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Case Report

Hemiparesis and Facial Sensory Loss following Cervical Epidural Steroid Injection

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Interlaminar cervical epidural steroid injections (ic-ESI) are safe and effective treatment options for the management of acute and chronic radiculopathy, spinal stenosis, and other causes of neck pain not responding to more conservative measures. However, the procedure inherently lends itself to possible spinal cord injury (SCI). Though reports of such events have been documented, the clinical presentation of patients with needle puncture SCI varies. In part, this may be due to anatomic considerations, as symptoms may be dependent on the cervical level intruded, as well as the volume and type of injectate used.

Many cases go unreported and therefore the true incidence of cord injections during ic-ESI is not known. Cervical epidurals can be performed by the transforaminal or interlaminar approach. It is generally accepted that ic-ESI is safer than transforaminal epidurals. There are numerous reports of arterial invasion or irritation with the latter despite an inherently greater risk of cord puncture with the former. The likelihood of cord interruption rises when ic-ESIs are performed above C6-C7 as there is a relatively slim epidural layer compared to lower cervical epidural zones. Though most cases of devastating outcomes, such as hemiplegia and death, have been reported during cervical transforaminal epidural injections and rarely with ic-ESI, it is important to understand the symptoms and potential pitfalls of performing any cervical epidural injection. Cervical epidural malpractice claims are uncommon, but exceed those of steroid blocks at all the levels combined, demonstrating the need for improved awareness of potential complications in ic-ESI. Here, we will describe an unusual presentation of a spinal cord injection during an ic-ESI procedure.

Key words: Cervical epidural, spinal cord, hemiparesis

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Interlaminar cervical epidural steroid injections (ic-ESI) are safe and effective treatment options for the management of acute and chronic radiculopathy, spinal stenosis, and other causes of neck pain not responding to more conservative measures (1). However, the procedure inherently lends itself to possible spinal cord injury (SCI). Though reports of such events have been documented, the clinical presentation of patients with needle puncture SCI varies. In part, this may be due to anatomic considerations, as symptoms may be dependent on the cervical level intruded, as well as the volume and type of injectate used (2,3).

Many cases go unreported and therefore the true incidence of cord injections during ic-ESI is not known. Cervical epidurals can be performed by the transforaminal or interlaminar approach. It is generally accepted that ic-ESI is safer than transforaminal epidurals. There are numerous reports of arterial invasion or irritation with the latter despite an inherently greater risk of cord puncture with the former. The likelihood of cord interruption rises when ic-ESIs are

performed above C6-C7 as there is a relatively slim epidural layer compared to lower cervical epidural zones. Though most cases of devastating outcomes, such as hemiplegia and death, have been reported during cervical transforaminal epidural injections and rarely with ic-ESI, it is important to understand the symptoms and potential pitfalls of performing any cervical epidural injection. Cervical epidural malpractice claims are uncommon, but exceed those of steroid blocks at all the levels combined, demonstrating the need for improved awareness of potential complications in ic-ESI. Here, we will describe an unusual presentation of a spinal cord injection during an ic-ESI procedure.

Case Report

History

A 54-year-old woman with a history of hypertension, hyperlipidemia, arthritis, and right-sided chronic head and neck pain for 10 years underwent 2 cervical facet injections for the latter with minimal relief. Subsequently, a right C5-C6 interlaminar injection was performed at an outside institution with sedation. Upon waking from anesthesia, she experienced severe right neck pain, right face, arm, and leg numbness. followed by gradual right arm and leg weakness over one hour. She did not report any other constitutional symptoms. Acetaminaphen 500 mg did not improve her pain. There was minimal strength improvement over the next 9 hours with conservative care and she was sent to our medical center emergency room and was admitted for further observation and treatment.

