1. Interventional Pain Management: Low Back Pain

Interventional Pain Management: Low Back Pain

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2. Low Back Pain

Low Back Pain

- 90% will be limited for less than 30 days
- Only 5% will have evidence of nerve root compromise
- Only 2% will have strong physical findings indicating good surgical outcome
- Up to 85% will have no definitive diagnosis secondary to lack of correlation with imaging studies
  - Majority will be musculoskeletal

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3. Impact on the Work Environment

Impact on the Work Environment

- Most common cause of disability for workers under 45
- Second most common cause for absence from work (common cold)
- Estimated that 25 million Americans could not work one or more days annually because of low back pain
- Costs to system include direct health care costs, wages lost, and wage replacement
- Small percentage, 7.5%, account for 75% of costs

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4. Etiology

Etiology

- Vertebral and paravertebral
  - HNP
  - DJD
    - Spinal stenosis, facet arthropathy, SI joint disease
    - Arachnoiditis
- Musculoskeletal
  - strain, sprain, spasm
- Neoplastic
  - metastatic, multiple myeloma, primary spinal
- Infectious
  - Epidural abscess, osteomyelitis, Pott’s disease, herpes zoster
- Rheumatic
  - Ankylosing spondylitis, Reiter’s syndrome, fibromyalgia
- Referred causes
  - Vascular causes
    - AAA, arterial occlusive
  - Biliary
  - GI perforated viscus
  - Pancreatic-CA, pancreatitis
  - Uterine origin
    - Ovarian, endometrial CA

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5. Functional Anatomy

**Functional Anatomy**

- **Two segments**
  - Anterior segment-weight bearing
    - Vertebral body
    - Intervertebral disc
    - Bound by anterior and posterior longitudinal ligaments
  - Posterior segment-movement
    - Facet joints, ligaments

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6. Intervertebral Discs

**Intervertebral Discs**

- **Annulus fibrosis**
  - Intertwined fibroelastic mesh
- **Nucleus pulposus**
  - 88% fluid
  - Mucopolysaccharide
  - High concentration of Phospholipase A2

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7. Intervertebral Discs

Intervertebral Discs

- Self contained system which absorbs shock, permits transient compression, and allows movement
- Disc actually dehydrates during the day secondary to compressive forces, rehydrates during night
- With aging, elastic collagen replaced by fibrous tissue
  - Results in loss of elasticity

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8. Disc Herniation

Disc Herniation

- Normal disc, nucleus
  - Force distributed evenly to annulus
- Degeneration of nucleus
  - Leads to unequal distribution of compressive forces
  - Can lead to herniation

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9. **Posterior Unit**

**Posterior Unit**

- Bony structures and ligaments
- Facet joint
  - True arthroidal joint
    - Lined with synovium and synovial fluid within joint capsule
    - Orientation determines motion

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10. **Nerve Supply**

**Nerve Supply**

- Articular nerves
  - Posterior primary division
    - Sends sensory fibers to fascia, ligaments, periosteum, and facet joints
    - Medial branch of posterior primary division supplies facet joint
    - Similar efficacy between MBB and intra-articular facet injection

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11. Nerve Supply

Nerve Supply

- Meningeal nerves (recurrent nerve of Luschka)
  - Structures within spinal canal and longitudinal ligaments, as well as annulus fibrosis
  - No free nerve endings within disc

12. Evaluation

Evaluation

- History
  - Onset
  - Course
  - Aggravating/relieving factors
  - Quality/characteristic pain
  - Associated symptoms
    - Radiation, weakness, bowel, bladder
    - Constitutional
      - Fever, weight loss, night sweats, etc.
13. Evaluation

Evaluation

- Physical examination
  - Inspection
    - Posture, gait, scoliosis, skin rashes
    - Observe ease of movement after exam is done
  - Palpation
    - Paraspinal muscles, SI joint, trochanteric bursa, piriformis muscle
  - Muscle Function
    - Evidence of wasting
    - Subjective to effort

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14. Physical Examination

Physical Examination

- Neurologic examination
  - Evidence of sensory deficits, change in reflexes
- Straight Leg raising
  - Knee in full extension, ankle in neutral position, ipsilateral leg is raised gradually
    - Stretches the lumbosacral roots-usually at 30-70 degrees
    - Lasègue's sign-dorsiflexion of the ankle increases stretch on the LS roots, exacerbating pain
    - Contralateral SLR is probably more indicative of herniated disc

