a living unrelated donor. Regarding his SCID, he is status post a bone marrow biopsy as a child, and his disease is complicated by bronchiectasis and bronchiolitis obliterans due to frequent childhood pneumonias. His baseline blood pressure is 130-140/80s on amlodipine and oral clonidine.

Due to his severe lung disease, it was decided to proceed with the renal transplant under epidural anesthesia, with general anesthesia as a backup. Pulmonary function tests in early June 2014 showed a reduced FVC of 2.25 (44%), a reduced FEV1 1.03 (26%), and an FEV1/FVC ratio of 0.46 indicating a very severe obstruction pattern. He requires 2 liters home oxygen at night. His cardiac studies showed an ECG showing normal sinus rhythm and a stress test negative for ischemia with normal perfusion and a globally mildly hypokinetic left ventricle with an ejection fraction estimated between 50 – 60%. His airway exam was unremarkable with a Mallampati score of 1, thyromental distance of 5cm and normal cervical range of motion and mouth opening.

His vital signs were within normal limits on the morning of the surgery, with a blood pressure of 127/81, pulse of 96 and an oxygen saturation of 94% on room air. His dosing weight was 79 kilograms with a body mass index of 24.3.
Pertinent labs included a hemoglobin level of 12.2, creatinine of 11.1, platelets of 224 and an INR of 1.0. The patient denied any signs or symptoms of platelet dysfunction, and denied any recent easy bruising or bleeding.

An epidural catheter was placed on a single attempt with the patient in the sitting position at the L3-L4 level using an 18 gauge Tuohy needle. Loss of resistance to saline was at 5cm of needle insertion depth, and a catheter was placed at 9cm depth. A test dose of 5ml Lidocaine 1.5% with Epinephrine 1:200,000 was negative for intravascular or intrathecal catheter placement.

In the operating room, the patient was pre-treated with 2mg Midazolam. Under local anesthesia, an arterial line was placed in the right radial artery, as well as a 7 French triple lumen central line in the right internal jugular vein assisted by ultrasound guidance. Verbal contact was maintained with the patient and the placement of invasive monitors was well tolerated. Induction was via the epidural catheter with 20ml of 2% Lidocaine with Epinephrine 1:200,000. The patient had a block corresponding to approximately the L3 level and additional local anesthetic was administered incrementally through the epidural catheter over the next 25 minutes until a T6 dermatomal surgical level was achieved. The additional local anesthetic administered was 20ml of 0.5% Bupivacaine. One hundred micrograms of Fentanyl was administered via the epidural catheter 15 minutes prior to incision. The patient verbalized comfort at the time of incision.

The patient was sedated with a Propofol infusion at a rate between 35 and 50 mcg/kg/min for the duration of the case, as well as a total of 120mg Ketamine and 36 mcg Dexmedetomidine administered intravenously around the time of incision. Overall, the anesthetic requirements for this patient appeared high; however the patient remained responsive to verbal command throughout the entire procedure. One exception was during the vascular and ureteral anastomoses when the patient did receive deeper sedation at the request of the surgeon, and was only minimally responsive for a short period of time. Near the conclusion of the surgery, another 10ml of 2% Lidocaine with Epinephrine 1:200,000 was administered through the epidural catheter to facilitate skin closure. With verbal communication maintained throughout the majority of the procedure, the patient’s comfort was confirmed.

Hemodynamically, blood pressures during the procedure ranged from 95-185/45-80 measured by the arterial line, and the heart rate range was 90-110 beats per minute. Respiratory rate ranged between 10-20 breaths per minute with oxygen saturation constant at 100% on 10 liters supplemental oxygen via simple face mask. The surgery was successful without any immediate postoperative complications. Total operating time was 2 hours and 46 minutes. Total fluid input was 3.2 liters of 0.9% normal saline, with an estimated 100ml blood loss and urine output of 200ml recorded at the end of the case.

Post-operatively the patient pain scores between 4 and 6. His epidural catheter was connected to a 0.2% Ropivacaine infusion at 6 ml/hr, with a bolus of 5ml available every 30 minutes for breakthrough pain and a one hour limit of 12 ml. Blood pressures post-operatively ranged from 125-160/70-90. The epidural was removed in the evening on post-operative day 1 due to adequate pain control, and to allow for easier ambulation and prevention of atelectasis. Afterwards the patient's pain was well controlled with a transition of intravenous to oral opioids. On post-operative day three he suffered respiratory distress thought secondary to Pentamidine given for PCP pneumonia prophylaxis and required a brief ICU stay, but otherwise had an uneventful hospital course and was discharged home on post-operative day five.

Discussion:

The choice to use regional anesthesia for renal transplant, specifically an epidural catheter alone is somewhat rare and controversial. This is mainly due to an increased tendency for uremic patients to develop coagulopathy, thus increasing concern for epidural hematoma. Also, epidural associated hypotension in the post-operative period can complicate graft survival from decreased perfusion. Other complications include increased risk of epidural bleeding from residual heparin given during dialysis, the possibility for an inadequate block either due to prolonged duration of surgery or incomplete epidural coverage, as well as some concerns from the medicolegal complexity of preexisting neuropathy.

However, general anesthesia is not without its risks when used for renal transplant. Drawbacks include prolonged paralysis requiring postoperative mechanical ventilation, iatrogenic pulmonary infection, and adverse effects of potent inhalation agents. Given our patient’s rare medical history causing severe lung dysfunction, we opted to proceed with regional anesthesia alone. There was concern that prolonged intubation postoperatively would result in the patient becoming a pulmonary cripple. It is important to note that the patient had an easy airway as described above, and mask ventilation and intubation were anticipated to be routine. In the event the epidural failed we had a low threshold to convert to a general anesthetic.

Typically, coverage for renal transplant is best achieved with an epidural placement at T12-L1 or L1-L2. We opted to proceed with the epidural slightly lower, at L3-L4. The rationale for this was to preserve intercostal nerve and
accessory respiratory muscle function to the greatest extent possible while still achieving a surgical block, and to dose the epidural gradually to achieve an exact dermatomal level.

Coagulopathy is a large concern when performing regional anesthesia in a patient with end stage renal disease due to fear of causing an epidural hematoma. Most patients with chronic renal disease are regularly treated with erythropoietin, which not only improves anemia but also the hemostatic defect associated with the renal insufficiency. Desmopressin, a short-acting compound used for reversal of platelet dysfunction, is indicated only for those patients not treated with erythropoietin. The patient received erythropoietin during his hemodialysis treatments, and had only a loading dose of 1000 units heparin without maintenance doses during dialysis one day prior to the surgery. His lab values were encouraging and he denied any easy bruising or bleeding. There was no clinical evidence of coagulopathy, easy bruising, or residual heparin effects. Thus, desmopressin was not administered prior to epidural placement.

Although initially concerned with the idea of epidural anesthesia, the patient was willing to proceed due to his severe pulmonary disease. It is possible he will eventually be listed for lung transplant due to the evolution of his pulmonary disease, and the thought was that if the surgery were done under general endotracheal anesthesia and he failed multiple extubations, he might have required transplant earlier than expected. Although he initially wished to remain asleep for the surgery, the patient was happy with the anesthesia he received via the epidural and denied any negative side effects of the Ketamine, which was chosen for analgesia due to minimal respiratory side effects.

In conclusion, as demonstrated in this innovative case, although regional anesthesia provides many challenges for renal transplant, it can be an acceptable and successful alternative anesthetic approach.

References:

STRESS CARDIOMYOPATHY IN LIVER TRANSPLANT

**Presenter/Affiliation:** John Rossi, MD/Department of Anesthesia, Penn State Hershey Medical Center, Hershey, PA 17033  
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**Introduction:** Stress cardiomyopathy, also known as Takotsubo cardiomyopathy, is a recently described medical condition where high amounts of systemic catecholamines along with other hormones can cause a transient dysfunction in cardiac contraction. This dysfunction is described as ventricular ballooning and akinesia of the distal ventricular wall during systole along with a hyperdynamic base. This case report discusses an adult patient undergoing a liver transplant who received high doses of adrenergic medications ultimately causing cardiogenic shock likely due to stress cardiomyopathy.

**Case Description**  
A 60 year-old man, with significant history of hypertension, chronic obstructive pulmonary disease, end stage liver disease secondary to nonalcoholic steatohepatitis, complicated by hepatorenal syndrome and hepatic encephalopathy, underwent an orthotopic liver transplant. Intra-operatively, the patient’s course was complicated by severe hemorrhage, which required a massive transfusion, as well as prolonged cross-clamping of the inferior vena cava. After graft reperfusion, the patient became hemodynamically unstable, requiring pressor support, including norepinephrine, epinephrine and vasopressin. Despite adequate resuscitation, the patient remained hemodynamically unstable. At that time, a transesophageal echocardiogram was obtained, which showed severe apical hypokinesis with ventricular ballooning. The procedure was finished and the patient was taken to the intensive care unit in critical condition and continued pressor support. Cardiology service evaluated the patient for new onset cardiogenic shock. An EKG was obtained and was not significant for ST segment changes in the possible setting of NSTEMI type 2. A transthoracic echocardiogram was suggestive for stress-induced (Takotsubo) cardiomyopathy. Due to the severity of the patient’s medical status, no intervention was undertaken. The patient was maintained on pressor support; however, he later went into asystole. CPR was initiated; however, the patient expired later that afternoon.

**Discussion:** Stress cardiomyopathy is well described in recent medical literature. Recent publications have reported the correlation between systemic catecholamines and the transient dysfunction in the myocardium. However, the pathophysiology of the dysfunction is not well understood. The cause is believed to be multifactorial, including coronary microvasculature impairment, cardiotoxicity of catecholamines, and an exaggerated stimulation of the sympathetic nervous system. It is believed that these causes lead to inflammatory changes in the myocardium which result in the unique contractile dysfunction. In this case, the iatrogenic catecholamines, combined with the sympathetic response to surgery, were the likely cause of stress cardiomyopathy. With more cases of stress cardiomyopathy being reported, it is important better understanding of the pathogenesis to develop prevention strategies.

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ANESTHETIC MANAGEMENT OF CESAREAN SECTION IN A PARTURIENT WITH HETEROTAXY SYNDROME AND SEVERE MITRAL STENOSIS, A CASE REPORT

Amanda Lukof, M.D., Suzanne Huffnagle, D.O., H. Jane Huffnagle, D.O., Michele Mele, M.D., Michelle Beam, M.D., Justin Baptist, M.D.

INTRODUCTION: Heterotaxy syndrome is a rare congenital disorder caused by embryonic failure to differentiate left-right asymmetry. There is little data regarding outcomes in pregnant women with this disorder. We present a case of a pregnant female with heterotaxy syndrome complicated by severe mitral stenosis for elective cesarean delivery (C/S) using combined spinal/epidural (CSE) anesthesia.

CASE: A 31 y/o G3P1101 female presented for C/S at 37 4/7 weeks with a history of heterotaxy syndrome and increasing shortness of breath. She had polysplenia, misaligned gastrointestinal organs (volvulus repair at 34 days), and an endocardial cushion defect (mitral valve annuloplasty as a child). She developed severe stenosis of the mitral annuloplasty site, moderate pulmonary hypertension, chronic congestive heart failure, and atrial flutter necessitating pacemaker placement and anticoagulation (SQ heparin). An ECHO showed an EF 40%, RVH, decreased RV function, mean PAP 55 mmHg, and elevated peak and mean mitral valve gradients (MV area 2.1 cm²). She was morbidly obese (BMI 37) with obstructive sleep apnea (OSA) requiring nasal CPAP. Prior to delivery, the abdominal pacemaker was converted from VVI to VOO mode and an arterial catheter was inserted. We placed a CSE (intrathecal bupivacaine 0.75% 10 mg, fentanyl 10 mcg, hydromorphone 100 mcg) and maintained her MAP within 20% of baseline during the uneventful C/S.

DISCUSSION: Heterotaxy syndrome is a serious congenital defect resulting from disorders of left-right axis determination during embryonic development (1). The incidence is 1 in 5,000-7,000 live births and factors that worsen prognosis include increasing A/V valve regurgitation, elevated pulmonary vascular resistance, and impaired ventricular function (2). Cardiac manifestations involve meso or dextrocardia, atrioventricular discordance, single ventricle physiology, AV septal defects, AV valve regurgitation, hypoplastic sinus node, congenital AV block, partial anomalous pulmonary venous drainage, and pulmonary stenosis or atresia. Extra-cardiac characteristics include symmetrically lobed lungs and bronchi, asplenia or polysplenia, malrotation of the intestine, midline liver, and bronchial cilia dysfunction.

