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# Epidural steroid injections for pain therapy

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## EPIDURAL STEROIDS

- Objectives:
  - To describe the indications for epidural steroid injections in cancer and non-cancer related pain
  - To describe the current nomenclature to define spinal conditions amenable to treatment with epidural steroid injections
  - To discuss the pros and cons of the different approaches used for epidural steroid injections

## EPIDURAL STEROIDS

- Questions:
  - In whom is it indicated?
  - When?
  - How do I interpret the radiologic tests supporting the indication to perform the procedure?
  - How many injections should I perform
  - What approach?
  - Should I use fluoroscopy all the time?
  - What do I look for in the fluoroscopy study?
  - What are the concerns?

## DISC PAIN

## NATURAL HISTORY

- Nonspecific back pain
  - 1/3 recover within 1 week
  - 2/3 recover in 7 weeks
  - 40% of patients have recurrences within 6 months
- Herniated disk
  - Only 10% of patients have pain after 6 weeks
- Acute *vs* chronic

## EPIDURAL INJECTIONS: INDICATIONS

- Severe neuropathic pain associated with cancer
- Post-herpetic neuralgia
- Radiculopathy, radicular pain, or radiculitis
- Axial pain?
- Lumbar stenosis?

## EPIDURAL STEROIDS

- An epidural steroid injection was first used in 1957 for the treatment of “sciatica”

Lievre, et al. Bull Soc. Med Paris, 1957.

## EPIDURAL STEROIDS: MECHANISM

- Steroids decrease neuropeptides such as calcitonin gene-related peptide (CGRP) and substance P (sP) that are involved in neurogenic inflammation
- It also induces the production of kynurenic acid, a post-synaptic NMDA antagonist

Hong D, et al. Pain 1993; 55:171
Marek P, et al Brain Research 1991; 558:163

## EPIDURAL STEROIDS

### CANCER RELATED PAIN

Cancer pain syndromes due to peripheral nerve injury

| Pain syndrome | Associates signs and symptoms | Affected nerves |
|---|---|---|
| Tumor infiltration of a peripheral nerve | Constant burning pain with dysesthesia in an area of sensory loss. Pain is radicular and often unilateral | Peripheral |
| Postradical neck dissection | Tight, burning sensation in the area of sensory loss. Dysesthesias may occur. Second type of pain are not unusual | Cervical plexus |
| Postmastectomy Pain | Tight, constricting, burning pain in the arm, axial, and anterior chest wall. Pain exacerbated by arm movement | Intercostobrachial |

cont...

Cancer pain syndromes due to peripheral nerve injury

| Pain syndrome | Associates signs and symptoms affected | Nerves |
|---|---|---|
| Post-thoracotomy pain | Aching sensation in the distribution of the incision with or without autonomic changes | Intercostal |
| Postnephrectomy | Numbness, fullness, or heaviness in the flank, anterior abdomen, and groin. Dysesthesias are common | Superficial pain Intercostal |
| Postlimb amputation | Phantom limb pain. Stump pain several m/yrs post-surgery. Burning dysesthesia that is exacerbated by movement | Peripheral Endings and central projections |

cont...

Cancer pain syndromes due to peripheral nerve injury

| Pain syndrome | Associates signs and symptoms | Affected nerves |
|---|---|---|
| Chemotherapy-induced PN | Painful paresthesias and dysesthesia. Hyporeflexia. Motor and sensory loss is rare. Associated with vinca alkaloids, cisplatinum, taxol, taxotere and navelbine | Distal peripheral nerves |
| Acute and PHN | Painful paresthesia and dysesthesia. Constant burning and aching pain. Shock-like paroxysmal pain. Immunosuppression is a risk factor. Incidence increases with age | Thoracic and Cranial (VI) are most common |

## EPIDURAL INJECTIONS: INDICATIONS

- Severe neuropathic pain associated with cancer
- Herpetic neuralgia
- Radiculopathy, radicular pain, or radiculitis
- Axial pain?
- Lumbar stenosis?

