Interventional Options for the management of cancer related pain:

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Purpose

• Importance of pain control
• Interventional/surgical options
  • Vertebro-augmentation
  • IT pump/catheter placement
• Patient selection
• Side effects/adverse events
Pain Control

• Despite efforts, moderate to severe pain prevalence is high in the range of 60 to 80% in advanced cancer patients.

• When present, cancer pain is moderate in severity and interferes with activity and enjoyment of life to a great extent.

Pain Control

• Cancer pain can be relieved in 80% to 90% of patients using an opioid-based analgesic regimen and the WHO analgesic ladder as guidelines.

• In patients who do not get pain relief with systemic analgesic therapy, interventional pain procedures should be considered as part of multimodal approach to cancer pain management.
# Pain Control

- Frequent hospitalizations:
  - Increased morbidity/mortality
  - Decreased QoL
  - Increased Cost
- Common reason for hospitalizations in advanced stage cancer patients is uncontrolled pain

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# Vertebro-augmentation

- Osteoporosis (widely used)
- Compression Fractures (metastatic dz)
- Failed Conservative management
- Vertebroplasty/kypophoplasty
- Timing, Indications, Contraindications
- Risks/Side Effects
Clinical Consequences of Vertebral Compression Fractures (VCFs)

- Of clinically-detected fractures, 84% are associated with pain
- The greater the deformity of the fracture, the greater the pain and disability:
  - Reduced exercise tolerance
  - Early satiety and weight loss
  - Functional decline, reduced ability to perform ADLs
  - Depression, loss of self-esteem, sleep disorders
  - Kyphotic deformity resulting in gastrointestinal and pulmonary dysfunction
  - Increased hospitalization and mortality

Risk factors for VCFs

- National Osteoporosis Foundation predicts 1 in 3 women over age 50 will suffer a VCF as a result of osteoporosis
- Lifetime risk of symptomatic vertebral fracture for women is 16%; for men, 5%
- Secondary osteoporosis resulting from use of therapeutic drugs (often part of cancer patients’ regimen):
  - Steroids
  - Anticonvulsants (neuropathic pain)
  - Chemotherapy
  - Heparin (DVT)
Effect of PMMA (used in vertebro-augmentation) on VCFs

- Main benefit of vertebroplasty: immediate pain relief
- While the precise mechanism of pain relief has not been proven it is believed to be achieved by:
  - Immobilization of the fracture
  - Relieving stress on the remaining bone by providing increased tensile strength and stiffness
  - Destruction of nerve endings by causing necrosis through:
    - Heat – exothermic reaction of monomer and polymer in the cement
    - Direct toxic effect

VCF Morphology

- Fracture Classifications
  - Superior endplate
  - Inferior endplate
  - Biconcave
  - Crushed
  - Vertebra Plana
- Posterior Wall Involvement
  - Burst
  - Intact but bulging posterior wall
Options

- Medical treatment
  - Pain control, Bracing, Bed rest
- Surgery often contraindicated
  - Too soft to hold instrumentation
- Inactivity may cause (1-4):
  - PE/Pneumonia/Bone & Muscle loss
- PMMA injection
  - Stabilizes fx
  - ↓ pain & ↑ ambulation
  - Decrease debilitation

Indications for Vertebroplasty

- Painful osteoporotic fractures less than one year old
- Pain refractory to traditional medical therapy
  - No long-term relief with analgesics (and/or side effects to dosage includes excessive drowsiness, confusion or constipation)
  - Pain negatively impacting mobility and ADLs
  - Worsens with weight bearing
  - Relieved with rest or when recumbent
- Painful fracture related to benign or malignant tumor (metastatic disease, hemangiomas)
- Patient with multiple compression fractures for whom further collapse would result in compromised pulmonary or GI function
Contraindications

- **Absolute-**
  - Coagulopathy, infection, refusal
  - Unstable Fx involving posterior element
  - Lack of definable level of vertebral collapse

- **Relative-**
  - Inability of the patient to lie prone
  - Lack of surgical backup (NS or Spine)
  - Lack of proper facilities and monitoring equipment (ASA)
  - Presence of neurological compromise
  - Compression greater than 50% of the original vertebral body height
  - Mild retro-pulsion without impending neurological consequences

Pain distribution in VCF
**Fracture Age and Timing of Treatment**

- *Osteoporotic VCF progressively collapse over 6-18 months*

| Nov 28, 2004 | Feb 23, 2005 |

**Fracture Age and Timing of Treatment**

- **Acute Stage of fracture**
  - 3 months or less
  - Prevention of functional decline
  - Decrease adverse side effects of medical management
- **Sub-acute/chronic**
  - 1 year or less:
    - NEJM study noted no difference between conservative management vs vertebroplasty
### Pre-Procedure Imaging