Examination

In the emergency room, her vital signs were normal. She was alert, able to communicate appropriately, and followed complex commands correctly. She had significant loss of sensation on the right side of her face, along all branches of the fifth cranial nerve distribution. No facial droop was apparent. Right sided upper extremity manual muscle testing displayed weakness of 0/5 proximally and 2/5 distally; she was able to perform a shoulder shrug on the left, but not on the right side. Right lower extremity strength was diffusely 3/5. Left upper extremity and lower extremity had normal strength. Pressure, light touch, and vibration sensation was decreased on the right face, arm, and leg; temperature discrimination was diminished over the left lower extremity. Reflexes were diffusely 3+, except for the right upper extremity, where they were muted. Plantar response were muted. Her gait was unsteady and ataxic with a pronounced left sided lean. A right paracentral puncture site was identified over the dorsal neck approximating C5-C6 (Fig. 1).

Fig. 1. *A right paracentral puncture site was identified over the dorsal neck approximating C5-C6.*

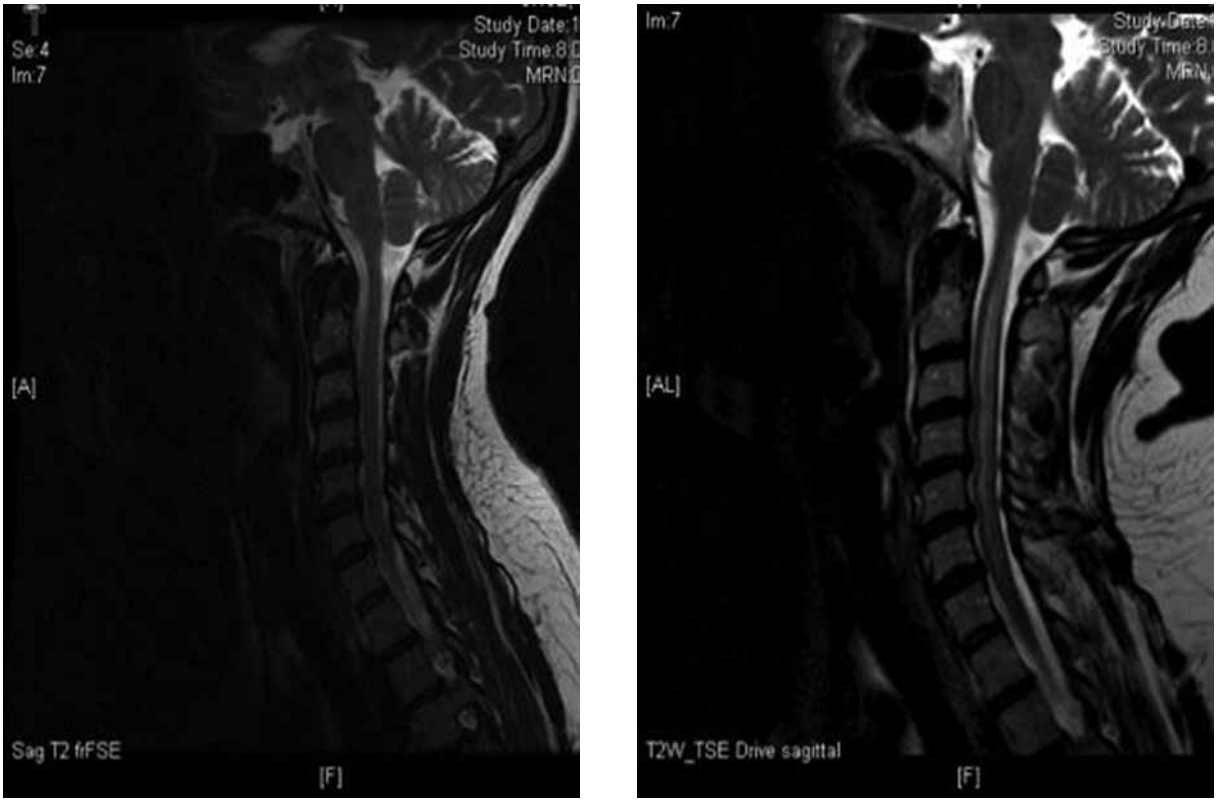

Fig. 2. MRI cervical spine pre-procedure (left) compared with post procedure (right) displayed a new abnormally increased T2 weighted signal in the cervical spinal cord extending from C6-C7to the base of the brain.

