Management of Metastatic Spinal Neoplasms

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Management of Spinal Metastases

- Epidemiology
- Diagnosis/Imaging
- Management
  - Radiation vs Surgery
  - Surgical Indications
  - Surgical Approach
  - Surgical Strategies
Metastatic Spinal Neoplasms

- 18,000 New Cases/Year
- Most frequent site of bone metastasis
- 1 to 5% of all cancer patients will present with cord compression
- 90% of patients will have spine mets at the time of death
Cervical – 10%

Thoracic – 70%

*T4 to T11

Lumbar – 20%
Tumors That Disseminate to the Spine

- Breast
- Lung
- Prostate
- Renal Cell
- Myeloma, Lymphoma, GI
Metastatic Tumors: Breast CA

- Most Common Source of Mets to Spine
- Clinical Course Varies Greatly
- Spread via the Azygous Venous System
Metastatic Tumors: Lung

- Spine Lesions often Multiple
- AdenoCAs are the most common subtype
- Cancer cells enter the pulmonary venous system -> Heart -> Skeletal spread
- Direct Spread
Sites of Metastases
Signs & Symptoms: Pain

☐ Most Common Presenting Symptom
☐ Occurs in 83 to 95%
☐ Three Classic Syndromes
  ■ Local
  ■ Mechanical
  ■ Radicular
Local Pain

- Aching, Nocturnal
- Periosteal Stretching
- Local Inflammatory Process
- Responds to Steroids and Anti-Inflammatories
Mechanical Back Pain

- Instability of the Spinal Column
- Posturally Related
- Worsens as day progresses
- Relief with change in position or external bracing
- Refractory to narcotics, and anti-inflammatories
Radicular Back Pain

- Compression or Irritation of Exiting Nerve Root
- Dermatomal distribution
- Stabbing, Shooting
Don’t Wait for a Sensory Level – Listen to the Symptoms: a Prospective Audit of the Delays in Diagnosis of Malignant Cord Compression

P. Levack*, J. Graham†, D. Collie†, R. Grant†, J. Kidd‡, I. Kunkler†, A. Gibson§, D. Hurman¶, N. McMillan®, R. Rampling‖, L. Slider‖, P. Statham†, D. Summers§, The Scottish Cord Compression Study Group

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- Median Time to Diagnosis – 2 Months
- New Onset Back/Neck Pain
- Thoracic Pain
Signs & Symptoms

- Anorexia, unexplained weight loss
- Palpable mass on examination
  - Paraspinal
  - Rectal
- Myelopathy – poor coordination, Hoffman’s sign
Radiographic Studies: X-ray

- Most are Osteolytic
- Breast/Prostate can be Osteoblastic
- “Winking Owl” Sign
- Subtle Clue: Indistinct Posterior VB Margin
- Other Osteolytic Lesions: Eosinophilic Granuloma, Plasmacytoma, Hemangioma, Osteomyelitis, Brown Tumor of HyperPTH
“Winking Owl” Sign
Radiographic Studies: CT

- Multiple Lytic Lesions
- Irregular/Non-Sclerotic Margins
- Cortical Breakthrough
- Epidural Extension
Radiographic Studies: MRI

- Contrast Enhanced MRI: Standard
- Complete Spinal Axis
- Distortion of CSF Spaces
- Paraspinal/Epidural Masses
- Occult Mets
Diagnosis: Biopsy

- Open, Incisional, Excisional
- Needle Biopsy:
  - Small Sample
  - Sampling Error
- Non Diagnostic Rate 30-40%
Therapeutic Decision Making

- General Medical Condition
- Tumor Type/Radiosensitivity
- Tumor Stage/Life Expectancy
- Previous Tx
- Neurologic Condition
- Spinal Involvement/Instability
- Patient/Family Wishes
Therapy Algorithm

Spinal Metastasis

Need for tissue diagnosis?
  No
  Epidural Compression of Cord?
    No
    Conventional XRT, Stereotactic XRT, Vertebroplasty, Systemic Chemotherapy
    Yes
    Highly radiosensitive tumor
    Spinal instability, Bony compression of cord, Rapid neurological decline
    OR
    <3 month survival
  Yes
  Failure of treatment?
    No
    Surgery and XRT
    OR
    CT guided biopsy and XRT
    Yes
Treatment

- Medical Management
- Preoperative Embolization
- Radiotherapy
- Surgery
Treatment: Medical Mgmt

- Steroids may improve pain relief and possibly neurological function
- No optimum dosing schedule
- Sorenson et al (1994 *Euro J Cancer*)
  - Randomized trial of 57 patients
  - High dose dexamethasone
  - After six months, 59 vs 33% ambulatory
  - 11% with significant side effects
Adjunct Therapy: Embolization