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15. Physical Examination

Physical Examination

- Nonorganic signs (Waddell’s)
  - Superficial nonanatomic tenderness
  - Axial loading
  - Torso rotation
  - Distraction test
  - Nonanatomic distribution of sensation, pain, or weakness

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16. Studies

Studies

- Plain films
  - Low diagnostic yield
  - Indications are suspicion of major trauma, infection, or tumor

- Myelography
  - Should be limited to those patients being considered for surgery
  - Can further delineate if followed by CT scan

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17. **Studies**

**Studies**

- **Discography**
  - Questionable benefit
  - Should see reproduction of symptoms
- **CT scanning**
  - Helpful in diagnosing tumor, infection, and trauma
  - Better for visualizing bone
- **MRI**
  - More practical for imaging soft tissue
    - Radiculopathy

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18. **Specific Disorders**

**Specific Disorders**

- Low Back 'Strain'
- Stretching injury to the ligaments, tendons, and/or muscles of the low back
- Results in microscopic tears of varying degrees in these tissues
- Considered one of the most common causes of low back pain

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19. Low Back Strain

Low Back Strain

- Most often occurs in persons in their forties
- Overuse, improper use, or trauma
- Characterized by localized discomfort in the low back area with onset after an event that mechanically stressed
- Diagnosis of lumbar strain is based on the history of injury, the location of the pain, and exclusion of nervous system injury. Usually, x-ray testing is only helpful to exclude bone abnormalities.

Treatment of lumbar strain consists of resting the back (to avoid re-injury), medications to relieve pain and muscle spasm, local heat applications, massage, and eventual (after the acute episode resolves) reconditioning exercises to strengthen the low back and abdominal muscles.

- Long periods of inactivity in bed are no longer promoted as this treatment may actually slow recovery
- Spinal manipulation for periods of up to 1 month has been found helpful in some patients that do not have signs of nerve irritation

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20. Specific Disorders

Specific Disorders

- Spinal stenosis
  - Signs and symptoms
    - Deep aching, or cramping, and radiates from the back into both thighs
    - Exacerbated by walking, relieved by leaning forward or sitting
      - Neurogenic claudication

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21. Specific Disorders

Specific Disorders

- Disc disease
  - Low back pain with radiates down to foot
  - Signs of irritation with SLR
  - Sensory and motor loss to varying degree

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22. Specific Disorders

Specific Disorders

- Spondylolisthesis/ facet arthropathy
  - Low back and leg pain
  - Usually increased lordosis
  - Tightness in posterior thigh
  - Walk with an antalgic gait

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23. **Specific Disorders**

### Specific Disorders

- **Myofascial pain**
  - Muscle relaxants
  - NSAID's
  - Trigger point injections
  - Physical therapy
  - TEN's unit

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24. **Pain Management Treatment Options**

### Pain Management Treatment Options

- **Pharmaceuticals**
  - NSAID's
  - Antidepressants
    - TCAs
    - SSRIs
  - Anticonvulsants
  - Local anesthetics
  - Opiates
  - α-Adrenergic agents
  - Topical agents
  - Muscle relaxants

- **Nerve blocks**
  - Sympathetic
  - Somatic

- **Interventional therapies**
  - SCS
  - IT Pump
  - Epidural Portacaths

- **Neurodestructive procedures**
  - DREZ
  - Chemical neurolysis

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25. Complete Chronic Pain Treatment Continuum

![Complete Chronic Pain Treatment Continuum Diagram](c) 2007, Wilfred L. Hynes, MD

26. Epidural Steroid Injections

**Epidural Steroid Injections**

- **Indications**
  - Clear indication
    - Radicular pain secondary to disc herniation
    - Not improved after 4 weeks
    - Spinal stenosis with radicular symptoms
    - Neurogenic claudication
  - Chronic low back pain
    - Individualized

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27. Epidural Steroid Injections

Epidural Steroid Injections

• Mechanism
  – Inhibit Phospholipase A2
    • Interrupt inflammatory cascade
    • Reduction in local tissue edema
  – May also block neural transmission directly
    • Have been shown to inhibit ectopic discharge in neuromas

