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Factfinders for patient safety: Epidural steroid injections in the setting of severe cervical central and neuroforaminal stenosis

Patricia Zheng [a,*], Aditya Raghunandan [b], Mathew Saffarian [c], David Levi [d], on behalf of the International Pain and Spine Intervention Society's Patient Safety Committee

[a] Department of Orthopaedic Surgery, University of California – San Francisco, San Francisco, CA, USA
[b] Department of Rehabilitation Medicine, University of Texas Health – San Antonio, San Antonio, TX, USA
[c] Department of Physical Medicine and Rehabilitation, Michigan State University, Lansing, MI, USA
[d] Jordan-Young Institute, Virginia Beach, VA, USA

A B S T R A C T

This FactFinder presents a brief summary of the evidence surrounding the safety of epidural steroid injections in patients with severe cervical central canal or neural foraminal stenosis. With proper consideration of anatomy, level, and approach, cervical epidural steroid injection risks may be mitigated in a patient with severe cervical central canal and/or neuroforaminal spinal stenosis.

Myth: Cervical epidural steroid injections are contraindicated in the setting of severe cervical central canal or neural foraminal stenosis.

Fact: With proper consideration of anatomy, level, and approach, cervical epidural steroid injection risks may be mitigated in a patient with severe cervical central canal and/or neuroforaminal spinal stenosis.

Cervical epidural steroid injections have been performed to help manage persistent and debilitating cervical radicular pain [1]. Studies have demonstrated favorable results with both the interlaminar and transforaminal epidural steroid injection approaches [2–9], with 38 %–75 % of patients reporting improvement in pain, depending on the study [10].

Complications from injections are rare [2,11]. Fluoroscopic guidance with live visualization of epidural contrast spread can improve safety [10,12]. In a study of 345 fluoroscopically guided interlaminar cervical epidural injections, Botwin et al. found a complication rate of 16.8 % [10], though most of these consisted of increased neck pain, non-positional headaches that resolved within 24 h, and insomnia the night of the injection. The authors of these studies did not attribute any of these symptoms to the degree of spinal stenosis. In a retrospective analysis of 1036 fluoroscopically guided transforaminal injections, Ma et al. reported a complication rate of 1.64 % [13]. Beckworth and colleagues reviewed 6241 cervical transforaminal epidural steroid injections and reported no catastrophic complications [14], which were defined as "spinal cord injury, stroke, death, infection, or any other concerning event." Differences in complication rates arise from variations in how complications are defined.

The risks of severe complications vary with the injection approach. The most common side effects due to cervical interlaminar epidural steroid injections are minor, including insomnia (1.7 %), vasovagal reactions (1.7 %), and facial flushing (1.5 %), none of which would be related to the degree of stenosis present [10]. Paresthesia, neuropathic pain, and complex regional pain syndrome [15] have also been reported. Some have theorized these may be caused by medication-induced nerve irritation or iatrogenic trauma to the nerves independent of whether or not the procedure resulted in dural puncture or spinal cord transgression [16]. There is no evidence to support these would be affected by the degree of stenosis present.

Intrinsic spinal cord damage after fluoroscopically guided interlaminar injections at C5-6, likely due to direct needle injury that happened under heavy sedation, has been reported [17]. It is now recommended that procedures be performed at C6-7 or below and that heavy sedation be avoided to mitigate this risk [18]. Epidural hematomas have also been reported, which may be more common in patients on antiplatelet therapy, with difficult-to-access epidural space, or with a history of multiple prior cervical epidural injections [16].

In the setting of severe central stenosis, the risks from cervical epidural steroid injections may theoretically be amplified both at the level of stenosis and possibly even at adjacent levels, though there is little evidence to support or refute this hypothesis. It has been *theorized* that pre-existing severe spinal stenosis can be a risk factor for direct

* Corresponding author. University of California San Francisco Department of Orthopaedic Surgery San Francisco, CA, USA.
E-mail address: patricia.zheng@ucsf.edu (P. Zheng).

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needle access of the cord. Guidelines recommend cervical interlaminar injections to be performed no higher than C6-7, which may help prevent injection at the area of the tightest canal, which is most likely to happen at C5-6 [19].

