Discussion #2:
Indications for medical intervention of primary osteodiskitis and epidural abscess

- Diagnosis
- Treatment considerations
- When to consider surgical consultation

Disclosures:

Alphatec spine consulting
Biomet spine consulting
DepuySynthes spine – travel expenses, speaking honorarium
Globus spine – travel expenses
Zimmer spine consulting

This presentation will not include product names, promote use of any company’s products, or promote the off-label use of any drugs or devices

1. Diagnosis of osteomyelitis and epidural abscess

- Clinical presentation
- Laboratory markers
- Imaging studies
1. Diagnosis of osteomyelitis and epidural abscess

- Clinical presentation

Onset or exacerbation of neck or back pain
No relief with rest or analgesics
Pain often worse at night
Fever
New neurologic deficit
Cachexia

Epidemiologic features:

- Immunosuppression: HIV infection, chemotherapy, organ transplantation, chronic steroid use
- Intravenous drug use
- Advanced age
- Diabetes mellitus
- Chronic renal disease
- Chronic liver disease
- Malignancy
- Prior trauma or surgery

Illustrative case – ‘Tony’

60 yo M, h/o DM and HTN. s/p MVA 4 months ago.

Presented to outside hospital with 3 months of thoracic back pain, chest pain and SOB

CT chest PE study obtained demonstrating bony destruction and surrounding mediastinal enhancement

Patient was transferred to University Hospital
1. Diagnosis of osteomyelitis and epidural abscess

-Laboratory Markers

- Peripheral WBC

- Procalcitonin
  - Specificity for epidural abscess or osteomyelitis
  - Elevated neutrophil count from peripheral smear more useful
  - Excellent sensitivity and specificity
  - Level tends to remain high for prolonged period
  - Acute phase reactant
  - Generalized marker of inflammation
  - Poor sensitivity
  - Poor specificity
  - Poorly elevated in presence of infection with hepatic insufficiency
  - Not affected by noninfectious inflammatory processes (e.g., trauma, MI, recent surgery, DVT)
  - Highly sensitive and specific for infection

- Elevated neutrophil count from peripheral smear more useful

- Acute phase reactant
  - Faster response to clinical picture
  - Poor specificity
  - Liver production
  - Dampened response with hepatic insufficiency

- Sedimentation Rate
  - High sensitivity for pyogenic infection
  - Level tends to remain high for prolonged period
  - Generalized marker of infection/inflammation

- Elevated serum procalcitonin (PCT) levels (p<0.001) and C-reactive protein (p<0.01) seen in postop infection

From Nie et al

Normal postoperative CRP values and deterioration in patients without complication. Values represent decrease from postop peak CRP value (peak is variable and typically seen postop day 2-3).

From Mok et al

Greater elevation of WBC, ESR, CRP, and PRL seen in pyogenic compared to tuberculous osteomyelitis

Greater yield of blood cultures (40-50%) in pyogenic compared to tuberculous osteomyelitis (0-10%)
1. Diagnosis of osteomyelitis and epidural abscess

Illustrative case – ‘Tony’

CT looked suspicious for osteomyelitis, however only axial views present

PEx: AAOx3, Neurologically nonfocal exam
Mid SOB
Tender to palpation/percussion over thoracic spine
Afebrile

Blood cultures ordered (subsequently demonstrated no growth)
WBC 7.1
ESR 97
CRP 34
HIV negative
Quantiferon gold negative

Neurosurgery consulted – MRI T spine +/- contrast recommended as well as TLSO brace
Illustrative case – ‘Tony’

2. Antibiotic treatment factors

- Empiric abx – pro/con
- Isolation of organism
- Treatment duration


Broad-spectrum coverage generally advocated until organism isolated
Immobilization of infected spinal column via bracing
Short term course of abx (<4 days) reported to not impact yield of biopsy
In some cases an organism is never isolated
2. Antibiotic treatment factors