Most patients with severe mitral stenosis are delivered via C/S using epidural anesthesia because of its hemodynamic stability (3,4). We chose a CSE using a reduced dose of intrathecal bupivacaine to minimize maternal hemodynamic fluctuations, provide intense motor/sensory block, and to allow an extended duration of action. We recovered our patient in the ICU, carefully monitoring cardiac function, volume status, and postoperative pain, instituting nasal CPAP to minimize airway obstruction.

NOVEL USE OF PHARMACOGENETIC TESTING IN THE IDENTIFICATION OF CYP2C9 POLYMORPHISMS RELATED TO NSAID-INDUCED GASTROPATHY

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Introduction:

Pain is the most common reason for people to seek medical care in the United States, and NSAIDs are one of the most commonly prescribed pain medication. With their therapeutic and adverse effects influenced by metabolism via liver CYP P450 enzyme, genetic polymorphisms in CYP P450 can decrease metabolic activity and increase risk of side effects. We report a case of a patient suffering from Interstitial cystitis (IC)/bladder pain syndrome, treated with celecoxib who developed severe NSAID induced gastropathy, which was found to be related to her allelic variant of CYP P450, CYP2C9.

Case Description:

This is a 24-year-old female who presented to an outpatient pain clinic center with a complaint of dull aching and cramping constant lower abdominal and pelvic pain, accompanied by occasional episodes of painful urination. Her past medical history was significant with diagnosis as IC by an urogynecologist and treatment with high-dose opioids and muscle relaxants were ineffective. Since she was highly functional and interested in pain medications with minimal side effects, a therapeutic trial of celecoxib (CelebrexVR) 200 mg BID was initiated for approximately 8 weeks. Three days later she started developing multiple episodes of gastritis with gastric bleeding, which eventually required endoscopic assessment, GI care, and proton pump inhibitor and H2 blocker. Pharmacogenetic testing performed identified her as an intermediate metabolizer of CYP2C9 gene. Celecoxib was discontinued and no further intervention for gastritis was required. She was counseled on impact of this gene on her risk of bleeding, potential gastric ulcer formation, and decreased clearance of celecoxib and other CYP2C9 substrates such as warfarin, and potential increased side effects.

Discussion:

Pharmacogenetics is study of molecular basis of genetic factors that may influence pharmacokinetics and pharmacodynamics of drugs. Polymorphisms can affect their metabolizing pathways. Hepatic enzyme CYP2C9 plays a key role in metabolism of nearly 15% of clinically used drugs including NSAIDs such as celecoxib. CYP2C9*2 and CYP2C9*3 are two frequent allelic variants, which are highly frequent among individuals presenting with GI bleeding following NSAID therapy. They can also affect the variability in pharmacokinetics of celecoxib whose selective COX-2 inhibition might disturb COX-2 enzyme mediated protective PG production, necessary to keep the gastric mucosa healthy and to heal ulcers. Pharmacogenetic testing can help understand the impact of such variations on NSAIDs pharmacokinetics, diagnose genetic risks behind therapeutic failure and guide pain management by allowing safer and efficacious medication selection. It may also help companies to design personalized drugs for high-risk population and physicians to identify and administer them appropriately, significantly saving on cost and unwanted adverse effects. So far, it has been mainly used retrospectively to identify and explain causes of abnormal drug responses. Its clinical application remains limited because of paucity of studies and due to expensive cost of current testing methods. Recently, use of economically feasible tests and readily available SNP’s on major CYP enzymes has expanded its application further. Although pharmacogenetic testing is still not widely clinically applied, pain physicians must nevertheless be aware of its potential utility.

Word Count: 497
REPEATED CARDIOPLEGIC ARREST OF DONOR ALLOGRAFT DURING ORTHOTOPIC HEART TRANSPLANT

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Authors: Natalia Martinez Acero, MD; Theodore Cios, MD, MPH; Erina Ng, MD; Dmitri Guvakov, MD.

Introduction

Repeated cardioplegic arrest of a transplanted heart during the stunned myocardium phase has not been reported. We describe a case of repeated cardioplegic arrest after initial reperfusion of a donor heart during orthotopic heart transplantation (OHT).

Case description

A 57-year-old man with systolic heart failure, pulmonary hypertension and ischemic cardiomyopathy after coronary artery bypass (CABG) and left ventricular assist device (LVAD) placement, presented for a cardiac transplantation. The donor allograft had normal function and anatomy with the exception of a left atrial injury and an unknown aortic tear sustained during trauma.

A repeat sternotomy was performed, complicated with LVAD outflow graft injury, leading to emergent institution of cardiopulmonary bypass (CPB) via femoral cannulation. Massive transfusion resuscitation was required. The recipient cardiectomy was completed and the LVAD was explanted, followed by anastomosis of the donor graft. The aortic cross-clamp (AoX) was removed, reperfusing the donor heart which spontaneously converted to sinus bradycardia. After 55 minutes of reperfusion, a 1-cm tear in the donor aorta was discovered. After discussion with the surgeon, the aorta was re-clamped. Repeated, antegrade, cold cardioplegia was given to the donor heart, inducing cardiac arrest for an additional 14 minutes. The AoX was removed and reperfusion begun again for 40 minutes. Total graft ischemic time was 217 minutes.

The patient was weaned from CPB using isoproterenol, norepinephrine and epinephrine infusions. The initial transesophageal echocardiogram showed preserved left ventricular (LV) and failing right ventricular (RV) function, correlating with pulmonary hypertension (pulmonary artery systolic pressure of 60 mmHg). RV function started to improve with inhaled nitric oxide. No mechanical circulatory support was utilized and the patient was transported to the intensive care unit in critical condition.

The patient required inotropic and vasopressor support, in addition to renal replacement therapy for the following two weeks. By post-operative day 30, RV function improved and LV function remained normal. The patient was discharged to a long-term acute care facility and eventually home without further need for dialysis.

Discussion

Primary graft failure (PGF) is defined as severe ventricular dysfunction immediately after OHT not caused by rejection or infection. PGF is a leading cause of death in the first 30 days post-operatively. A major risk factor for PGF is increased total ischemic time of the donor allograft, by 43% for every hour of ischemia time. The incidence of PGF requiring mechanical circulatory support after heart transplant is 23%. These patients have an increased mortality rate (62%) in the first year, compared to those without PGF (22%). Our patient had multiple comorbidities and a complicated operative course, including LVAD graft injury with massive transfusion, repeated cardioplegic cardiac arrest, stunned myocardium, and RV failure with pulmonary hypertension. We demonstrate a successful outcome with aggressive pharmacological management, avoiding the high-risk mechanical circulatory support.
Figure 1. Intra-operative TEE after reperfusion of the transplanted heart.

Figure 2. Intra-operative TEE after cardioplegic arrest of transplanted heart.

References


MODIFIED NASAL TRUMPET FOR AIRWAY MANAGEMENT OF A PATIENT WITH UNDIAGNOSED OBSTRUCTIVE SLEEP APNEA UNDERGOING AN AWAKE CRANIOTOMY

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Introduction:
Awake craniotomy presents unique airway challenges to the anesthesiologist. The patient requires adequate sedation for comfort and surgical exposure, while over-sedation could result in airway obstruction and hypoventilation. This case describes the airway management of a patient with undiagnosed obstructive sleep apnea undergoing an awake craniotomy using a nasal CPAP system made from equipment available in most ORs.

Case:
A 55 year-old man with no significant past medical history presented to the ED with right-sided weakness, facial droop, and personality changes over two weeks. Further evaluation revealed a 7 cm right perihilar lung mass and a 5 cm left frontal opercular lesion, likely a metastasis from the lung mass. Due to the location of the brain lesion and the patient being left hemisphere dominant, an awake craniotomy with intraoperative speech corticography was selected to resect the tumor. Preoperative evaluation revealed an obese man with a thick neck and large tongue. He denies obstructive sleep apnea (OSA) but has noted increase work of breathing and copious amounts of secretions. Due to his unfavorable airway exam and secretions, sedation with Dexmedetomidine and small boluses of Fentanyl and Propofol was chosen. Shortly after lateral positioning and head-pinning, the patient started to move and cough. Boluses of Propofol were given to deepen the patient but due to concern of airway obstruction, a modified nasopharyngeal airway was inserted into the right nostril (see figure 1) and connected to the circuit to assist ventilation. This only partially relieved the airway obstruction. It was thought that due to the patient’s large tongue and lateral positioning, the posterior tongue could have collapsed around the nasopharyngeal airway causing partial airway obstruction. A second nasopharyngeal airway was inserted into the left nostril and both nasopharyngeal airways were connected to a double lumen tube adapter that was connected to the anesthesia circuit (see figure 2&3). This setup provided unobstructed spontaneous ventilation and continuous positive airway pressure (CPAP), while allowing assisted ventilation as needed through the double nasopharyngeal airways. The remainder of the case was uneventful and the patient was able to count and read as required for his intraoperative neurological assessment with both nasopharyngeal airways in place.

Discussion:
Airway management is crucial during an awake craniotomy. Not only is airway access difficult due to bed and patient positioning, rescue maneuvers such as intubation or LMA insertion may also be hard with the patient in head-pins. Although there are cases describing the management of airway obstruction in patients with known OSA using a CPAP or nasal BiPAP device, this case demonstrates a simple double nasopharyngeal airway setup that can be assembled from supplies found in most operating rooms. Not only does the setup alleviate airway obstruction and provide CPAP, it also provides end tidal CO₂ monitoring and positive pressure ventilation as needed, which proved invaluable in our patient with undiagnosed OSA.

Conclusion:
Although airway management with double nasopharyngeal airways have been described as early as 1969, our double nasopharyngeal airway setup uses supplies found in most operating rooms and could be useful in alleviating airway obstruction in future awake craniotomies.
Figure 1: Modified Nasal Trumpet. Nasal trumpet connected to anesthesia circuit via an ETT connector.

Figure 2: Double nasopharyngeal airway connected to a standard double lumen tube connector. The top right (blue) end is connected to the anesthesia circuit to provide end tidal CO2 monitoring and allow positive pressure ventilation/CPAP as needed.

Figure 3: Patient in right lateral position and head-pins with double nasopharyngeal airways in place.

References:

MANAGEMENT OF HEPATOPULMONARY SYNDROME POST LIVER TRANSPLANT

Amanda Trommello-Lukof, MD; Nicole Khetani, MD; Elia Elia, MD; Yoogoo Kang, MD

Introduction

Hepatopulmonary syndrome is a disorder of gas exchange that occurs secondary to intra-pulmonary vascular dilations in the presence of liver dysfunction. These vascular abnormalities create a trans-pulmonary shunt effect. The vessel distortion prevents the red blood cells from contacting the alveolar surfaces; therefore oxygen cannot be extracted from the alveoli to be carried to the rest of the body. This is in contrast to shunting from diseases intrinsic to the lung in which there is contact between the alveoli and the red blood cells, but the alveoli lack oxygen because of the disease process, e.g. inflammation in acute respiratory distress syndrome. The figure below illustrates this concept.

![Figure 1: Cause of Shunting in Hepatopulmonary Syndrome](image)

Hepatopulmonary Syndrome. The normal lung architecture; the inner oval represents the alveolus with oxygen (green) and the outer layer represents a blood vessel filled with red blood cells (red). In intrinsic lung disease the vessel is unchanged, but the disease process (yellow) displaces the oxygen, preventing extraction. In hepatopulmonary syndrome the alveolus is appropriately oxygenated, but the red blood cells do not contact the surface, preventing oxygenation.

Hepatopulmonary syndrome carries a very poor prognosis, and while there are some strategies to improve quality of life, such as oxygen, the only known effective treatment is liver transplantation. It was previously thought that end-stage liver patients with hepatopulmonary syndrome (HPS) were poor candidates for transplant. However, in the past ten years evidence has supported transplant since, if managed correctly post-operatively, these patients do just as well as patients without the syndrome. Although liver transplant does treat this disease, it can take several months for patients physiology and symptoms to improve. The key to success with these patients is effective management of their respiratory status, particularly in the immediate post-operative period. Our case demonstrates an example of a successful liver transplant in a patient with severe hepatopulmonary syndrome and her postoperative course following early extubation.
Case

A 62-year-old female with end stage liver disease secondary to non-alcoholic steatohepatitis (NASH) cirrhosis, underwent an orthotopic liver transplant. At the time of diagnosis of liver failure, the patient was also diagnosed with hepatopulmonary syndrome. Her pulmonary function tests revealed pO2 51, 16% shunt, alveolar-arterial gradient of 61. Diffusion capacity was also reduced. Prior to her transplant, patient was persistently hypoxic with oxygen saturations of 84-89%, however was asymptomatic. She was eventually placed on home oxygen to help optimize her condition.