Clinical Course

Magnetic resonance imaging (MRI) of the brain was unremarkable. An MRI of the cervical spine post procedure compared with pre procedure displayed a new abnormally increased T2 weighted signal in the cervical spinal cord extending from C6-C7 to the base of brain (Fig. 2a and 2b). She was started on IV steroids and neuro-surgical evaluation was obtained emergently. No surgical intervention was recommended.

The patient was started on intensive physical and occupational therapy on post-operative day 2. No changes were made to her medical regimen. Her gait improved over 5 days as did her sit to stand transfers. By post-procedure day 3 she displayed a modest improvement of right shoulder abduction (0 to 40 degrees) without improvement of right shoulder shrug; on post procedure day 5 she was discharged to an acute rehabilitation center.

Examination 3 Months Later

Three months after discharge, her hemi-sensory deficit had returned to normal. However, she remained moderately weak in the right leg; manual muscle testing was grossly 4/5. She required a cane to walk in the house and could only tolerate walking > 50 feet with a rolling walker. Flexion and abduction of the shoulder was limited due to pain.

Discussion

This patient presented with acute cervical cord syndrome and depicts one of the serious complications of cervical epidural injections. Cases of plegia have been described, but facial numbness has never been reported.

We would like to describe the anatomy of the trigeminal nerve, concentrating mainly on the spinal trigeminal nucleus, to understand its involvement in our case. The trigeminal nerve is the main sensory nerve of the head. It contains one motor nucleus and 3 sensory nuclei, which are located in the brain stem. The 3 sensory nuclei are

1) principal sensory nucleus,
2) mesencephalic nucleus, and
3) spinal trigeminal complex.

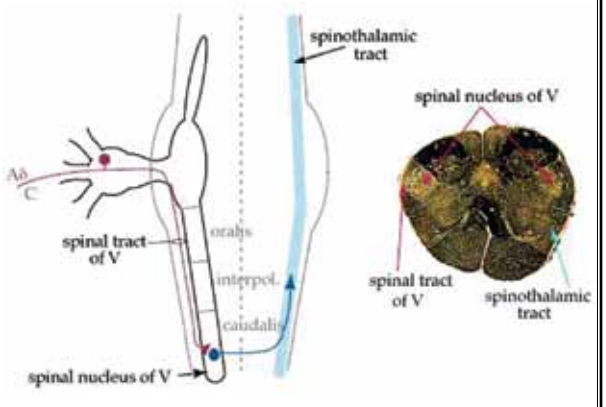

Fig. 3. *Sensory nerve fibers from the trigeminal ganglion form the spinal tract V which synapses in the spinal trigeminal nucleus (www.bioon.com/bioline/neurosci/course/face.html).*

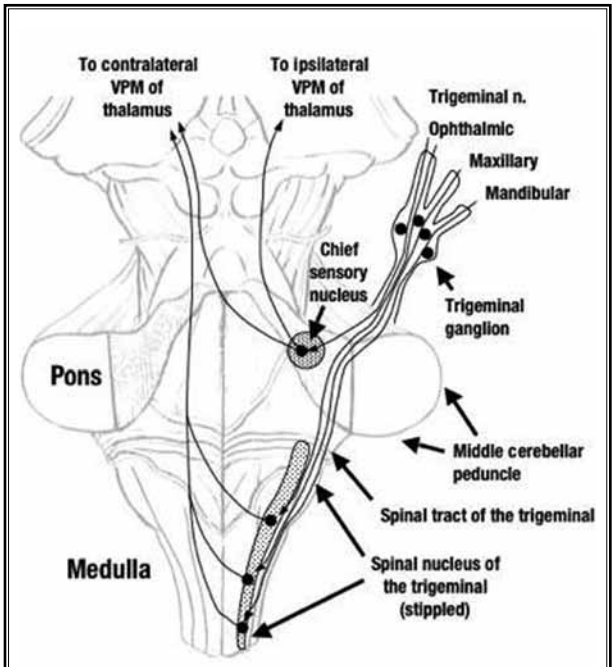

Fig. 4. *Trigeminal tracts and nuclei are superimposed over a dorsal view of the brain stem with the caudal medulla at the lower aspect of the figure and the midbrain at the upper. Note that the mesencephalic tract and nucleus are not shown (www.dartmouth.edu/~rswenson/NeuroSci/figures/Figure_16.html).*

The spinal trigeminal nucleus is the longest nucleus and extends caudally from the medulla to the third cervical segment of the spinal cord.

