Cross-Sectional Study

# Variations of Technique in Transforaminal Epidural Steroid Injections and Periprocedural Practices by Interventional Pain Medicine Physicians in the United States

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**Background:** Interlaminar and transforaminal epidural steroid injections (ILESI and TFESI) are commonly performed procedures. However, the United States Food and Drug Administration has required the addition of drug warning labels for injectable corticosteroids. Updated evidence and scrutiny from regulatory agencies may affect practice patterns.

**Objective:** To characterize TFESI practices as well as to provide an update on periprocedural practices for any type of epidural steroid injection (ESI), we surveyed pain medicine physicians in the United States.

**Study Design and Setting:** This was a cross-sectional survey of pain medicine physicians in the United States.

**Methods:** A web-based survey was distributed to pain medicine physicians in the United States selected from the Accreditation Council for Graduate Medical Education accredited pain medicine fellowship program list as well as the American Society of Interventional Pain Physicians membership database. Physicians were queried about TFESI practices, including needle size, use of image guidance, methods to detect vascular uptake, and preference for injectate.

**Results:** A total of 249 responses were analyzed. Only a minority of respondents reported performing cervical TFESI. There were variations in needle size, methods to detect vascular uptake, and choice of injectate. There were also variations in monitoring practices.

**Limitations:** The response rate is a limitation. Thus the results may not be representative of all US pain medicine physicians.

**Conclusions:** Though all respondents used image guidance for TFESI, variations in other TFESI practices exist. There are also differences in periprocedural practices. Since the closure of this survey, a multisociety pain workgroup published recommendations regarding ESI practices. Our survey findings support the need for more evidence-based guidelines regarding ESI.

**Key words:** Epidural steroid injections, transforaminal epidural steroid injection, steroids, local anesthetic, survey, interventional pain

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Epidural steroid injections (ESIs), both transforaminal and interlaminar, remain among the most commonly employed treatments for cervical and lumbar radicular pain or radiculopathy. Pain is thought to originate from irritation and/or inflammation from herniated disc material or narrowed neural foramen (1). An ESI is thought to improve symptoms via analgesic, irrigative, and anti-inflammatory effects while avoiding the side effects of systemically dosed steroid medications.

Interlaminar epidural steroid injection (ILESI) and transforaminal epidural steroid injection (TFESI) are 2 distinct approaches to deliver medication to the same targeted irritated nerve roots. The TFESI allows for a more direct approach into the neuroforaminal space (2). Ventral epidural spread of corticosteroid has been associated with superior pain and functional outcome improvements (3). Lumbar TFESI has been shown to reduce pain, improve function, and postpone or prevent spine surgery when used for radicular pain (3). TFESI may be preferred over ILESI in cases of spinal surgery where there is no longer an intact ligamentum flavum or clear unaltered pathway to the epidural space through an interlaminar approach (2).

In recent years, the use of ESIs has come under scrutiny. In 2011 the label for triamcinolone was updated, warning against epidural use. In April 2014, the Food and Drug Administration (FDA) issued a warning that ESIs can cause "rare but serious adverse events, including loss of vision, stroke, paralysis, and death." This warning was mainly based on case reports of direct spinal cord injury and of infarctions related to TFESI of particulate steroids (4), although it implicated all steroids including dexamethasone. For infarctions, inadvertent vascular injury is believed to be the initial step leading to complications. Theories on the resultant major complications include intravascular injection of steroid, arterial injury, dissection, dislodgement of plaque causing embolism, and arterial muscle spasm (5). The embolization path is believed to start through the periradicular arteries, which exit the neural foramen and accompany the nerve to the spinal cord (6). Although most complications have been seen with particulate steroid and cervical spine TFESIs, case reports of spinal infarction have been seen with nonparticulate steroid lumbar injections (7). TFESIs are associated with other complications as well. TFESIs, compared to ILESIs, are associated with a 12-fold increased risk of intradiscal injection. Additionally, TFESIs do not decrease the risk of known complications of ILESIs, such as dural and subdural punctures, hematoma formation, and cauda equina syndrome (8). Although complications are rare, they can be catastrophic, and the implementation of safety guidelines based on common practice has been attempted. The FDA convened a panel of experts, including pain medicine experts, to determine specific techniques of this procedure that may reduce potential harm, but consensus was not reached on all the items (9).