**X-rays**
- Compare w/ prior studies (is it really acute?)
- Evaluate height loss (>50%)
- Look for retropulsed fragment
- Degree of canal invasion

**Bone Scan**
- Note metastatic disease
- Infection

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### Pre-Procedure Imaging

**MRI**
- T1, T2, STIR sequences (w/n 3 months)
- Assess for marrow edema
- Exclude critical stenosis
- Assess cortical integrity (obviously CT scan better for bone details)
Height Restoration - Kyphoplasty

• McKiernan, et al (Spine 2003)
  • “magnitude of height restoration very variable with conventional kyphoplasty, nearly 4-fold depending on fx severity & reporting method.
• More appropriate in T-spine

Height Restoration

<table>
<thead>
<tr>
<th>Kyphoplasty</th>
<th>Vertebroplasty</th>
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<tbody>
<tr>
<td>35% mean ↑ in height (2.9 mm)</td>
<td>27% mean ↑</td>
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<tr>
<td>Ant restoration - 4.6 mm</td>
<td>↑ of 2.7 mm</td>
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<tr>
<td>Restoration of 4.3 mm</td>
<td>Height restoration in 23 of 65 pts</td>
</tr>
<tr>
<td>Feltes (Neurosurg Focus 2005)</td>
<td>Mean restoration 3.0 mm</td>
</tr>
<tr>
<td>No height restoration</td>
<td>Dublin (AJNR 2004)</td>
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<td></td>
<td>49% mean ↑</td>
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Different Approaches

Transpedicular

Parapedicula

Risks and Adverse Effects

- Infection, nerve injury, paralysis, PE, stroke, death
- Adjacent compression fractures:
  - Most Common:
    - Up to 52%
  - Factors found to contribute:
    - Lower bone mineral density
    - Greater restoration rate of vertebral height
    - Pre-existing fracture
    - Intradiscal cement leakage
<table>
<thead>
<tr>
<th>Risks and Adverse Effects</th>
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- Acute pain due to compression fracture
  - Less than 12 weeks
    - Fractures heal significantly within 6-8 weeks
- Severe Immobilizing pain
  - Inpatient setting
  - Elderly:
    - Prone to deconditioning syndrome
    - Patients with intractable cancer pain
- Possibility of bone bx if needed

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<th>Possible utilization of vertebro-augmentation</th>
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Intrathecal Pain Pump Therapy

- Understanding of the modality
- Patient selection
- Adverse events/safety record
- Current available medications
- Indications/Contraindications
Patient Selection

• A treatment for individuals with severe pain due to:
  • Metastatic Dz
  • Failed back surgery
  • Post Chemo neuropathy
  • Failed or intolerant to oral therapy
  • Pain not controlled by multiple modalities
  • Progressively worsening pain
  • Chronic pain
• Can be used with or in place of orally administered medications
• Nondestructive, adjustable, and reversible therapy (by pump explantation)

How IT Therapy Works

• Uses an implantable, programmable SynchroMed® II pump to deliver precise amounts of medication intrathecally, directly to the site of action at the spinal cord via the cerebrospinal fluid (Targeted Drug Delivery Therapy)
• Because IT Therapy delivers medication directly to the spinal cord, a fraction of the oral medication dose may be needed (300:1 oral:IT morphine)
The SynchroMed II Infusion System

- Consists of two fully implantable components
  - SynchroMed II pump
  - Intraspinal Catheter
- Uses a clinician programmer to deliver precise and customized therapy to patients
- Can deliver medication at either a constant rate or a variable rate
- Available patient controlled system for bolus infusions

Device Reliability

- SynchroMed II 20 mL pumps are 98.3% reliable* (event-free) at 48 months and 51 months¹
- SynchroMed II 40 mL pumps are 99.2% reliable* (event-free) at 48 months and 51 months¹
- Battery life averages 5-7 years
- Replaced surgically

*Reliability is the probability a pump remains event-free through the time interval. Events are defined as any change that prevented delivery of the therapy to the intended location, required surgical intervention to correct, and were related to a problem with the pump.

Device Reliability

• Most common cause of pump failure:

Intrathecal Drug Delivery System Product Performance Events

<table>
<thead>
<tr>
<th>Event</th>
<th>Number of Product Performance Events</th>
<th>Number of Patients with Events</th>
<th>Percent of Patients with Event (n=5,362)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter kink/occlusion</td>
<td>189</td>
<td>170</td>
<td>3.17%</td>
</tr>
<tr>
<td>Catheter dislodgment from intrathecal space</td>
<td>167</td>
<td>152</td>
<td>2.83%</td>
</tr>
<tr>
<td>Catheter break/cut</td>
<td>118</td>
<td>107</td>
<td>2.00%</td>
</tr>
<tr>
<td>Motor stall</td>
<td>52</td>
<td>52</td>
<td>0.97%</td>
</tr>
<tr>
<td>Medical device complication</td>
<td>31</td>
<td>31</td>
<td>0.58%</td>
</tr>
</tbody>
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Medications

