

An update on technical and safety practice patterns of interlaminar epidural steroid injections

Berkenesh Gebrekristos^{a,*}, Razvan Turcu^b, Dana Kotler^a, Ashley E. Gureck^a, Alec L. Meleger^a

^a Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital/Harvard Medical School, Boston, MA, USA

^b Department of Anesthesiology, Dartmouth Medical School, Hanover, NH, USA

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ABSTRACT

Introduction: Interlaminar epidural steroid injections (ILESIs) are mainstay in the management of low back, neck and radicular pain and are a commonly performed pain management procedure in the United States. Our survey aims to provide an update in practice patterns of ILESIs among interventional pain physicians.

Methods: We distributed a 91-item survey nationwide to private and academic interventional pain physicians who perform epidural steroid injections (ESIs). The survey was distributed via REDCap with a series of questions inquiring about current practices in epidural steroid injections from March 2021 to March 2022. Cross sectional data from survey responses specific to ILESI-related practices were captured and synthesized.

Results: Of 103 complete survey responses, 96 physicians perform ILESIs (cervical, 87.5 %; thoracic, 82.3 %; lumbar 99 %). Nearly all surveyed physicians utilize fluoroscopy (98.1 %) over other modalities like MRI and ultrasound. For CIESIs, dexamethasone was the preferred steroid (52.4 %) over methylprednisolone (23.7 %); the converse was true for LIESIs in which methylprednisolone (44.2 %) was preferred over dexamethasone (32.6 %). The majority of providers performing ILESIs (91.7 %) preferred a Tuohy/Weiss needle while only a small fraction preferred the Quincke needle (7.2 %). Sedation practices were more varied with only about half of providers (47.6 %) offering medications. Furthermore, a great fraction of providers continue to use contrast for LIESIs (97.9 %) and CIESIs (89.6 %).

Discussion: Our survey suggests that despite updated consensus recommendations, variability continues to exist in procedural practice patterns. Highlighting areas of variable adherence to current safety guidelines can assist with what is emphasized in the generation of future evidence-based guidelines. Though our survey was conducted in the context of the COVID-19 pandemic with resultant supply chain shortages, more research is needed to elucidate what variables may factor into why proceduralists may stray from guideline concordant care.

1. Introduction

Low back pain is the 4th leading cause of years lived with disability since 1990 and remains a significant global public health concern [1,2]. Neck pain similarly remains an international burden with an age-standardized prevalence rate of 27.0 per 1000 population in 2019 [3]. An analysis by the Journal of the American Medical Association revealed that low back and neck pain accounted for the highest amount of health care spending in the United States [4].

Given how taxing these conditions are, many pharmacological and non-pharmacological treatment options have been explored. ESIs are considered an integral part of the nonsurgical management of low back, neck and radicular pain and are commonly performed pain management

procedures in the United States [5]. While the risks associated with these interventions are considered to be lower than those of controlled substances like opioids and are less invasive than surgical interventions [6], safe technique is necessary to prevent rare, but potentially devastating complications of ESIs such as infection and neurological injury.

Prior studies have documented the variability in practice patterns and safety protocols assumed by US interventional pain physicians [7–11]. In search of a consensus, several multidisciplinary task forces and societies have released guidelines for safe practices and procedures [12–14]. Since the COVID-19 pandemic, an updated multidisciplinary consortium of experts have made provisions to safety protocols to address how to best continue offering these interventions while mitigating disease spread [15]. Additionally, it is unclear how pandemic-related supply chain shortages have impacted practice

* Corresponding author. Department of Physical Medicine and Rehabilitation, 300 First Ave., Charlestown, MA, 02129, USA.

E-mail address: berkenesh.gebrekristos@gmail.com (B. Gebrekristos).

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Abbreviations

ESI	Epidural steroid injections
ILESIs	Interlaminar epidural steroid injections
CIESIs	Cervical interlaminar epidural steroid injections
LIESIs	Lumbar interlaminar epidural steroid injections
ICM	Iodinated contrast media

patterns. Our, which was conducted during the COVID-19 pandemic, seeks to describe practice patterns of ILESIs among interventional pain physicians.

