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MEDULLARY CORD INJURY AFTER INTERLAMINAR CERVICAL EPIDURAL STEROID INJECTIONS: TWO CASE REPORTS

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Background: While the complications of cervical epidural steroid injections have been closely studied, there have been no reports of medullary cord injury, including myelopathy, myelomalacia, or syringomyelia, after these injections. We report here a case of myelopathy progressing to myelomalacia and a case of syringomyelia after properly performed cervical intralaminar epidural steroid injections.

Case Report: One case was characterized by a long history of advanced cervical spondylosis, the other by a distant history of cervical trauma. In neither case was there any evidence to suggest that the patients were at risk for medullary cord injury.

Conclusions: Epidural injections can generate clinically significant pressure changes in susceptible patients. Flexion and rotation of the neck should be done if unexpected pain occurs after an injection. These adverse outcomes, while rare, can occur in the absence of any departure from the standard of care on the part of the performing physician.

Key words: Cervical epidural steroid injection, complications, myelopathy, syringomyelia, case report

BACKGROUND

Complications after cervical epidural steroid injections have been extensively studied. Rathmell et al (1) reviewed claims collected from the American Society of Anesthesiology's (ASA) closed claims database between 2005 and 2008. The complications after transforaminal and interlaminar cervical epidural steroid injections that they reported were caused by, in decreasing order of occurrence, direct needle trauma to the cord or nerve, cord infarction after intraarterial injection, dural puncture, hematoma, infection/abscess, total spinal block, intravascular injection of local anesthetic, and pneumothorax. Albrecht et al (2), reviewing the same ASA database from 2009 to 2016, found similar complications, although Albrecht et al's review is notable for the decline in the incidence of transforaminal cervical injections. Eworuke et al (3), looking at Medicare claims data from 2009 to 2015, found that all of the spinal adverse events, whether lumbar or cervical, were hematomas. Gilligan and Rathmell (4) have pointed out the absence of any cases of infarct or direct needle trauma in the Medicare data reviewed.

There is a recent report of persistent neurological deficits after the intramedullary injection of air during an interlaminar cervical epidural injection (5), and the literature contains reports of adverse sequelae of varying degrees of severity after the intramedullary injection of contrast media (6-8). Smith et al (9) reported worsening syringomyelia-induced symptoms after 3 cervical epidural injections. The syrinx was known to exist prior to the injections.

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Schreiber et al (10) looked at patients admitted to an acute rehabilitation hospital between 2001 and 2008 because of cervical interlaminar and transforaminal injections. The causes for admission were intraparenchymal injection, abscess, hematoma, and one patient was listed as having a contusion. The patient with a contusion had the onset of hypotension, chest pain, and upper-extremity paresthesias within minutes of the procedure. It is not known whether she had an interlaminar or transforaminal procedure nor how the diagnosis of contusion was made. She had the persistent inability to move against gravity, but it is not clear which muscles were involved.

Other than the one poorly defined report of contusion, there have been no reports of damage to the cord by injections into the epidural space. We report 2 cases of myelopathy-caused cervical interlaminar epidural steroid injections.

CASE REPORTS

Patient 1

Patient 1 is a 50-year-old woman with a 20-year history of axial neck pain. She had seen several orthopedic spine and neurosurgeons. Cervical x-rays and magnetic resonance imaging (MRI) showed a disc/osteophyte complex at C5-6 with mild central stenosis and moderate-to-severe left foraminal stenosis. After having failed chiropractic therapy, she consulted with another spine surgeon, who referred her for a C5-6 epidural steroid injection.

She underwent a C5-6 interlaminar epidural steroid injection using loss-of-resistance technique and a 20-gauge Tuohy needle, sedation with 2 mg of midazolam and 100 mg of propofol. The epidurogram with 2 cc of contrast medium showed epidural filling in the anteroposterior and lateral views. She was injected with 10 mg of dexamethasone and one mL of preservative-free saline. Her postprocedure course was uneventful and she was discharged home.

The following day, she reported burning pain in the left arm. She was provided a Medrol Dosepak (Pfizer, New York, New York). She returned to her pain management physician 10 days after the procedure with ongoing pain and allodynia in the dorsal lateral aspect of the left hand, with intact muscle strength. She declined an offer of physical therapy.

A repeat cervical MRI one month after the injection showed cord edema at C5-6, with no syrinx.

Approximately 2 months after the injection, she had 4 of 5 muscle strength in the intrinsic muscles of the left hand and a positive Hoffman's sign on the left. At this point, she started physical therapy.

Approximately 8 months after the injection, she had a positive Lhermitte's sign. Electrodiagnostic studies done 18 months after the injection showed no evidence of radiculopathy.

Two years after the injection, she had persistent burning pain in both hands in a glove-like distribution, worst in the left index finger with difficulty holding trays and typing. Lhermitte's sign continued to be positive and she had decreased sensation to pinprick on the dorsum of both hands. She was able to continue to work at a job that required significant cognitive skills.

Patient 2

Patient 2 is a 40-year-old woman with a history of a previous motor vehicle accident as a teenager with resultant left-sided neck and shoulder pain. She was able to work at a job requiring extensive use of the hands. She had cervical MRIs showing mild spondylosis at C5-6 and C6-7.

She had an interlaminar cervical epidural steroid injection at C7-T1, with a Tuohy needle placed to the left of midline. The epidurogram showed dye spread from C4 to T2. She was injected with 6 mL of a mixture of betamethasone 6 mg/2 mL, 1% lidocaine 2 mL, and preservative-free saline 2 mL. She was sedated with 2 mg of midazolam. About 45 minutes after arriving in the recovery room, she reported that she was unable to move her left hand or fingers. She was transferred to a hospital where the postprocedural MRI was read as being suspicious for edema in the cord from C6 to T2. A neurology consult found evidence of left C8 radiculopathy. She was treated with intravenous steroids.

