Epidural Steroid Injections: A Review of the Recent Literature
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What is an Epidural Steroid Injection?
- An injection of a steroid medication into the epidural space with the intent to alleviate pain

Epidural anatomy
- Spinal meninges
- Pia mater
- Arachnoid
- Dura

Epidural
“outside the dura”
How is it administered?

Translaminar: lumbar or cervical

Needle inserted via the midline through the spinal ligament


How is it administered?

Transforaminal: lumbar

- Transforaminal – lumbar
  - Needle inserted via a lateral approach to the neuroforamin
  - Cervical transforaminal steroids no longer recommended

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Vertebral artery
Nerve root

20°-30°
How is it administered?

Caudal

- Needle inserted thru sacral hiatus
How do steroids work?

- Reduce inflammation by blocking transmission of C fiber input.
- Steroids decrease inflammation by inhibiting phospholipase \( A_2 \) action.
- Epidural steroid injection places the medication at the site of inflammation

Indications for Epidural Steroid Injection

- Herniated nucleus pulposus with nerve root irritation
- Herniated nucleus pulposus with nerve root compression
- Annulus tear—hasten recovery
- Spinal stenosis—transient relief
- Post laminectomy syndrome

Contraindications of ESI

- Uncontrolled diabetes
- +/- epidural lipomatosis
- Bleeding concerns
  - Anticoagulation
  - Bleeding disorders
    - Bleeding factor deficiencies
    - Von Willebrand's disease
    - Idiopathic thrombocytopenic purpura (ITP)
    - Low platelet count
    - Severe liver dysfunction
    - Hemophilia
- Infection
### Anticoagulants and ESIs

- **Warfarin (Coumadin)**
  - Stop 5 days in advance of procedure

- **Clopidogrel (Plavix)**
  - Stop 7 days in advance of procedure

- **Low Molecular weight heparin (Enoxaparin)**
  - Last dose 24 hours prior

- **Ticlopidine (Ticlid)**
  - Stop 14 days prior

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### Anticoagulants and ESIs (cont)

- **Platelet GP IIb/IIIa receptor antagonists**
  - abciximab (Reopro)
  - eptifibatide (Integrilin)
  - tirofiban (Aggrastat)
    - Stop 5 days in advance of procedure
    - Resume on postop day
    - Enoxaparin bridge

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### Newer Anticoagulants

- **Dabigatran (Pradaxa)**

- **Rivaroxaban (Xarelto)**

- **Apixaban (Eliquis)**--investigational

- Dabigatran and Rivaroxaban approved in post-op total hip and knee patients

- Research in other settings

How is the procedure performed?

- Lumbar
  - Prone—Preferred
  - Sitting—if person too heavy for procedure table, blind stick
  - Side lying—more likely used with inpatients, blind stick
  - Caudal – through sacral hiatus
  - Loss of resistance technique +/- contrast
- Cervical
  - Prone—Preferred, may use fluor
  - Sitting
  - Loss of resistance or hanging drop technique +/- contrast
  - Fluoroscopic guidance—current standard of care
  - Ultrasound guidance—help determine depth

Potential complications

- Dural puncture—“wet tap”
- Hematoma
  - Spinal injury
  - Direct nerve injury
- Infection
- Direct nerve injury from needle or pressure of injectate
- Vertebral artery dissection
- Stroke
- Death

Potential side effects of the steroid medication

- Localized increase in pain
- Non-positional headaches resolving within 24 hours
- Facial flushing
- Anxiety
- Sleeplessness
- Fever the night of injection
- High blood sugar
- A transient decrease in immunity because of the suppressive effect of the steroid
- Stomach ulcers
- Severe arthritis of the hips (avascular necrosis)
- Cataracts

Epidural Space Identification

- Liquid or air as medium for loss of resistance
- 5 publications included in a meta analysis
- Hypothesis: LOR technique with liquid medium associated with fewer epidural-related complications
- Results
  - Not statistically different in obstetric population
  - Small statistically difference (1.5%) in chronic pain population for post dural puncture headache with fluid