• Opioids:
  • Morphine
  • Hydromorphone
  • Fentanyl
  • Sufentanil
• Local Anesthetic:
  • Bupivicaine
• Clonidine (α₂ adrenergic agonist)
• Ziconotide: N-Type V-gated Ca Blocker
• Baclofen (for spasticity)
### Medications

2012 Polyanalgesic Consensus Guidelines for Management of *Nociceptive* Pain by Intraspinal Drug Delivery Line Recommended Regimen

- **Line 1:** Morphine or Hydromorphone or ziconotide or Fentanyl
- **Line 2:** Morphine + bupivacaine or ziconotide + opioid or hydromorphone + bupivacaine or fentanyl + bupivacaine
- **Line 3:** Opioid (morphine, hydromorphone, or fentanyl) + clonidine or sufentanil
- **Line 4:** Opioid + clonidine + bupivacaine or bupivacaine + clonidine
- **Line 5:** Sufentanil + bupivacaine + clonidine


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### Medications

2012 Polyanalgesic Consensus Guidelines for Management of *Neuropathic* Pain by Intraspinal Drug Delivery Line Recommended Regimen

- **Line 1:** Morphine or Morphine+Bupivicaine or Ziconotide
- **Line 2:** Hydromorphone or hydromorphone + bupivacaine or hydromorphone + Clonidine or Morphine + clonidine
- **Line 3:** Clonidine or ziconotide + opioid or fentanyl or fentanyl + bupivacaine or fentanyl + clonidine
- **Line 4:** Opioid + clonidine + bupivacaine or bupivacaine + clonidine
- **Line 5:** Baclofen

Adverse Events

• Possible adverse events may include:
  • Respiratory/CV depression
  • Somnolence
  • Nausea
  • Vomiting
  • Headaches
  • Convulsion
  • Dizziness
  • Paresthesia

Adverse Events

• Overdoses have been identified and in extreme cases may be life threatening
• No deaths been reported for overdosing in Ziconotide
• Possible device complications may include:
  • Catheter or pump moving within the body or eroding through the skin
  • Catheter leak, tear, kind, or dislodgement, resulting in under dose or no medication infusion
  • Pump failure may cause overdose or under dose of intrathecal medication
Contraindications

IT Drug Therapy and implantation of the SynchroMed programmable pump are contraindicated:

- In the presence of infection or spinal anomalies
- When the pump cannot be implanted 2.5 cm or less from the surface of the skin
- In patients whose body size is not sufficient to accept the pump bulk and weigh
- In patients with hypersensitivity to infused medication
- Infusion of medication pH<3
- Safety and effectiveness in pediatric patients below the age of 4 have not been established.

ITB Pump and Catheter
Summary

- Pain is common in cancer patients and can be difficult to manage in severe cases
- Interventional techniques can be an option to help with the management of pain for these patients
- Vertebro-augmentation may be an option for acute vertebral fractures in these patients
- Ultimately if other modalities fail or if the pain is anticipate to worsen, IT pump therapy is a very good option
References/acknowledgements:

- Neurotherm vertebroplasty workshop
- A Randomized Trial of Vertebroplasty for Osteoporotic Spinal Fractures Kallme et al, NEJM 2009
- Risk Factors of New Compression Fractures in Adjacent Vertebrae after Percutaneous Vertebroplasty, Kim et al, ASJ 2011
- Percutaneous vertebroplasty: indications, contraindications, and technique, PEH et al, BJS 2003
- Prialt Medtronic education lecture
- Pain Medicine News April 2014;34-39

Radiofrequency Ablation
Hip
Knee
Sacroiliac joint

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## Radiofrequency Ablation (RF)

- Lesions peripheral nerves
  - Conventional: >45 degrees Celsius
  - Pulsed: less than 42 degrees
- Uses high frequency alternating current to heat tissue
- RF typically provides pain relief for over 6 months

## Lesion Size and Probe

- Conventional RF needle:
- Water-cooled RF needle:
Why Consider RF?

- Minimally invasive
- Recovery time is minimal
  - 2-5 days
- Excellent choice for patients who
  - Are not good surgical candidates
  - Don’t want surgery
  - Pain despite surgery

How much relief?