2. Methods

This study was approved by the Mass General Brigham (MGB) Institutional Review Boards.

2.1. Survey

A 91-item questionnaire was created using the research electronic data capture (REDCap) tools hosted at MGB to gauge interlaminar epidural steroid injection (ILESIs) practice patterns among interventional pain providers in the United States.

2.2. Study participants

The study was distributed to 111 program directors of Accreditation Council for Graduate Medical Education pain fellowships selected using the FREIDA™ database. Forty-two North American Spine Society and Interventional Spine and Musculoskeletal Medicine recognized fellowship directors were also selected. To ensure adequate opportunity for representation from private practice physicians, 100 physicians with private practices were randomly identified using American Society of Interventional Pain Physicians doctor finder feature and Yelp. To further optimize study participant responses, posts were made on member only private platforms like Physforum of the American Academy of Physical Medicine and Rehabilitation.

2.3. Data collection

Emails with a link to the encrypted and password protected REDCap survey were distributed to this generated list of interventionalists a total of 3 times over a 12-month period (03/2021-03/2022). Only the principal investigator and actively involved researchers had access to the data.

2.4. Data analysis

Survey responses were exported and analyzed using Excel software and STATA [16] for frequency analysis.

3. Results

3.1. Demographics

One hundred and twenty interventional pain physicians responded to the survey, 100 of whom completed all 91 items. Of the respondents who reported a primary specialty, 50 (48.5 %) completed training in Anesthesiology, 51 (49.5 %) in Physical Medicine and Rehabilitation (PM&R) and 2 (1.9 %) in Radiology. Eighty-nine (86.4 %) of the respondents completed a fellowship. All 44 fellowship trained anesthesiology providers completed an anesthesiology-based pain medicine fellowship, whereas the 45 p.m.&R providers had more varied

fellowship training. Fellowships completed among the physiatrists were as follows: 13 (28.9 %) PM&R pain, 12 (26.7 %) interventional spine, 10 (22 %) anesthesia pain, 8 (17.8 %) sports medicine and 2(4.4 %) in other. Neither of the two radiology physicians completed a fellowship. All respondents were actively performing ESIs at the time of the survey, with 76 (73.79 %) practicing >5yrs, and 73 (70.87 %) performing >10 procedures a week.

3.2. Types of ILESIs performed and advanced imaging

Of those who perform ILESIs, 84/96 (87.5 %) perform cervical interlaminar epidural steroid injections (CIESIs), 79/96 (82.3 %) perform thoracic interlaminar epidural steroid injections, and 95/96 (99.0 %) perform lumbar interlaminar epidural steroid injections (LIESIs). For all ESIs, 91/103 (88.3 %) of the respondents require advanced imaging. Of the 84 physicians who perform CIESIs, 73 (86.9 %) require advanced imaging. When advanced imaging prior to CIESIs is available, 13 (15.4 %) review the radiology report, but not the imaging itself, while 68 (80.9 %) review both the imaging and report. Two respondents (2.4 %) review the images alone, while 1 (1.2 %) reviews neither the imaging nor report.

3.3. Sedation

The majority of respondents, 54/103 (52.4 %), do not offer sedation under any circumstance, while 49/103 (47.6 %) offer sedation in some situations. The primary specialty breakdown of those who offer sedation are anesthesiology (23, 46.9 %), physiatry (25, 51.0 %) and radiology (1, 2 %). Among these 49 physicians who offer sedation, 24 (49 %) provide it > 25 % of the time, and 6 (12.2 %), offer it >75 % of the time. Further detail on the type of sedation offered is available in Table 1.