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28. Epidural Steroid Injections

Epidural Steroid Injections

• Results
  – Duration of symptoms key variable in success rates
    • < 3 months 83-100% success
    • 3-6 months 67-81%
    • 6-12 months 44-69%
    • > 12 months 40-58%
  – Multiple confounding variables in studies

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29. Epidural Steroid Injections

Epidural Steroid Injections

- Complications
  - Needle placement
    - Post-dural puncture headache
    - Pain at injection site
    - Nerve injury
    - Infection
    - Epidural Hematoma
  - Steroids
    - Hypertension
    - Fluid retention
    - Hyperglycemia
    - Cushing's syndrome
  - Local anesthetic
    - Motor block
    - Cardiac arrhythmia
    - Seizure

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30. Interventional Procedures

Interventional Procedures

- Lumbar facet injections
  - Clinical evidence of facet joint irritation
    - Pain with facet loading
      - Lumbar extension
    - May have pseudoradicular symptoms
      - Usually not distal to knee

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31. Lumbar Facet Injections

**Lumbar Facet Injections**

- MBB vs Intra-articular
- No difference in efficacy

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32. Lumbar MBB

**Lumbar MBB**

- Injecting along the path of medial branch of dorsal ramus
- Sensory supply to facet joint
- Junction of transverse process and pedicle

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33. **Facet Injection**

**Facet Injection**

- Intra-articular injection
- Angle of joint changes
  - Angle of approach

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34. **Nerve Root Injections**

**Nerve Root Injections**

- Isolated unilateral radiculopathy unresponsive to lumbar ESI
- Diagnostic purposes for neurosurgery
- Contrast used to delineate path of root

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35. Nerve Root Injection

Nerve Root Injection

- Position needle at approximate position of neuroforamen

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36. Nerve Root Injections

Nerve Root Injections

- Lateral view

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37. Nerve Root Injection

Nerve Root Injection

- Contrast injection
- Central spread

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38. Interventional Procedures

Interventional Procedures

- Radiofrequency lesioning
  - Destruction of medial branch of dorsal ramus by heat
    - Pure sensory fibers
    - Interrupts transmission of pain impulse from facet joint
    - Nerve will regenerate
      - Relief from 6-18 months

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39. Questions?

40. Invasive Pain Management Modalities

- Lantable system

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41. Mechanism of Action of Spinal Cord Stimulation

Mechanism of Action of Spinal Cord Stimulation

- Gate Control Theory
- Electricity-Mechanism of action at cellular level

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42. Mechanism of Action of Spinal Cord Stimulation (continued)...

Mechanism of Action of Spinal Cord Stimulation (continued)

- Stimulation pattern-High frequency, low amplitude
  - More sympathetic recruitment
  - A-Beta fibers recruited
  - At higher amplitudes
    • A-Delta recruitment
  - Large fiber stimulation inhibits small fiber input

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43. Mechanism of Action (Continued)

Mechanism of Action (Continued)

- Activation of descending inhibitory tracts
- Evidence of neurohumoral activity
  - Increase in endorphin and serotonin levels in CNS
  - Not attenuated by naloxone

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44. Patient Selection

Patient Selection

- Neuropathic vs. nociceptive
- Failed Conservative Therapy
- Pathologic Basis for Disease
- Further Surgical Intervention Not Indicated
- No Serious Drug Habituation problems exist

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45. Patient Selection (continued)

Patient Selection (continued)

- Psychologic Clearance
- No Contraindications exist to implantation
- Successful trial screening (>50%)
- Patient able and willing to use therapy
- Patient understands the limits and risks of therapy

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46. Results

Results

- Kumar - 10 years experience, 1991
  - 121 patients, 56 failed back
  - 140 implants
  - mean follow-up of forty months
  - 51% overall reported satisfactory pain relief, 66% of those internalized

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47. Results (continued)

Results (continued)

• North - SCS 5 year outcomes, 1991
  – 50 FBSS patients
  – 3.1 previous operations
  – Mean follow-up of 2.2 and 5 years
  – 53% success at 2.2 years
  – 47% at 5 years
  – 20% returned to work
  – Increase in ADL’s in most patients

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48. Results (continued)

Results (continued)

• North - SCS vs Reoperation
  – Prospective, randomized comparison
  – 6 month crossover
  – 15 patients first operated on; 10 opted for SCS (67%)
  – 12 patients received SCS first; 2 opted for crossover (17%)