Post-operatively she was transported to the intensive care unit (ICU) intubated on assist control ventilation. Eight hours post-operatively, oxygen saturation was 91% on pressure support of 8 and 70% FiO2 with a respiratory rate of 12. The patient was awake and following commands and her arterial blood gas (ABG) revealed pH 7.33, pCO2 39, pO2 68, HCO3 20. Blood pressure was 154/78 and pulse 100. Despite the low oxygenation, patient was extubated successfully and placed on re-breather mask.

After extubation, the patient’s oxygen saturation was 93%, pulse 101, blood pressure 146/75, respiratory rate 13. Her CVP was 5 and her pulmonary artery pressures were 34/20. ABG: pH 7.26, pCO2 47, pO2 87, HCO3 20. Patient was switched to a non-re-breather without significant change.

Her post-operative course in the ICU consisted of oxygen saturations of 84-96% and did not require intubation. Although the patient’s saturations varied, there was no clinical change. When desaturations occurred, various maneuvers were attempted. One successful maneuver was moving the patient into different positions to alter the physiology of her shunting. Placement on her sides or lying her flat would temporarily improve saturations. Increasing the flow on her inhaled oxygen also improved saturations. Post-operative management was directed with the goal of avoiding re-intubation due to the rationale that positive pressure could worsen the existing shunt, therefore lower saturations were tolerated. Noninvasive ventilation was considered, but never attempted as patient recovered with other maneuvers described above. The patient eventually stabilized on 2 liters via nasal cannula with oxygen saturations at a mean of 92%. She was discharged from the ICU on post-operative day (POD) five and from the hospital on POD twelve.

Discussion

Many patients are left intubated after surgical procedures, particularly lengthy operations with increased anesthetic exposure, and extubated in the intensive care unit or post-operative care unit when extubation criteria are met. These criteria are based on four tenets: strength of respiratory muscles, ability to protect airway and clear secretions, acceptable oxygenation, and appropriate following of commands. Oxygenation is measured clinically by pulse oximetry and arterial blood gases, however this information primarily identifies hypoxemia. The true determining factor is whether the lungs are providing enough oxygenation to prevent tissue hypoxia. This can be measured indirectly by approximating vital organ function through clinical exam, labs, and urine output.

Hepatopulmonary syndrome patients are often left intubated much longer than other patients undergoing liver transplants because they consistently appear hypoxemic on pulse oximetry and arterial
blood gases. Even though they are hypoxemic, these patients should exhibit signs of tissue oxygenation. Our patient exhibited signs of appropriate tissue oxygenation: her urine output was greater than 1mL/kg/h with creatinine and BUN within normal limits suggesting renal perfusion, she was calm and followed commands reflecting brain perfusion, and her electrocardiogram was unchanged reflecting cardiac perfusion. Many clinical exam and lab findings can reflect adequate tissue oxygenation; these are merely an example. In this setting, recent evidence is showing improved outcomes when patients are extubated earlier based on this altered criteria5. Our patient is an example of a successful outcome using this method.

Early extubation is critical for these patients. The positive pressure exerted by mechanical ventilation can lead to worsened shunting; this can explain why the patient’s saturation improved after extubation. Although she did have an occasional desaturation once extubated, she would recover with maneuvers such as repositioning. One key feature of HPS is platypnea. The West Zones of the lungs are a key principle of respiratory physiology that divides the lungs into segments based on ventilation-to-perfusion ratios. These are based on an upright patient, however lying flat or laterally can alter these ratios. Lying flat leads to improved perfusion and oxygenation in patients with HPS. It utilizes the West Zone principal to improve oxygen extraction in areas of normal vasculature to help compensate for the areas of disease. This principle guides the intervention of repositioning post-operatively to optimize the VQ matching and improve oxygenation.

Our case exemplifies the importance of early extubation in patients who present with HPS when receiving a liver transplant. The benefits of this could lead to shorter post-operative course and aid in earlier recovery. Education of staff seems to be beneficial in aiding with this process as well.

References

MATERNAL CYCLICAL TACHYCARDIA DURING LABOR: A SIGN OF HYPOVOLEMIA

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Introduction: The presence of new onset arrhythmia in an otherwise healthy parturient during labor has been well documented in literature\(^1\-\(^3\), with sinus tachycardia being the most common offender. Potential causes include pain, effect of labor induction agents, hypovolemia, and side effect of labor analgesia. However, persistence of sustained sinus tachycardia after significant volume resuscitation often leads to a myriad of work-up. This report identifies a clinical sign that served as a reliable guide to adequate resuscitation and resolution of sustained sinus tachycardia during labor.

Case: 23-year-old G\(_2\)P\(_1\) at 40 weeks by ultrasound was scheduled for induction of labor secondary to obesity, BMI 37. On admission, she reported a recent history of four episodes of pre-syncope. Her medical, surgical, and social history was unremarkable. Home medications included prenatal vitamins, ferrous sulfate and Vitamin D. After receiving one liter of Isolyte, Anesthesiology was consulted for a labor epidural. Her pre-epidural vitals were BP 118/65 HR 92. An epidural was uneventfully placed at L3-L4 interspace, with loss of resistance at 5 cm. Test dose with 3ml of 1.5% Lidocaine was negative. She was given a 10 ml bolus of 0.125%Bupivicaine/ Fentanyl 5mcg/ml in small aliquots over fifteen minutes. An infusion of 0.0625% Bupivacaine/Fentanyl 1.5mcg/ml/ Epinephrine 1:700 000 was started at a rate of 10ml per hour. Thirty minutes later the patient was hypotensive 82/43 with marked tachycardia in the 150s, with fetal decelerations. Her pressure responded to phenylephrine, and one liter of Isolyte, but her tachycardia persisted for hours. The patient reported lightheadedness on review of systems. Multiple EKGs demonstrated sinus tachycardia, 130- 160 BPM, with frequent premature ventricular complexes and some ST changes. Cardiac enzymes and electrolytes were normal. Cardiology was consulted, and an ECHO was performed. ECHO revealed mild concentric left ventricular hypertrophy but was otherwise normal. Her fetal monitoring strip revealed a pattern of worsening tachycardia with each contraction that would subside to a baseline in between contractions. The patient was given additional volume until resolution of the cyclic pattern on fetal monitoring; this coincided with improvement of her tachycardia.

Discussion: Given our patients recent episodes of pre-syncope our threshold for further workup of this new onset sustained tachycardia was relatively low. Reported rate of arrhythmia is as high as 83%\(^1\) during labor and delivery. Although our pre-epidural vital signs were normal, a patient who is hypovolemic can quickly decompensate with the sympathetomy response after epidural analgesia. This effect is confounded by concomitant oxytocin infusion, and progression of labor in which a surge of catecholamine’s cause cardiac excitability\(^4\). Given the inherent risks of aggressive fluid administration in a physiologically overloaded state\(^5\), it can be hard to gauge when it’s enough. Evaluating a two lead fetal tracing for patterns of cyclic maternal sinus tachycardia with each contraction can be a simple and cost affective resource for managing hypovolemia during labor.
References


A RARE GENETIC VARIANT OF THE RYANODINE RECEPTOR IN A SUSPECTED MALIGNANT HYPERTERMIA PATIENT

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INTRODUCTION
The case report describes the anesthetic management of a suspected intraoperative malignant hyperthermia (MH) episode. Gene sequence testing of the RYR1, CACNA1S and STAC3; result: heterozygous: exon 90 of the RYR1 gene; a rare sequence variant designated c.12553G>A. AA substitution: p.Ala4185Thr. This variant has been reported in one other individual known to be susceptible to MH5, studied and has been classified as “deleterious,” “possibly damaging,” and “disease-causing.”

CASE REPORT
17 year old male, in halo (C5 vertebral fracture) was scheduled for a C5 corpectomy & C4-C6 fusion (+ SSEP & MEP monitoring). Airway management included an awake fiberoptic intubation followed by TIVA maintenance with sufentanil and propofol. At the conclusion of the case, TIVA discontinued and volatile anesthetic initiated resulting in sudden, marked increase in end-tidal CO2, tachycardia, tachypnea, increased minute ventilation and elevated temperature. Empirical treatment with Dantrolene, cooling measures and appropriate flushing of the anesthetic circuit were initiated resulting in rapid normalization of cardiopulmonary parameters.

DISCUSSION
Malignant hyperthermia (MH) is autosomal dominant with an incidence of 1:5,000 to 1:50,000-100,000. The pathogenesis involved uncontrolled skeletal muscle contraction from impaired calcium regulation. Triggers are volatile anesthetics and succinylcholine. The cause is unknown. Initial presenting signs are hypercarbia in 38%, and sinus tachycardia in 31% of cases. If left untreated, MH will progress to DIC, renal failure, cardiac failure and death. Treatment involves resuscitation, removing the triggering agent, 100% FiO2 and Dantrolene. Dantrolene 2.5-10mg/kg IV, binds to the ryanodine receptor, decreases intracellular calcium and discontinues the muscle contraction. The advent of Dantrolene reduced the mortality from MH from 70% to <5%. Diagnosis of MH can be determined by the Caffeine Halothane Contracture Test (CHCT) or by genetic testing sequencing of the Ryanodine Receptor (RYR1) and the skeletal muscle calcium channel gene (CACNA1S). Caffeine halothane Contracture Test is considered the “gold standard.” It requires a muscle biopsy and has a specificity of >99% and a sensitivity of >80%. Genetic testing sequencing of the RYR1 and CACNA1S requires a blood or tissue DNA sample on which sequencing of both receptors are performed. Mutations in the RYR1 gene account for 70% of MH cases and CACNA1S account for 1% of MH cases.

CONCLUSION
Malignant hyperthermia is a potentially lethal inherited disorder of skeletal muscle calcium regulation with uncontrolled skeletal muscle hypermetabolism. Heterozygosity for this rare variant in the gene that encodes the ryanodine (RYR1) receptor (present on chromosome 19), has been reported in only one other individual who is proven to be susceptible to malignant hyperthermia.
References:
PARRC 2015 Abstract - Case Report

PNEUMOTHORAX AFTER TRIGGER POINT INJECTIONS – IS IT REALLY AS RARE AS WE THINK?

Presenter: Neha M. Soares M.D., Department of Anesthesiology, Penn State Hershey Medical Center.

Author(s): Soares N, Giampetro D, Gordin V

Introduction:

Trigger point injection is a well described relatively safe treatment for chronic myofascial pain syndrome. We present two cases of pneumothorax complicating trigger point injection in thoracic back muscles.

Case Descriptions:

CASE 1 – 48 year old female, BMI 26.4, suffered whiplash injury in motor vehicle accident resulting in chronic left sided myofascial pain syndrome in cervical and thoracic region. She received trigger point injections in left trapezius, left rhomboid major and left rhomboid minor muscles by palpation of taut band, dry needling and injection of bupivacaine 0.5%, 2ml in each muscle with a 25G 1.5 inch needle. Thirty minutes later, while being observed in chronic pain clinic, she complained of left pleuritic chest pain and dyspnea. On auscultation reduced air entry in left lung was noted. Vitals signs remained stable, and the patient was taken to the emergency department (ER).

CASE 2 - 49 year old female, BMI 23, diagnosed with bilateral thoracic back chronic myofascial pain secondary to scoliosis and multiple back surgeries. She received trigger point injections in left rhomboid major and minor and right rhomboid major muscle by palpation of taut band, dry needling and injection of bupivacaine 2ml of 0.25% and triamcinolone 10mg in each muscle with a 25G 1.5 inch needle. The patient was discharged home but presented to the ER next morning with steadily worsening right sided pleuritic chest pain and dyspnea.

ER course in both patients: Moderate sized pneumothorax was identified with chest radiography. Pigtail chest catheter was placed and the patients followed overnight. The following morning, the catheters were clamped, resolution of pneumothorax confirmed with chest radiography, catheters removed and both patients discharged home within 24 hours without further complications.