In 2002, Cluff et al conducted a survey to investigate variations in ESI practices throughout the United States (10). The results indicated that there was no clear consensus regarding the approach for the procedure, the type of medications used, and other technical aspects. Another survey study on periprocedural practices by Ahmed et al revealed that there was no consensus for ESIs regarding the nil per os (npo) status of the patient, the type of vital sign monitoring during the injection, the use of intravenous (IV) sedation, and the duration of postprocedural monitoring before discharge (11). A survey study by Kohan et al in 2017 also noted wide variations in practice patterns such as sedation among US interventional pain physicians (12).

Previous survey studies have not focused on TFESI practices. Thus we surveyed US pain medicine physicians on technical aspects of TFESI as well as periprocedural practices for any type of ESI.

## Methods

This study was approved by the Institutional Review Board of our institution. We created a 22-item online "Survey Monkey" questionnaire that included open- and closed-ended questions on the background of pain medicine practitioners, the variations of their technique for ESIs, and parameters regarding patient follow-up. There are 3 sections to the questionnaire. The background section includes questions on what type of setting the physicians work in, what board certifications they hold, their experience level, and the volume of ESIs they perform. The techniques section elicits data on whether the patients receive sedation, how they are monitored, technical differences in the procedure (e.g., interlaminar vs transforaminal, the use of fluoroscopy, etc.), and what type of medications are injected into the epidural space. The final section inquires about the type of monitoring the patients receive after the injection as well as during follow-up time. This manuscript focuses on TFESI injection practices and periprocedural monitoring for any type of ESI. Results regarding ILESI practices have been published (13).

A link to this survey was emailed to 1800 pain management practitioners across the country, including those in academic centers, private practices, government hospitals, and community settings. These participants were selected from the most current Accreditation Council for Graduate Medical Education (ACGME)-accredited pain management fellowship program list as well as the American Society of Interventional Pain Physicians (ASIPP) membership database. After allowing time for the initial responses, a reminder email was sent to participants at 1, 2, 3, and 4 weeks. Two additional reminder emails were sent out 4 months

later. The data was stored in the online password-protected "Survey Monkey" account, only accessible by the principal investigator and actively involved researchers. Data were collected between October 28, 2014 and April 2, 2015.

Descriptive analysis was done using Survey Monkey's data analysis tools and Microsoft Excel.

## Results

### Demographics

There were 249 pain medicine physicians who responded to the survey, yielding a 13.8% response rate. Of the respondents, 73% worked in private practice, 21% in academia, 2% in a government hospital, and 4% other, including hospital employment. Of the 238 who reported a primary specialty, 69% had an anesthesiology background and 24% had a background in physical medicine and rehabilitation. Other specialties represented were psychiatry, radiology, neurosurgery, and orthopedics.

Respondents had been performing ESIs for a median of 15 years (interquartile range [IQR], 9-24 years). Only 34.1% of respondents reported performing cervical TFESIs. For those who performed cervical TFESIs, the median number done per month was 5 (IQR, 1-10). For those who performed lumbar TFESIs (97.6% of respondents), the median number done per month was 30 (IQR, 20-50).

### TFESI Injection Practices

For the subset of respondents who performed both cervical TFESI and ILESI (n = 85), when asked whether an interlaminar or transforaminal approach was generally used first in the cervical spine in a patient who had not previously had spine surgery, 20% reported choosing the transforaminal route first. For respondents who performed both lumbar TFESI and ILESI (n = 243), 47.8% reported generally using a transforaminal approach first in a patient without previous spine surgery. For lumbar postlaminectomy patients with a same-level disc recurrence, 78.1% of respondents reported generally using TFESI first, and 2.5% reported using an interlaminar approach at the level of surgery. The remaining respondents reported using an interlaminar approach above or below the level of surgery.

Regarding needle size, for those who performed cervical TFESI, 25-gauge (G) and 22-G needles were preferred (67% and 24.7% of respondents, respectively). Less commonly preferred sizes included 20-G, 23-G, 26-G, and 27-G needles. For lumbar TFESI, 22-G and 25-G needles were preferred (68.3% and 18.9% of respondents, respectively). Other less commonly used sizes were 18-G to 23-G needles.