- Isolation of organism:
  - Yield of blood culture (20-50%)
  - Yield of percutaneous CT guided biopsy (53% Marschall; 32% Heyer; 72% Luzzatti; 48% Pupaibool)
  - Yield of surgical biopsy (91% Marschall; 92% Luzzatti)
  - 60% concordance between blood culture result and biopsy result (Nanda)

  Lower yield if TB is organism
  Lower yield in diabetic patient
  Greater yield if presence of paraspinal abscess
  Greater yield if higher CRP value

- Isolation of organism:
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Illustrative case – ‘Tony’

MRI T spine interpreted as consistent with osteomyelitis at T8-9

Minimal kyphosis

Minimal canal stenosis

Infectious Disease consulted

TLSO brace ordered

Interventional Radiology consulted for CT guided biopsy of T8-9 disk

Illustrative case – ‘Tony’
Illustrative case – ‘Tony’

Following failure of CT guided biopsy to identify an organism, in the rib head or otherwise, neurosurgery is consulted to perform an intraoperative, fluoroscopically guided biopsy:

2. Antibiotic treatment factors

- Treatment duration:
  Standardized duration (6 weeks)
  vs
  Serial monitoring of serologies (Yoon et al and Bettini et al, below):
  - follow-up ESR, CRP for appropriate response at 4 weeks (ESR >55 and CRP > 2.75 corresponded with treatment failure); treatment duration based on lab value responses to treatment

Treatment failure/recurrence:

Most treatment failure seen within 2 years; average under 5 months
Most failure seen with S. aureus as organism and greater duration of infection prior to treatment
Treatment failure more likely with shorter duration of antibiotic therapy
Failure LESS likely in osteomyelitis cases with no isolated organism
75% rate of failure of medical treatment of cervical epidural abscess due to neurologic deterioration (Alton)
Greater likelihood of treatment failure with tuberculous osteomyelitis due to deformity and/or neurologic deficit (Colmenero)
Illustrative case – ‘Tony’

Intraoperative biopsy is positive for Streptococcus group G

Patient is started on IV vancomycin and Zosyn once biopsy obtained and PICC line is placed; subsequently abx changed to IV ertepenem

Do note the TLSO brace the patient is wearing

<table>
<thead>
<tr>
<th>wbc</th>
<th>esr</th>
<th>crp</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 weeks of treatment</td>
<td>5.4</td>
<td>81</td>
</tr>
<tr>
<td>4 weeks of treatment</td>
<td>6.1</td>
<td>54</td>
</tr>
<tr>
<td>IV abx stopped at 5 weeks, changed to PO keflex</td>
<td>5.6</td>
<td>57</td>
</tr>
<tr>
<td>8 weeks of treatment</td>
<td>4.9</td>
<td>52</td>
</tr>
<tr>
<td>10 weeks of treatment</td>
<td>5.3</td>
<td>21</td>
</tr>
<tr>
<td>IV abx stopped</td>
<td>6 weeks of treatment</td>
<td>5.6</td>
</tr>
</tbody>
</table>

3. When to consider surgical referral

- Development of spinal deformity
- Onset of neurologic deficit
- Failure to identify organism via CT-guided biopsy
- Infection recalcitrant to medical therapy

No vertebral edema, ventral phlegmon resolved; sclerotic endplates with mild kyphosis on CT scan 9 months post-biopsy


• Thank you!
Indications and Techniques for Surgical Intervention for Primary Vertebral Osteomyelitis/Discitis (PVO)

Patrick C. Hsieh, M.D.
Associate Professor
USC Spine Center
Department of Neurological Surgery
USC Keck School of Medicine

Disclosures

• Depuy Spine
  – Consultant and research support
• Medtronic
  – Consultant

Pathophysiology

• PVO can lead to:
  – Epidural abscess
  – Spinal instability
  – Sepsis
• Spinal Cord/Nerve Compression
• Vascular compromise
  – Arteritis
  – Thrombophlebitis
Diagnostic Work-Up

- Clinical suspicion
- Laboratory
  - CBC with differential
  - ESR
  - CRP
  - Blood Cultures (~50-60%)
- Imaging
  - MRI
  - CT with contrast
- Biopsy
- Lumbar puncture?