Discussion:

Pneumothorax is a rare but serious complication after trigger point injection for myofascial pain, in the neck or shoulder area. According to Seug et al because the rhomboid major muscle is very thin, the depth of needle insertion should vary based on the patient’s BMI. Ultrasonographic guided detection of the taut bands can add to the safety of the procedure. Should ultrasonography be used routinely when performing trigger point injections in the neck and shoulder area? Is it reasonable to measure each patient’s back muscle thickness with computerized tomography prior to procedure? Is the standard 1.5 inch needle too long for the average sized patient,
should smaller needles be routinely used and should needle stoppers or markers be considered? We recommend further research to address the above concerns.

References:

2) Seung et al. Appropriate Depth of Needle Insertion during Rhomboid Major TPI. Annals of Rehabilitation Medicine, 2014; 38: 72-76
SUBCUTANEOUS EMPHYSEMA AND PNEUMO-MEDIASTINUM SECONDARY TO PYRIFORM SINUS PERFORATION DURING AN EMERGENT INTUBATION ATTEMPT

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Authors: Soares, Neha and Carr, Zyad

Introduction: Pyriform sinus perforation is a serious, though relatively rare, complication of endotracheal intubation. We present a case in which this complication was encountered, when intubation was attempted emergently, during a respiratory arrest in a ‘cannot ventilate’ situation.

Case Description: A 78 year-old female was admitted to Intermediate Care from the post anesthesia care unit, three hours following right fracture neck femur surgery, due to multiple co-morbidities including hypertension and chronic obstructive pulmonary disease, and associated post-operative hypotension with arrhythmias. On day two of admission, during a session with the physical therapist, the patient complained of acute severe shortness of breath. Despite resuscitative efforts, this quickly progressed to cyanosis, inability to bag mask ventilate, unresponsiveness, bradycardia and pulseless electrical activity. Along with standard ACLS protocol, an oral intubation attempt was made using direct laryngoscopy with a MacIntosh blade and a cuffed size 7 endotracheal tube. This resulted in subcutaneous emphysema within 3-4 positive pressure breaths. The endotracheal tube was immediately withdrawn, a laryngeal mask airway (LMA) was successfully inserted, and satisfactory ventilation was obtained. Spontaneous circulation returned within three minutes. Using a Glidescope, the LMA was then exchanged for an endotracheal tube.

The subsequent chest radiograph and computed tomography confirmed extensive pneumo-mediastinum and subcutaneous emphysema. Upper endoscopy revealed a small right pyriform fossa full-thickness perforation which was clipped with two endoclips and a nasal feeding tube positioned during endoscopy. The patient was extubated after 24 hours, and empiric broad spectrum antibiotics were given for six days. A repeat chest radiograph three days after the intubation revealed near-complete resolution of pneumo-mediastinum. The patient was discharged on day six after the event. Two months later, upper endoscopy showed a healed perforation. No further complications occurred.

Discussion: Hypopharyngeal perforations account for <2% of perforations in the pharyngoesophageal region. Recognized causes include iatrogenic instrumentation, blunt and penetrating trauma, tumor invasion, spontaneous perforation, foreign body, blast injury and emesis.

Early presentation includes subcutaneous emphysema, pain, odynophagia, hoarseness and hemoptysis. Late presentation includes swelling, fever, retropharyngeal abscess, carotid artery pseudoaneurysm, mediastinitis, pyopneumothorax, septic shock and death.

Prompt identification, early diagnosis and appropriate medical and surgical management are essential to avoid further life-threatening complications. This is a rare report of the use of endoscopic clipping at patient’s bedside for a pyriform sinus perforation.
References:

ANESTHETIC CONSIDERATIONS FOR A LARGE, LONG-STANDING, SYMPTOMATIC TRAUMATIC DIAPHRAGMATIC HERNIA REPAIR.

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ABSTRACT

A 68 year old female status post motor vehicle crash in 1980 was incidentally found to have a large diaphragmatic hernia in 1992 during a breast cancer workup. She was asymptomatic for 30 years after the injury until she began to experience worsening shortness of breath, regurgitation, hoarseness, and sought surgical management. CT scan revealed a large right diaphragmatic hernia containing colon, a large portion of liver, and gallbladder. A thoracoscopy, thoracotomy, repair of diaphragmatic hernia with mesh, and right middle and lower lobe wedge resection of lung were performed. Anesthetic considerations include the risk of difficult intubation from tracheal deviation, aspiration, hypoxia, and cardiovascular collapse upon induction of anesthesia and positive pressure ventilation. There is very little in the anesthesia literature regarding anesthetic management for repair of this injury. This case highlights the unique challenges faced by the anesthesiologist for this unusual condition. Relevant radiology images will be reviewed.

DISCUSSION

Traumatic diaphragmatic hernias are a serious complication of blunt injury. Most herniations occur after motor vehicle accidents and may not have any clinical symptoms for weeks to years after the initial injury¹². Once abdominal organs intrude upon the thoracic cavity, they generally do not return to the abdominal cavity, secondary to the gradient between abdominal and thoracic pressures. Despite multiple potentially life-threatening anesthetic complications, our patient safely underwent the repair of her diaphragmatic hernia due in large part to our careful anesthetic preparation.

Difficult airway equipment was prepared due to a potential difficult intubation as a result of the abdominal viscera in the thorax. With administration of a paralytic, the abdominal viscera could have advanced further into the thoracic cavity, causing tracheal obstruction or compression of the heart and great vessels. Herniation of abdominal viscera into the pericardial sac causing tamponade physiology with induction of anesthesia has been described⁵⁶. Her dyspnea indicated a reduced pulmonary reserve and she was at risk of desaturation due to the compressive effect of the viscera in the right pleural cavity. For this reason, she was pre-oxygenated before induction and the time between induction and intubation was minimized.

Administration of a non-particulate antacid or an H2-blocker with a rapid sequence induction could have been considered. However, in this case the stomach was not herniated through the diaphragm so gentle ventilation with cricoid pressure was used to prevent gastric insufflation.

Large bore IV access was obtained and blood products were immediately available given the

References:
possibility of adhesions and massive hemorrhage. Additionally, invasive blood pressure monitoring was used for rapid identification of potential visceral compression of venous return or decrease in cardiac output.

Figure 1. Barium enema. Colon herniates into the right pleural cavity through a defect in the diaphragm.

Figure 2. Herniated liver, colon, omentum, and gallstone-containing gallbladder into the right thorax.
RESCUE TEE DIAGNOSIS OF ACUTE PULMONARY EMBOLISM PROMPTING PULMONARY EMBOLECTOMY

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Introduction: Pulmonary embolism (PE) is associated with significant perioperative morbidity and mortality, especially if not diagnosed early and treated aggressively.

Case Presentation:
A 19 year old female presented for revision of a ventriculoperitoneal (VP) shunt that was placed after resection of a left parietal meningioma. A laparoscopic and endoscopic-assisted placement of left parietal VP shunt was performed without complications. Shortly following extubation, the patient exhibited shortness of breath and cyanosis, with an SpO₂ of 85%. The patient’s trachea was re-intubated, but she developed bradycardia and pulseless electrical activity for which cardiopulmonary resuscitation was initiated. Ventricular fibrillation (VF) followed, and the patient was defibrillated to a sinus rhythm. A transesophageal echocardiography (TEE) probe was inserted and imaging revealed a dilated, hypokinetic right ventricle, severely under filled hyperdynamic left ventricle, and a dilated pulmonary artery (PA) with high suspicion for pulmonary embolus. An intravenous infusion of epinephrine was started and cardiothoracic surgery was contacted.

An emergent median sternotomy was performed and cardiopulmonary bypass (CPB) was initiated. A large saddle embolus was removed from the pulmonary artery (PA) after main pulmonary and right pulmonary arteriotomies were performed. CPB was converted to veno-venous extracorporeal membrane oxygenation (V-V ECMO). TEE showed improved right and left ventricular function and V-V ECMO was removed on the third postoperative day. The patient was discharged from the hospital to rehabilitation.

Discussion:
TEE is an important diagnostic tool for the perioperative management of patients with sudden cardiovascular collapse. Practice guidelines from the Society of Cardiovascular Anesthesiologists and the American Society of Echocardiography strongly recommend TEE for diagnosis and management of acute, life-threatening intraoperative hemodynamic instability. TEE imaging may reveal direct visualization of a PE and demonstrate secondary signs of PA obstruction, such as right ventricular dilation, pulmonary artery dilation, and tricuspid regurgitation. Severe pulmonary artery obstruction if not relieved, will lead to cardiac arrest and death in up to 70% of patients within the first hour of presentation. Although TEE permits direct visualization of the PE in some patients, the interposition of the trachea and left main stem bronchus between the esophagus and great vessels may interfere with visualization in all patients, particularly if the PE is in the left PA. TEE evidence of PA obstruction along with the clinical presentation may be sufficient to make the diagnosis. Immediate availability of surgical and diagnostic techniques provided by anesthesiologists have improved the survival of patients with acute PE.

References:
BIVALIRUDIN USED IN PATIENT WITH HISTORY OF HEPARIN INDUCED THROMBOCYTOPENIA (HIT) WITH PREVIOUS CORONARY ARTERY BYPASS GRAFT (CABG)
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Introduction: Heparin Induced Thrombocytopenia (HIT) is an undesirable effect of heparin that could lead to systematic and fatal thrombosis. Patients with previous diagnosis of HIT require alternative for anticoagulation for cardiovascular surgeries.

Case Presentation:
A 71 year old female w/ PMH of HTN, CAD, PVD, DMII, and HIT presents for a left carotid endarterectomy (CEA). The patient developed Type II HIT, a more severe immune mediated form of HIT s/p CABG 15 years ago, presenting with thrombotic events and requiring a month in the ICU. It was explained that the antibodies responsible for the HIT reaction were most likely gone, but the patient refused to have heparin used for her surgery. Bivalirudin was used and the patient had an awake CEA performed with a superficial cervical block. A loading dose of bivalirudin was given, the ACT was in normal therapeutic range, and the patient was placed on an intraoperative infusion. There were no surgical, anesthetic, or postoperative complications. The patient returned five months later for a femoral-femoral bypass and refused heparin again. A bilateral femoral artery endarterectomy and a left to right femoral-femoral bypass were performed with bivalirudin, also with no complications.

Discussion:
HIT is a potential catastrophic, adverse immune mediated, prothrombotic response to heparin. HIT is associated with a risk of thromboembolic events (deep vein thrombosis, pulmonary embolus, myocardial infarction, cerebral vascular accident, limb amputation, etc), clinically significant bleeding, and life-threatening complications. Still, HIT is transient with recovery of normal platelet count within days to weeks and disappearance of pathologic HIT antibodies within weeks to months. Direct thrombin inhibitors (DTIs) are recommended for first line therapy, with argatroban being the only FDA approved drug for treatment and prevention of HIT. Argatroban has a significantly longer half-life compared to bivalirudin (50 vs 25 minutes), making bivalirudin more desirable for surgical procedures. Bivalirudin is an attractive off label option, has favorable anecdotal experience but low strength of evidence with use in HIT.

A retrospective analysis included 461 patients with a suspected, confirmed, or previous history of HIT who received bivalirudin for anticoagulation. New thrombosis was identified in 4.6% of patients while they were on treatment with therapeutic doses of bivalirudin, but no patients required amputation. Still, major bleeding occurred in 7.6% of patients, with an increase in the critically ill population. The 30-day all-cause mortality rate was 14.5%, and 8 of 67 (1.7%) deaths were HIT-related. Another retrospective analysis compared bivalirudin to argatroban for anticoagulation in patients with known or suspected HIT. The results showed a greater proportion of patients with supratherapeutic partial thromboplastin time (ptt) with argatroban versus bivalirudin (18% vs 8%), similar bleeding events and time to therapeutic goal, and thromboembolic events developing in 8% of patients with bivalirudin versus 4% with argatroban. Bivalirudin, due to its fast onset, short half-life and minimal renal excretion, appears to be a safe alternative for prevention and treatment of HIT for surgical patients.

References:
2. Chest. 2004 Sep;126(3 Suppl):311S-337S.
ACUTE HYPOTENSION FOLLOWING 50% DEXTROSE INJECTIONS: A CASE REPORT

Presenter: Victoria Saites MD, Hospital of the University of Pennsylvania, Department of Anesthesiology and Critical Care

Authors: Victoria Saites MD, Krzysztof Laudanski MD PhD, Maisie Jackson MD

Abstract:

Introduction: Animal studies have reported systemic hypotension following the rapid administration of small volumes of hyperosmotic solutions, including dextrose, mannitol, and hypertonic sodium chloride. This phenomenon may be of clinical significance in certain vulnerable patient populations.