Electrodiagnostic studies done 2 weeks after the injection showed left more than right subacute C8 radiculopathy with active denervation of the left C8 innervated muscles.

Subsequent MRIs up to 21 months after the procedure were read as showing a persistent syrinx.

As of one year after the procedure, she had persistent burning pain in the left arm with ongoing muscle weakness in the C8 distribution.

DISCUSSION

We present 2 cases in which intramedullary damage occurred after seemingly unremarkable cervical

interlaminar epidural steroid injections. These are the first explicit reports of injury to the medulla of the spinal cord by extrinsic pressure on the cord from an interventional pain management procedure. Previous reports describe intraparenchymal injections. While we do not have access to either the intra- or postprocedural imaging, the operative reports clearly describe epidural spread and the MRIs are notable for the absence of the description of T2 hyperintensity or T1 hypointensity distinct from the central changes that might represent needle trauma.

The first case had findings of myelopathy/central cord edema, first presenting the day after the procedure with the clinical findings of myelomalacia progressing over the next several months. The myelopathy occurred in the setting of long-standing cervical degeneration and stenosis. The second case showed a monoradicular radiculopathy with the first symptoms occurring 45 minutes after the procedure. The immediate MRI showed cord edema which evolved into a persistent syrinx. In this instance, while there was a prior history of cervical trauma decades before, the preprocedural MRI did not show stenosis.

Both myelopathy and syringomyelia can occur as the result of trauma (11-14). Degenerative cervical myelopathy is the most common form of spinal cord impairment in adults (15-18). If persistent, myelopathy will evolve into myelomalacia, with microcystic degeneration, gliosis, and Wallerian degeneration (17). As suggested by the high prevalence of myelopathy in the setting of stenosis, myelopathy/cord edema is felt to arise from localized disturbances of the venous microvasculature caused by the stenosis or other causes, including tumors (17-19).

The first case, with myelopathy that clinically progressed to myelomalacia, was likely made susceptible to development of the myelopathy from the pressure of the epidural injectate in the presence of her long-standing cervical spondylosis.

The second case involved the development of a syrinx. Syrinxes are differentiated from myelopathy or myelomalacia in that a syrinx is filled with fluid of the same density as cerebrospinal fluid (CSF) on MRI, whereas myelopathy or myelomalacia will not have a fluid-filled cavity (14,20). Syringomyelia is most commonly seen after obstructions to CSF flow arising from Chiari malformations. Syringomyelia can also arise from cervical spondylosis (21,22). Rarely, syringomyelia can occur after trauma (23). The extent of cord injury from a syrinx can vary between no neurologic symptoms to a complete cord lesion. Generally, the onset of symptoms will be on the order of years. In only 2.4% of cases did symptoms from the syringomyelia start within 3 months of the accident (14), although the second case's initial symptoms were related to the myelopathy. Syringomyelia can cause focal neurologic findings, as seen in Case 2, where the findings were limited to one nerve root (21).

In neither case was there any evidence of injection into a loculation. Injection into a loculation would run the risk of localized pressure on the cord. In these cases, the issue appears to be the susceptibility of the spinal cord rather than the amount of force to which the cord was subjected.

Several case reports support the concept that pressure changes to related epidural injections can be significant. Smith et al's (9) patient with known syringomyelia due to a type I Chiari malformation was felt to have worsening symptoms because the epidural injections increased pressure in the spinal canal. This patient required a craniectomy to release pressure. Hetts et al (24) presented 3 cases where subdural arteriovenous fistulas were diagnosed because of acute paraparesis after lumbar epidural injections. Increased epidural pressure from the injection was felt to be sufficient to impair venous drainage, causing paraparesis in patients who already had early venous congestive myelopathy.

There is no way for an interventionalist to know which patient will have a susceptible spinal cord. Epidural injections are commonly performed in patients with spinal stenosis without the development of symptomatic myelopathy. The absence of previous reports of the complication of myelopathy after properly performed cervical interlaminar epidural injections documents the rarity of this complication. As such, there is no act of commission or omission on the part of the interventionalist that led to the symptomatic cord edema.

In that there is no way to reliably prevent the rare complication of symptomatic cord edema/myelopathy, it is important for the interventionalist to follow best practices when performing cervical interlaminar procedures. Pain with injection should prompt needle relocation. Severe stenosis on imaging may indicate the need to enter the epidural space at a level below the tight stenosis. If there is unexpected pain after the procedure, beyond what might be seen simply from needle placement, pressure in the cervical epidural space can be relieved by flexion and rotation of the head and neck to allow lateral runoff and release of pressure through the

enlarged neural foramina (25,26). It does not follow that flexion/rotation would reliably have prevented damage to the medulla of the cord in these cases.

The strength of this report is that it is the first report of the complication of intramedullary injury from epidural injections. A weakness of this report is the absence of either intraoperative epidurograms or postincident MRIs.

CONCLUSION

Injury to the medulla of the cord, characterized by edema/myelopathy that can progress to either myelomalacia or syringomyelia, can occur after appropriately performed cervical intralaminar epidural steroid injections. While a history of previous trauma or spondylosis was present in these cases, the widespread prevalence of both previous trauma and spondylosis coupled with the rarity of intramedullary damage prevents using either trauma or spondylosis as a predictor of the possible occurrence of intramedullary damage. In the absence of any steps that can be taken that would reliably prevent this rare occurrence, it should be reiterated that interventionalists should attempt to follow best practices when performing cervical interlaminar injections, including flexion/rotation should unexpected pain occur after a procedure.

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