Identification of Cervical Spinous Level

- Control group—palpate for C7 with patient in anatomical position, N=48
- Flex/Ex group—palpate for C& for flexing and extending patients neck, N=48
- Used fluoro to confirm accuracy
- Control—37.5% accurate
- Flex/Ex—77.1% accurate


Ultrasound Guidance

- Advantages
  - Portability, cost, ability to see soft tissues, lack of radiation
  - Help identify needle depth
    - 100% lumbar L4/5, less at higher levels
  - Helpful in pediatric/infant populations
Ultrasound Guidance (cont)

- Limitations
  - Lack of contrast medium for visualization of vascular structures
  - Small window for visualization of needle, injectate and dura mater.
  - Requires 2 people


Quality of Evidence Developed by U.S. Preventive Services Task Force

- Evidence obtained from at least one properly randomized controlled trial
- II-1: Evidence obtained from well-designed controlled trials without randomization
- II-2: Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group
- II-3: Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence
- III: Opinions of respected authorities, based on clinical experience, descriptive studies and case reports or reports of expert committees


Outcome measures

- Short term relief—< 6 months
- Long term relief—> 6 months
- Improvement in function or psychological status
  - This wasn’t always commented on in the reviews
- Return to work
  - Not commented on in the reviews
- Reduction in opioid intake
  - Not commented on in the reviews
- All of these reviews done by the same clinical group
Buenaventura--
Lumbar Transforaminal

- Systematic Review—4 randomized studies included
- Results
  - Short term—level II-1
  - Long term—level II-2
  - Pain reduction—64-81%
  - Disability reduction—60-63%
  - Reduce depression—56%


Benyamin-Cervical Interlaminar

- Systematic Review—1,994 reviewed—3 systematic reviews, 3 randomized studies and 5 observational studies included
- Studies included multiple injections
- Some used local anesthetic alone instead of steroid
- Results—Level II-1
  - Pain reduction—68-79% at 6 months
  - Disability reduction—not reported
  - Reduce depression—not reported
- Limitation—paucity of available research


Parr—Lumbar InterLaminar

- Systematic Review—1,647 reviewed—8 systematic reviews, 20 randomized studies and 30 observational studies included
- Studies included multiple injections
- Some used local anesthetic alone instead of steroid
- Results—
  - Level II-2 for short term and level III for long term—disc herniation or radiculitis
  - Level III for short and long term—spinal stenosis and discogenic pain without radiculitis or hernation
Parr—Lumbar InterLaminar (cont)

- Pain reduction—at 3, 6 and 12 months
  - No significant difference for disc herniation or radiculitis
  - Significant difference in 1 study at 3 months, no significant difference at 6 or 12 months
- Disability reduction—not reported
- Reduce depression—not reported


Conn—Caudal

- Systematic Review—3,387 reviewed—18 randomized studies and 20 observational studies included
- Studies included multiple injections
- Some used local anesthetic alone instead of steroid


Conn—Caudal (cont)

- Results—
  - Level I for short and long term for disc herniation and/or radiculitis and discogenic pain
  - Level II1 or II-2 for Post-laminectomy syndrome and spinal stenosis
  - Pain reduction
    - 56-81% for disc herniation or radiculitis
    - 65-77% post-laminectomy syndrome
  - Disability reduction—not consistently stated in the review
    - One study showed > 40% decrease in 55-70% of patients

Abdi—Epidural Steroids

- Combines all types of ESIs
- < 6 weeks short term and > 6 weeks long term
- Concludes:
  - Moderate evidence for interlaminar cervical and lumbar for long term relief
  - Moderate for cervical and lumbar transforaminals for long term relief in nerve root pain
  - Moderate evidence for caudal for long term relief in nerve root pain and chronic LBP


Boswell—Practice Guidelines-2007

- Includes all spinal procedures but puts into separate procedures
- Caudal—states the reviews come to different conclusions from the same studies
- Concludes
  - Chronic LBP and radicular pain
    - Short term—strong
    - Long term—limited
  - Post laminectomy syndrome and spinal stenosis
    - Limited evidence