Case Description: This is a case report of a sixty-year-old female, intubated and sedated, status post replacement of her aortic valve, root, and arch who developed a substantial, although transient, drop in systemic arterial pressure after the administration of small volumes (≤ 50 milliliters) of 50% dextrose through an internal jugular catheter and a pulmonary artery catheter. The magnitude of the drop in systemic arterial pressure was more significant with injection of 50 mL of 50% dextrose than with 40 mL and 20 mL of 50% dextrose. Heart rate and pulmonary artery pressure remained relatively unchanged. Systemic arterial pressure returned to baseline within twenty seconds. Transthoracic echocardiogram demonstrated unchanged systolic function and no alterations in inferior vena cava variability. To our knowledge, the case presented is the first describing the hypotensive response to 50% dextrose in human subjects.

Discussion: Because hyperosmolar induced hypotension has been described with various hyperosmotic solutions, including dextrose, mannitol, and hypertonic sodium chloride, it can be concluded that the response depends on osmotic load rather than on chemical composition of the solution. Additionally, animal studies and our case report demonstrate that the magnitude of the hypotensive response increases in a concentration-dependent manner. The most plausible explanation for this phenomenon of hyperosmolar induced hypotension from animal studies is systemic vasodilation, specifically by activation of a neural reflex with cardiopulmonary afferents and vasomotor efferents. Pretreatment with either H1- or H2- blockers or indomethacin did not prevent hypersomolar induced vasodilation, suggesting that the vasodilatory response is not mediated by the release of histamine or by the effects of prostaglandins. Of note, a majority of animal studies cite simultaneous hypotensive and bradycardic responses to the rapid administration of hyperosmotic solutions. The most likely explanation for our observation of unchanged heart rate is that the patient was receiving inotropes, potentially masking bradycardia. Since hypotension occurred without bradycardia, it can be concluded that bradycardia is more likely in response to hypotension rather than vice versa. This case provides interesting observations and sheds some insight into the hypothesized mechanisms for the acute decrease in systemic arterial pressure with the rapid administration of hyperosmotic solutions.

Clinicians should be aware that rapid infusions of even small volumes of hyperosmotic solutions may result in a substantial decrease in systemic arterial pressure. Although the drop in systemic arterial pressure is transient, it may be dangerous if uninterrupted blood flow is critical, such as in patients with an ischemic stroke or with underlying cardiac dysfunction. For this reason, we recommend a slow rate of infusion of hyperosmotic solutions.
References:


Table 1: Volume and Location of 50% Dextrose Injection with Blood Pressure, Heart Rate, and Pulmonary Artery Pressure Recordings Pre and Post Injection

<table>
<thead>
<tr>
<th>Volume of 50% Dextrose Injection (Location of Injection)</th>
<th>Systolic / Diastolic Blood Pressure Pre Injection</th>
<th>Systolic / Diastolic Blood Pressure Post Injection</th>
<th>Heart Rate Pre Injection</th>
<th>Heart Rate 20 Seconds Post Injection</th>
<th>Pulmonary Artery Pressure Pre Injection</th>
<th>Pulmonary Artery Pressure 20 Seconds Post Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mL (Internal Jugular catheter)</td>
<td>108/46</td>
<td>52/18</td>
<td>72</td>
<td>70</td>
<td>28/11</td>
<td>31/16</td>
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<tr>
<td>40 mL (Internal Jugular Catheter)</td>
<td>106/48</td>
<td>58/24</td>
<td>66</td>
<td>69</td>
<td>33/17</td>
<td>32/16</td>
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<tr>
<td>20 mL (Internal Jugular Catheter)</td>
<td>114/56</td>
<td>78/40</td>
<td>70</td>
<td>71</td>
<td>37/15</td>
<td>33/17</td>
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<tr>
<td>20 mL (Pulmonary Artery catheter)</td>
<td>110/54</td>
<td>76/46</td>
<td>74</td>
<td>76</td>
<td>37/15</td>
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A TRACHEAL RESECTION COMPLICATED BY THE UNINTENDED SUTURING OF AN ENDOTRACHEAL TUBE TO THE TRACHEA THROUGH THE MURPHY EYE

Presenter: Derek S. Lauter, M.D.

Authors: Derek S. Lauter, M.D., and Patrick J. Forte, M.D.

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Introduction: Endotracheal tubes (ETTs) with supplemental lateral eyes were first introduced by Dr. Frank Murphy in 1941 as a solution to the problem of distal ETT occlusion preventing ventilation. Through the years, complications involving the Murphy eye have been infrequently reported in the literature, but include guidewires during percutaneous tracheostomy, fiberoptic bronchoscopes, and suture during a pediatric tracheoesophageal repair all passing through or becoming caught in Murphy eyes. We present the case of a Murphy eye complication following a cricotracheal resection and the subsequent management and resolution.

Case Report: A 72-year-old female with tracheal carcinoma presented to the operating room for a total thyroidectomy, neck dissection, and tracheal resection. Anesthesia was induced with propofol, fentanyl, and succinylcholine. The patient was intubated using a Glidescope to facilitate placement of a 6.5 mm ETT with Dragonfly laryngeal surface electrodes. General anesthesia was maintained with sevoflurane and fentanyl.

After completion of the thyroidectomy and neck dissection, a 6.5 mm reinforced ETT was placed by the surgeon through a distal tracheostomy, which was used for ventilation during the tracheal resection. Partial resection of the cricoid cartilage and complete resection of tracheal rings one through three were performed with primary tracheal reanastomosis. The patient was then orally reintubated in a retrograde fashion with the assistance of a cephalad-directed exchange catheter passed through the tracheostomy site once the reinforced ETT was removed. The surgical site was sutured closed. The patient was taken to the ICU intubated, sedated, and ventilated.

The following day, extubation was attempted, however the ICU team was unable to completely remove the ETT. A fiberoptic bronchoscope exam visualized a suture through the Murphy eye of the ETT. The ETT was advanced back into the trachea, and the patient was sedated and brought to the OR for direct laryngoscopy and planned extubation in a more controlled setting.

In the operating room, an exchange catheter was passed through the ETT to establish a reintubation route and the surgeon performed a direct laryngoscopy, withdrew the ETT to the point of tension, and snipped the offending suture under visualization with a straight endoscope. The freed ETT was advanced over the catheter back into the trachea, secured, and the patient was then awakened and extubated without incident. The patient’s further postoperative course was uneventful.

Discussion: As mentioned above, the Murphy eye serves a useful purpose on ETTs. However, the above case illustrates a complication that can arise from this seemingly innocuous ETT feature. This may have been prevented by the performance of a fiberoptic bronchoscopy exam at the conclusion of the surgery before leaving the OR. Gopinath and Murray advocated a similar strategy to aid in percutaneous tracheostomies to prevent Murphy eye complications during guidewire placement.

In conclusion, one must be aware of this rare complication during tracheal procedures. Complications could arise if the error is not recognized before the attempted removal of a sutured endotracheal tube, including the disruption of a potentially difficult airway or excessive force used to remove such ETT causing disruption of a fragile suture line.
Figure 1. Image taken with zero-degree endoscope of endotracheal tube with exchange catheter in place showing the suture that passed through the Murphy eye, thereby inadvertently securing the endotracheal tube to the trachea.

References:
TRICUSPID AND PULMONIC VALVE REPLACEMENT IN A PATIENT WITH CARCINOID HEART DISEASE: A CASE REPORT OF EARLY POST-OPERATIVE IMPROVEMENT IN FUNCTIONAL STATUS

Albert Tsai, MD; Department of Anesthesiology and Critical Care, University of Pennsylvania

Albert Tsai, MD; Aris Sophocles, MD; Prakash Patel, MD; John Augoustides, MD

Introduction:

Carcinoid syndrome is a rare disorder involving the release of vasoactive substances by neuroendocrine tumors most commonly found in the small bowel. When released in the portal circulation, these tumor products are inactivated by the liver, and the patient remains asymptomatic. The diagnosis of carcinoid tumors, therefore, is often made in the presence of hepatic metastasis, wherein released vasoactive substances bypass the portal circulation and lead to episodes of flushing, bronchospasm, and secretory diarrhea. Carcinoid heart disease – characterized by plaque-like deposits on right-sided valvular structures leading to right heart failure – can occur in up to seventy percent of patients with carcinoid syndrome and serves as the major cause of morbidity and mortality in this patient population. Currently, surgical valve replacement is the only effective treatment for carcinoid heart disease; however, its long-term outcome has yet to be extensively characterized.

Case Description:

A 58 year-old male with history of insulin-dependent diabetes mellitus, chronic renal insufficiency, hypertension, morbid obesity, and recently diagnosed low-grade metastatic carcinoid tumor of the liver treated with octreotide presents with one-month history of profuse diarrhea, lower extremity edema, exertional dyspnea, and 60-lb weight gain. Physical examination was notable for stable vital signs, diminished heart sounds, and diffuse anasarca. Laboratory studies were remarkable for elevated creatinine (1.8) and 24-hour urine 5-HIAA (442 mg). TTE demonstrated hyperdynamic LVEF (75%), moderately dilated RV, mild-moderate decreased RV function, moderate tricuspid regurgitation, mild-moderate pulmonic regurgitation, and elevated PASP (45 mmHg).

On hospital day 14, the patient underwent an uncomplicated tissue TVR and PVR. Aortic cross clamp time was 53 min, bypass time was 73 min, and post-operative TEE revealed LVEF of 60%, trace central TR, trace central PR, and mildly decreased RV function. Hemodynamic support was provided by low-dose milrinone and vasopressin infusions. The patient remained on octreotide therapy throughout the perioperative course, and underwent aggressive diuresis post-operatively. The patient was discharged to home on POD 13 following an uncomplicated post-operative course. He was seen in outpatient clinic ten days later and reported a 90-lb weight loss since admission and marked improvement in lower extremity edema, respiratory status, and exercise tolerance.

Discussion:

The low prevalence of carcinoid heart disease has limited studies of its surgical outcomes to small, retrospective analyses. Nevertheless, the combination of increased mortality in patients with cardiac involvement of carcinoid disease and recent improvements in perioperative survival has expanded the role of surgery in the management of carcinoid heart disease. Recent analysis of predictors of 10-year all-cause mortality in patients with carcinoid heart disease revealed a hazard ratio of 0.44 (95% CI 0.29 to 0.61, \( P<0.001 \)) in patients having undergone cardiac surgery, and a separate study reported improvement in median NYHA class from III to I at one-year follow-up post-valve replacement. Furthermore, carcinoid disease itself – rather than surgical complications – has been identified as the major source of postoperative mortality in this patient population. Therefore, despite its palliative role and lack of extensive long-term prognostication, the significant benefit of valve replacement surgery in improving
functional status — as evidenced by our patient — warrants its strong consideration in patients afflicted by carcinoid heart disease.

References:


Anesthetic Management of a Patient with Complete Placenta Previa and Placenta Accreta Who Refuses Administration of Blood Products

Matthew M. Corriveau, MD, Xianren Wu, MD, Michael H. Entrup MD, and Bradley S. Lahet, MD
Geisinger Anesthesiology Residency Program

Background: A 38 y.o. patient with complete placenta previa, placenta accreta, and possible increta presented for cesarean delivery. Obstetric history included G4P2012 with two prior C-sections. Ultrasound performed at 19 weeks revealed complete placenta previa. After an episode of vaginal bleeding, repeat ultrasound at 27 weeks confirmed the diagnosis and also revealed placenta accreta with possible increta. The patient was admitted to our hospital. Pertinent past medical history included asthma, anemia secondary to vaginal bleeding, and gastric reflux. Lab data included Hgb 11.8 g/dl, platelets 147,000/mcL, and creatinine 0.3 mg/dl. Her care and management would be more challenging by her refusal to accept blood products due to her religious beliefs. The patient was amenable to receiving albumin, isovolumic hemodilution and cell saver in closed circuit, and erythropoietin. She would not accept whole blood, PRBCs, plasma, or platelets.

