Musculoskeletal Imaging and Intervention Section Procedures
Fluoroscopic Cervical Transforaminal Epidural Steroid Injection

INDICATIONS
• To relieve radicular symptoms with or without neck pain from cervical root irritation; to delay or prevent surgery
•Goal: Deliver injectate to ventral epidural space in region of posterior annulus, ventral aspect of nerve root sleeve and intervertebral neural foramen (pain sources)

RISKS
• Hematoma • Pain • Infection • Nerve damage • Transient weakness or paralysis • Injury to carotid or vertebral arteries • Stroke (thought to be secondary to intravascular injection of a particulate steroid with embolism of vascular structures with infarction) • Death

PREREQUISITES
• Patient accompanied by someone to drive home
• AP and lateral C-spine radiographs
• Cervical spine MR scan within the last 24 months
• Obtain signed consent

MATERIALS
• 3 mL syringe (medication is clear, so don't use a 10 mL syringe)
• 25G 2", 2.5" or 3.5" needle
• 1% lidocaine (for skin numbing); preferably buffered with sodium bicarbonate
• Omnipaque 300
• 1% preservative-free lidocaine without epinephrine
• Dexamethasone 10mg/cc

TECHNIQUE
1. Review imaging, check request, and discuss symptoms with patient to confirm or determine level. When evaluating the patient's MRI, always identify the vertebral artery at the level to be injected to assure that it is not aberrant and/or completely blocking access to the neural foramen. Be familiar with the anatomy, remembering that there are 7 cervical vertebrae and 8 cervical nerves; e.g. if the C5 nerve is to be blocked, target C4-C5.

2. Place patient supine on the fluoroscopy table. Have the patient turn head AWAY from symptomatic side as much as is comfortable/tolerable.
3. Move the C arm/I-I in the same direction as head rotation to obtain a true AP projection to the target. Store this projection so you can get return to it later.
4. Obtain the trajectory view and localize the proper level and neural foramen by counting down from C2. Generally, the tube will need to be angled 40-45° toward the side to be injected. Within or close to this range, optimize the size of the target foramen (slight change in obliquity may open up the foramen more optimally). Store this projection also. Do not use craniocaudal tilt unless absolutely necessary (doing so increases distance to the foramen).

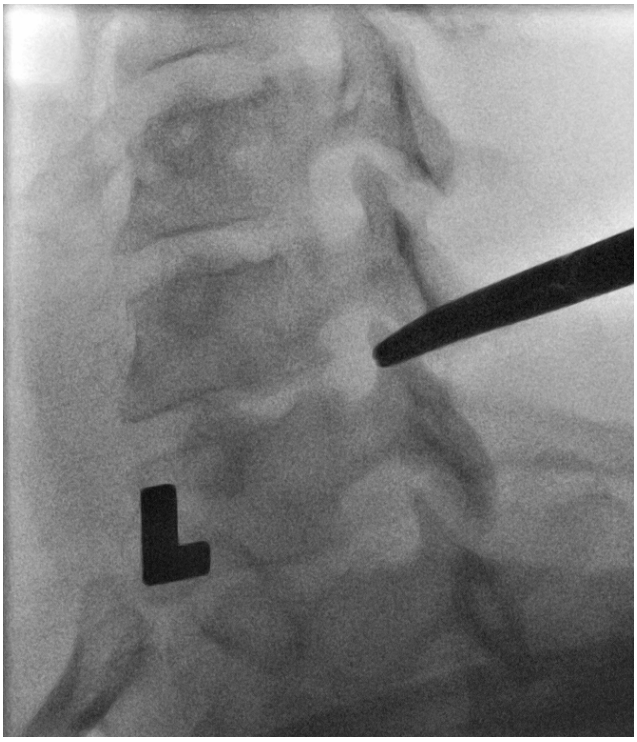

Fig 1: Foramen selection.