Fluoroscopy was utilized by all respondents. For those who performed cervical TFESI, regarding methods to detect or prevent intraarterial entry during cervical TFESI, 68.2% of respondents used flashback all the time, and 80% of respondents used aspiration all the time. Extension tubing was used by 69.4% of respondents all the time, and blunt needles were used by 37.6% of respondents all the time. A local anesthetic test dose was used by 30.6% of respondents all the time. Regarding fluoroscopy, contrast medium during live fluoroscopy was used all the time by 84.7% of respondents. Digital subtraction angiography (DSA) was used by 25.9% of respondents all the time. Combination of contrast medium during live fluoroscopy and DSA were used all the time by 22.4% of respondents. For those who performed lumbar TFESI, 67.1% of respondents used flashback all the time, and 87.1% of respondents used aspiration all the time as techniques to detect or prevent intraarterial entry. Extension tubing was used by 57.2% of respondents all the time, and blunt needles were used by 30% of respondents all the time. A local anesthetic test dose was used by 11.1% of respondents all the time. Regarding fluoroscopic techniques, injection of contrast medium during live fluoroscopy was used all the time by 70.8% of respondents. A combination of contrast medium during live fluoroscopy and DSA were used all the time by 5.7% of respondents.

Preferences for injectate solution are listed in Tables 1 and 2. For steroid, the most commonly preferred agents were dexamethasone for both cervical and lumbar TFESI (72.3% and 36% of respondents, respectively). For local anesthetics, the most commonly preferred agent for cervical TFESI was lidocaine; for lumbar TFESI, it was bupivacaine.

### Periprocedural Practices for Any ESI

For cervical ESI, 36.5% of respondents reported never using sedation, while 10% of respondents always used sedation. For the rest of the respondents, sedation was used a median 50% of the time (IQR, 5-80%). For lumbar and caudal ESI, 31.8% of respondents never used sedation while 8% of respondents always used sedation. For the rest of the respondents, sedation was used a median 40% of the time (IQR, 5-75%). The most common factors determining whether sedation

Table 1. *Percentage of respondents who prefer each steroid in injectate*

| | Cervical TFESI (n = 83) | Lumbar TFESI (n = 242) |
|---|---|---|
| Betamethasone | 12.1 | 14.4 |
| Dexamethsone | 72.3 | 36 |
| Methylprednisolone | 8.4 | 31.8 |
| Triamcinolone | 2.4 | 17.4 |
| No steroid | 4.8 | 0.4 |

Abbreviations: TFESI, transforaminal epidural steroid injection.

Table 2. *Percentage of respondents who prefer each local anesthetic in injectate.*

| | Cervical TFESI (n = 85) | Lumbar TFESI (n = 242) |
|---|---|---|
| Bupivacaine | 29.4 | 43.8 |
| Lidocaine | 50.6 | 40.9 |
| Ropivacaine | 0 | 2.9 |
| Other | 3.5 | 0.8 |
| None | 16.5 | 11.6 |

Abbreviations: TFESI, transforaminal epidural steroid injection.

was used were patient anxiety (reported by 63.8% of respondents), patient preference (54.1%), and patient inability to be still/stable field (33.7%).

For cervical ESI, 28% of respondents did not place IV lines while 39.3% always did. For the rest of respondents, an IV line was placed a median 50% of the time (IQR, 10-75%). For lumbar and caudal ESI, 40% of respondents did not place IV lines while 20.6% always did. For the rest of respondents, an IV line was placed a median 40% of the time (IQR, 5-73%). Monitoring (of blood pressure, heart rate, or pulse oximetry) was never used by 12.9% of respondents for cervical ESI. Monitoring was always used by 72.6% of respondents for cervical ESI. For the rest, monitoring was used a median 20% of the time (IQR, 5-50%). Monitoring was never used by 16.6% of respondents and always used by 66.8% of respondents for lumbar or caudal ESI. For the rest, monitoring was used a median 20% of the time (IQR, 5-50%).

Post procedure, for cervical, lumbar, and caudal injections, patients were monitored for a median time of 20 minutes (IQR, 15-30 minutes). A registered nurse or licensed practical nurse helped 74.9% of respondents to monitor patients after injections.

Fifty-nine percent of respondents followed up patients in 2 weeks; 20% of respondents followed up patients in 4 weeks.

## Discussion

This survey elucidates variations in TFESI practice patterns and periprocedural practices for any type of ESI.

The majority of major complications have been associated with cervical ESIs, specifically TFESIs (7). In this survey, only 34% of respondents performed cervical TFESI. Of these respondents, only a minority reported choosing the transforaminal approach first in the unoperated cervical spine. In the unoperated lumbar spine, approximately 50% of respondents reported choosing a transforaminal approach first. For lumbar postlaminectomy patients, 78.1% of respondents reported generally using TFESI first. In comparison, Cluff et al noted in 2002 that approximately 30% of practices used TFESI and 30% used a caudal approach after lumbar laminectomy (10).