Case Description and Discussion: Delivery was performed at 30 weeks gestation. A lumbar epidural catheter was placed. An interventional radiologist then placed bilateral hypogastric artery catheters. Radial artery and internal jugular vein catheters were placed and isovolumic hemodilution was conducted, replacing harvested whole blood with 5% albumin. Epidural anesthesia was instituted via the previously placed catheter. When an adequate level of anesthesia was obtained, the patient underwent cesarean delivery via a vertical midline incision. Newborn Apgar scores were 2 and 7 at 1 and 5 minutes, respectively. After delivery, general endotracheal anesthesia was induced. Bilateral hypogastric artery embolization was performed. Uterine and abdominal incisions were closed. The patient was extubated and transferred to the ICU. Estimated blood loss was 600 ml and the final Hgb was 9.7 g/dl. During the subsequent six hours, the patient developed vaginal bleeding. Hgb declined to 6.5 g/dL. The patient was returned to the operating room for emergent hysterectomy. The procedure was uncomplicated with 450 ml blood loss. Hgb was 5.2 g/dl at the conclusion of surgery. The patient remained intubated over night. Follow-up Hgb values were 4.9 g/dl on POD 3 and 4.3 g/dl on POD 5. Platelet count held steady at >90,000/mcL throughout. The patient continues to recover as an inpatient at the time of this writing.

Conclusions: Obstetric patients with complete placenta previa are at high risk of excessive blood loss and present a challenge to the anesthesiologist. Our case was further complicated by the presence of placenta accreta with possible increta, the planned surgical procedures, and the patient’s refusal to accept transfusion of blood products. A multidisciplinary approach to planning the management of this patient contributed to the successful outcome for both mother and baby. This case further illustrates that, despite the best planning, the operative team must be prepared to act with short notice should complications arise.
AN INCIDENTAL FINDING OF CLEFT PALATE—A CASE REPORT
D. Kim M.D., A. Sethi D.O., Temple University Hospital, Philadelphia, PA

Introduction: Cleft lip and cleft palate are the most common craniofacial abnormalities, with an incidence of 1 in 750 live births\(^1\). Cleft palate may cause complications relating to multiple facets of life, including difficult feeding, hearing loss, speech difficulties, and psychosocial difficulties. Cleft palate can be associated with over 150 congenital conditions with major anesthetic implications, including Pierre Robin, Goldenhar, and Treacher Collins syndromes\(^2,3\). Current recommendations call for surgical repair before the patient is aged 1 year\(^4\). Many guidelines and case reports exist on managing pediatric patients with cleft palate; however, there is minimal data on managing adult patients presenting with cleft palate.

Case Description: This patient is a 68 year old Honduran female with past medical history of diabetes, who presented to the outpatient endoscopy center at Temple University Hospital (upon referral from her community physician) for colonoscopy to evaluate the patient’s intense lower abdominal pain with associated diarrhea. On preoperative history, the patient also mentions symptoms of gastroesophageal reflux and epigastric burning pain. On physical exam, patient was noted to be well-developed, with no obvious cardiopulmonary abnormalities. However, upon airway examination, it was noted that patient had unilateral cleft palate involving the hard and soft palate (see figure 1). The patient indicated that she was aware of this abnormality, but would often use a friend’s denture plate in order to alleviate any symptoms of her cleft palate. Given the possibility of intubation and possible associated cardiopulmonary defects it was decided to postpone the endoscopic procedure. The patient was recommended to follow-up with otolaryngology prior to the current procedure; however, upon record review, it appears that patient has not yet sought follow-up care.

Discussion: Anesthetic management of the cleft palate patient presents a unique set of obstacles for the anesthesiologist. This particular case is unique, as the patient presented in adulthood with cleft palate, which is primarily only seen in patients from developing countries with limited access to healthcare\(^4\). This patient was never evaluated or treated for her cleft palate in Honduras, but was able to circumvent many manifestations of cleft palate by utilizing an upper-denture plate. Management of endotracheal intubation in these patients indicates the importance of preoperative airway evaluation, and the ability to utilize advanced airway techniques, including utilizing fiberoptic bronchoscopy or laryngeal mask airway to assist in intubation\(^5,6\). Utilizing muscle relaxants for facilitating intubation contributed to fewer adverse events, and securing the endotracheal tube 1.5 cm above the carina led to decreased inadvertent extubation\(^7\). Relaxation of the oropharyngeal musculature can cause the tongue to fall into the cleft, causing oropharyngeal obstruction, which can be alleviated with the use of an oropharyngeal airway. Patient’s found to have cleft lip or palate must be preoperatively evaluated for associated genetic disorders, which may have associated cardiac abnormalities, including VSD, PDA, dextrocardia, or cardiac valvulopathy. In addition, airway morphology may change as the patient grows or as a result of corrective surgical intervention\(^6\).
References:


Figure 1:

Patient with unilateral cleft involving hard and soft palate.
**ARRHYTHMIA DURING TRANSVERSUS ABDOMINIS PLANE BLOCK WITH EXPAREL**

**Authors:** James Lamberg, DO; Milena Pilipovic, MD
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**Introduction**
We present a case of ventricular tachycardia occurring shortly after injection of liposomal bupivacaine for a transversus abdominis plane block. We discuss typical presentation of bupivacaine toxicity as well as the toxicity attributes of liposomal bupivacaine. We also discuss the importance of differential diagnosis to avoid fixation errors, as well as the evaluation leading to the actual cause of arrhythmia in this patient.

**Case Presentation**
A 56-year-old 99kg female presented for ileocolectomy for severe colitis. She had been hospitalized in the days prior to surgery for initiation of antibiotics, steroids, and total parenteral nutrition. Pre-operative bilateral transversus abdominis plane (TAP) blocks were planned and the patient was prepared for the procedure. Anxiolysis was provided with midazolam and fentanyl. The patient was turned to their left side first, 1% lidocaine was used for skin infiltration, and a mix of 10mL 0.25% bupivacaine with 10mL liposomal bupivacaine was injected into the right TAP using ultrasound guidance.

At this point, irregular heart tones were heard by audible pulse oximetry. The monitor showed an irregular ventricular tachycardia. The patient was immediately turned onto their back with the plan to follow Advanced Cardiac Life Support guidelines. An observing provider left the room to obtain a lipid rescue kit. However, the arrhythmia stopped and the patient denied any symptoms. The decision was made to investigate other causes of arrhythmia and not administer intralipids.

Serum electrolytes and resting electrocardiogram were within normal limits. A chest radiograph showed a peripherally inserted central catheter (PICC) with its tip in the right atrium. The etiology of ventricular tachycardia was determined to be the PICC line movement, which was placed the week prior for parenteral nutrition. The line was retracted and proper placement was confirmed by chest radiograph. The patient underwent left TAP blockade, proceeded to the operating room, and had no further arrhythmias.

**Discussion**
Liposomal bupivacaine is a relatively new medication with safety information warning providers about using non-bupivacaine local anesthetics and about mixing other local anesthetics with the liposomal drug. However, liposomal bupivacaine has been shown to be safe in standard dosing (one vial) and unlikely to cause toxicity. Typical management of non-sustained ventricular tachycardia is aimed at identifying the underlying cause by obtaining serum electrolytes, an electrocardiogram, and a chest radiograph. There have been numerous reports of ventricular arrhythmias with PICC malposition and with patient positioning, particularly the lateral position.

**Conclusion**
Non-sustained or positional ventricular tachycardia should prompt the provider to consider other diagnoses in an effort to avoid fixation error. Vascular catheter associated arrhythmias are not uncommon and should be considered in patients central venous lines.

**References**
PENETRATING TRAUMA COMPLICATED BY MASSIVE INTRAOPERATIVE PULMONARY EMBOLISM AFTER TRANEXAMIC ACID TREATMENT

Michael S. Thompson, DO1, Theresa A. Gelzinis, MD2
1Resident, presenter 2Professor, Department of Anesthesiology, University of Pittsburgh School of Medicine, Pittsburgh, PA

Introduction

Based on CRASH-2 trial data, tranexamic acid is frequently administered to lower the risk of death due to bleeding in trauma patients. There have been multiple trials supporting its efficacy and safety in trauma as well as orthopedic, spine, and other surgical subspecialties. There are a small number of case reports in which tranexamic acid is associated with thrombotic events. We present a trauma patient who developed massive pulmonary embolism and hemodynamic collapse after tranexamic acid treatment.

Case Description

A healthy 24 year old male presented to the Emergency Department after sustaining a single stab wound to the left chest. His blood pressure was initially unstable in the 70/40’s. A chest tube was placed and immediately drained 600ml of blood. He was administered 4 units of PRBCs and 1,000mg of tranexamic acid in the trauma bay. However, hemorrhage persisted and the patient was transferred to the OR for operative management. Induction was uncomplicated and a left sided double lumen endotracheal tube was placed. The trauma surgeons successfully ligated the left internal mammary artery resulting in hemothrosis. One hour into the case he patient developed hypoxemia and hypercarbia (SpO2 80%, ABG 6.99/94/64/23.) The patient remained hemodynamically unstable despite aggressive fluid resuscitation and PRBC transfusions. He subsequently developed PEA and ventricular tachycardia requiring defibrillation with internal paddles and cardiac massage. The trauma surgeons explored the pericardium and chest using a clamshell incision to rule out other injuries. Intraoperative TEE was performed by the on-call cardiothoracic anesthesiologist who diagnosed a large pulmonary artery saddle embolus with severe RV dilation and dysfunction, severe tricuspid regurgitation and decreased LV function. After further attempts at resuscitation including an epinephrine drip the patient was pronounced dead after 2.5 hours of surgery. At autopsy, the patient was found to have bilateral lower extremity deep vein thrombosis (DVT) that were present premortem.

Discussion

Our patient had no history of a thrombophilia or previous thrombotic event and it is unlikely that his DVT’s were present prior to his injury. He likely succumbed to acute right and left heart failure due to massive pulmonary embolism (PE) and clot burden. Known incidence of perioperative PE in trauma surgery ranges from 2.3-6.2%, with 0.4-2% being fatal. Additionally, he also had TEE evidence of a patent foramen ovale (PFO) which in the setting of elevated right atrial pressure worsens right to left interatrial shunting likely contributing to our patients hypoxia.

Tranexamic acid is a “synthetic derivative of lysine that inhibits fibrinolysis by blocking lysine binding to plasminogen.” Traumatic injury leads to a complex systemic immune response and tranexamic acid may be involved in reducing the inflammatory response via decreased fibrin split products.

CRASH-2 trial data suggests that early treatment (<1 hr) with tranexamic acid (1g over 10 min followed by infusion of 1g in 8 hours) in bleeding trauma patients significantly decreases overall risk of death due to bleeding (5% vs 7.7%) compared to placebo. Additionally, CRASH-2 trial data showed no difference in the risk of vascular occlusion (stroke, myocardial infarction, and PE) in the treatment or placebo groups (.3% vs .5%, p=.096) and numerous other studies have also supported the safety of tranexamic acid in orthopedic and spine surgery. There are however, several case reports of DVT and pulmonary embolism associated with tranexamic acid use in the prophylactic treatment of menorrhagia and hemoptysis. A Cochrane Database review of tranexamic acid use in emergent surgery found that the effect on deep
vein thrombosis is uncertain overall. It is still unknown if certain population subsets might be susceptible to thrombosis with tranexamic acid treatment and may benefit from either a reduced dose or no antifibrinolytic treatment. Further studies may be warranted to determine more specific treatment guidelines.

References


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DYNAMIC AIRWAY COLLAPSE MASQUERADING AS ESOPHAGEAL INTUBATION?

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Introduction
Lack of confirmatory evidence of tracheal intubation is very disconcerting for the anesthesia care provider, especially when the airway seemed to be easy and intubation un-eventful. If the same result is obtained after multiple attempts, it creates an alarming situation. If not EtCO₂ is detected, the differential diagnosis may include many conditions such as esophageal intubation or cardiac arrest. This situation becomes difficult to ascribe to bronchospasm if there was no previous history of breathing difficulty. Here we present a case that posed an acute management dilemma for the anesthesiologist when apparently easy repeated intubation attempts resulted in absent breath sounds and undetectable EtCO₂.