- “You get to try it before you buy it”
- Diagnostic blocks are done with local anesthetic before radiofrequency ablation
- Typically at least one block is done first
- RF procedure considered if patient gets at least 50% pain relief
RF for Hip

- Who is a good candidate
  - Patients with prior hip replacement
  - Also an option for cancer pain
  - Not surgical candidates
- The target nerves are the sensory branches of the femoral and obturator nerves
- Sensory testing is performed prior to ablation
### Sensory innervation of the hip

Femoral and obturator primarily innervate the anterior lateral and medial capsule

![Diagram showing innervation of the hip](image)

### Evidence Based Medicine

- Most of the evidence is based on case reports
- No large, multicenter placebo controlled studies have been done for the hip
- Many confounding factors which is why diagnostic block is vital to decide if this procedure is appropriate for patients
RF Knee

- Can be done with both conventional and water cooled RF needles
- Target are the genicular nerves
  - Superior lateral and medial
  - Inferior medial
- Diagnostic block done prior to ablation
- Sensory stimulation done to isolate nerve
- Great option for patients who are non-surgical candidates
RF Knee - water cooled

EBM Knee

- Many case reports to support procedure
- One recent placebo controlled double blinded study to support RF knee
  - 19 patients in each treatment arm
    - Control (lidocaine) vs RF
- Study found the VAS, oxford knee score, and global perceived effect all improved 4 and 12 weeks in the RF group
RF Knee- EBM

Clinical Experience

- RF for orthopedic injuries allow patients to perform physical therapy, overcome painful exacerbations, and sometimes are done prior to their surgery
- Goals and expectations must be clearly explained to patient
- Functional improvement, weight loss, decrease in pain medications are common goals
### Sacroiliac Joint Dysfunction

- Common cause of 5-30% of low back pain
- Low back, buttock, groin, and/or posterior leg pain
- More common if:
  - Lumbar fusion
  - Spondyloarthropathies (ie ankylosing spondylitis)
  - Gait abnormality
  - Leg length discrepancy

### Sacroiliac joint dysfunction

- Conservative management
  - Physical therapy (aquatic and land based)
  - Manipulation, osteopathic or chiropractic
  - Oral medications
  - Sacroiliac joint belts
  - Massage therapy
  - CAM (acupuncture, etc)
### Sacroiliac joint dysfunction

- Diagnosis is made clinically and confirmed with sacroiliac joint injection
- Ablation is considered if injection only provides short term relief
- Two common methods to ablate the sacroiliac joint (L5-S3 medial branch nerves)
  - Water cooled (Synergy)
  - Multi-lesion probe (Simplicity)

### Water cooled Sacroiliac joint ablation
Evidenced Based Medicine

• 2 recent studies using water cooled method
  – Steltzer: retrospective case series of 126 patients

**Quality of Life**

<table>
<thead>
<tr>
<th>% of Subjects</th>
<th>Much Improved</th>
<th>Improved</th>
<th>Same</th>
<th>Worse</th>
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<tbody>
<tr>
<td>4–6 Months</td>
<td>79</td>
<td>70</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>6–12 Months</td>
<td>17</td>
<td>23</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>&gt;12 Months</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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• Patel: prospective, placebo (sham intervention), single site study of 52 patients
• Outcomes were measured at 12 months
• Mean decrease in NRS (numeric rating scale) was 2.7
• Function improved based on SF-36 of 15.8
• Oswestry disability scale decrease of 13.9
Simplicity Probe

- ‘Strip lesion’ along the entire sacroiliac joint created
- Less timing consuming, similar recovery time

Sacroiliac joint RF
### Evidenced Based Medicine

- Schmidt: Retrospective study of 77 patients from two academic centers (Virginia Mason, and Univ of Virginia)
- 16 out of 77 failed to respond
- 55% had greater than 50% pain relief at 6 months
- Inclusion criteria was not as selective as the water cooled study- steroid was used in diagnostic injection

### Lumbar/Cervical facet pain

- Most common and most studied use of RF for chronic pain
- Addresses primarily axial pain arising from cervical, thoracic, and lumbar facet joints
- Very common cause of pain after surgery
  - Failed back syndrome, junctional disease
  - After lumbar laminectomy
Pain Referral Patterns

Contraindications to RF

- Patient does not want procedure
- Platelets less than 75
- Unable to stop blood thinner
  - Bleeding disorder
- Active infection
Complications

- Serious complications are uncommon
  - Infection
  - Hematoma
  - Nerve injury (motor testing done prior to RF)
- Post-procedural pain, 2-5 days
- Post-op neuritis
  - ‘sunburn’, hypersensitivity of skin

References

5. Schiltenwolf M, Fischer C.
References

- 5. Sacroiliac joint radiofrequency ablation with a multilesion probe: a case series of 60 patients.
  Schmidt PC, Pino CA, Vorenkamp KE.

- 6. Twelve-Month Follow-Up of a Randomized Trial Assessing Cooled Radiofrequency Denervation as a Treatment for Sacroiliac Region Pain. Patel N.
  PMID: 25565322

  Stelzer W, Aiglesberger M, Stelzer D, Stelzer V.