

# The Technical Aspects of Epidural Steroid Injections: A National Survey

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Although epidural steroid injections (ESIs) are a common treatment for chronic pain conditions, it is not clear whether there is consensus on their technical aspects. The current literature suggests that variations in technical aspects may affect ESI outcomes. The goal of the survey was to help establish a standard frame of reference for the performance of ESIs. We analyzed survey results from 68 academic anesthesia programs and 28 private practices in the United States. The main finding in this survey is that there is no clear-cut consensus as to the ideal method to perform ESI. There is a wide variation among individual practices in almost every technical aspect of ESI. Private

practices use significantly more fluoroscopy than academic centers. The large difference was found in the cervical region where 73% of private practices and only 39% of academic institutions polled perform the ESIs with fluoroscopic guidance ( $P = 0.005$ ). A similar discrepancy was found in approaches to the epidural space after laminectomy where 61% of private practices, but only 15% of academic centers, use the transforaminal approach. The study results indicate that there is no consensus, and that there is a wide variation in current practices.

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Low back pain is one of the leading causes of disability. Up to 70%–85% of all people have back pain at some time in their lives (1). In the United States, back pain is the most common cause of limited activity in people younger than 45 years of age, the second most frequent reason for visits to the physician, the third most common indication for surgery, and the fifth-ranking cause of hospital admissions (1).

One common treatment for low back pain is the epidural steroid injection (ESI). The purpose of an ESI is to deliver medication directly to the affected nerve roots, thereby limiting the effects of systemically administered steroids. The first report of an epidural injection used to treat low back pain (and sciatica) was in 1901 by Cathelin (2), who injected cocaine via the caudal route. In 1953, Lievre et al. (3) reported the use of epidural hydrocortisone in 20 patients. Since then, ESIs have been used to treat back pain in patients with a wide variety of spinal pathology, including radiculopathy, spinal stenosis, disk-space narrowing, annular tears, spondylosis, spondylolisthesis, vertebral

fractures and postlaminectomy syndrome. Despite the wide range of etiologies, the common denominator of these different causes of back pain seems to be nerve root irritation (4).

Although ESIs have been used for decades to treat low back pain with radiculopathy, controversy still exists as to whether the procedure provides long-term benefit. More than 40 publications have described clinicians' experiences with ESIs. The success rates reported have varied greatly, ranging from 18% to 90% (5,6). However, the number of published randomized controlled trials is small, with most containing serious methodological flaws (5,6). One of the best designed studies (5), a randomized, double-blinded, placebo-controlled study by Carette et al. (7), showed no improvement in outcomes after ESI at a 3-month follow-up. However, even this study has been criticized for not using fluoroscopy during the ESIs.

In addition to lumbar ESI for low back pain, ESI can also be used at thoracic and cervical levels. The clinical outcome studies for cervical ESI showed similar success rates and have similar methodological flaws as the publications that focused on lumbar regions (8–10).

One underlying problem encountered when conducting clinical trials on the efficacy of ESI is that there seems to be no consensus on what constitutes a "proper epidural steroid injection." Differences in opinion as to

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what represents the optimal treatment extend to virtually all aspects of ESIs, including the type and dose of steroids, volume of injectate, frequency of administration, approaches and methods of identifying the epidural space, and the utility of fluoroscopy.

Too often, practitioners arrive at practice techniques guided solely by previous experiences and anecdotal reports. In an attempt to record the most commonly used procedural practices and to determine whether there is any consensus as to what constitutes the optimal injection technique, a questionnaire was sent to all academic pain centers and selected private practices in the United States. Our goal in conducting this survey was to help establish a standard frame of reference for the performance of ESIs in the treatment of chronic pain conditions.

## Methods

The survey consisted of 21 questions divided into two parts. The first part elicited information regarding the type and demographics of the facility participating in the survey. The second section sought information about the manner in which ESIs were performed, the types of medication injected and whether the institution performs related procedures, such as lysis of epidural adhesions or epiduroscopy.

Surveys were mailed to the directors of 85 anesthesia pain fellowship academic programs listed by the American Society of Regional Anesthesia and 100 private practices listed by the International Spinal Injection Society. Programs not responding within 4 wk were then called by one of the authors, and were sent a second survey by fax. Completed questionnaires were returned by 70 academic programs and 36 private practices with a response rate of 87% and 36%, respectively. Follow-up indicated that two of the academic programs not responding had closed. Two academic programs reported they did not administer ESIs and thus were not included in the analysis. Eight private practices were excluded because they reported they were academic types of practices. Questions left unanswered or with ambiguous responses were not included in the data analysis.

Outcomes were summarized as a percentage of the institutions or an average from the institutions  $\pm$  SD. The statistical analysis was performed using *t*-tests for continuous outcomes and Fisher's exact tests for categorical outcomes. A two-sided *P* value  $\leq$  0.05 was considered as statistically significant.