3.4. Needle

For physicians performing ILESIs, 91.7 % selected a Touhy/Weiss needle as their needle of choice. For the 88 who selected Touhy/Weiss as their preferred needle, 46 (52.8 %) use a 20g, 27 (30.7 %) use an 18g, 11 (12.5 %) use 22g and 4 (4.5 %) used another size not listed in our survey. The second most commonly used needle by the respondents was the Quincke needle. Of the 7 (7.2 %) who selected this needle, a 20g was selected as the most preferable gauge by 6 (85.7 %), while 1 (14.3 %) preferred a 22g. One interventionalist selected a 20g Crawford needle as their needle of choice for ILESIs.

3.5. Imaging guidance and safety view

Of the 103 physicians who responded to questions regarding image guidance while performing ESIs, 101 (98.1 %) use fluoroscopy, 2 (1.9 %) use MRI and 1 (1 %) uses ultrasound. In addition to anteroposterior (AP) view to gauge needle tip depth, physicians who perform ILESIs in this survey most commonly reported using a combined contralateral oblique

Table 1
Frequency and type of sedation provided by respondents that use sedation.

% of Time Sedation Offered	Type of Sedation Used			Total (%)
	IV %	Oral %	IV or Oral %	
0-5%	10.2	8.2	8.2	26.6
6-25 %	14.3	2.0	8.2	24.5
26-50 %	14.3	0.0	6.1	20.4
51-75 %	14.3	0.0	2.0	16.3
76-100 %	10.2	0.0	2.0	12.2
Total (%)	63.3	10.2	26.5	

n = 49.

Numerical data are reported as percentages.

Abbreviations: PM&R, Physical Medicine and Rehabilitation.

(CLO) and lateral view (36/96, 37.5 %). This was followed by CLO only (34/96, 35.4 %) then lateral view only (17/96, 17.7 %). Five (5.2 %) reported using AP view alone while 4 (4.2 %) selected AP view with needle tip contacting adjacent lamina.

3.6. Accessing epidural space

Most respondents selected the loss of resistance (LOR) to saline technique to identify the epidural space during ILESIs (60/96, 62.5 %). Loss of resistance to air (31/96, 32.3 %) was the second most commonly selected to confirm the epidural placement followed by contrast puffs (12/96, 12.5 %). When asked about levels used to access the cervical epidural space specifically, 13/84 (15.5 %) access the epidural space above C6/7. These providers were more likely to be in practice over 10 years and anesthesiologists. The levels selected for access along with specialty and experience of providers is available in Table 2.

3.7. Contrast

When asked about procedures for which a provider uses contrast dye, 94/96 (97.9 %) report using it for LIESIs, while 86/96 (89.6 %) report using contrast dye for CIESIs. Of those who responded, the majority (41/86, 47.7 %) use <1 ml of contrast, followed by 1–2 ml when performing CIESIs. For LIESIs, 51/94 (54.3 %) use 1–2 ml of contrast volume and 29/94 (30.9 %) use <1 ml. The entirety of contrast dye volumes preferences is available in Table 3. The fluoroscopic position used to evaluate the contrast spread include AP 85.1 %, CLO 52.1 % and lateral 41.5 % of the time. The majority 63/96 (65.6 %) report using extension tubing when administering contrast and steroid.

3.8. Injectate characteristics in CIESIs

Dexamethasone was the steroid of choice among providers who perform CIESIs (44, 52.4 %, Fig. 1), with 31/44 (70.5 %) using 10 mg (Fig. 2). Methylprednisolone was the second most preferred (23, 27 %), and of those who shared their most frequently used dosage, the majority, 15 (68.2 %) use 80 mg. Seven responders use triamcinolone with 80 mg being the most favored dose, and betamethasone was used by 6 respondents, with 4 (66.7 %) choosing 12 mg as their preferred dose. Thirty-seven of 96 (38.5 %) add local anesthetic for all ILESIs, while 4/96 (4.2 %) use it only in the setting of a diagnostic ILESI. The total injectate volume, including steroid, saline and/or anesthetic, was 3cc (31, 36.9 %), 4cc (17, 20.2 %) and 2cc (16, 19.0 %). The rest is tabulated in Fig. 3.

3.9. Injectate characteristics in LIESI

Methylprednisolone was the steroid of choice when performing a LIESI (42, 44.2 %), followed by dexamethasone (31, 32.6 %),

Table 2

Cervical epidural space access and characteristics of providers who access above the C6/7 level.

Cervical level used to access epidural space (n=84)		2 (2.4 %)
Cervical level used to access epidural space (n=84)	C3/4	2 (2.4 %)
	C4/5	5 (6 %)
	C5/6	13 (15.5 %)
	C6/7	43 (51.2 %)
C8/T1	82 (97.6 %)	
Provider specialty for those who access above C6/7 (n=13)	Anesthesiology	9 (69.2 %)
	PM&R	4 (30.8 %)
	Radiology	0
Years in practice for those who access above C6/7	0–10 yrs	4 (30.8 %)
	>10 yrs	9 (69.2 %)

Numerical data are reported as number of providers (%). Abbreviations: PM&R, Physical Medicine and Rehabilitation, yrs, years.

Table 3

Volume of contrast injected by respondents for CIESIs and LIESIs.

Volume of Contrast (ml)	CIESI (%) (n = 86)	LIESI (%) (n = 94)
<1	47.7	41.3
1–2	45.3	47.8
2–3	5.8	9.8
3–4	1.2	1.1
>4	0.0	0.0

Numerical data are reported as percentage.

Abbreviations: CIESI, cervical interlaminar epidural steroid injection, LIESI, lumbar interlaminar epidural steroid injection.

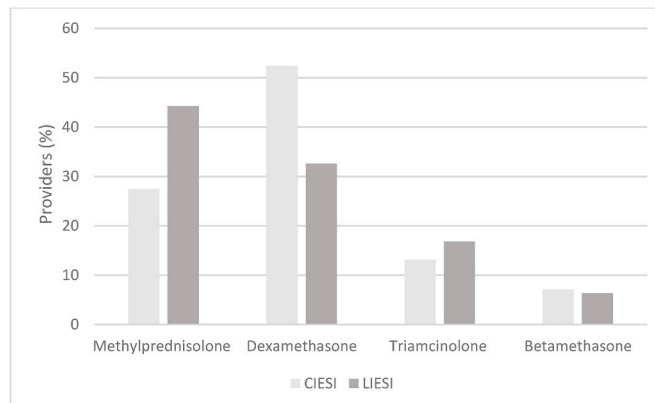


Fig. 1. Dexamethasone was the steroid of choice for 52.4 % of providers who perform CIESIs, followed by methylprednisolone (27.4 %), triamcinolone (13.1 %) then betamethasone (7.1 %). For LIESIs, the preferred steroid was methylprednisolone (44.2 %), while 32.6 %, 16.8 % and 6.3 % chose dexamethasone, triamcinolone and betamethasone respectively. n = 84 (CIESIs), n = 96 (LIESIs).

Abbreviations: CIESI, cervical interlaminar epidural steroid injection, LIESI, lumbar interlaminar epidural steroid injection.

triamcinolone (16, 16.8 %), betamethasone (6, 6.3 %). Complete responses to dosage preferences are available in Fig. 2. The total volume injected into steroid, saline and/or anesthetic, was most commonly reported to be 3cc by physicians who perform CIESI's (28, 29.5 %). This was closely followed by 4cc (25, 26.3 %) then 5cc (18, 18.9 %). The rest is tabulated in Fig. 3.

14. Discussion

This is the first study to provide updated practice patterns for cervical and lumbar ILESI a year after the onset of the COVID-19 pandemic.