With regard to injectate for cervical TFESI, 72% of respondents reported using dexamethasone, while 4.8% of respondents reported injecting no steroid at all. In 2015, a multisociety pain workgroup published recommendations to minimize risks for ESI, advising against particulate steroid use in all cervical TFESI procedures (9). Our survey was completed prior to the publication of these recommendations, but results demonstrate that a majority of respondents' practices align with this recommendation. With regard to the use of local anesthetic in cervical TFESIs, lidocaine was most often used, followed by bupivacaine and none.

The type of injectate used in lumbar TFESI procedures is more varied. Dexamethasone was preferred by 36% of respondents. This likely reflects decreased incidence of major complications when performing lumbar TFESI procedures (9). It is important to mention that major complications with the use of dexamethasone have also been reported (7). With regard to local anesthetic used in lumbar TFESI procedures, bupivacaine and lidocaine were most commonly preferred.

The physicians in the current study indicated some agreement with respect to tools to detect/prevent intraarterial entry with transforaminal injections. Fluoroscopy was used by all respondents. This is likely a consequence of several studies from the last decade documenting the advantages of routine use of fluoroscopy for ESI (4). In comparison, Cluff et al reported that 69% of academic practices and 93% of private practices used fluoroscopy. In this survey, contrast medium during live fluoroscopy was used all the time by 84.7 % of those respondents performing cervical TFESIs and 70.8% of respondents performing lumbar TFESI procedures. This

is in line with the multisociety pain workgroup's recommendations for safe practice regarding fluoroscopy, including the need for live fluoroscopy to be employed in all cervical TFESI procedures (9).

The findings of this survey suggest a trend away from the use of sedation in ESIs. With cervical ESIs, only 10% of practitioners used sedation all the time; for lumbar ESIs, 8% of respondents used sedation all the time. For the rest of the respondents, sedation was used a median 50% of the time in the cervical area; for lumbar and caudal ESI, sedation was used a median 40% of the time. These results are similar to those reported by Kohan et al in 2017, in which sedation was used on epidural injections 54% of the time (12). In claims related to cervical procedures, severe injury was more common in patients who received sedation (14,15). Although overall there is a low rate of complications with interventional pain spine interventions, it is possible that having a patient fully alert with the ability to report abnormal sensations during the procedure could prevent complications. Respondents used monitoring more often, on average, for cervical ESIs than for lumbar ESIs. The average postprocedural monitoring times reported in this study, 20 minutes, represented a modest decline from the monitoring times documented by Ahmed et al; in that study, the median recovery time reported by respondents was 30 minutes for all procedures. In our study, IV lines were also more likely to be placed when performing cervical ESIs compared to lumbar, consistent with the findings by Ahmed et al. There appears to be, however, an overall decline in the use of IVs for cervical ESIs compared to the practice a decade ago.

There are several limitations to this study. One limitation was the unequal distribution of academic and private practice respondents; thus, it is possible that the experiences of private practitioners may have been overrepresented in this study. We also could not control for any degree of nonresponse bias; in particular, it is possible that there may have been some difference between physicians who took the time to respond and those who did not with respect to their practice. There may be some element of recall bias as the physicians relied on memory and estimation to answer certain questions in this survey. Relevant but not included in this survey were the rates of TFESI by either the "safe" or Kambin's triangle. The rates of use of each of these techniques are particularly relevant given the ongoing debate regarding how to best balance safety and efficacy during ESI (16). The use of a catheter to aid injection was not assessed. Finally, the reasons for an individual practitioner's use of injectate, injection technique, and use of sedation were not surveyed. The relative importance of the physician's initial training as compared to the impact of ongoing literature review may be of particular interest in a complex and rapidly changing field.

## Conclusion

ESIs are performed by many different types of physicians throughout the United States. Thus far, attempts to elucidate any consensus regarding various technical aspects of the procedure have been unsuccessful. The current study has shed some light on which aspects are performed with regularity amongst practitioners and which are still in disagreement. We will launch a future study to explore in more depth variations in TFESI practices and to assess changes in practice over time. Future studies on how these variations in technical practices of ESIs influence patient outcomes may also drive physicians toward increased uniformity with respect to these points.

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