Based on the cytoarchitecture, the spinal trigeminal nucleus is divided into
1) subnucleus oralis,
2) subnucleus interpolaris, and
3) subnucleus caudalis.

The sensory nerve fibers from the trigeminal ganglion form the spinal tract V which synapses in the spinal trigeminal nucleus (Fig. 3). From the spinal nucleus, second order neurons cross to the opposite spino-thalamic tract and are relayed to the thalamus (Fig. 4). Spinal trigeminal nucleus and spinal tract V are also associated with facial, glossopharyngeal, and vagus nerves as the sensory information conveyed by these nerves is also routed through spinal tract V and spinal trigeminal nucleus to the brain. Thus any involvement of the spinal nucleus can impair the sensation of the ipsilateral face. It has been proposed that the spinal trigeminal nucleus is also closely associated with the spinal accessory nerve where there is convergence of trigeminal and cervical afferents in the trigeminocervical complex of brain stem (Fig. 5) (4,5).

Cervical epidural injections can be performed by the transforaminal route or the inter-laminar route. The transforaminal approach has the advantage of delivering medication close to the desired nerve root level but needle injury causing peri-arterial spasm and embolism risk is significant (6). Ic-ESIs deliver medication 2 to 3 cervical levels from the injection site but risk of spinal cord injury is inherently higher than transforaminal approach due to the approximation of the needle tip and spinal cord, which can be as close as 1 mm at the C5 level (7). Loss of resistance techniques to identify the epidural space lack specificity, as ligamentum flavum, a proprioceptive guide when performing interlaminar epidurals, may be deficient. This lack of proprioceptive feedback can result in inadvertent cord puncture (8,9). Pain elicited during epidural injection may alarm the provider to potential cord invasion; however, if the patient is sedated, a painful response may not be elicited (10). The performance of ic-ESIs are recommended at the C7-T1 level because the epidural space at C7-T1 is the widest cervical segment. Though other cervical levels are commonly injected, they remain inherently more precarious (11). Comorbid flavum hypertrophy, disc bulges, or anterior canal disc-osteophyte complexes may deteriorate the epidural space.

In our case, the patient had an interlaminar epi-

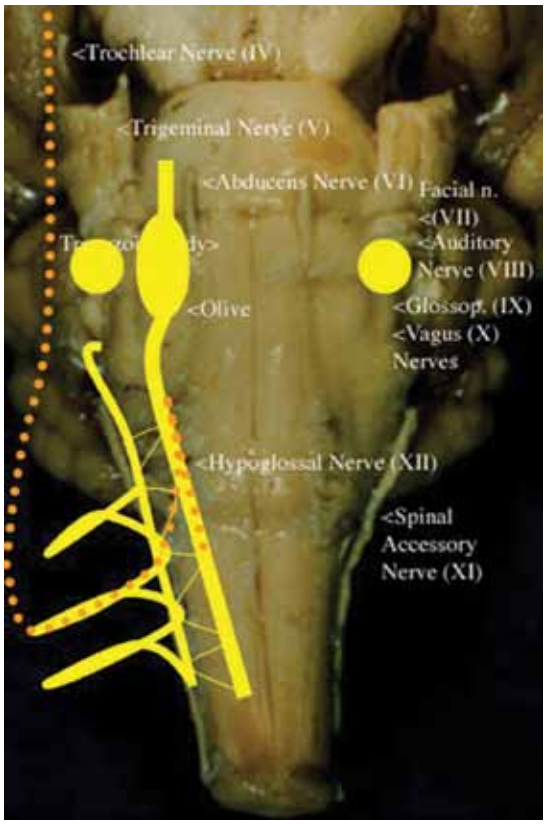

Fig. 5. *Figure demonstrating that the spinal trigeminal nucleus may be closely associated with the spinal accessory nerve where there is convergence of trigeminal and cervical afferents in the trigemino-cervical complex of brain stem.*