## EPIDURAL INJECTIONS: DEFINITIONS

- Radiculopathy: A pathological condition in which the function of the nerve root is impaired leading to numbness, motor loss, and pain, depending on which fibers of the nerve root are involved. Paresthesia , segmental numbness, weakness, and loss of reflexes are reliable and valid signs of radiculopathy that allow the diagnosis to be made clinically, without the recourse to investigations.

## EPIDURAL INJECTIONS: DEFINITIONS

- Radicular pain: A conditions caused by the stimulation of the sensory dorsal root of a spinal nerve, or its dorsal root ganglion, and is not the same as radiculopathy. Radicular pain may resemble the distribution of classic dermatomal maps, but pain can be outside the distribution of the classic dermatomal maps.

## EPIDURAL INJECTIONS: DEFINITIONS

- Radiculitis: The symptoms produced by chemical irritation with nerve root inflammation by the nuclear material from a disrupted disc.
    - Radiculopathy or radicular pain may manifest clinically in these patients.

## NEURAL IRRITATION OR COMPRESSION

Disc herniation
Canal/recess stenosis
Osteophytes
Spondylolisthesis
Tumors
Extra-spinal causes

## PAIN WITHOUT NERVE COMPRESSION

Internal disc disruption (> 39%)
Facets (15%)
SI joints (12%)
Soft tissue
Fractures/mechanical



## EPIDURAL INJECTIONS: DEFINITIONS

- Thus, having solely radiculopathy or radicular pain does NOT justify an epidural injection
- Spinal stenosis: Both central and canal narrowing and foraminal narrowing

## SPINAL STENOSIS

- More common in older individuals
- Osteophytes, facet capsular hypertrophy, and diffuse multi-level broad-based disc bulge
- Foraminal narrowing can be caused by all of these changes, as well as loss of disc height, or loss of vertebral height
- Spondylolisthesis may also cause foraminal narrowing

## EPIDURAL INJECTIONS: HX

- Patients with spinal stenosis may develop axial and extremity pain
    - Achy
    - Non-dermatomal specific
    - Increases with walking: neurogenic claudications (especially downhill and with the spine extended)
    - Rest and flexion of the spine will alleviate the symptoms

## EPIDURAL INJECTIONS: HX

- Acute compression of a spinal root will generate paresthesia and/or numbness, but NOT persistent pain
- In contrast, compression of a normal DRG will generate radicular pain and/or radiculopathy and sustained pain

Howe JF, et al. Pain 1977;3:25
Howe JF. In Advances in Pain Research and Therapy 1979;3:647

## PATHOPHYSIOLOGY OF DISC DISEASE

- Old concept: Compression of a nerve root, so decompressive surgery was reasonable
- In the 50's Kelly said inflammation was the key due to the mismatch of w/u findings and the pt's symptoms
- McCarron et al's model: High PLA-2 content = a toxic spill of inflammatory mediators
- Growth of nerves into the healing annulus results in discogenic pain

## PATHOPHYSIOLOGY OF DISC DISEASE

- Put in another way……
- Loss of elasticity in the annular fibers (over time, as with aging) creates fissures

- When poorly distributed pressures are applied, nucleous pulposous material leaks out, causing swelling of nerve roots (these nerves don't work right!)
- Perhaps there is also CNS sensitization due to neuropathic pain

## EPIDURAL INJECTIONS

- Physical examination
  Dermatomes
  Epidural injections: DTRs
  Epidural injections: PE
  Epidural injections: PE

## EPIDURAL INJECTIONS: PE

Sensory
Innervation
of foot

## MOTOR MOVEMENTS OF FOOT

EPIDURAL INJECTIONS: PE
EPIDURAL INJECTIONS: PE

- Furcal nerve:
  - Arises from L4 root level
  - Contributes to both the lumbar and sacral plexus of nerves
  - Neurologic symptoms suggesting two nerve root involving frequently result from furcal nerve compression