Treatment

- Timely treatment impacts outcome
  - Sepsis
  - Paralysis
  - Death
- The mortality of SEA dropped from 34% in the period of 1954-1960 to 15% in 1991-1997 (Reihsaus et al; Spinal epidural abscess: a meta-analysis of 915 patients)

Treatment

- Medical treatment
  - Culture based antibiotics Rx
  - Empirc antibiotics Rx
  - ID consult
  - Neurosurgery/neurology consult
  - Serial neuro monitoring
  - Favorable factors
    - Neurological intact patient
    - Lumbar or sacral disease
    - Minimal spinal canal compromise
    - Age
    - Trending CBC/ESR/CRP/fever
  - Optimize volume status and BP
Surgical Treatment

- Surgical treatment indications
  - Neurological deficits
  - Failed medical treatment
  - Spinal instability
  - Post-infectious deformity
- Timing
  - Emergent/urgent versus Delayed
  - Neurological status
  - Location of abscess
  - Degree of spinal canal compromise

Goals of Surgical Treatment of PVO

- Neural decompression
- Confirm tissue diagnosis
- Debridement of devitalized bone and tissues
- Spinal stabilization when indicated

Surgical options

- Decompression only
  - Laminectomy
- Decompression and stabilization
  - Anterior
  - Posterior
Surgery Options

• Posterior approach
  – Laminectomy
  – Laminectomy and fusion
• Anterior approach
  – Corpectomy and fusion
• Anterior and posterior approaches
  – Posterolateral corpectomy and PSF

Surgical Consideration

• Minimize foreign bodies/non-vascularized
  – PEEK implant?
• Implant selection
  – Titanium Vs. Stainless Steel
• Graft selection
  – Autograft
  – Vascularized graft
  – rhBMP-2
• Tissue management
  – Obliterate dead space
  – Vascularized tissues

Summary

• Vertebral osteomyelitis/discitis with spinal epidural disease is associated with high morbidity/mortality rate
• Early diagnosis and treatment is paramount
• Antibiotics therapy is mainstay therapy
• Surgery indicated in progressive neurological deficits, failure of medical treatment, post-infectious instability or deformity.
Treatment of postoperative infection

Nader Dahdaleh, MD
Assistant professor
Northwestern Neurosurgery

Conflict of Interest

• None

Postoperative infection

Early: weeks
Delayed: months

Superficial
Deep

Non instrumented
Instrumented
Postoperative infection

Early: weeks
Delayed: months

Superficial → Wound care and antibiotics
Deep

Non instrumented
Instrumented
Risk factors

Patient factors:
• Advanced age
• Malnutrition
• Immunocompromised

Intra-operative factors:
• Length of surgery
• Number of levels
• Posterior surgical approach
• Open surgery
• Use of intra-operative equipment: microscopes, O-arm or C-arm

Timing

• Early: Staphylococcus aureus and beta-hemolytic Streptococcus
• Delayed: less virulent pathogens, most commonly Propionibacterium acnes

Management of deep wound postoperative infections in the presence of hardware

• Retaining versus removing the hardware

• Duration of antibiotics
Case 1

- 70 year old man
- Metastatic lung Ca: diagnosed 2005
- L5 metastases: s/p chemo and Rx Therapy X2
Presented 4 weeks post op:

Confusion, draining wound
Fever, SBP: 90
WBC: 22,000
CRP 25
ESR >120

Blood cultures: E. coli and Proteus Vulgaris

Wound washout: emergent + broad spectrum antibiotics
Wound cultures: same as blood cultures