dural steroid injection at the C5-C6 level. We assume that the practitioner selected this level because it most closely approximated her neural injury level. However, this level was affected by degenerative disc disease and amelioration of epidural space (Fig. 6). Our patient was sedated during the procedure and could not prompt the technician with the painful response of an intramedullary injection. We believe that intramedullary injection was performed because close approximation of the cord and the lamina mitigated the proprioceptive feedback (loss of resistance) used by most physicians to inject into the epidural space. After the injection, there was clear evidence that the cord was injured. An initial MRI done after the procedure displayed increased T2 weighted signal in the cervical spinal cord extending from C6-C7 to the base of brain. On repeat MRI of the cervical cord, hematoma was observed within the le-

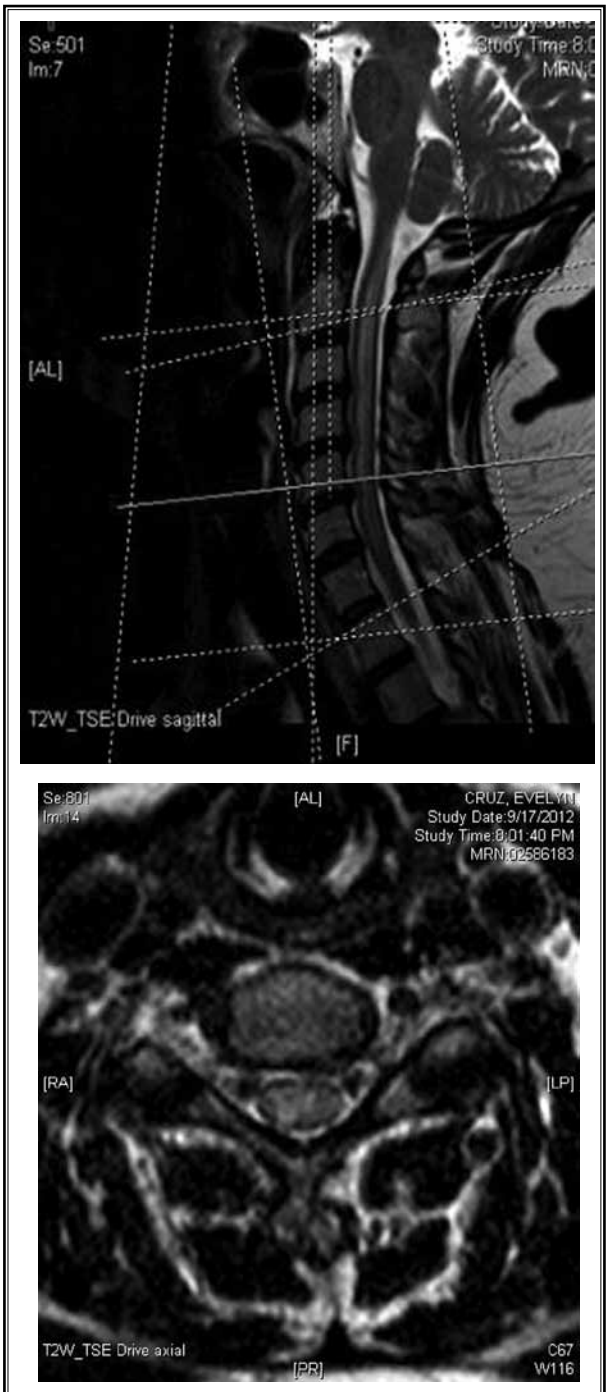

Fig. 6. *Degenerative disc disease displaying amelioration of epidural space at C5-C6. Note the area of hyperintensity (arrow) demonstrating site of needle entry within cord.*