5. Mark the posterior-inferior corner of the neural foramen to be injected. Optimal target is the bone overlying the junction of the inferior/caudal posterior half of the IVF and the superior articular process (SAP) with skin entry over the SAP.
6. Prep the skin. Local anesthetic is used sparingly in the deep soft tissues in order to avoid the consequences of infiltration in the cervical epidural space. Some staff elect to numb the skin in the normal fashion with 1% buffered lidocaine with only a skin wheel, while others will use the 1.5-inch needle to numb half way in.
6. Choose proper needle. In thinner patients or in the mid to upper C spine, a 2-inch 25-gauge needle may be adequate. In larger patients, a 2.5- or 3.5-inch 25 G spinal needle may be needed.
7. Hold needle tip with Kelly clamp to check spot. Once spot is confirmed, advance needle through skin before holding needle with Kelly clamp to check needle trajectory under fluoro.
8. Once trajectory is confirmed (“bullseyed”), remove Kelly clamp and advance needle slowly in the oblique control view with frequent checks in the true AP plane to determine depth. The needle tip should not stray anteriorly or superiorly as this will greatly increase the chances of encountering the vertebral artery or contacting the targeted nerve or the one above.
8. The expected depth of the nerve root to be injected is greater than 2 mm inside the most lateral cortex of the articular pillar (lateral masses) but not farther than the half way point to the uncinate process at this level.

Advance to this depth or until the patient reports radicular shoulder or arm pain, and the needle tip is in vicinity of the proper depth.

9. At this point, carefully connect the low-pressure tubing, and Inject a small amount of Omnipaque 300 under real-time fluoroscopy in AP projection. The injection should produce a flow along the nerve root with extension toward the epidural space (Figure 2 & 3); eventually contrast will enter the epidural space, both superiorly and inferiorly. Be cognizant of any vertically oriented or rapidly dissipating contrast that might represent an intravascular injection. If intravascular injection is seen, either advance or retract depending on current depth of the needle as detailed in "potential pitfalls" below.

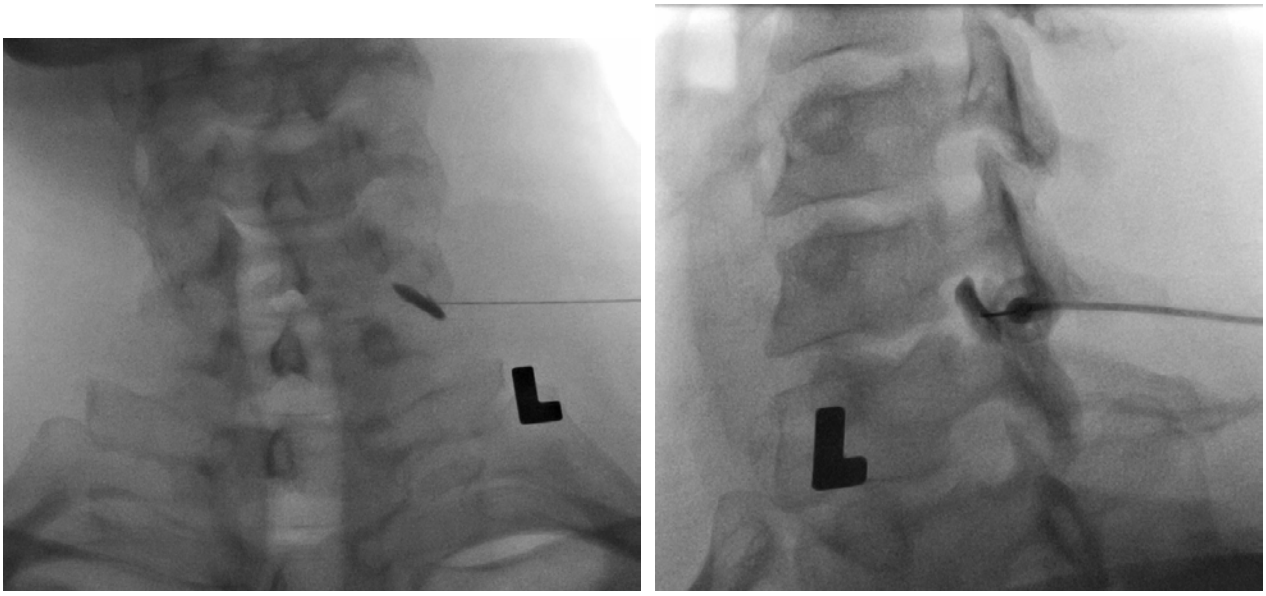

Fig 2 and 3: Contrast injection.

