Case Study

- 54 y.o. man with 3 mo h/o neck pain
- 9 cm kidney mass resected (renal cell)
- C3 treated with conventional XRT for R arm pain
- Progressive pain 4 weeks after XRT
Epidemiology

• 30% of spinal tumors intradural
• 70% intradural tumors are extramedullary
  – 2/3 are primary tumors of the nervous system
  – Metastases can occur but are rare

Presentation

• Based on location
• Mostly due to direct compression
  – Myelopathy (thoracic/cervical)
  – Radiculopathy (lumbar)
    – Parasthesias
    – Pain
    – Numbness
    – Weakness
INTRAMEDULLARY TUMORS

Treatment Strategies

• Rare
• Diagnosis based on MRI
• Most common
  – Ependymoma and astrocytoma
• Surgical resection is therapy of choice
  – Goals:
    – Establish diagnosis (biopsy)
    – Do no harm
    – Gross total resection if possible
Work-up

- Aimed at ruling out non-neoplastic pathology
  - LP
    - Inflammatory
    - Infectious
  - Serial imaging
  - Spinal angiogram

Imaging

- Hemangioblastoma
- Ependymoma
- Astrocytoma
KISS PRINCIPLE

Keep It Simple, Stupid!

Intramedullary tumors

• KISS:
  — If it’s not growing watch it
  — If it’s growing go take a look at it
  — If you can take it out safely, do so
  — If not, leave it the #$%& alone
INTRADURAL EXTRAMEDULLARY

Nerve sheath tumors

• 1/3 of all adult intradural neoplasms
• Schwannomas and neurofibromas
  – 4th-5th decade
  – M=F
  – Schwannoma > neurofibroma
  – Schwannomas usually solitary
    – Schwannomatosis and NF-2
  – Neurofibromas more often multiple
    – NF-1
Nerve sheath tumors

• **Most common lumbar**
  – Can occur elsewhere esp NF-1/NF2

• **Generally considered benign but MPNST can occur**
  – 50% associated w/ NF-1

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Imaging / Diagnosis

• **MRI study of choice**

• **Schwannoma and NF indistinguishable on MRI**
  – Isointense on T1
  – Hyperintense T2
  – Variable enhancement
Treatment

• Surgical resection is therapy of choice
  – Goal is total resection when possible
• If asymptomatic consider observation
• Radiosurgery?
  – Limited data
  – Tissue diagnosis
  – Reserve for recurrence
Surgical therapy NST

• Usually amenable to dorsal or dorsolateral approach
  – Lumbar virtually all resectable via dorsal midline approach
  – Cervical / thoracic
    – Dorsal – laminectomy alone
    – Ventrolateral/ ventral – consider posterolateral approach +/- fusion (trans facet)

Spinal Meningioma

• 46% of spinal neoplasms
• F>M
• 5th - 7th decade
• Thoracic is most common
• Usually dorsal or lateral to cord
• Usually solitary but can be multiple in NF-2
Spinal meningioma

- MRI study of choice for diagnosis
- Iso or hypo intense on T1
- Hyperintense on T2
- Vivid homogeneous enhancement
  - Dural tail?
- Frequently calcified
  - Can prevent enhancement
  - Change signal characteristics on MRI
Spinal Meningioma

- **Treatment based on symptoms**
  - Surgical debulking/resection treatment of choice

- **Dural resection?**
  - Controversial
  - Rarely recur (<5%)
  - ?? Increased morbidity

Myxopapillary Ependymoma

- 40-50% of spinal ependymomas
- Associated w/ filum terminale
- Present w/ radiculopathy
- Benign, well circumscribed
Myxopapillary Ependymoma

• MRI
  – Hypointense T1
  – Hyperintense T2
  – Homogeneous enhancement
  – Well circumscribed
  – Associated with conus/ Filum

Myxopapillary Ependymoma

• Treatment
  – Surgery aimed at gross total resection
  – If not possible aggressive debulking followed by XRT
    – Immediate vs delayed
  – Wide field if possible seeding
  – Early recurrence or recurrence after total resection = poor prognosis
Other

• Paraganglioma
• Embryonal tumors
  – Lipoma
  – Dermoid / epidermoid
• Mets

Intradural extramedullary

• KISS
  – If it’s not growing can usually leave it alone
  – If it’s causing a problem or growing take it out
  – Try to leave nerves intact
  – EMG is helpful
• Principles of surgery
  – Dorsal / dorsolateral approach
    – Don’t let the bone stop you
Primary Spinal Bone Tumors

- Relatively rare – less than 10% of all primary bone tumors treated surgically
- Presenting symptom: pain at rest, night pain-similar in malignant and benign disease
- Neurologic deficit – often prolonged period of symptoms prior to diagnosis
Diagnosis

- Imaging is key
- CT is most helpful
- MRI and X-ray

Examples (Benign)

- Hemangioma
- ABC
- Giant Cell
- Osteoid osteoma / osteoblastoma
Primary bone tumors (benign)