Boswell—Practice Guidelines

- Concludes
  - Interlaminar in lumbar radiculopathy
    - Short term—strong
    - Long term—limited
  - Interlaminar in postlaminectomy syndrome
    - Limited
  - Interlaminar in cervical radiculopathy
    - Short term & long term—moderate
  - Transforaminal lumbar
    - Short-term—strong
    - Long term—moderate
Boswell-Practice Guidelines (cont)
- Transforaminal cervical
  - Short and long term—moderate
  - Evidence is indeterminate in managing axial LBP, axial neck pain, and lumbar disc extrusions


ASIPP IPM Guidelines-2009
- Chronic Spinal Pain Interventional Techniques
- Comprehensive review


ASIPP--Caudal
- Level 1—caudal for disc herniation or radiculitis and discogenic pain
- Level II-1 or II-2 for post-laminectomy and spinal stenosis
ASIPP—Cervical, Lumbar & Thoracic Interlaminar

- Level II-1 or II-2

ASIPP

- Common Indications for ESIs
  - Chronic pain poorly responsive to non-interventional or non-surgical therapy
  - Disc herniation or radiculitis
  - Spinal Stenosis
  - Post spinal surgery syndrome
  - Epidural fibrosis
  - DDD/discogenic pain
  - Absence of facet pain
  - Pain causing functional disability
  - Average pain level > 6
  - “Other causes”

Transforaminal Cervical ESIs

- Fallen into disfavor
- Catastrophes
  - Cerebellar and cerebral infacts
  - Spinal cord injury and infarction
  - Massive cerebral edema
  - Visual defects r/t vascular occlusion
  - Persistent neurological deficits
  - Transient quadriplegia
  - Subdural hematoma
- Unknown incidence, but “rare”

**Frequency of ESIs**

- One week apart if in diagnostic phase, 2 weeks preferred in cancer pain
- 2 months or longer in therapeutic phase provided > 50% pain relief ofr 6-8 weeks
- Repeated only as necessary according to medical necessity criteria
- Limit to a max of 4-6 per year


**What steroid does one use?**

- Depends on the type of ESI to be performed
- Cerebral/cerebellar complications occur mainly through intravascular embolization of the particulate steroid in transforaminal ESIs
- No CNS events reported with interlaminar ESIs
- No CNS events reported with non-particulate steroid

**Medications**

- Methylprednisolone (Depo-medrol)
- Triamcinolone (Kenalog)
- Dexamethasone (Decadron)
- Betamethasone (Celestone)
  - Betamethasone sodium phosphate/betamethasone acetate
  - Betamethasone repository (compounded drug)
  - Betamethasone sodium phosphate/betamethasone acetate
  - Betamethasone sodium phosphate
- No study has directly compared efficacy
Comparison of Drugs
- Measured using laser scanning confocal microscope
- Compared diluted vs non-diluted drug
- Compared to size of blood vessels
- Derby measured size of blood vessels

Steroid Medications
- Methylprednisone 80mg/ml with more particles than 40mg/ml
- Compounded betamethasone with more particles than commercial betamethasone
- No statistical difference between methylprednisolone and triamcinolone and compounded betamethasone
- INCREASED proportion of particles in MORE HIGHLY DILUTED methylprednisolone 80mg/ml
- Otherwise dilution decreased % larger particles
- Dexamethasone and betamethasone phosphate were pure liquid

Steroid Medications Recommended
- Benzon recommends non-particulate steroid
  - betamethasone phosphate for transforaminal ESI's
- Benzon states dexamethasone should be used with caution until further studies clarify safety and efficacy
- Derby states “Interventionalists might consider using a nonparticulate steroid when performing cervical transforaminal injections”
- Derby states “Dexamethasone is less likely to cause arterial or capillary obstruction…”

Summary

- ESIs most used interventional technique
- Many patients achieve significant benefit
- Conflicting results from systematic reviews
- None reach Level I evidence
- No specific medication recommendations for interlaminar ESIs
- Non-particulate medications recommended for transforaminal ESIs
- Debate as to whether to do cervical transforaminal injections
- ASRA recommendations for anticoagulation
- Use of fluoroscopy is standard of care

References: