Cervical Interlaminar Epidural Steroid Injections
Objectives

- Indications/contraindications
- Pathophysiology
- Pharmacology
- Efficacy
- Complications and side effects
- Anatomy
- Technique
History

- Cervical ILESI first described by Dogliotti in 1933
- Early injections were performed “blind” with interlaminar “loss of resistance” technique or “hanging drop” technique
Indications

- Cervical radiculitis or radiculopathy
- Cervical discogenic pain
- Cervical spondylosis
- Chronic cervicalgia
- Diabetic polyneuropathy/plexitis
-Chemotherapy related neuropathy
- Postherpetic neuralgia
- Complex regional pain syndrome
- Postcervical laminectomy syndrome
- Cervicogenic headache

Radiculopathy first described in 1817
Epidemiological survey Rochester, MN 1976-1990
561 patients (332 males and 229 females)
Average annual age-adjusted rates for cervical radiculopathy have been documented as 83 per 100,000 population per year
Most common levels are C7 46.3% and C6 17.6%
Pathophysiologic basis for radicular pain rests upon three proposed mechanisms: biomechanical, biochemical/inflammatory, and neovascularization

Lidocaine

- Has been shown to have an anti-inflammatory effect on nucleus pulposis induced nerve injury
- Has been shown to increase intra-radicular blood flow in an animal compressed nerve root model
- May improve intra-neural metabolism and reduce inflammatory mediators
- May dilute epidural inflammatory mediators

Corticosteroids

- Mitigate nerve conduction slowing due to inflammation
- Block nocioceptor C-fiber conduction
- Inhibit prostaglandin synthesis
- Affect cell-mediated activity and cytokines which may be involved in the pathogenesis of radicular pain

Corticosteroids

- Dexamethasone - Particles were 5-10 times smaller than red blood cells, contained few particles, and showed no aggregation.
- Triamcinolone - Particles varied greatly in size, were densely packed, and formed extensive aggregations.
- Betamethasone - Particles varied greatly in size, were densely packed, and formed extensive aggregations.
- Methylprednisolone - Particles were relatively uniform in size, smaller than red blood cells, densely packed, and did not form very many aggregations.

Corticosteroids

Dexamethasone

Betamethasone

Corticosteroids

- Volunteer patients randomized to receive a single transforaminal injection with either dexamethasone or triamcinolone.
- Ratings obtained by an independent unbiased assessor at 4 weeks via a telephone interview.
- VAS used preprocedurally and verbal integer scale used at 4 weeks to assess severity of radicular pain.
- Both groups exhibited statistically and clinically significant improvements in pain at 4 weeks.
- Although the triamcinolone group exhibited a somewhat greater improvement, the difference between groups was not significant.

Contraindications

- **Absolute:**
  - Patient refusal - “no” means “no”
  - Bacterial infection (systemic or localized)
  - Bleeding diathesis
  - Intracranial hypertension

- **Relative:**
  - Allergy to medications (< 1% incidence with non-ionic contrast)
  - Pregnancy
  - Medications which increase bleeding risk
  - Hyperglycemia
  - Adrenal suppression
  - Immune compromise
  - CHF
  - Altered epidural anatomy
Efficacy

- Most early studies were performed blind.
- Blind cervical ILESI may be misplaced 53% of the time on first attempt to enter the epidural space using loss of resistance technique (13-30% in the lumbar spine).
- A multicenter, retrospective analysis of cervical epidurograms.
- Epidurograms of 38 cervical epidural steroid injections in 31 patients were reviewed.
- Drawback: medication in the epidural space tends to flow in the direction of least resistance: unilateral in 51% and ventral in only 28%.
- Foraminal and entrance zone disc herniations, cervical spondylotic foraminal stenosis, and epidural fibrosis can potentially block the flow of medication from an ILESI to the involved DRG.

<table>
<thead>
<tr>
<th>Investigators</th>
<th>Study design</th>
<th>N</th>
<th>Diagnosis</th>
<th>CESI type</th>
<th>F/U</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rowlings and Kirschenbaum</td>
<td>Retrospective</td>
<td>25</td>
<td>Non-specific</td>
<td>Blind</td>
<td>8.9 months</td>
<td>24% excellent 40% &gt;75% relief</td>
</tr>
<tr>
<td>Mangar and Thomas</td>
<td>Observational</td>
<td>40</td>
<td>HNP Spondylosis</td>
<td>Blind</td>
<td>Not stated</td>
<td>38% &gt;70% relief 7% &gt;50% relief 32% no relief</td>
</tr>
<tr>
<td>Ferrante</td>
<td>Retrospective</td>
<td>100</td>
<td>Mixed</td>
<td>Blind</td>
<td>13.5 months</td>
<td>62% with radiculitis with &gt;50% relief</td>
</tr>
<tr>
<td>Stav</td>
<td>Randomized</td>
<td>60</td>
<td>Mixed</td>
<td>Blind</td>
<td>1 year</td>
<td>&gt;50% decrease VAS ESI: 68% T.P. 11.8%</td>
</tr>
<tr>
<td>Castagnera</td>
<td>Randomized</td>
<td>24</td>
<td>Chemical radiculitis</td>
<td>Blind</td>
<td>3 months</td>
<td>VAS 87% decrease Steroid:lidocaine = Steroid:morphine</td>
</tr>
<tr>
<td>Grenier</td>
<td>Prospective</td>
<td>29</td>
<td>Chemical radiculitis</td>
<td>Blind</td>
<td>2 years</td>
<td>83% Success</td>
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</table>

Complications and Side Effects

- **Needle Placement:** Pain at the injection site, nerve root injury, spinal cord injury, epidural hematoma, epidural abscess, meningitis, osteomyelitis, postdural puncture headache, CRPS, pneumothorax
- **Local Anesthetic Effect:** Weakness from motor block, hypotension, cardiac arrhythmia, seizure, allergic reaction
- **Steroid Effect:** Fluid retention, elevated blood pressure, hyperglycemia, hypothalamic-pituitary-adrenal axis suppression, Cushing syndrome, steroid myopathy, generalized erythema/facial flushing, allergic reaction

Complications and Side Effects

- Rate of complication ranges from 0% to 16.8%.
- Many early studies flawed due to inclusion of transient acceptable known side effects or complications resulting from earlier inadequate technique.

## Complications and Side Effects

<table>
<thead>
<tr>
<th>Minor</th>
<th>Major</th>
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</thead>
<tbody>
<tr>
<td>Increased axial neck pain</td>
<td>Subdural complications</td>
</tr>
<tr>
<td>Headache</td>
<td>Dural puncture</td>
</tr>
<tr>
<td>Facial flushing</td>
<td>Post dural puncture headache</td>
</tr>
<tr>
<td>Vasovagal episodes</td>
<td>Neuropathic symptoms</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>Intracranial hypotension</td>
</tr>
<tr>
<td>Fever</td>
<td>Epidural granuloma</td>
</tr>
<tr>
<td>Hypotension</td>
<td>Permanent spinal cord injury</td>
</tr>
<tr>
<td>Respiratory insufficiency</td>
<td>Intravascular uptake of injectate</td>
</tr>
<tr>
<td>Subjective weakness</td>
<td>Pneumocephalus</td>
</tr>
<tr>
<td>Insomnia</td>
<td>Venous air embolism</td>
</tr>
<tr>
<td>Acne</td>
<td>Cervical epidural abscess</td>
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<tr>
<td>Muscle contractions</td>
<td>Cushing’s syndrome</td>
</tr>
<tr>
<td>Prevertebral abscess</td>
<td>Retinal hemorrhage</td>
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<tr>
<td>Superficial infection</td>
<td>Death</td>
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Complications and Side Effects

- Tetraplegia has occurred after cord penetration of sedated patients following interlaminar CESI
- Needle penetration of the cord in alert patients can be without pain or paresthesias, but injection of contrast agent into the cord produces pain
- Excessive sedation may increase risk of intramedullary injection
- Injury thought due to cord ischemia

Complications and Side Effects

- Retrospective survey of 17/29 ISIS course instructors: ILESI 4389/5968.
- 23 (0.52%) minor complications; rate not different from TFESI
- Include dural puncture headaches, transient vagal episodes, prolonged complaints of new or increased numbness or paresthesias.
- Overall, there were about 5 minor complications per 1000 epidural injections

Complications and Side Effects

- Retrospective cohort design study.
- Charts of 157 patients who received 345 injections were reviewed.
- Complications per injection included 23 increased neck pain (6.7%), 16 transient non-positional headaches that resolved within 24 hours (4.6%), 6 episodes of insomnia the night of the injection (1.7%), 6 vasovagal reactions (1.7%), 5 facial flushing (1.5%), 1 fever the night of the procedure (0.3%), and 1 dural puncture (0.3%).
- All complications resolved without morbidity and no patient required hospitalization.

Anatomy

- The epidural space contains loosely packed connective tissue, fat, a venous plexus, small arterial branches, lymphatics, and fine fibrous bands which connect the thecal sac with lining tissue of the vertebral canal.
- Diameter of the posterior epidural space: 1.5-2 mm at C7, 3-4 mm at T2.
- Bordered posteriorly by the ligamentum flavum and laminae, anteriorly by the PLL and vertebral bodies.
- Bordered laterally by the pedicles and intervertebral foramina.

Anatomy

- The ligamentum flavum has a left and right portion
- Becomes thinner in the thoracic ad cervical spine
- Demonstrates a variable degree of midline fusion.
- Incidence of midline gaps: C5-6 (74%), C6-7 (64%), C7-T1 (51%), T1-2 (21%).
- The interspinous ligament is absent in the cervical spine
- Lack of resistance due to absence of interspinous ligament and unfused ligamentum flavum could lead to inadvertent dural and cord puncture

Anatomy

- Posterior internal vertebral venous plexus is located within and drains the interlaminar space.
- The plexus connects to the internal vertebral vein which travels with the exiting spinal nerve.
- The vertebral vein drains into the brachiocephalic vein at the junction of the internal jugular vein and subclavian vein.
- Left and right brachiocephalic veins join to form the brachiocephalic trunk.

Technique

Technique

- Patient prone on fluoroscopy table with arms at side
- Neck is slightly flexed
- Skin C7-T1 interspace
- Skin wheal raised with 10:1 mixture of 1% lidocaine and 8.4% bicarbonate over the C7-T1 interspace
- Needle is advanced until contact is made with the lamina of T1
- Lateral view is obtained and needle is repositioned slightly superiorly

Technique

- Needle is advanced in the lateral plane until positioned just posterior to spinolaminar line
- Loss of resistance syringe is attached
- Needle is advanced until tip is midline and at or slightly beyond the spinolaminar line
- Once loss of resistance occurs or needle tip is at the spinolaminar line syringe with non-ionic contrast is attached using low volume extension tubing

Technique

- Contrast is injected under live fluoroscopy
- Venous pattern: needle withdrawn and repositioned
- Arterial pattern: procedure should be abandoned
- Myelographic/subarachnoid/subdural pattern: procedure should be abandoned
- Next, a 3-5 cc volume of solution consisting of 1.5-2cc steroid and the remainder 0.5-1% preservative-free lidocaine is injected.

Technique
Technique

Conclusions

- ICESI is a safe and effective procedure in the management of cervical radicular syndromes.
- Estimation of complications may be exaggerated due to the inclusion of transient acceptable known side effects or complications resulting from earlier inadequate technique.
- True incidence of complications is difficult to identify.
- Mastery of injection techniques and management of complications should be mandatory.
Questions?
Safety

- Mild conscious sedation
- Fluoro with digital subtraction
- Multiplanar imaging
- Contrast with extension tubing
- 1 cc test dose preservative-free 1% lidocaine; wait 60-90 seconds
- Small volume of injectate (~3cc)
- Dexamethasone mixed with normal saline (instead of lidocaine)