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Factfinders for patient safety: Epidural steroid injection in patients with lumbar spinal stenosis

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A B S T R A C T

This FactFinder presents a brief summary of the evidence suggesting that epidural steroid injections can be safely performed even in the setting of severe, multilevel lumbar spinal stenosis.

Myth: Epidural steroid injection can exacerbate symptoms of lumbar spinal stenosis and is contraindicated.

Fact: Available evidence suggests that epidural steroid injection can be safely performed even in the setting of severe, multilevel lumbar spinal stenosis.

Lumbar spinal stenosis (LSS) refers to a narrowing of the canal of the lumbar spine. It is commonly due to an age-related degenerative process involving a combination of degeneration involving intervertebral discs, thickening of the ligamentum flavum, and/or facet osteoarthritis [1]. There are less common etiologies of canal stenosis, including congenital narrowing, disc herniation, epidural lipomatosis, tumors, and vascular malformations. The relative and absolute prevalence of acquired stenosis increases with age and is 47.2 % and 19.4 %, respectively, in those 60–69 years old. The relative and absolute prevalence of congenital stenosis is 4.7 % and 2.6 %, respectively [2]. Radiographic findings of LSS do not necessarily correlate with the presence or severity of symptoms [3], though moderate to severe LSS is less likely to be asymptomatic than other common findings such as disc degeneration [4]. Clinical symptoms include neurogenic claudication (NC), characterized by pain, paresthesias, dysesthesias, cramping, and/or weakness in the legs, typically exacerbated by standing and walking and may be associated with radicular pain. In addition to radiographic evidence of stenosis, these symptoms constitute the clinical diagnosis of LSS [5–7]. In patients who have failed to respond to non-interventional treatments, epidural steroid injections (ESIs) may be utilized as a component of the treatment pathway for pain associated with LSS. This FactFinder aims to determine if there is any published evidence that therapeutic ESI in the setting of LSS poses a risk of short- or long-term worsening of neural element compression and resultant sequelae.

In the setting of severe LSS, some may have concerns that adding volume to the already constricted canal may aggravate the pain symptoms of LSS and possibly cause neurologic compromise [8]. Expansion of high volumes of fluid into the epidural space, such as an epidural hematoma, can certainly cause neural compromise [9]. ESIs add volume to the epidural space; however, fluid dynamics dictate the injectate will pass along the path of least resistance throughout the epidural space. Considering Poiseuille's law, the flow of fluid depends on the length, radius, pressure differential, and viscosity of the fluid. Thus, injectate flow may also be impacted by the location of injectate deposition, the degree and location of the stenosis, and the approach of needle entry. Unlike blood, which coagulates if flow is slowed, there is no evidence to suggest that the injectate administered as part of an epidural injection will coalesce.

A literature search identified no published case reports of such significant complications. However, there are published cohorts of ESIs that can be reviewed for evidence of such complications. One study of

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52,935 ESIs quantified complications requiring hospitalization [10]. The authors did not stratify based on the stenosis severity, nor were the number of LSS study participants included. Of the ESIs performed, 22, 298 were lumbar transforaminal, 9891 were lumbar interlaminar, and 10,151 were caudal. The remaining injections were at thoracic and cervical levels. Procedure-related complications for the entire study population included CSF leakage (n = 8), spinal infection (n = 3), hematoma (n = 2), and sepsis (n = 1), with additional potential complications that were deemed "uncertain" as to having been caused by the ESI, such as symptom aggravation (n = 156) and ischemic brain stroke (n = 8). The article does not state how many of the 156 cases of symptom aggravation were in patients with LSS or how many were suspected to be due to volume effects. However, no neurologic complications were reported due to volume effects. Another study published on 16,638 consecutive ESIs in all spinal segments (14,956 TFESI and 1682 ILESI) did not report a single case of major neurologic injury [11]. Neither of these studies stratified outcomes. In totality, these studies would suggest that the risk of neurologic damage occurring after ESI, not accounting for the severity of stenosis or volume of injectate, and that can be attributed to the volume effects of the injectate, is 0/69,573.

Other potentially relevant literature evaluated ESI in the setting of LSS and reported on the severity of spinal stenosis, injection at the level of the greatest degree of stenosis, or volumes of injectate used.

Bajpai et al. compared interlaminar ESI with 8 mL of injectate at the level of greatest central stenosis with ESI at less stenotic levels [12]. Of the 80 patients included, 20 were lost to follow-up. No complications were noted, and neither group had increased pain during the post-injection period. Injection at the most stenotic level was associated with better outcomes. Mean canal narrowing was noted to be 6.3 mm (range 2.8–9.2 mm), with L4-5 being the most common level, followed by L3-4. Fukusaki et al. also reported on ESI using volumes of 8 mL. Fifty-three patients with LSS, defined as an AP diameter of <15 mm, reported no complications [13]. No additional criteria for defining the severity of the stenosis were included in the paper. All injections were performed via an interlaminar approach. No subjects were lost to follow-up.