Kikuchi S, et al. Spine 1986;11:1002

## BEWARE OF THE "OLDER" PATIENT

- After age 65, cancer, compression fractures, spinal stenosis and abdominal aortic aneurysms are more common
- Spinal stenosis results in psuedo-claudication
- Pain, numbness, and tingling in the LEs improves with flexion, worse with extension

## LABS RADIOLOGIC EVALUATION

- Plain films rarely used for the initial evaluation (LBP)
- Two large prospective studies demonstrated low yield of lumbar spine radiographs
  - Scavone JG, Latshaw RF, Rohrer GV. Use of lumbar spine films. Statistical evaluation at a university teaching hospital. JAMA; 1981:246:1105-8.
  - Scavone JG, Latshaw RF, Weidner WA. Anteroposterior and lateral radiographs: an adequate lumbar spine examination. AJR Am J Roentgenol; 1981:136:715-7.
- CBC
- Sed rate
- Other specific test as per clinical evaluation

## LABORATORY STUDIES

- Do Y-O-U need imaging before performing an ESI?
- The correlation between radiological studies and the success of ESI still is not established
- Thornberry et al: The diagnostic accuracy of MRI, CT and CT/myelogram is not statistically different (1993)
- Can you make this dx based on hx & PE?

## DISC HERNIATIONS

- Not
- Herniated nucleus pulposus
- Protruded disc
- Ruptured disc
- Prolapsed disc

## PHYSIOLOGIC ASSESSMENT

- EMG/nerve conduction test
  - Peripheral neuropathy *vs* radiculopathy or myopathy
  - Electrodiagnostic studies are examiner dependent
  - Should be performed by physicians who are specialists in electrodiagnostic medicine

Dumitru D. Electrodiagnostic medicine. Philadelphia: Hanley & Belfus, 1995.
Wilbourn AJ, Aminoff MJ. AAEM minimonograph 32: the electrodiagnostic examination in patients with radiculopathies. American Association of Electrodiagnostic Medicine. Muscle Nerve 1998;21:1612-31.

## TREATMENT

- Oral steroids
  - What is the appropriate dose?

## TECHNIQUE: EPIDURAL INJECTION

- Interlaminar
  - Most widely used
- Transforaminal
  - More Target Specific?
  - Allow for lower doses of steroid to be used?
- Caudal
  - Preferred for fused backs or for sacral radiculopathies

### EPIDURAL STEROIDS

- Interlaminar approach

### EPIDURAL STEROIDS

- Transforaminal approach

### HERNIATED NUCLEUS PULPOSUS

- With 1.8 transforaminal steroid injection, 75% of patients (N = 69) had good outcomes at 80 weeks
- Transforaminal > Interlaminar > Caudal
- Cost effective

Lutz GE, Vad VB, Wisneski RJ. Fluoroscopic transforaminal lumbar epidural steroids: An outcome study. Arch Phys Med Rehabil 79:1362-1366,1998
Manchikanti L, Pakanati RR, Pampati V. Comparison of three routes of epidural steroid injections in low back pain. Pain Digest 9:277-285,1999
Zennero H, Dousset V, Viaud B et al. Peri-ganglionic foraminal steroid injections performed under CT control. Am J Neuroradiol 19:349-352,1998
Manchikanti L. Focused review: Transforaminal lumbar epidural steroid. Pain Physician. 3:374-398,2000

### OBLIQUE VIEW OF LUMBAR SPINE ANATOMY OF THE L4 NERVE ROOT EPIDURAL STEROIDS

- Caudal approach

### TECHNIQUE ESI

- Flouroscopic guidance recommended
  - Up to 40% blind **Caudal** injections are improperly delivered (location)
  - Up to 20% blind epidural injections are improperly delivered (location)
  - 10% vascular uptake despite negative aspiration

Stitz MY, Sommer HM. Accuracy of blind versus fluroscopically guided caudal epidural injections. Spine 24:1371-1376,1999
Fredman B, Nun MB, Zohar E et al. Epidural steroids for treating "failed back syndrome" Is fluoroscopy really necessary? Anesth Analg 88:367-372,1999

### EPIDURAL STEROID INJECTIONS

- Once the needle/catheter is in position:
  - Turn fluoroscopy unit on
  - Inject while image is on:
    - Rule out IV spread
    - Rule out subarachnoid spread
  - Inject the predetermined amount of medication

### EPIDURAL INJECTION DOSE AND MEDICATIONS

- Old dogma: 120 mg X 3
  - Risk of CHF in elderly population
- Methylprednisolone 40 mg
- Triamcinolone 40 mg
- Betamethasone 6 mg

### CONTROVERSIES: 1, 2 OR 3 ESI?

- Evaluate response after each ESI
- Wait at least two weeks between ESI's due to suppression of Hypothalamic-pituitary axis

Bogduk N. Spine update Epidural steroids Spine 20:845-8,1988
Cicala RS, Westbrook A, Angel JJ. Side effects and complications of cervical epidural steroid injections. J Pain Sympt Manag 4:64-6,1989

### EPIDURAL STEROIDS

- Which steroid?

### PARTICULATE STEROID

Role of particle sizes of steroids investigated
Tiso et al:
MP, TRA, CLTN, BTM Na phosphate
Sizes determined up to > 50 u
Benzon et al:
MP, TRA, DXM, BTM Na phosphate, CLTN
Sizes determined up to > 10,0000 u
Effect of dilution noted

### NASS POSITION STATEMENT (1996)

- "Favorable outcomes for some controlled and many uncontrolled studies suggest that ESI's benefit lumbar radicular pain"
- Therapeutic Success may be best attained with concurrent use of physical therapy



### AHCPR GUIDELINES

- 74 articles screened, 9 RCT's met criteria for review (6 pro, 3 con)

- "ESI are an option for short relief of radicular pain after failure of conservative treatment and as a means of avoiding surgery"

## COMPLICATIONS AND ADVERSE EFFECTS

- Headaches
- Infection
- Bleeding
    - Coumadin ticlid, plavix, asprin, lovenox, etc…
- Paraplegia
- Nerve root injury
- Miscellaneous
    - Increased blood sugar
    - Hypertension
    - Pedal edema, CHF

## CHRONIC PAIN MANAGEMENT – ASA CLOSED CLAIMS PROJECT

- Fitzgibbon DR, Posner KL, et al Anesthesiology 2004;100:98-105
- 284 pain claims – nerve injury and paralysis were the most common
- ESIs were 40% of all claims, including brain damage and death
- Frequent and payments for pain claims increased in the 90's

## PARAPLEGIA

- Two circumstances that co-exist: Unusually low origin of the artery of Adamkiewicz and undetected intra-arterial penetration
- The artery enters the intervertebral foramen at the superior or middle portion of it

Houten J, Errico TJ. Paraplegia after lumbosacral nerve root block: Report of three cases. Spine 2:70-75,2002

## SPINAL CORD INJURY AFTER TF ESI

Spinal cord injury: paraplegia
Injury/vasospasm, occlusion of *segmental/radicular artery*
Proximal *intraneural* spread of injectate

## BRAIN INJURY AFTER TF ESI

Brain: cerebellar/cerebral infarct
Vasospasm of artery
*Vertebral artery* injection
Particulate embolization/occlusion of anterior spinal artery feeder vessels (*ascending & deep cervical arteries*)

## STEROIDS FOR ESI

Lumbar, thoracic, cervical *interlaminar* ESI: any steroid (MP, TRA, BTM)

Lumbar *transforaminal* ESI:

- Betamethasone (if available)
- Triamcinolone
- Methylprednisolone (preferably not)