## Results

The average number of anesthesiologists practicing pain management at academic institutions was 4.8 (range, 1-25) and 2.4 at private practices (range, 0-6).

The academic institutions reported seeing an average of 47 new pain patients (range, 4-110) (83% with nonmalignant pain) and having 107 (range, 25-350) follow-up visits per week, whereas the corresponding number for private settings was 30 new patients (range, 4.5-100) (87% with nonmalignant pain) and 124 (range, 11-1000) follow-up visits.

The most common medications used for treatment of chronic pain in both academic and private settings were nonsteroidal antiinflammatory drugs followed, in order of decreasing frequency, by opioids, anticonvulsants, and antidepressants.

The average weekly number of ESIs performed was 18 ( $\pm$ 16.4) at academic pain centers and 36 ( $\pm$ 31.6) at private institutions (*P* = 0.008). At academic centers, in order of decreasing frequency, these injections are performed in the lumbar (62%), cervical (15%), caudal (12%), and last thoracic (5%) spinal regions. In private practices, the ESIs are most often performed in the lumbar region (59%), followed by the cervical (19%), caudal (10%), and thoracic (5%) regions. (Note: these percentages do not add up to 100% because they are the averages across institutions.)

Ninety-seven percent of the academic institutions and 79% of the private practices polled reported using the loss of resistance technique as the primary means to identify the epidural space, with the difference between those two programs being statistically significant (*P* = 0.007).

In cervical levels, the "hanging drop" technique is used in 62% of academic centers, and 30% of private practices (*P* = 0.006). Eight percent of academic centers and none of the private practices polled said that they sometimes use "alternative methods" to establish their location within the epidural space, with the most common being the "fluid column" technique. Academic centers stated that in 11% ( $\pm$ 21) of their ESIs, they use a catheter to administer medications, whereas a catheter is used in 9% ( $\pm$ 11) of private practices.

Ninety percent of the academic centers and 64% private practices polled stated they do not believe that the medication injected into the epidural space remains unilateral (*P* = 0.006). However, 39% of academic centers reported that they consistently attempt to inject ipsilateral to the symptomatology during ESIs versus 54% for private practices.

At the academic institutions, the mean maximal number of ESIs performed in one patient per year was 4.74 ( $\pm$ 2.6) with a range of 0 to 20. In private practices, 6.9 ( $\pm$ 6.9S) (range, 3-40), was the mean maximal number of ESIs clinicians would perform in one patient per year.

## Fluoroscopy

The use of fluoroscopy to perform ESIs was considerably more prevalent in private practice groups than among the respondents from the academic programs,

with the difference being statistically significant for each spinal level. The large difference was seen at cervical levels where 73% of private practices, but only 39% of academic institutions use fluoroscopy. Of those centers that use fluoroscopy, the majority use contrast media and a lateral fluoroscopic view (Table 1).

### Position

In academic practices, the most common position used for cervical (46%), lumbar (50%), and caudal (88%) ESI was prone. This was followed closely by the sitting position (cervical 35%, lumbar 30%, caudal 0%) and lateral decubitus position (cervical 10%, lumbar 6%, and caudal 6%). For thoracic ESIs, the most common position was sitting (41%), followed by prone (34%), and lateral decubitus (14%).

In private practice, the prone position was by far the most common, being used in 61% of cervical, 59% of thoracic, 75% of lumbar, and 96% of caudal ESIs. The second most used position was sitting, used in 35% of cervical, 32% of thoracic, and 77% of lumbar ESIs. In approximately 47% of cervical, thoracic, and lumbar injections, respondents reported using the lateral decubitus position.

### Approach After Lumbar Laminectomy

Whereas only 15% of academic institutions reported the transforaminal approach as the most common approach in postlaminectomy patients, this approach was used most commonly in 61% of private practices. The other approaches used in decreasing order were caudal, midline, and above/below the surgical site (Table 2).

### Medication Administered

The steroid/local anesthetic mixture was the most common medication used for cervical, thoracic, lumbar, and caudal ESI in both academic institutions and private practices. The results for other medications vary, with a minority of centers adding opioids, clonidine, or using local anesthetic alone for their injections (Table 3).

### Special Techniques

Eighteen percent of academic centers and 29% of private facilities reported the use of epiduroscopy at their facility. With regard to the lysis of epidural adhesions, 5% of academic centers and 12% of private practices reported using the procedure in the cervical region, with 38% of academic centers and 59% of private practices using the technique within the lumbar region.

## Discussion

The main finding in this survey is that there is no clear-cut consensus as to the ideal method to perform ESI. There is wide variation among the individual practices in almost every technical aspect of ESI. The small rate of response of private practices to our survey limits the adequate comparison between academic and private settings.