Case Description
A 19 year old male, s/p pedestrian struck 2 days prior, was brought to the operating room for an orthopedic procedure. He had a remote history of asthma as a child, but no recent history of difficulty with breathing. Of note, upon initial arrival in the trauma bay the patient underwent an uneventful intubation by an emergency department resident. However, this time intubation was different. After a smooth IV induction and intubation no breath sounds were heard in the chest and EtCO₂ was absent. A repeat attempt by a senior resident, with clear visualization of cords, yielded same result. A third intubation by the attending using a smaller ETT allowed some ventilation. No wheezing was appreciated on auscultation, but with poor arterial oxygen saturation the procedure was aborted after two hours. Five days later, after consultation with ENT, the patient was brought back to the operating room for an urgent surgical procedure without any clear diagnosis of the problem. Close questioning of the patient along with chest auscultation did not reveal any evidence of asthma exacerbation. After nebulization of the airway with bronchodilators and local anesthetic, an asleep fibroptic intubation was carried out with 6.0 ETT under clear visualization of the supraglottic area with the help of glidescope while the patient was breathing spontaneously. An impressive dynamic collapse of the trachea was observed through the fibroptic scope on expiration. Once the airway was secured, the patient was paralyzed and procedure was completed successfully. Postoperative work up by the pulmonary service found a marked element of bronchospasm that improved remarkably with bronchodilator treatment. A work up for relapsing remitting polychondritis to explain dynamic tracheal collapse was inconclusive.

Discussion
Severe, uncontrolled asthma precipitating bronchospasm on induction & airway instrumentation is a very common occurrence. However, asthma causing dynamic tracheal collapse on intubation is a rare & potentially life threatening event, especially when mistaken for a missed intubation &/or difficult airway. As such, the anesthetic provider must always be prepared with a clear anesthetic plan to facilitate prompt recognition & avoidance of such disastrous consequences. This may include suppression of airway reflexes with local anesthetic, pre-treatment with bronchodilators, maintainance of spontaneous breathing, & early progression to fiberoptic intubation for direct visual confirmation of tracheal intubation.

References
A CASE OF INTRAOPERATIVE AWARENESS IN A CHRONIC PAIN PATIENT DESPITE MORE THAN ADEQUATE DEPTH OF ANESTHESIA

Rano Faltas, MD, Eugene Viscusi, MD

Presenter: Rano Faltas, MD
Affiliation: Sidney Kimmel Medical College, Thomas Jefferson University

INTRODUCTION:

Intraoperative awareness is defined as an event where a patient is able to recall or retain an explicit memory during anesthesia. It is a relatively rare complication; it occurs in about 0.2% of administered anesthetics. However, it can be very detrimental when it happens. We present a case of awareness in a patient despite more than adequate depth of anesthesia.

CASE REPORT:

We present a case of a 44 year old male with biopsy proven SSC of the hard palate. The patient receives mass resection and a free flap reconstruction. His PMH is significant for back pain for which he receives a total of 900 mgs of morphine equivalents per day and street heroin use. The patient was premedicated with 2mg of Midazolam and induced. The patient was maintained on Sevoflorane with a high expired concentration so that the age adjusted MAC value was above 1.3. The patient's GA was augmented with ketamine, the patient received a total of 10mg of Hydromorphone IV and a Sufentanly drip was utilized (titrated up to 0.4mg/kg/hr). The patient's SBP was consistently 140-150mmHg prompting the increase in narcotic dose, while concern was kept for maintaining the MAP for the flap. The patient’s HR throughout the case was in the 80s and never increased. Neuromuscular blockers were only utilized towards the end of the case during the microvascular anastomosis of the flap. The patient never moved throughout the case. A BIS monitor could not be utilized since it would have interfered with the operative field. On the second postoperative day the patient reported awareness; he recalls explicit events. He reports minimal pain and claims to have been awake for 10 hours at least. The patient does not report being paralyzed but cannot explain why he didn’t move. The patient goes back to the OR two more times as described in table 1.

DISCUSSION:

The incidence of awareness is discussed based on specialty. Conditions where awarness is more likely are presented, with specific focus on Increased anesthetic requirement of some patients. A differential diagnosis for the likely causes of awareness in this case are formulated. Among other causes, we proposed that preoperative opioid use might have modified the patients response to anesthesia. This Theory was backed up by evidence from a case report of awareness in a chronic pain patient. We also considered that ketamine might have heightened the patient’s auditory perception facilitating awareness. This was backed up by another case where the authors reported "patient's memories were probably related to dreams caused by ketamine, although influences from real events cannot be ruled out”. Our discussion is concluded with a literature review of ways to reduce awareness in patients with high risk it.

CONCLUSION:

We conclude that Intraoperative awareness might be more likely in the chronic pain patient. We recommend taking extra precautions to prevent awareness in this patient population such as using the BIS monitor when possible, consider using higher midazolam premedication doses or multiple doses throughout the surgery.
<table>
<thead>
<tr>
<th></th>
<th>Operation performed</th>
<th>Total time under GA</th>
<th>End Tidal Sevoflurane Concentration Range</th>
<th>Narcotics used</th>
<th>Other drugs used</th>
<th>BIS Used?</th>
<th>Intra-operative awareness?</th>
</tr>
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<tr>
<td>First surgery</td>
<td>Left Maxillectomy, Orbital Exenteration, neck dissection, fibular free flap</td>
<td>14.5 hrs</td>
<td>Before incision 1.6 to 2.5% After incision 1.9 to 2.6</td>
<td>Fentanyl bolus 250mcg total Hydromorphone bolus 10mg total Sufentanyl infusion at 0.2-0.4 mcg/kg/hr</td>
<td>Ketamine 10-35mg/hr Midazolam only as premedication 2mg</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Second surgery</td>
<td>Wound debridement, left radial forearm free flap</td>
<td>8.5 hrs</td>
<td>Before incision 1 to 1.6% After incision 2.1 to 3.1%</td>
<td>Fentanyl on induction 250 mg Sufentanyl infusion at 0.3-0.6 mcg/kg/hr</td>
<td>Ketoamine at 65 – 85mg/hr Midazolam boluses and then infusion (20mg total)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Third surgery</td>
<td>Split thickness skin graft to the left arm</td>
<td>4.5 hrs</td>
<td>1.1 to 2.1 %</td>
<td>Fentanyl bolus 250mcg total Sufentanyl infusion at 0.2-0.4mcg/kg/hr</td>
<td>Ketamine at 60 mcg/hr Midazolam boluses (5mg total)</td>
<td>Only during induction and emergence</td>
<td>No</td>
</tr>
</tbody>
</table>

References:

THE PERIOPERATIVE MANAGEMENT OF AN ADULT PATIENT WITH A 
SYMPTOMATIC MEDIASTINAL MASS

Hammond BM, Erkmen CP, Schartel SA, Keresztury M, Salamanca YY

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INTRODUCTION

Mediastinal masses compressing the airway can cause cardiopulmonary collapse on induction of 
general anesthesia. The authors propose an algorithm to approach the anesthetic challenges.

CASE SUMMARY

A 60-year-old woman presented with acute dyspnea. Chest CT revealed a mediastinal thyroid 
goiter. A fractured tracheal stent narrowed to 8 mm under the posterior compression of the tumor 
(Figure 1). Helium-oxygen mixture was administered in semi-Fowler’s position. Standard 
monitoring, large bore venous access, and an arterial catheter were placed. Both groins were 
prepped and draped and an extracorporeal membrane oxygenation (ECMO) circuit was primed. 
The posterior pharynx was topicalized and mild sedation was achieved with titration of 
midazolam. Awake tracheal intubation was facilitated with a flexible bronchoscope. An 8.0 mm 
armed endotracheal tube was advanced to the level of the buckled tracheal stent. A 
spontaneously breathing inhalational induction with sevoflurane resulted in decreased tidal 
volume and increased airway pressures despite manual assisted ventilation. Arterial oxygen 
saturation began to decrease. Venovenous ECMO (ECMO) was instituted at 4 L/minute using 
bilateral femoral venous cannulas. Hemodynamic stability was achieved. The surgical team 
performed complete resection of the mass via a median sternotomy. The fractured tracheal stent 
was removed using a rigid bronchoscope and an endotracheal tube was replaced. The next day 
she was successfully weaned from ECMO and her trachea was extubated.

DISCUSSION

Anesthetic management is often the most precarious aspect of treating mediastinal masses. 
Assessment of the patient’s potential challenges and coordination of an individualized treatment 
plan can often avert hemodynamic catastrophe.

Preoperative assessment begins with evaluating the degree of dyspnea, orthopnea, stridor, jugular 
venous distension, and cyanosis, which portend cardiopulmonary compromise. CT is useful for 
identifying tracheal compression and correlates with risk for perioperative respiratory 
complications.

Basic goals of induction include judicious titration of sedation, consideration of awake tracheal 
intubation, maintenance of spontaneous ventilation, avoidance of neuromuscular blockade until 
ability to ventilate is confirmed, and if possible, semi-Fowler’s positioning. For sedation, use of 
 drugs with minimal respiratory depression (e.g., dexmedetomidine and ketamine) should be 
considered. Helium-oxygen mixtures promote laminar gas flow distal to significant obstructions. 
Rigid bronchoscopy, ECMO and CPB should be immediately available. For high risk patients, 
awake ECMO is an option. However, cannulation can be challenging in an awake patient unable 
to tolerate supine position.

In summary, anesthetic management of a patient with a mediastinal mass must be managed on an 
individualized basis. A well-coordinated, multidisciplinary approach is essential.
**CASE REPORT: AMNIOTIC FLUID EMBOLISM – A SURVIVING CASE**

Presenter/Affiliation: Manish Shah MD / Department of Anesthesiology, Penn State Milton S. Hershey Medical Center

Authors: Manish Shah MD, Sonia Vaida MD, Anita Malhotra MD

**Introduction:**
Amniotic fluid embolism (AFE) is a rare and most often results in fatal complications. The onset is sudden and characterized by severe hypoxia, hypotension, seizures, altered mental status, and disseminated intravascular coagulation. We describe a case of AFE with a successful outcome for both mother and the fetus.

**Case presentation**
A 33-year-old G3P2 woman, at 36 weeks gestation with a history of placenta previa underwent an elective c-section under spinal anesthesia. Following the delivery of a viable infant and placenta, the patient became unresponsive with pulseless electrical activity. She resuscitated following the Advanced Cardiovascular Life protocol. The airway was secured by endotracheal intubation; the end tidal carbon dioxide was 17 mm Hg. She continued to have poor oxygenation as well as respiratory and metabolic acidosis. She further developed severe disseminated intravascular coagulopathy (DIC) and received massive blood transfusions and underwent an emergent hysterectomy.

She continued to deteriorate with biventricular failure with severe pulmonary edema and hypoxemia despite maximal ventilation support and nitric oxide. It was decided the initiate veno-arterial extracorporeal membrane oxygenation (ECMO), however after venous and arterial cannulation, oxygenation saturation dramatically improved. Postoperatively, she remained on mechanical ventilation and maintained on vasopressor and ionotropic support in the ICU.

Throughout her hospital course, she significantly improved. Her anemia and coagulopathy were corrected. Diuretics were administered and she was weaned off vasopressor and ionotropic support. The patient was extubated on postoperative day three with no neurological deficits. She was discharge on postoperative day 10.

**Discussions**
AFE is a very rare cause maternal mortality with an incidence 4-6 per 100,000 live births and accounts for 12% of maternal deaths. The mortality rate among women who experience AFE is between 25% and 80%. Two thirds of these affected woman die within the first 5 hours of AFE onset and those who do survive often suffer permanent neurological dysfunction.

Although the etiology of AFE is not fully known, an immune response from the amniotic fluid containing agents such as leukotrienes and arachidonic acid may cause this syndrome. The pathophysiology of AFE is a biphasic model. The early phase is transient and includes vasospasm and acute pulmonary hypertension leading to severe right-sided heart failure and subsequent low cardiac output and hypotension. This stage is consistent with sudden
cardiopulmonary arrest during cesarean section as in our case study. The second phase is characterized by left ventricular failure and pulmonary edema as well as coagulopathy presenting as DIC as seen in this case. The treatment is supportive and included correction of coagulopathy, massive transfusion and cardiovascular and respiratory support with iontropes and mechanical ventilation, respectively, as well as ECMO if needed.

References

DELAYED ONSET OF HORNER’S SYNDROME AFTER A STELLATE GANGLION BLOCK IN A PATIENT WITH COMPLEX REGIONAL PAIN SYNDROME – CASE REPORT

Presenter/Affiliation: Manish Shah, MD/ Department of 1Anesthesiology, Penn State Hershey Medical Center, Hershey, PA

Authors: Manish Shah, MD, Julia Caldwell, MD

Introduction
A stellate ganglion block is a treatment intervention used for sympathetically mediated pain conditions such as complex regional pain syndrome, head and neck neuropathies, and post herpetic neuralgia, as well as vascular disorders. After a successful block, the patient is expected to experience an ipsilateral warm sensation in the arm, conjunctival injection, as well as the combination of symptoms (i.e., ptosis, miosis, and anhidrosis) that characterize Horner’s Syndrome. The presence of Horner’s Syndrome, with a typical onset of 3 to 10 minutes, has been used to indicate a successful stellate ganglion block. There are no reported cases of a delayed onset of Horner’s syndrome associated with a successful stellate ganglion block. We report the case of a patient who received a right side stellate ganglion block and developed delayed ipsilateral Horner’s syndrome three days after the procedure.