Milburn et al. reported on 57 study participants with LSS who had interlaminar ESI with 6 mL of injectate at the level of maximal central stenosis or two levels cephalad with less stenosis [14]. The mean degree of LSS at the most stenotic level was 6.1 mm (range, 2.5–9.1 mm). The most common maximally stenotic intervertebral level was L4-L5, followed by L3-L4 and L5-S1. No complications were reported. Injection at the level of maximal stenosis was associated with better outcomes. No subjects were reported to be lost to follow-up.

Another study retrospectively evaluated 128 subjects who received ESI in the setting of moderate to severe central LSS and did not report any injection-related complications [15]. Of note, all subjects received ESI at the most stenotic level, using the interlaminar approach with an injectate volume of 8 mL. The authors defined moderate stenosis as the aggregation of some cauda equina. Severe stenosis was defined as the absence of cauda equina separation, which created a bundle-like appearance.

Sencan et al. compared interlaminar and bilateral transforaminal ESI in 72 patients with multilevel degenerative LSS of at least a moderate degree and with symptoms of chronic NC [16]. The level below the central stenosis was selected, as the author expressed concern about increasing pressure at the stenotic segment. The extent of LSS was confirmed by evidence on MRI. An area of 100 mm^2 was defined as moderate stenosis, and an area of 75 mm^2 or less was defined as severe. After confirmation of the presence of an epidural distribution without vascular distribution, a total of at least 5 mL of injectate consisting of 80 mg methylprednisolone acetate, 2 mL saline, and 2 mL 0.5 % bupivacaine was delivered to the epidural space for interlaminar ESI. The same mixture was divided into two equal doses and injected into the right and left foramina for patients who had injections via the TFESI approach. No significant complications were reported for the 67 patients who completed the study (2 patients in the ILESI group and 3 patients in the bilateral TFESI group were excluded, as they did not follow the control schedule post-injection). Lower extremity motor blocks (3 in the transforaminal group) and injection site pain (1 in the interlaminar group) were reported.

Park et al. evaluated over 100 caudal ESIs in patients with radicular pain from either a disc herniation or spinal stenosis using volumes as high as 20 mL [17]. While the authors did not quantify the number of subjects with LSS, there were no reports of neurologic compromise immediately or through one-year follow-up. Several other smaller studies of <100 participants demonstrated no evidence of harm or significant complications due to epidural injection in the setting of LSS [18–23].

A retrospective subgroup analysis of the Spine Patient Outcomes Research Trial (SPORT) evaluated the role of ESI as compared with surgical management [8]. The study demonstrated that patients who received ESIs reported less improvement over the study period and that the ESI population who went on to surgery had increased operative time and length of hospital stay compared to those who had surgery with no prior ESI. The study authors hypothesized that the most likely explanation for this effect was that the volume of injectate may have exacerbated the underlying LSS and radiculopathy via mass effect, amongst other reasons. The authors' speculations were not supported by any data presented. Furthermore, there were no reports of neurologic damage due to ESI and volume effects. Additionally, subjects who had ESI early in the course of symptoms were excluded, and their outcomes are otherwise unknown. There was no control group and a lack of randomization in this retrospective study, which may have led to selection bias and differing outcomes between the groups.

In totality, no documented cases of neurologic injury following ESI have been attributed to a volume effect of the injectate, even when higher volumes of injectate were utilized, regardless of whether the delivery was at or near the most significant level of stenosis. However, studies that provide some relevant data on the volume of injectate used, the degree of LSS present when ESI was performed, and the level of entry relative to the level of LSS are limited by a small number of participants.

Conclusion and recommendations

- There is no published evidence that the volume effects of injectate administration during ESI in the setting of LSS increases the risk of neurologic injury. The majority of reported complications for ESI in LSS patients have found no causal relationship with the documented severity of the stenosis, the needle approach, or the volume of the injectate.
- Volumes of injectate as high as 8 mL via the interlaminar approach and 20 mL via the caudal approach have not been associated with any significant complications.
- Emerging evidence suggests that the presence of severe LSS is not an absolute contraindication to a properly performed ESI, even when the target is at or adjacent to the level of maximal central stenosis. However, the physician is always encouraged to review cross-sectional imaging to ensure adequate epidural space for needle placement and minimize the risk of unintentional intrathecal access.
- Studies that provide relevant data on the volume of injectate used, the degree of LSS present when ESI was performed, and the level of entry relative to the level of LSS are limited by a small sample size. As should always be the case, any new or worsening pain/symptomatology during injection must be continuously monitored.

Conflicts of interest

None.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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