- Safe, effective
- Facilitate tumor resection
- Renal Cell CA
- Avoid major spinal feeding arteries (Adamkiewicz)
Treatment: Radiotherapy

- Diminished risk of Morbidity
- May be initial choice of mgmt
- Pain control in 50 to 90%
- Neurologic Improvement in 40%
Radiotherapy Limitations

- Harmful Side Effects to local tissue/skin
- Radiation resistant tumors
- Low tolerance of spinal cord to XRT
- Mets progress or recur
- Radiation Induced Myelitis
- Tolerance dose 5/5 is 5 Gy
- Tolerance dose 50/5 is 7 Gy
The Dark Ages

- Prior to 2003, only one Class I study was published in the peer-reviewed literature
- Randomized prospective comparison:
  - 16 pts underwent laminectomy/radiation
  - 13 pts underwent radiation alone
- Mean followup: 4 months
No significant difference was found in the effectiveness of the two treatment methods in regard to pain relief, improved ambulation, or improved sphincter function.
The Dark Ages: Laminectomy

☐ Spine mets are most often located anteriorly in the VB
☐ Poor for resection/decompression
☐ May predispose patient to spinal instability
Dark Ages Continued

- In many centers patients were referred for surgery:
  - After Chemotx and XRT had failed
  - Emergency decompression with acute and rapid neurologic failure
  - Considerable morbidity
Clinical Original Contribution

EFFECTIVENESS OF RADIATION THERAPY WITHOUT SURGERY IN METASTATIC SPINAL CORD COMPRESSION: FINAL RESULTS FROM A PROSPECTIVE TRIAL

ERNESTO MARANZANO, M.D. AND PAOLO LATINI, M.D.
Radiation Oncology Center and University School of Medicine, Perugia, Italy

Conclusion: Early diagnosis of MSCC was a powerful predictor of outcome. Primary tumor histology had weight only when patients were nonwalking, paraplegic, or had bladder dysfunction. The effectiveness of RT plus steroids in MSCC emerged in our trial. The most important factors positively conditioning our results were: the high rate of early diagnoses (52%) and the number of tumors with favorable histologies (124 out of 209, 63%) recruited, and the choice of best treatment based on appropriate patient selection for surgery and RT or RT alone.
Surgical Treatment of Spinal Cord Compression From Epidural Metastasis

By Narayan Sundaresan, Ved Prakash Sachdev, James F. Holland, Frank Moore, Max Sung, Paolo A. Paciucci, Li-Teh Wu, Kevin Kelligher, and Laura Hough

Postoperatively, 82% were improved in terms of ambulatory status and pain relief
Surgery for Solitary Metastases of the Spine
Rationale and Results of Treatment

Narayan Sundaresan, MD, Allen Rothman, MD, Karen Manhart, RN-ANP, and Kevin Kelliher, MS

Results. The overall median survival after surgery was 30 months, with 18% surviving 5 years or more. Survival varied by tumor type, with the best prognosis noted in patients with breast or kidney cancer. The surgical morbidity was significantly higher in those receiving prior irradiation ($P < 0.03$), and the local recurrence rate also increased in patients who had received prior irradiation.
Dark Ages Continued

- Uncontrolled Series and Metaanalysis
- Patient Selection bias
- Heterogenous tumor types
- Unclear inclusion criteria
- Imprecise endpoints
Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial


Summary

Background The standard treatment for spinal cord compression caused by metastatic cancer is corticosteroids and radiotherapy. The role of surgery has not been established. We assessed the efficacy of direct decompressive surgery.

Interpretation Direct decompressive surgery plus postoperative radiotherapy is superior to treatment with radiotherapy alone for patients with spinal cord compression caused by metastatic cancer.
Patchell RA, et al.

- Randomized, non-blinded prospective trial (n=123)
- Surgery and XRT vs XRT alone
- Primary Endpoint: Ability to walk
- Secondary Endpoints: Urinary continence, muscle strength, functional status, survival time, need for steroids/opioids
Patchell RA, et al.

123 assessed for eligibility
- 22 excluded
  - 9 did not meet inclusion criteria
  - 5 refused to participate
  - 8 physician refusal

101 randomised

50 surgery group
- 0 lost to follow-up
- 4 no or incomplete postoperative radiotherapy
  - 50 analysed

51 radiation group
- 0 lost to follow-up
- 1 treated initially with surgery
  - 51 analysed
Patchell RA, et al.