10. Disconnect the contrast from the low-pressure tubing and attach the syringe with the treatments solution (1 mL dexamethasone & 1 mL preservative-free 1% lidocaine). The cervical epineural space is the smallest space that we inject, and this minimizes manipulation of the needle tip during the procedure.

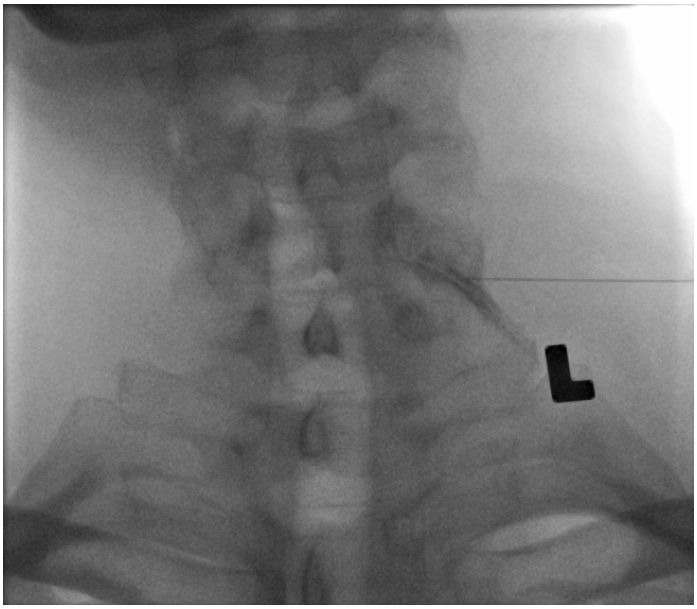

Figure 4

11. If epidural flow was produced, either inject:
1) A 1 cc test dose of 1% preservative free lidocaine under fluoro to confirm no vascular flow and see expected dilution of contrast in the desired epidural space (Figure 4). Wait 60-90 seconds, and ask the patient if they experience any abnormal symptoms before injecting 1.0 cc of Dexamethasone 10mg/mL
OR
2) Inject a small amount of a 2 mL injectate composed of 1 cc Dexamethasone 10mg/mL and 1 cc 1% preservative-free lidocaine under fluoro to confirm dilution of contrast before slowly injecting the remaining portion of the injectate to treat the desired level.
12. Remove the needle. Ask if the patient's symptoms have changed and discuss how to keep a "pain diary" with the patient to present to the referring clinician.

POTENTIAL PITFALLS
1. Intraarterial injection: NEVER inject medication if there is a possibility of intraarterial injection. There is a risk of stroke though this risk is reduced because nonparticulate injectate is used (dexamethasone and 1% preservative-free lidocaine). The needle tip should be advanced or incrementally withdrawn until no additional intraarterial injection can be seen. If the needle tip is close enough to the expected position of the nerve root, the therapeutic injection can proceed as flow will often extend into the epidural space. The ability to detect intraarterial injection is the strength of fluoroscopy guidance over CT guidance.
2. Intravenous injection: If a clear intravenous injection is encountered, the needle must be repositioned. Often withdrawing the needle will result in continued intravenous injections until you are too superficial to inject the targeted cervical nerve root. Often minutely advancing the needle will result in resolution of the intravenous injection and it will be safe to inject the therapeutic solution. Side note: intravenous dexamethasone can produce short-term perineal burning/tingling!
3. Avoid dural sleeve and spinal cord puncture; Do not advance the needle tip beyond the midline of the articular pillar.
4. Persistent radicular pain: The patient can develop transient radicular pain as you approach an inflamed cervical nerve root or as you enter the epineural space. This pain should dissipate over a short time. If the pain persists, it is likely that the needle tip is within the nerve itself, and the needle should be carefully withdrawn in very tiny intervals until the patient's pain subsides.
4. Premature radicular pain: The nerve roots run very close together after they exit the neural foramina, especially in the region of the brachial plexus. If the patient experiences significant radicular pain with the needle tip superficial to the depth at which we would expect to encounter the targeted nerve root, try re-routing slightly and continue advancing the needle until the tip overlies the lateral vertebral cortex on the true AP projection. Injecting a nerve root lateral to the lateral masses will end up treating the wrong level.

Write-up credit: Kelly Capel, MD