Post op: CRP dropped then increased over the next few days

2nd wound washout: broad spectrum antibiotics, discharged

Presented with draining wound, increasing crp 10 days later
3rd wound washout and replacing hardware
18 month follow up:
Wound healed
Suppressive antibiotic treatment: Ciprofloxacin

Case 2

• 73 year old female
• Metastatic melanoma
• Mid thoracic pain, Neurologically normal → T5 metastases
Presented 4 weeks later with draining wound

No fevers
NI WBC count
NI CRP

Wound washout → hardware retained

4 weeks oxacillin
4 weeks cephalaxin

Case 3

• 25 yo female with history of adolescent idiopathic scoliosis s/p selective thoracic fusion

• She presented to the ED with right sided paraspinal pain and bump, s/p aspiration at an outside hospital
Taken for wound exploration and washout

Intraoperative purulent material involving the hardware on both sides

Stainless steel hardware removal

Cultures: P. Acnes

Antibiotics: vancomycin then Meropenem X 12 weeks
Deep wound infection in the presence of hardware

Recent: weeks

- Gram positive
  - Wound washout and keep hardware
  - Antibiotics, follow clinically CRP

- Gram negative
  - Multiple wound washouts, consider replacing hardware
  - Antibiotics, follow clinically CRP

Delayed: months/years

- Wound washout and removal of hardware
- Antibiotics, follow clinically CRP
Prevention and Cost of Post-Operative Infection
VuMedi LSRS Presents: Infections in Spine Surgery Webinar

Daniel S. Yanni, MD
Director, Comprehensive Spine Neurosurgery Service
March 31st, 2015

Rates of Post-Operative Infection

• Rates of spinal SSI range from 1-12%
  • Surgery type, duration, and risk factors influence (Beiner, 2003)

• Bone grafts and instrumentation increase risk of SSI
  • Implantation of foreign bodies

• Revisions have a higher rate of SSI (up to 12%) (Radcliff, 2015)

• MIS may have lower rate of SSI

• Medical comorbidities WILL increase rates of SSI considerably

• Time of day procedure performed can also influence
  • Surgery performed later in the day have been found to carry higher risk of SSI (Gruskay, 2012)

Surgical Infections

MIS Groups carry Decreased risk of surgical infections

• O’Toole et al. retrospective review of 1338 MIS procedures
  • Simple decompression SSI 0.10%
  • Fusion SSI 0.74%
  • Composite for all MIS procedures 0.22%

• Historically, open procedures SSI 2-6%
  • Decompression < 1%
  • Fusion > 10%

SSI = surgical site infection

Prevention: Patient Selection and Modifiable Risk Factors

- **Conservative/non-operative management**
  - multiple medical comorbidities, osteoporosis, and advanced age should be managed medically or OPTIMIZE prior to surgical intervention

- Obese patients should be encouraged to reduce **BMI <30** prior to surgery (De la Garza-Ramos, 2015)
  - Significantly higher risk of post-op complications with elevated BMI

- **Smoking cessation** interventions for 1-2 months minimum before surgery can reduce risk of SSI (Thomsen, 2009)

- **Strict pre- and post-operative control of serum glucose levels**
  - <125 mg/dl pre-op and <200 mg/dl postop can reduce post-op SSI (Olsen, 2008)

Prevention: Preoperative Reduction of Bacterial Colonization

- **Bathe** preoperatively with Chlorhexidine gluconate (4%) to reduce postoperative spinal infections (Epstein, 2011)

- Screening and decolonization of known nasal carriers of S. aureus
  - Also can reduce risk of SSI (Bode, 2010)

Prevention: OR Prep of the Surgical Site

- Significant variability in surgeon practices of preoperative skin preparation in spine surgery

- Chlorhexidine appears to be more effective than povidone-iodine alone at reducing SSI (Al Maqbali, 2013)