Figure 2: Kaplan–Meier estimates of length of time all study patients remained ambulatory after treatment
Patchell RA, et al.

- Post-treatment ambulatory rate in the surgery group was 84% and 57% in the radiation group ($p=0.001$)
- Patients retained the ability to walk for 122 days in the surgery group versus 13 days in the radiation group ($p=0.003$)
- Median hospital stay was 10 days in both the surgery and radiation group ($0=0.86$)
<table>
<thead>
<tr>
<th></th>
<th>Radiation group (n=51) median</th>
<th>Surgery group (n=50) median</th>
<th>Relative risk*</th>
<th>95% CI*</th>
<th>P*</th>
<th>Significant predictors**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance of continence</td>
<td>17 days</td>
<td>156 days</td>
<td>0.47</td>
<td>0.25–0.87</td>
<td>0.016</td>
<td>Surgery RR=0.51 (0.29–0.90) Baseline Frankel Score RR=0.56 (0.3–0.73)</td>
</tr>
<tr>
<td>Maintenance of ASIA score</td>
<td>72 days</td>
<td>566 days</td>
<td>0.28</td>
<td>0.13–0.61</td>
<td>0.001</td>
<td>Surgery RR=0.30 (0.14–0.62) Stable Spine RR=0.43 (0.22–0.83) Cervical Spinal Level RR=0.49 (0.26–0.90) Baseline Frankel Score RR=0.65 (0.46–0.91)</td>
</tr>
<tr>
<td>Maintenance of Frankel score</td>
<td>72 days</td>
<td>566 days</td>
<td>0.24</td>
<td>0.11–0.54</td>
<td>0.0006</td>
<td>Surgery RR=0.26 (0.12–0.54) Stable Spine RR=0.39 (0.20–0.75) Cervical Spinal Level RR=0.53 (0.74–0.98) Baseline Frankel Score RR=0.62 (0.44–0.88)</td>
</tr>
<tr>
<td>Survival time</td>
<td>100 days</td>
<td>126 days</td>
<td>0.60</td>
<td>0.38–0.96</td>
<td>0.033</td>
<td>Surgery RR=0.60 (0.40–0.92) Breast Primary Tumour RR=0.29 (0.13–0.62) Lower Thoracic Spinal Level RR=0.65 (0.43–0.99)</td>
</tr>
</tbody>
</table>

* Based on a Cox model with all covariates included. ** Based on a Cox model with only significant predictors included (stepwise selection).

Table 2: Secondary endpoints
### Table 1. Review of the Literature for Treatment of MESCC by Witham et al.\(^{43}\)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Improved Neurologic Function (Mean)</th>
<th>Surgical Mortality (Mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XRT alone</td>
<td>36%</td>
<td>N/A</td>
</tr>
<tr>
<td>Laminectomy, ±XRT</td>
<td>42%</td>
<td>6%</td>
</tr>
<tr>
<td>Laminectomy, spinal stabilization, ±XRT</td>
<td>64%</td>
<td>5%</td>
</tr>
<tr>
<td>Anterior decompression, spinal stabilization, ±XRT</td>
<td>75%</td>
<td>10%</td>
</tr>
</tbody>
</table>

MESCC, metastatic epidural spinal cord compression; N/A, not applicable; XRT, radiation therapy.
Indications for Surgery

- Failure of Radiation Therapy
- Unknown Diagnosis
- Pathologic Fracture/Dislocation
- Paraplegia: Rapidly Progressing/Far Advanced
Precautions for Surgery

- Elderly
- Debilitated
- Poor Nutritional Status
- Impaired Immune Function
- Low Bone Marrow Reserve
Factors Determining the Surgical Approach

- Tumor Location
- Spinal Level
- Tumor Extent
- Bony Integrity
- Patient Debility
Surgical Approaches

- Anterior Approaches
- Posterior Approaches
- Posterolateral Approaches
  - Transpedicular
  - Costotransversectomy
  - LECA
Anterior Approaches: Craniocervical Junction

- Foramen magnum, C1, C2, structures contained within
- Transoral-transpalatopharyngeal approach
- Lateral Extrapharyngeal Approach
Transoral-transpharyngeal Approach

Fig. 1. Incising the soft palate to one side of the uvula.
Transoral-transpharyngeal Approach

Fig 2. After infiltration, a midline incision is made in the pharyngeal mucosa. To allow for retraction, the incision should extend well above and below the lesion.
Transoral-transpharyngeal approach

Fig 3. The ligaments and muscles are dissected from the bone.
The switches retain the soft tissue.
Transoral-transpharyngeal approach