4.1. Sedation

The risk of spinal cord injury during ESIs have been associated with patients being sedated or unresponsive at the time of the procedure [17]. Additionally, there is some data demonstrating spinal procedures that are performed without sedation have patient satisfaction rates as high as 93 % [18]. It is the current standing of multiple societies, including International Pain and Spine Intervention Society (IPSI) and American Society of Anesthesiologists and ASRA that if sedation is necessary for tolerance of the procedure (e.g., movement disorder, extreme anxiety), sedation should be light enough for the patient to be able to communicate adverse or abnormal sensations [19,20]. Despite this, we found that 12.24 % of our respondents provide sedation as a standard practice >75 % of the time, while 52.4 % do not offer sedation under any circumstances. These practices may suggest that providers should more strongly consider patient-specific characteristics when deciding on

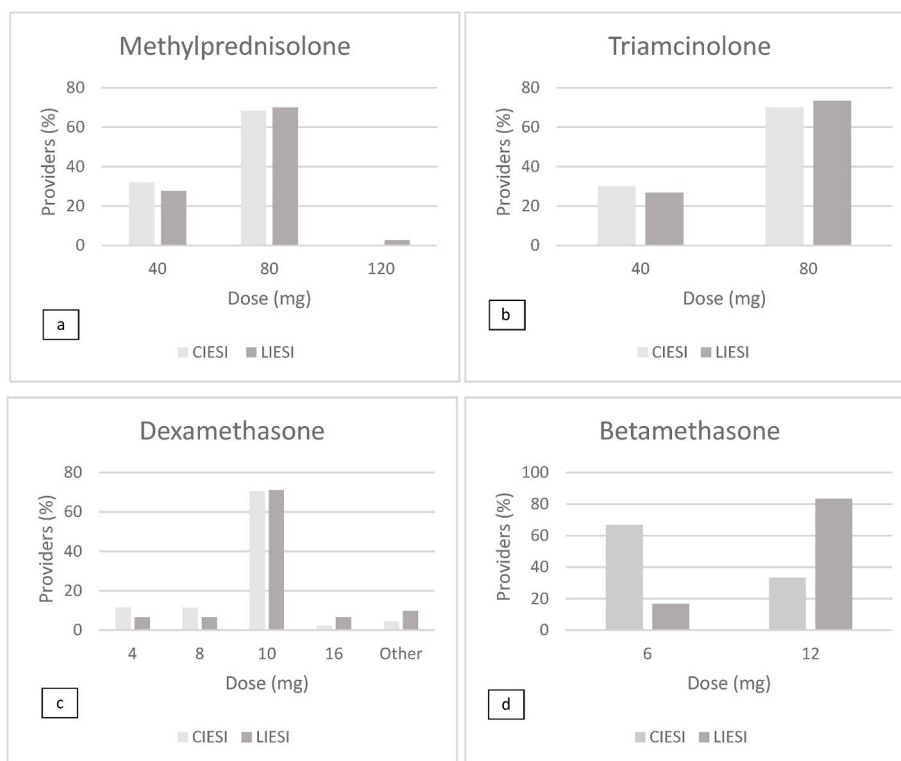


Fig. 2. 2a and 2b: 80 mg is the selected dose of methylprednisolone (68.2 %, 70.0 %) and triamcinolone (70.0 %, 73.3 %) for both CIESIs and LIESIs respectively. **Fig. 2c:** 10 mg of Dexamethasone is the preferred dose for CIESIs (70.5 %) and LESIs (71.0 %). **Fig. 2d:** Respondents who use Betamethasone prefer 6 mg for CIESIs (66.7 %), while 83.3 % use 12 mg for LIESIs.

Abbreviations: CIESIs, cervical interlaminar epidural steroid injection, LIESI, lumbar interlaminar epidural steroid injection.