- Preoperative antiseptic skin preparation using chlorhexidine followed by povidone-iodine has been shown to reduce SSI in neurosurgical procedures (Guzel, 2009)

  - Thorough, sterile antiseptic skin preparation by a **trained provider** is critical in reducing SSI
Prevention: Intraoperative Contamination

- Time in-room prior to procedure (>1hr) has been shown to increase SSI in spine surgery (Radcliff, 2013)
- Insufficient intraoperative irrigation of the wound has been shown to be a risk factor for spinal SSI (Watanabe, 2010)
- Many surgeons opt to use antibiotic-impregnated (Bacitracin) saline irrigation to reduce intraoperative bacterial growth,
  - reduction of SSIs is not clear (Savitz, 1998; Barnes, 2014)

Paraspinal Muscle Injury and Infection

MIS vs Open

Paraspinal Muscle Ischemia and Infection

- Stevens et al. compared intramuscular pressure generated by open vs MIS retractors
  - Cadaveric model showed 3 x higher pressure in open retractors vs MIS
  - Tissue perfusion pressure = retractor pressure – MAP
  - Open retractors can give a zero tissue perfusion pressure
  - Recommend taking down retractors and irrigating periodically during lengthy procedures
  - Correlated on post-op MRI with significant increase in T2 and ADC measurements
  - Attributed to edema associated with denervation and ischemia

*ADC = apparent diffusion coefficient

Prevention: Intraoperative Local Application of Antibiotics

- Vancomycin powder is an easy, safe and inexpensive option for reduction of SSIs in spine surgery
- Multiple studies and meta-analyses have demonstrated reduction in spinal SSI with use of vancomycin powder
- Greater benefit in instrumented spine cases (Khan, 2014)
- Some reports of sterile seromas with use of vancomycin powder
Prevention: Postoperative Antibiotic Prophylaxis

- Antibiotic prophylaxis has been demonstrated to reduce spinal SSI by 63% (Barker 2002)
- NASS recommends prophylactic antibiotics for instrumented and non-instrumented spine surgery
- JCAHO recommends Administration of IV antibiotics within 1 hour of incision
- Increase the antibiotic dosage to adjust for obesity


Prevention: Closed-Suction Drains and Suture

- Closed-suction drains have not been shown to have a significant affect on spinal fusion SSIs (Scuderi, 2005; Diab, 2012)
- Some studies suggest antibacterial-coated sutures reduce the adherence of bacteria to the suture and may decrease the rate of SSI (Edmiston, 2006)
- Antibiotic coated suture may reduce SSI when compared to non-treated suture (Ueno, 2013)


Prevention: Dressing

- A Cochrane review found no particular wound dressing is more effective than others in reducing the rates of SSI
- Silver-impregnated dressings may decrease rates of SSI in lumbar fusions (Epstein, 2007)
  - may be preferable for patients with moderate to high risk of infection (Leaper, 2010)


Cost: Healthcare System Costs

- Nearly 1 million SSIs happen in the US every year, with an estimated total cost of $1.6 billion (Zhan, 2003)
- Direct health care cost of spinal SSI cervical and lumbar fusions ranges from $4,067 - $17,552 per infection
  • Can increase significantly when hardware affected
- More study is needed in this area to assess the costs of SSI in spinal surgery

Cost: Patient Costs

- Average 23 additional missed workdays for patients with dorsal cervical SSIs
  • approximately $3739 more in lost income (Kuhns, 2015)
- Medicaid patients have higher risk of SSI
  • higher associated cost
  • with a concurrent reduction in reimbursement following passage of the ACA (Manoso, 2014)

Key Points

- Appropriate patient selection and counseling reduces risk of SSI
- Reduction in bacterial colonization of skin and nares is a prevention strategy
- Copious irrigation and use of local and systemic perioperative antibiotic prophylaxis reduces SSI rate in spinal surgery
- Cost of spinal SSI is high for the health care system and patients and negatively affects outcomes
Thank you!