- **KISS**
  - Take them out (in one piece if you can…)
  - Pre-operative / Intraoperative embolization can be helpful (sometimes)
  - High recurrence with incomplete resection
PRIMARY MALIGNANT TUMORS

Plasma Cell

- Most common malignant tumor of the spine
- Multiple myeloma >>>> solitary plasmacytoma
- MM Male:Female 1:1
- Solitary Male:Female 2-3:1
- Plasmacytoma diagnosed with tissue
- MM Serum immunoglobulins, + bone marrow, urine electrophoresis, multiple lesions on bone survey, monoclonal spike in urine or serum, Bence-Jones proteins in urine
Management

• Radiation for plasmacytoma if no instability or neurologic deficit

• 50% plasmacytoma progress to MM in 5 years

• Chemotherapy for MM +/- XRT, controversial for solitary lesion

Chordoma

• 5% of all malignant tumors of the spine

• Notochord remnant

• 50% sacrococcygeal, 40% sphenoccipital, 10% remainder of spine

• Male:Female 2:1

• Mean age 50 years

• 5-10% metastasize within 1-10 years
Chordoma

- Pain is common presenting complaint – 75%
- Sphincter disturbance 20%
- Radiculopathy 10%
- May affect 2 adjacent bodies sparing disc space

Management

- En bloc resection – difficult because of anatomy / neural structures
- Proton beam XRT
- SRS?
- No role for chemotherapy
Osteosarcoma

• Rare – only 2.2% of all osteosarcomas
• 2nd decade of life, slight male preponderance
• Begin in vertebral body
• Pain most common presenting complaint
• May occur post XRT and in patients with Paget’s Disease

Management

• Neoadjuvant chemo, aggressive resection, postop XRT appears to be the most effective
• Prognosis generally poor
• Variety of chemo protocols used
Chondrosarcoma

- Arise from cartilage
- Slight male preponderance
- Middle-aged and older patients
- Rarely from osteochondroma (1%)
- Imaging
  - Plain film and CT show osteolytic lesion with calcified matrix; calcification correlates with degree of differentiation
  - More malignant lesions have more soft tissue, more irregular calcification, more bone destruction

Management

- Survival correlates with degree of malignancy
- Complete resection often not possible
- Poor response to chemo and XRT; may try proton beam / SRS post resection
- Local recurrence common
Primary Malignant Tumors

• **KISS**
  - MM / Plasmacytoma:
    - XRT is the way to go
    - Surgery for stabilization / diagnosis / urgent decompression
  - All others:
    - En Bloc resection of solitary lesion (if possible)
    - Aggressive debulking +/- neoadjuvant chemo and XRT
    - Poor prognosis

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Intermission

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Spine Mets

- Spinal column is most frequent site of bone metastasis
  - Lumbar spine most frequent
  - In those that are symptomatic
    - Thoracic spine

- Most common
  - Breast, lung, prostate, renal cell
  - Myeloma, lymphoma, GI
Presentation of Spinal Metastases

- **90% Pain**
  - persistent, progressive, night pain

- **47% Neurological Symptoms**
  - Sensory Loss 70-80%
  - Paraparesis / Paraplegia > 60%

- **11-34% w SCC are ambulatory at diagnosis**

- **In 50% the primary tumor is unknown**

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Pain

- **Local pain**
  - Constant
  - Stretching of periostium
  - Responds to XRT

- **Radicular pain**
  - Dermatomal-pain and paresthesias
  - Fracture or compression due to tumor mass
  - Surgery vs. XRT (if responsive)

- **Mechanical**
  - Worse with activity, better with rest
  - Responds to stabilization
Etiology of Spinal Cord Compression

• Direct extension
• Pathologic Fracture
• Retropulsion
• Progressive kyphosis
• Epidural metastases
• Dural or intradural metastases (rare)

Treatment Options for Spinal Metastases

• Analgesics

• Bracing & Bedrest
  ✓ Radiotherapy
  ✓ Chemotherapy
  ✓ Surgery
    ✦ Prophylactic
    ✦ Palliative
    ✦ Rarely curative
Surgical Indications for Spinal Metastases

PAIN

NEUROLOGICAL SYMPTOMS

INSTABILITY

...in a patient with > 6 weeks survival, a reconstructable lesion, when chemo & rads are ineffective or inappropriate

• Goals of therapy
  • Palliative
    – Restoration or preservation of neurologic function
    – Relief of pain
  • With prompt therapy
    – Many with cord compression will maintain their ability to walk
Surgical Considerations

• Patient
• Tumor Biology
• Approach
• Reconstruction
• Surgeon & Hospital

Surgery – Why?

Goals

Neural Decompression
Tumor Burden
Neurologic Function
Life expectancy
Quality of Life
Mobility
Diminish pain
Spinal Stability
Surgery – When?