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Results (continued)

- North - 2 Decades, 1993
  - 320 patients implanted between 1972 and 1990
  - Mean follow-up of 7.1 years
  - 52% of 171 patients
    - > 50% continued pain relief
  - Majority had increases in ADL’s and decreases analgesic use

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Results (continued)

- Turner - SCS meta analysis
- Articles from 1966-1994
- 39 studies
  - Mean follow-up of 16 months
  - Average of 59% of patients had >50% pain relief
  - Complications rate was 42% (generally minor)

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51. Cost Effectiveness in Failed Back Surgery Syndrome

Cost Effectiveness in Failed Back Surgery Syndrome

- Estimated cost of chronic low back pain = $25 Billion annually
- Bell, Kidd, and North, 1997
  - Cost effectiveness analysis
  - Compared theoretical FBSS patient treated with SCS, with medical management, or with repeat surgery
  - Initial high cost of SCS therapy
  - Five years cost effective

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52. Intrathecal Pumps Patient Selection

Intrathecal Pumps Patient Selection

- Neuropathic vs. nociceptive
- Failed conservative therapy
- Pathologic basis for disease
- Further surgery not indicated
- No serious drug abuse
- Psychological clearance
- No contraindications
- Successful trial screening

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53. Intrathecal Pumps Indications

Intrathecal Pumps Indications

- Nociceptive pain
  - Opiates, local anesthetics
- Neuropathic pain
  - Opiates, neostigmine, clonidine, local anesthetics, SNX-111?
- Spasticity
  - Baclofen

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54. Intrathecal Agents Low Back Pain

Intrathecal Agents Low Back Pain

- Opiates
  - Transmission modulated by mu receptor

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Intrathecal Agents Low Back Pain

- Local anesthetics
  - Conduction blockade

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Intrathecal Agents
Low Back Pain

- Clonidine
  - Alpha-2-agonist

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Agents

- Opiates
- Non-opiates
- Pain
- Spasticity

Current Intraspinal Agents

- FDA approved
  - Morphine
  - Baclofen
- Commonly administered
  - Analgesia
  - Spasticity
- Experimental agents
### Initial Analgesic Agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>70%</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>11%</td>
</tr>
<tr>
<td>MS + Bupivacaine</td>
<td>8%</td>
</tr>
<tr>
<td>MS + Tetracaine</td>
<td>4%</td>
</tr>
<tr>
<td>Hydromorphone + Bupivacaine</td>
<td>2%</td>
</tr>
<tr>
<td>Sufentanil</td>
<td>3%</td>
</tr>
<tr>
<td>Bupivacaine</td>
<td>2%</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>2%</td>
</tr>
<tr>
<td>Sufentanil + Bupivacaine</td>
<td>1%</td>
</tr>
<tr>
<td>Meperidine + Bupivacaine</td>
<td>0.7%</td>
</tr>
<tr>
<td>Fentanyl + Bupivacaine</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

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### Intrathecal Opiates

- **Choice of agent**
  - Familiarity
  - Lipophilicity
- **Changing agents**
  - Analgesia—generally adjust dose
  - Side effects
    - Adjust dose, or change agents
    - e.g., sedation with morphine, switch to hydromorphone

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Intrathecal Opiates

Opiate Receptors

- Mu
  - Mu1
    - Analgesia, resp. depression
  - Mu2
    - Dysphoria, physical dependence
- Kappa-Spinal analgesia
- Sigma-Dysphoria
- Delta-Nausea
- Epsilon

Intrathecal Opiate Effects

- Inhibition of Pain Transmission
- Elicits an inhibitory effect on release of Substance P
  - Level of substantia gelatinosa
- Clinical target-rationale for IT use
63. Adverse Effects

**Adverse Effects**

- Respiratory depression
  - Immediate and delayed
  - More likely in opioid naïve patients
  - Monitoring recommended for 24-48 hours
  - Caution indicated with concurrent sedatives, oral/parenteral narcotics
  - Adjustment of oral regimen during transition essential
  - TRIPLE CHECK INFUSION PRINTOUT!!!!
    - 2 signatures?