Theoretically, with severe stenosis, there may be concern regarding nerve injury from pressurization caused by injection volume into a tight space, which may be an issue even at levels adjacent to the stenosis. To our knowledge, no studies or case reports have directly looked to see if the rates of complications after cervical interlaminar epidural steroid injections were higher in patients with spinal canal stenosis. According to the available IPSIS FactFinder on epidural steroid injection in patients with lumbar spinal stenosis, there have been no documented cases of neurologic injury following epidural steroid injections that can be attributed to the volume of the injectate, even when higher volumes were used [20]. This holds true regardless of whether the injection was administered at or near the most significant level of stenosis in the lumbar region. If a physician is concerned about injectate volume, it is possible to tailor the volume of injectate or level of injection to mitigate this risk [21]. While no evidence demonstrates an increased risk of these complications in patients with severe stenosis, it is still prudent for the physician to review cross-sectional imaging to ensure adequate epidural space for needle tip placement and minimize the risk of unintentional intrathecal or intramedullary access.

Serious complications resulting from cervical transforaminal epidural steroid injection are related to the proximity of the injection to arterial structures that supply the CNS blood vessels. Baker et al. described a case where a C6-7 transforaminal epidural steroid injection using digital subtraction and real-time fluoroscopic imaging revealed contrast medium filling a radicular artery that ran directly to the spinal cord [22]. Particulate steroids injected into the radicular artery can cause an embolism, which can result in a spinal cord infarct with the potential to lead to permanent neurologic injury. As such, using only non-particulate steroids for such injections is recommended under the careful use of digital subtraction and real-time fluoroscopic imaging [2]. Another concern is direct injury to the vertebral artery during a transforaminal injection, which can lead to dissection and/or death [23]. Studies have identified anatomic anomalies of the vertebral artery, including accessory vessels and lateral loops, which may increase the risk of cannulation during cervical transforaminal epidural steroid injections [24]. This topic is covered in detail in the available IPSIS FactFinder on risk mitigation strategies with cervical transforaminal epidural steroid injection, which focuses on the role of preprocedural review of advanced imaging (MRI and CT) [25].

Limited neuroforaminal space could theoretically increase the likelihood of encountering the vertebral artery. In a study on CT-guided cervical transforaminal epidural steroid injections, Fitzgerald and colleagues assessed the position of the vertebral artery relative to the typical cervical transforaminal injection point [26]. They found a correlation between the degree of foraminal vertebral artery covering and the severity of foraminal degenerative narrowing. In 65 % of severely narrowed foramina, the vertebral artery was in the way of the injection needle placement, versus 30 % in moderately narrowed foramina and 10 % in normal/mildly narrowed foramina. Appropriate review of cross-sectional imaging is important before cervical transforaminal steroid injections to ensure adequate space for the needle [25,27]. Essentially, the degree of stenosis is not a contraindication to the procedure, but it may result in neuroforaminal anatomy that precludes injecting at the stenosed level, a risk that should be mitigated by following recommended safety practices.

For cervical transforaminal steroid injections, the risks of damage or irritation to the spinal nerve may also be theoretically increased in cases of severe neuroforaminal stenosis, where there is less space to navigate and maneuver around the exiting spinal nerve in the setting of spondylotic changes or disc herniations. While there may be a theoretical concern that pressurizing a confined space with injectate could irritate or compress the nerve, no literature supports this theory. To our knowledge, no studies have directly investigated whether complication rates are higher in patients with severe neuroforaminal stenosis following cervical transforaminal epidural steroid injections. Further research on this topic is encouraged.

Conclusions/recommendations

- In general, there is a lack of literature regarding the specific risks with cervical epidural steroid injections in the setting of severe stenosis. While certain best practices are recommended, such as reviewing cross-sectional imaging before injection, no literature supports the idea that cervical epidural steroid injections may be contraindicated because of the degree of stenosis.
- Before performing *cervical interlaminar epidural steroid injections*, the physician should review cross-sectional imaging to ensure adequate epidural space for needle placement. The physician should recognize the theoretical risk that increased volume caused by the injection or bleeding may cause pressure effects on the spinal cord, though there is a paucity of literature to support or refute this possibility - injectate volumes and injection level may be adjusted given the degree of stenosis.
- Before performing *cervical transforaminal epidural injections*, the physician should review cross-sectional imaging to evaluate the position of the vertebral artery, digital subtraction angiography may be used to enhance visualization of an inadvertent intravascular injection, and non-particulate steroids should be used. More care should be taken in the setting of severe neuroforaminal stenosis, where there is less room to navigate to the exiting spinal nerve and where the vertebral artery may obstruct access to the foramen.

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