There are many clinical recommendations on the maximal number of ESIs performed in one patient per year, although there are scant data to support any number. Although the chance of a patient developing adverse systemic effects from ESI is small, the risk may increase significantly depending on the number and frequency of injections performed (11,12). In our survey, one striking example of variability between institutions is in the maximal number of ESIs performed per patient per year, with the range being 2-20 in academic practices and 0-40 in private practices.

### Fluoroscopy

As was alluded to above, the findings of the majority of previously published studies regarding the efficacy of ESIs might potentially be limited by nonuse of fluoroscopy (5-7). Further outcome studies are needed to examine the value of fluoroscopy for ESI.

In our survey, one surprising finding was that private practices use fluoroscopy with more regularity than academic institutions. Possible explanations for this include better availability of resources and lucrative financial remuneration. In recent years, the clinical benefits of routine epidurography are becoming increasingly evident. In a study by White et al. (13), the authors reported successful placement of a needle in only 70% of cases of nonfluoroscopically guided (NFG) ESIs, whereas the reported success rate for blind caudal ESIs was only 48%. Fredman et al. (14) reported that in NFG ESIs, an inadequate spinal level was entered in 50% of cases, with contrast reaching the area of pathology in only 26% of injections. Stojanovic et al. (15) found a 53% rate of false loss of resistance during attempts to enter the epidural space in cervical levels without fluoroscopic confirmation. The same study found a unilateral epidural contrast spread in 51% of cervical ESIs. A smaller cervical epidural space when compared with lumbar levels and close proximity of the spinal cord can lead to rare, but serious complications in NFG cervical ESIs, including permanent spinal cord injury (16,17). But when performed under epidurography, Johnson et al. (18) reported only 4 minor complications of 5334 ESIs done at various spinal levels. Considering those factors, the use of fluoroscopy to guide cervical ESIs seems to be underused in academic pain programs.

The important variable with ESI may be the spread of the administered medication over time. Post-ESI follow-up studies of the spread of the contrast media

**Table 1.** The Percentage of Institutions Using Fluoroscopy and Epidurography for ESI by Spinal Level

Use of fluoroscopy	Academic <sup>a</sup> (%)	Private <sup>b</sup> (%)	Academic versus private ( <i>P</i> value)
All spinal levels	69	93	0.017*
Cervical	39	73	0.005*
Thoracic	34	75	<0.001*
Lumbar	38	77	0.001*
Caudal	59	92	0.004*
Contrast use	93	96	
% of ESI contrast used	79 (±34)	88 (±29)	
Lateral view use	80	88	
% of ESI lateral view used	69 (±43)	72 (±40)	
Tunneled view use	37	54	
% of ESI tunneled view used	29 (±43)	40 (±44)	

ESI = epidural steroid injection.

<sup>a</sup> Percentage of all academic institutions that responded to the survey.

<sup>b</sup> Percentage of all private institutions that responded to the survey.

\* Statistically significant results.

**Table 2.** Approach to the Epidural Space After Laminectomy

	Transforaminal	Caudal	Above/below	Midline	Other
Academic <sup>a</sup> (%)	15	31	16	28	7
Private <sup>b</sup> (%)	61	25	7	4	4
Academic versus private ( <i>P</i> value)	<0.001*	<0.63	<0.33	<0.006*	<0.67

<sup>a</sup> Percentage of all academic institutions that responded to the survey.

<sup>b</sup> Percentage of all private institutions that responded to the survey.

\* Statistically significant results.

**Table 3.** The Percentage of Institutions Using Given Medication for ESI by Spinal Region

	Cervical (%)	Thoracic (%)	Lumbar (%)	Caudal (%)
Steroid/local anesthetic	32/54	39/57	35/54	33/55
Steroid/local anesthetic/saline	18/4	20/14	27/12	29/14
Steroid/saline	31/17	0/10	17/8	17/5
Steroid	13/17	54/14	14/15	14/14
Local anesthetic	2/8	2/5	2/12	2/14
Steroid/opioid	2/0	0/0	2/0	2/0
Steroid/local anesthetic/opioid/clonidine	2/0	2/0	2/0	2/0
Local anesthetic/opioid	0/0	2/0	2/0	2/0

Data are presented as academic/private and are given in percentages.

ESI = epidural steroid injection.

or radiolabeled medication spread might be needed to better answer this question. This may answer the question of whether the medication needs to be administered exactly at the site of pathology.

### Choice of Injectate

The effects of epidurally administered corticosteroids stem from their ability to inhibit the synthesis of prostaglandins, their antiinflammatory effects, and their ability to inhibit ectopic discharges from injured sensory nerves (19,20). Local anesthetics exert their analgesic effects by blocking the conduction in nerves via their effects on Na<sup>+</sup> channels and suppressing the ectopic signal generation in injured nerves. In addition to providing temporary pain

relief, local anesthetics may provide prolonged benefits by putatively interrupting the cycle of pain. Although it seems logical that a larger dose of steroids injected around the affected nerve root would provide more effective analgesia than a smaller dose, the ideal dose and type of steroid has yet to be determined.