Neurological deterioration

- Rapid deterioration → Surgical emergency
- Gradual deterioration or complete > 48 hours → Urgent investigation, oncology consult +/− surgery
- Neuro normal → Semi-elective

Outcome after Surgery

- Mean survival time;
  - from diagnosis = 24 months
  - from surgery = 16 months
  - unknown primary = 6 months

- Complications;
  - peri-operative = 30%
  - mortality = 5%
Contemporary Management

• Addition of posterior stabilization
  – Neurologic improvement 48 to 88 %
  – Pain improvement 80 to 100%

• Anterior decompression and stabilization
  – Neurologic improvement 62-100%
  – Pain improvement 81 to 95%
  – Wound complication rates low

Vertebroplasty

• Has been used very effectively for painful spinal metastasis
Indications

• Pathological fracture in up to 3 vertebral bodies
• Pain localized to that level
• Mechanical pain

Contraindications

- Significant co-morbidities
- Unable to localize painful level
- Epidural disease
- Pedicle fractures

What’s New?

(Where are we going?)
MIS

- Approaches appear safe
- Smaller incisions and tissue dissection
  - Less pain
  - Less infection
  - Shorter hospital stay

ORIGINAL ARTICLE

Minimally Invasive Transpedicular Vertebrectomy for Metastatic Disease to the Thoracic Spine

Harel Deutsch, MD, Tibor Boco, MD, and Jeffery Lobel, MD

FIGURE 2. The tubular retractor allows a lateral exposure and view of the anterior portion of the spine. Posterior elements are preserved to assist in spine stability.
Combined Techniques

- MIS Decompression
- Anterior column reconstruction with Kyphoplasty
- Percutaneous pedicle screw placement

Combinatorial Therapies

Combination kyphoplasty and spinal radiosurgery: a new treatment paradigm for pathological fractures

PETER C. GERSZTEN, M.D., M.P.H., ANAND GERSHANWALA, M.D., STEVEN A. BURTON, M.D., WILLIAM C. WELCH, M.D., CHET DZHALAGUL, PH.D., AND WILLIAM J. VOGEL, R.T.

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Object: Patients with symptomatic pathological compression fractures require spinal stabilization surgery for mechanical back pain control and radiation for the underlying malignant process. The authors evaluated a treatment paradigm of closed fracture reduction and fixation involving kyphoplasty and subsequent spinal radiosurgery.

Methods: Twenty-six patients (six men and 20 women, mean age 72 years) with pathological compression fractures (16 thoracic and 10 lumbar) were prospectively evaluated. Histological diagnoses included 11 lung, nine breast, four renal, one cholangiocarcinoma, and one ocular melanoma. Seven lesions had received prior external beam radiation therapy. All patients underwent kyphoplasty that involved the percutaneous transpedicular technique. fiducial markers allowing for image guidance during CyberKnife treatment were placed, at time of the kyphoplasty, in the vertebra and adjacent levels. Patients underwent single-fraction radiosurgery (most time after kyphoplasty 12 days) in an outpatient setting. The tumor dose was maintained at 16 to 20 Gy (mean 18 Gy) to the 80% isodose line. The treated tumor volume ranged from 12.7 to 37.1 cm³. No acute radiation-induced toxicity or new neurological deficit occurred during the follow-up period (range 11–24 months, median 16 months). Axial pain improved in 24 (92%) of 26 patients.

Conclusion: The combined kyphoplasty and spinal radiosurgery treatment paradigm was found to be clinically effective in patients with pathological fractures, there was no significant spinal canal compromise. In this technique, two minimally invasive surgical procedures are combined to avoid the morbidity associated with open surgery while providing both immediate fracture fixation and administering a single-fraction immobilizer radiation dose.
Surgery for Spinal Metastases

Summary:

✓ surgery is palliative, not curative
✓ complication rate is significant; wound healing, infection, fixation failure tumor recurrence
✓ goals of surgery; pain relief, neurological protection & recovery
✓ surgery must provide for adequate decompression and stable fixation
✓ early consultation & multiple assessments essential

SPINE TUMOR SURGICAL PEARLS
Remember Your goals

• Palliation
  – pain control

• Decompression
  – Myelopathy
  – Radiculopathy

• Cure?

Surgical strategies

VISITORS ARE REMINDED NOT TO PURE SKUNKS

(sincerely, don’t do it)

Sometimes less is more...
Surgical strategies

- Sometimes you have to get creative...

- Think about the future:
  - Plan for non-union
    - Extra fixation?
    - Synthetic interbody
  - Plan for adjunctive therapies
    - Radiolucent materials?
    - f/u imaging for radiosurgery

- How long does construct need to last?
  - Months vs years
Case Study

- 54 y.o. man with 3 mo h/o neck pain
- 9 cm kidney mass resected (renal cell)
- C3 treated with conventional XRT for R arm pain (!?!)  
- Progressive pain 4 weeks after XRT

Old Paradigm

- No benefit to surgery
- Radiation is treatment of choice
Combined therapy
Combined Therapy

Thank You!