Fig 4. The clivus, arch of C₁, and the body of C₂ are exposed. Half of the anterior arch of C₁ has been removed.
Anterior Approaches: Thoracic Spine

- Upper segments (T1-T4) may be particularly challenging
- May require Sternotomy or Thoracotomy
- T5-T10 approached via right (to avoid the aortic arch) or left (difficult to mobilize liver)
Transthoracic vertebrectomy for metastatic spinal tumors

ZIYA L. GOKASLAN, M.D., JULIE E. YORK, M.D., GARRETT L. WALSH, M.D.,
IAN E. MCCUTCHEON, M.D., FREDERICK F. LANG, M.D., JOE B. PUTNAM, JR., M.D.,
DAVID M. WILDRICK, PH.D., STEPHEN G. SWISHER, M.D., DIMA ABI-SAID, PH.D.,
AND RAYMOND SAWAYA, M.D.

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Conclusions. These results suggest that transthoracic vertebrectomy and spinal stabilization can improve the
quality of life considerably in cancer patients with spinal metastasis by restoring or preserving ambulation and by
controlling intractable spinal pain with acceptable rates of morbidity and mortality.

FIG. 10. Artist's rendering of thoracic vertebrectomy, reconstruction with methylmethacrylate, and placement of anterior locking plate and screw construct.
Interaortocaval Subinnominate Window

(J Spinal Disord Tech 2004;17:543–548)
Anterior Approaches: Cont’d

- Thoracolumbar Junction (T11-L1): Thoracotomy and Retroperitoneal Approach
- Lumbar (L2-L4): Retroperitoneal or Transabdominal Approach
- Intra-abdominal contents at risk
- Patients should be expected to have post-op ileus
Posterior Approaches

- Resultant Instability requires Instrumentation and Fusion
- In the upper thoracic spine the scapula must be mobilized.
- Working distance can be extensive
- At T11-12 the diaphragm limits the working space
Transpedicular Approach
Costotransversectomy
Lateral Extracavitary Approach
Vertebroplasty/Kyphoplasty

- Percutaneous injection of PMMA
- Vertebroplasty – direct injection into the vertebral body
- Kyphoplasty – Expandable balloon placed to create a cavity
- Complications: Leakage, Misdirection, PMMA Pulmonary Embolus
Percutaneous vertebroplasty and kyphoplasty for painful vertebral body fractures in cancer patients

DARYL R. FOURNEY, M.D., F.R.C.S.(C), DONALD F. SCHOMER, M.D., REMI NADER, M.D., JENNIFER CHLAN-FOURNEY, PH.D., DIMA SUKI, PH.D., KAMRAN AHRAR, M.D., LAURENCE D. RHINES, M.D., AND ZIYA L. GOKASLAN, M.D.

Departments of Neurosurgery and Radiology, The University of Texas M. D. Anderson Cancer Center, Houston, Texas; and Department of Neurosurgery, Johns Hopkins University, Baltimore, Maryland

Conclusions: Percutaneous vertebro- and kyphoplasty provided significant pain relief in a high percentage of patients, and this appeared durable over time. The absence of cement leakage–related complications may reflect the use of 1) high-viscosity cement; 2) kyphoplasty in selected cases; and 3) relatively small 3-volume injection. Precise indications for these techniques are evolving; however, they are safe and feasible in well-selected patients with refractory spinal pain due to myeloma bone disease or metastases.

Painful thoracic or lumbar VB fracture in cancer patient

Epidural compression
- Bone or disc fragments, radioresistant tumor
  - Surgery (decompression, stabilization) +/- RT

No epidural compression
- Radiosensitive tumor
  - RT
- Conservative therapy (analgesics, bed rest, +/- external bracing)
  - Symptoms resolved
- Persistent axial pain
  - Disrupted posterior VB cortex
    - Kyphosis > 20 degrees
      - Kyphoplasty
  - Posterior VB cortex intact
    - No significant kyphosis (< 20 degrees)
      - Vertebroplasty

Fig. 1. Treatment algorithm for painful thoracic or lumbar VB fractures in cancer patients. See text for details. RT = radiotherapy.
Fig. 10. Bar graph showing pre- and postoperative median VAS scores in 56 patients who underwent vertebroplasty, kyphoplasty, both procedures, and all patients. A score of 10 indicates severe pain and a score of 0 indicates no pain. All results were significant (p < 0.05, Wilcoxon signed-rank test), except where indicated by an asterisk.
Spine Metastasis: Summary

- Spine Mets are not uncommon in patients with cancer
- Surgery and radiation therapy is superior to radiation therapy alone in selected patients
- Management of patients with spine metastases requires a multidisciplinary approach