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64. Urinary Retention

**Urinary Retention**

- Incidence 42-80%
- Older males, BPH
- Not dose dependent
- Not related to systemic absorption
- Central inhibitory effect
  - Detrusor relaxation
  - Increased sphincter tone
- Cholinomimetic agents

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65. Nausea and Vomiting

Nausea and Vomiting

- 4 hours
- Dose related
- Mechanisms
  - Central spread
  - Decreased gastric motility
  - Vestibular system

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66. Pruritus

Pruritus

- Onset in first few hours
- Dose related
- May precede analgesia
- Decreases with time
- Central spread
- Not due to histamine release

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67. Arthralgias

Arthralgias

- IT Morphine

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68. Constipation

Constipation

- Decreased GI motility
- Usually much less than oral or parenteral
- Central effect

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69. Edema/ Weight Gain

Edema/ Weight Gain

- Koulousakis et al.
  - 5-10% experienced weight gain, majority being observed in women
  - Not controlled by diet
  - Not dose dependent
  - Cause unknown
  - Managed with diuretics

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70. Sexual Dysfunction/ Endocrine Disturbances

Sexual Dysfunction/ Endocrine Disturbances

- Verhelst and Rogers
  - 68 patients
  - 86% demonstrated hypogonadotropic hypogonadism
  - 17% GH deficiency
  - 13% Adrenal corticoid insufficiency
  - Mean f/u of 26 months

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71. Sexual Dysfunction/ Endocrine Disturbances

Sexual Dysfunction/ Endocrine Disturbances

- Need to ask
- 4-8% incidence of decreased libido and sexual dysfunction
  - Testosterone levels
  - Supplementation if necessary

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72. Miscellaneous Effects

Miscellaneous Effects

- Excessive perspiration
  - Incidence 1.8-8.5%
- Special senses disturbances
  - Olfactory, taste
- Myoclonus
  - High doses, too rapid increase

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Dose Adjustments

- General guidelines
  - 25-33% increase for mild to moderate pain
  - 50% increase for moderate to severe
  - F/u 1-2 weeks

Local Anesthetic

- Indicated for relief of neuropathic and nociceptive
- Krames and Launing
  - 67% improved with nociceptive
  - 80% improved with neuropathic
75. Local Anesthetic

Local Anesthetic

- Limited by side effects
  - Sensory, motor disturbances; urinary disturbances
    - >15 mg/day
- Long term effects of chronic infusion?
- Can also see CNS toxicity
  - Tinnitus, metallic taste
  - Seizure

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76. Adrenergic Agonists

Adrenergic Agonists

- Clonidine
- Acts at alpha-2 receptor in CNS
  - Inhibits substance P release
  - Synergistic effect with LA and Opiates

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Adrenergic Agonists

- Adverse effects
  - Hypotension
  - Bradycardia
  - Sedation
  - Dry mouth

Adrenergic Agonists

- Efficacy
  - Double blinded, placebo controlled study
  - 85 Cancer patients
  - Epidural clonidine 30 mcg/hr + PCEA morphine
  - Neuropathic pain scores reduced compared to placebo
Adrenergic Agonists

- **IT Use**
  - MD Anderson, TX
    - 32 patients with IT pumps, intractable neuropathic pain
    - 480-900 mcg/day
    - 56% showed improvement in VAS

Results

- Winkelmuller, 1996
- 120 patients, nonmalignant pain syndromes
- Mean 3 years follow-up
- 74% success rate
  - average pain reduction of 67%
  - 36% required no additional medication
Results

- Tutak and Doleys, 1996
- 26 patients; 20 noted good or excellent outcome
  - average follow-up 23 months
- Pain improved on average 59%
- Functioning improved 50%
- Tolerance-doses increased on average seven-fold

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Results

- Penn, et al., 1996
- Multicenter, retrospective analysis
- 35 physicians polled, 427 patients
- 67% for nonmalignant pain
- 42% of total for failed back surgery syndrome

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83. Cost- Effectiveness

Cost- Effectiveness

- Long term cost of implantable pumps vs. conservative management for intractable low back pain in FBSS
- Factored in failed/removed/replaced pumps
  - infection, failed therapy, battery depletion, etc.
- Estimated cost was $1,300/ month

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84. Summary

Summary

- Need to continue to produce and improve on our results
- Patient selection
- Technology improvements
  - Costs may decrease

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