Case Description
A 61 year old woman presented with a history of complex regional pain syndrome affecting her right upper extremity after a distal radius and ulnar styloid fracture. Her fracture was initially managed with a closed reduction and subsequent casting. Two months after the injury she started to complain of significant swelling as well as erythema, mottling, and shiny appearance of the right hand. She had severe limited range of motion and stiffness of her right wrist and digit joints, and was diagnosed with complex regional pain syndrome.

After failing conservative treatment, such as physical therapy, gabapentin, verapamil, and ascorbic acid, a successful stellate ganglion block on the right side provided four months of relief. A second stellate ganglion block was performed under fluoroscopic guidance with 3 mL of 0.25% bupivacaine and 10 mg of dexamethasone. Three days after the injection, she developed delayed Horner’s syndrome, with right side facial and tongue swelling, erythema, pain that was secondary to the edema, and a right side ptosis. She was prescribed a tapering dose of oral prednisone which improved her symptoms. At her one month follow-up appointment after the second stellate ganglion block, she had excellent relief of the symptoms with improved mobility of her right hand and complete resolution of facial swelling and ptosis.

Discussion
Stellate ganglion block is an interventional procedure targeting the inferior cervical sympathetic ganglion and first thoracic sympathetic fibers. Two expected results after a stellate ganglion block are temperature elevation in the ipsilateral upper extremity and ipsilateral Horner’s Syndrome. The presence of these two findings is commonly indicative of a successful block. Rather than the typical immediate onset, this patient experienced an unusual delayed onset of Horner’s syndrome three days after the block. Regardless of the atypical immediate post-block course, she had improvement of her pain symptoms one month after the block. Thus, based on this case, the immediate onset of a Horner’s Syndrome may not be a reliable indicator of a successful stellate ganglion block.

References
EXTRACORPOREAL MEMBRANOUS OXYGENATION (ECMO) AS SUPPORT FOR HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS (HLH)

Presenter: Rachel Hadler, Hospital of the University of Pennsylvania
Authors: Rachel Hadler, Gutsche JT, Vernick WJ, Krzysztof Laudanski

Introduction: Hemophagocytic lymphohistiocytosis (HLH) is an unusual hematological disease characterized by excessive inflammatory response to innocuous triggers, resulting in severe respiratory and hemodynamic compromise. We describe a case in which a previously healthy young man ultimately required extracorporeal membranous oxygenation (ECMO). With appropriate support, he ultimately made a full recovery.

Case Description: A 21 year old male with recent exposure to infectious mononucleosis presented to an outside hospital with a 4-5 day history of lethargy, fevers, anorexia, and myalgias. He had no preexisting medical issues, no drug allergies, and no recent travel or insect exposure. He developed progressive respiratory distress and hypoxia requiring intubation on admission day 1. His respiratory function continued to deteriorate, and he was ultimately placed on venovenous extracorporeal membranous oxygenation (ECMO) on hospital day 3 and transferred to our institution. Physical examination was remarkable for erythematous conjunctiva, dark discoloration and desquamation of the tips of his ears bilaterally, a macular rash and peripheral petechiae in addition to bilateral scrotal swelling and ecchymosis. Laboratory findings were notable for anemia and thrombocytopenia. His plasma ferritin level was 13548 ng/ml (ref 30-400ng/ml). Fibrinogen was low (107 mg/dl, ref 170-410 mg/dl). Transaminases and bilirubin levels were elevated, as were creatinine and LDH. Comprehensive workup for an infectious agent was negative. Bone marrow biopsy showed hemophagocytosis and atypia.

After an initial decline in cardiopulmonary condition, the patient’s respiratory condition began to improve gradually, and he was decannulated from ECMO five days after transfer and ultimately discharged into the care of a hematologist with a presumptive diagnosis of HLH.

Discussion: Hemophagocytic lymphohistiocytosis is a syndrome whereby defective function of natural killer and cytotoxic T cells results in inappropriate activation of and cytokine production by T cells and macrophages. Diagnosis requires a minimum of five out of eight characteristic findings: fever, splenomegaly, at least two peripheral cytopenias, hypertriglyceridemia or hypofibrinogenemia, documented hemophagocytosis on bone marrow/lymphatic tissue biopsy, depressed natural killer cell function, elevated ferritin levels, and elevated CD25 levels. Other characteristic findings include elevated transaminases, LDH, PT, and PTT. Familial and sporadic variants exist. Polymerase chain reaction methodology (PCR) may show mutations in the genes for perforin, syntaxin, or munc 18-2.

Treatment for HLH is primarily supportive, although a variety of immunosuppressive regimens have been trialed with a survival rate of less than 10 percent. There are few reports discussing the use of ECMO as a mechanism of supportive care in hemophagocytic lymphohistiocytosis. In most cases, ECMO use in patients with HLH is associated with elevated morbidity and mortality, particularly secondary to bleeding, relative to other indications for ECMO. There are no studies to date comparing ECMO to conservative management in this population.

Conclusion: Although the limited studies available suggest that ECMO as a last resort in the pediatric population is associated with high morbidity and mortality, our experience suggests that it should not be rejected as a supportive modality in older patients with immune activation syndromes.
References:


THE USE OF A CONTINUOUS INFUSION OF INTRAVENOUS HEPARIN TO TREAT INTRACARDIAC THROMBOSIS DURING LIVER TRANSPLANTATION

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Background
Intraoperative thromboembolism is a well-documented complication associated with orthotopic liver transplantation (OLT) but its identification and intraoperative treatment is still an emerging topic in anesthesia. Intracardiac thrombus during OLT is associated with a high mortality rate (up to 68%)(1). There are only a few reports describing successful use of recombinant tissue plasminogen activator (rTPA) or heparin for treatment of thromboembolism during OLT (2). We describe a case where a continuous infusion of IV heparin was used to successfully treat an intracardiac thrombus during a live-donor liver transplantation (LDLT).

Case Description
A 42-year-old female with a history of extrahepatic cholangiocarcinoma, status post resection and neoadjuvant chemotherapy, who developed high-grade recurrence, presented for a LDLT. The patient’s past medical history also included an episode of acute renal failure secondary to dehydration, depression and asthma; her medications at the time of surgery were albuterol/ipratropium, cetirizine, and sertraline. Baseline values were: PT, 15.4; INR, 1.23; and PTT, 32.

The patient received 5000 units of subcutaneous heparin, as routine DVT prophylaxis, prior to induction of anesthesia. After induction, a TEE probe was placed for monitoring, and 6 hours later, a clot was found on the right internal jugular central venous line catheter tip. A heparin drip was started to prevent an increase in clot size. An initial bolus of 5000 units IV heparin was given, followed by an infusion (Table 1) with a goal PTT of 60. TEE demonstrated a decrease in the size of the initial clot with stable right ventricle function after graft reperfusion. At 19:13, the clot was no longer visualized on TEE.

The patient was hemodynamically stable throughout the case, only requiring transfusion with 2 units of packed red blood cells. Post-operatively, she was transferred to the surgical intensive care unit in stable condition. The heparin drip was continued post-operatively and she was transitioned to warfarin once her surgical drains were removed. A TTE performed on post-op day (POD) 1 revealed a small mobile shaggy mass, suggestive of a right atrial mass or thrombus, but was otherwise normal and did not demonstrate any right heart strain. She was successfully extubated on POD 4 when allograft function tests were favorable and there was no evidence of bleeding. A repeat TTE on POD 9 did not demonstrate the presence of a clot in the right atrium and was negative for right heart strain.

Discussion
In the literature there is a report describing 4 cases in which the patient became hemodynamically unstable and required immediate intervention during liver transplantation; low dose rTPA was used to treat intracardiac and pulmonary thrombosis in these cases and provided rapid improvement in hemodynamics(2). In two of the cases, a bolus of IV heparin was given with no improvement in hemodynamics.

Our case suggests that in the event of intracardiac thrombus, or pulmonary embolism, during OLT where the patient is hemodynamically stable, the use of IV heparin may be an alternative management option.
Table 1.

<table>
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<tr>
<th>Time</th>
<th>Heparin</th>
<th>PTT</th>
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<tr>
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References
FONTAN PHYSIOLOGY WITH SITUS INVERSUS FOR LAPAROSCOPIC CHOLECYSTECTOMY
by Ranjani Venkataramani MD, Vishal Patel MD, Nagaraj Lingaraju MD

Introduction:
An understanding of the hemodynamic changes associated with Fontan physiology and a preexisting history of situs inversus, presenting with acute cholecystitis for laparoscopic cholecystectomy is described in this case report.

Case Presentation:
A 19 year old African American female with diagnosed cholecystitis was scheduled to undergo a laparoscopic cholecystectomy. Pre-operative assessment revealed a history of situs inversus and double outlet right ventricle with hypoplastic left ventricle and pulmonary atresia that was palliated by a Fontan procedure(fenestrated) in childhood. Her past medical history was also significant for protein losing enteropathy and a gastric tube placement during childhood. A detailed surgical review revealed that she had undergone Blalock-Taussig shunt, followed by a Fontan operation in the form of a bidirectional Glenn procedure from SVC and IVC to pulmonary artery and a fenestration to good result. We aim to delineate the physiology of this condition, with implications of the situs inversus and its associations and approach to troubleshoot intra-operative problems and concerns.

Pre-operative vital signs were as follows: Weight 45 kg, BP 106/45 mm Hg, RR 10/min, HR 68/min, Spo2 96% on RA. Her pre-operative exercise tolerance was deemed to be good, considering she could undertake routine activities of young women at her physiological age.

Echocardiogram: complete unbalanced AV canal, hypoplastic LV with double outlet right ventricle, pulmonary atresia, left SVC to pulmonary artery confluence, Fontan conduit from IVC to PA, fenestration with a gradient of 6 mm Hg. Ventricular function showed mild-moderate impairment in contractility.

During surgery, 18 G IV line was placed on the contralateral limb (limb away from the BT shunt) followed by a femoral arterial line (due to failure to place a radial arterial line). She was pretreated with 500 mL of Isolyte prior to induction. Anesthesia was induced using Etomidate 6 mg, Versed 2 mg, Fentanyl and Rocuronium. Airway was secured uneventfully using a size 7.0 endotracheal tube. A TEE probe was inserted to monitor the filling pressures and guide volume resuscitation and ventricular contractility. Post induction attention was paid to minimizing intrathoracic pressures, maintaining an adequate preload, avoidance of tachycardia, and avoiding any rise in PVR(hypoxia, hypercarbia, acidosis). A surgical complication was encountered during placement of ports with accidental injury to the liver due to the nature of complex anatomy secondary to the situs inversus totals. Sudden bleeding of approximately 150 mL was encountered. Fluid bolus of 300 mL was given to ensure adequate filling of the ventricle. A quick decision by the surgeons to convert to open was made considering the anatomical complexities and the need to minimize duration of pneumoperitoneum. The rest of the case proceeded uneventfully and the patient was extubated at the end of the case with a morphine PCA for analgesia in the post op period.

Discussion:
Fontan physiology in patients requires special attention to:

- **Preload:** determined passively by the CVP.
- **Contractility / Cardiac Output:** avoid negative isotropy
- **Pulmonary Vascular Resistance (PVR):** hypothermia, hypoxia, hypercarbia and sympathetic stimulation leading to increased PVR and decreased cardiac output.
- **Cardiac and non-cardiac complications that include supraventricular dysrhythmias, restrictive lung disease, thromboembolic complications, protein losing enteropathy**

Accordingly, the patient was hydrated prior to induction, a real time use of TEE to monitor ventricular filling and contractility, IAP was minimized to 13 mm Hg for pneumoperitoneum, low intrathoracic pressures were utilized to avoid a drop in venous return, and prompt surgical conversion to an open cholecystectomy technique to achieve hemostasis were steps adopted in the anesthetic care of this patient.
References:

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4) Jacobs ML, Pelletier G. Late complications associated with the Fontan circulation. Cardiol Young 2006; 16(Suppl 1): 80–4