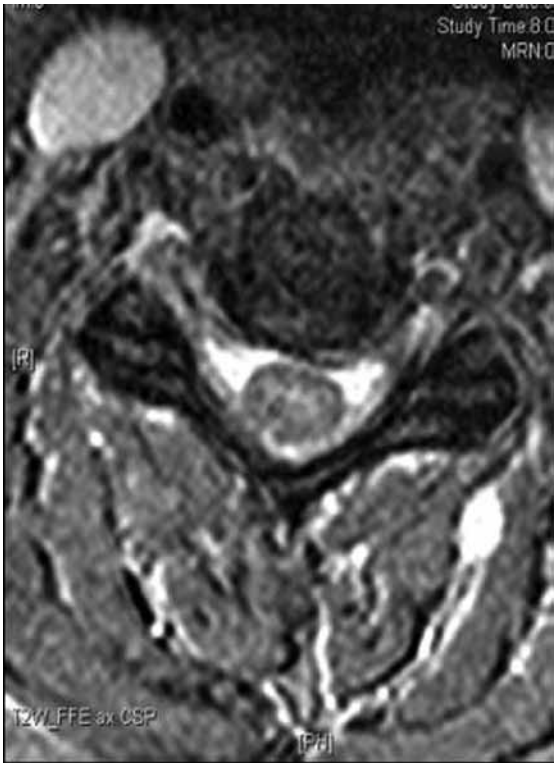

Fig. 7. *Cervical cord hematoma was observed within the lesion suggesting intramedullary injection.*

sion; suggesting intramedullary injection (Fig. 7).

The injection immediately produced ipsilateral facial droop and trapezius weakness. We postulate that the intramedullary injectate was pushed rostrally, affecting the spinal nucleus of the trigeminal nerve and causing sensory loss of the ipsilateral face. It is also feasible that the needle may have directly damaged the CN V spinal nucleus, which in some cases can extend lower than C3. Our patient's inability to actively shrug her shoulder may have been due to an indirect insult of the spinal accessory nerve due to CN V spinal nucleus injury, as co-innervation of CN V and spinal accessory nerve has been physiologically and anatomically described (4,12). The associated lower extremity hemiplegia was likely due to disruption of the motor fibers adjacent to the injectate.

It is important that evaluations and performance of cervical spinal injection are performed with diligence and care because of the potentially serious complications. Cervical spinal cord injuries secondary to interlaminar injections are rare but can cause weakness of the face or shoulder causing severe functional impairment. This is the first reported case of facial and shoulder paresthesia following c-spine injection and this expands the risks we describe to our patients pre- and post-procedure. This case also lends validity to the accessory nerve and cranial nerve V communication. It is important to understand that injury to the cervical cord may result in permanent damage and the following recommendations need to be followed diligently. These recommendations are not new but a reiteration will stress their importance.

Recommendations

Review of an MRI or computed tomography (CT) should precede every injection and the appropriate level of injection should be selected appropriately. Injection of interlaminar spaces devoid of apparent epidural signal is discouraged.

Axial or sagittal cuts should be measured by a radiologist or MRI annotating tool to approximate dermal to epidural distance of the desired interlaminar injection level. The physician can use this distance as a guide for needle depth determination when performing the procedure.

Perform the procedure with little or no sedation. Sedation mitigates painful patient feedback during the injection, which might indicate cord puncture or nerve root injury. Though uneventful pain responses do occur during spinal injections, good clinical judgment should determine whether or not to continue with the procedure. However, if extremity pain is commensurate with injection, cord trauma should be suspected and the procedure should be discontinued. In this case, immediate neurologic exam should be performed and a workup for cord injection should be initiated (4,10).

Unless otherwise indicated, the C6-C7 or C7-T1 interlaminar spaces should be the preferred sites of injection due to relatively thick epidural space compared to the rest of the cervical spine. Medication may be delivered as high as the C4-C5 nerve epidural space when the aforementioned interlaminars are performed correctly, mitigating the requirement for medication delivery to a more rostral level. Another benefit of low cervical epidural injections is the administration of medication a greater distance away from the respiratory centers and brain. The spinal nucleus of the trigeminal nerve and its associated epidural spinal accessory nerve may remain preserved if lower cervical injections are performed, as the CN V spinal nucleus can extend as low as C5 (13).

Safety data strongly supports the performance of

cervical epidurals using fluoroscopic guidance (4).

The procedure should be abandoned if a myelographic or arterial pattern occurs (14,15). Central canal stripe of injectate without flow to the lateral foramen may indicate cord injection and also mandates abandonment of the procedure.

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