In our survey, the two most frequent combinations of medications injected at all spinal levels were steroid/local anesthetic and steroid/local anesthetic/normal saline. In ESIs fluoroscopically directed toward the area of pathology, mixing steroids with inactive carrier fluids may undermine the effects of the drug by diluting the amount reaching the site of pathology. Alternatively, in injections performed blindly, increasing the injectate volume may increase the likelihood that the medication

administered actually reaches the area of pathology (21). However, published data have not revealed any difference in outcomes when different volumes of medication were used (5).

As can be seen by the decreased percentage of practices injecting local anesthetic into the cervical epidural space, the potential benefit of adding drugs such as local anesthetic, clonidine, or opioids must be weighed against the increased risk they add to the procedure.

### *Postlaminectomy Approach*

It is often observed that patients having undergone prior back surgery do not respond to ESIs as well as surgically naïve patients. Among other reasons, the decreased success rate of ESI in these patients may be attributable to the chronicity of their symptoms and epidural scarring limiting the spread of medication in the epidural space.

One major advantage of the caudal route in these patients is the decreased risk of dural puncture in comparison with the translaminar approach. el-Khoury et al. (22) reported a 97.5% success rate of caudal ESI when performed under fluoroscopy. This survey reveals that fluoroscopy is frequently used in both academic and private practices for the caudal approach, suggesting that practitioners do recognize the frequent failure rate when caudal injections are done blindly. A potential disadvantage of the caudal approach is the larger volume of medication required to reach the area of pathology. Although it seems logical that a diluted steroid solution reaching the area of pathology would diminish the effect of the block, the various approaches have not been directly compared. In patients with severe scarring, the medication administered via the caudal route may fail to reach the area of the pathology. The same concern holds for ESI performed above or below the surgical site. However, the increased volume of medication may have the beneficial effect of lysing epidural adhesions. Because of the anatomical changes that occur after back surgery, ESI performed through a surgical incision may carry an increased risk of dural puncture.

The potential benefits of a transforaminal approach may include minimal risk for dural puncture, better delivery of medication to the site of pathology, increased spread into the ventral epidural space, and subsequently a reduced amount of medication necessary to produce the desired effect. Whereas there are many reports that show fluoroscopically guided transforaminal steroid injections to be an effective treatment in patients with radicular pain from herniated discs (23), at the present time, there are no controlled studies comparing transforaminal ESIs with translaminar or caudal techniques.

### *Other Factors*

Recent studies have shown that the unilateral contrast media spread may occur in 50%–58% of fluoroscopically guided ESIs (15,24). Although the spread of contrast and medication mixtures may differ because of their different chemical properties, and larger injectate volumes may enhance spread, it nevertheless seems prudent to administer the medication ipsilateral to the area of pathology. In our survey, there is a strong disparity on this topic between beliefs and reported practices. The reasons for these differences are not clear.

The majority of practices polled use epidurography when performing ESI under fluoroscopy. In addition to ensuring the spread of injectate to the desired side and level(s), another benefit of epidurography is minimizing the chances of an intravascular injection. In a study by Furman et al. (25), the authors reported that the aspiration of blood is an unreliable method for detecting intravascular injections during transforaminal ESIs, being falsely negative >50% of the time.

Only a few centers polled use a catheter to administer medication during ESI. With the use of an epidural catheter, Fredman et al. (14) reported a <10% failure rate in locating the epidural space without fluoroscopy, compared with more frequent reported failure rates (26%–53%) when a catheter was not inserted (16,24). A confounding variable in comparing these results is the larger-sized Touhy needle that must be used when a catheter is inserted, which may by itself lead to increased accuracy.

### **Conclusions**

Despite the controversy surrounding the long-term benefits of ESIs, the results of our survey indicate that they are still a commonly used treatment in the United States. This is not surprising, considering the large body of evidence that supports their efficacy and safety. Our research indicates that there is no consensus, either at academic or private practices, as to what constitutes the best approach to the epidural space, the most effective injectate, and on the use and utility of fluoroscopy. There are similar differences in opinion regarding the maximal number of ESIs that can be performed in one patient per year and the use of adjuvant procedures such as epiduroscopy and the lysis of adhesions. Because the literature is filled with a wide variety of different recommendations on when and how best to perform ESIs, it is likely that the current patterns of practice have resulted from individual experiences, anecdotal accounts, and selected reviews of the literature. We hope that the information provided by our survey will be helpful in developing future standards of reference that can be used when

performing these procedures. Clearly, more research is needed before a consensus can be reached as to what constitutes the most effective method of performing ESIs.

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