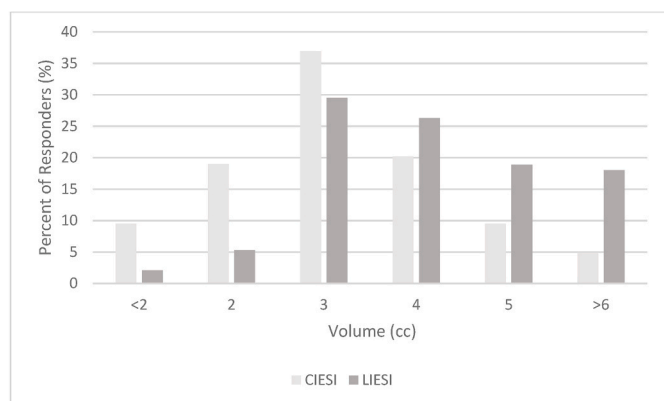


Fig. 3. For a typical CIESI and LIESI, the most commonly used total injectate used was 3 ml at 36.9 % and 29.5 % respectively. Total injectate volume includes steroid, saline and local anesthetic, if used.

Abbreviations: CIESIs, cervical interlaminar epidural steroid injection, LIESI, lumbar interlaminar epidural steroid injection.

periprocedural sedation.

4.2. Imaging

The false positive rate of LOR is high, with a recent study documenting the rate at 58.3 % [21]. In a review of injuries and liabilities associated with CIESI's, it has been reported 45 % of injuries could have been prevented had appropriate radiographic guidance been taken during the procedure [17]. Our results show that all providers perform ILESIs with image guidance, with 62.5 % confirming placement using LOR to saline. Interestingly, a 2002 study reported 69 % of academic and

93 % private practice proceduralists report using fluoroscopy for ILESIs at any level [7]. This trend in use of image guidance suggests increased adherence to safety guidelines over the decades. In concordance with multidisciplinary task force guidelines [12], 37.5 % of providers confirm needle placement with AP, lateral and CLO views, while some use AP and CLO only (35.4 %) or AP and lateral (17.7 %).

4.3. Access

Given the ligamentum flavum is thickest at C6-T1 levels with more frequent gaps cranially [14], all 13 of the assembled multigroup consortium recommend CIESIs be performed at C7-T1, but preferably not higher than the C6-7 level to minimize risk of catastrophic neurologic injury [13]. Our results demonstrated entry levels varied, with a majority 51.2 % injecting at C6/7 and 2.3 % injecting as high up as C3/4. The multigroup consortium again reached a unanimous consensus in recommending careful review of imaging prior to procedure to ensure adequate room for the needle at the target level [13]. Our results demonstrate 13.1 % of providers who perform CIESIs do not require advanced imaging prior to performing the procedure. Amongst the 86.9 %, 15.4 % review the radiology report, while 1.2 % review neither the imaging nor report. This appears to be guideline discordant care and more investigation into reasons why providers stray would be helpful to minimize risk of adverse neurologic outcomes.

4.4. Contrast

Iodinated contrast media (ICM) use is recommended given the risk of inadvertent dural puncture or vascular uptake during fluoroscopically guided ILESIs, which occurs at a reported rate of 0.2 % [22]. In a survey of radiology department chairs conducted in 2022, 60 % reported being significantly impacted by the ICM shortage and of those impacted, 57 % where using measures to preserve ICM including performing some

examinations without ICM [23]. American Society of Regional Anesthesia and Pain Medicine (ASRA) recommended, if experiencing ICM shortage, cautiously proceeding with LIESI after careful review of imaging, urgency and risk profile, but always delaying CIESIs until a later date once contrast has been obtained [24]. Despite the context in which our survey was conducted, results show that the vast majority of responders, one year from the stay-at-home order, report using ICM, 97.9 % for LIESI and 89.86 % for CIESIs.

If the decision is made to proceed with ILESIs without contrast, a multigroup practice advisory recommended removing lidocaine from the injectate to minimize risk of intrathecal injection of anesthetic, especially for cervical level injections. The advisory also recommended use of preservative-free, non-particulate steroid (e.g. dexamethasone) to reduce the possible complication of arachnoiditis if proceeding with ILESIs without contrast [25]. A good proportion (38.5 %) of pain physicians report using anesthetic in their steroid mixture in our survey. As our survey did not inquire about whether our respondents were experiencing shortages, it is not clear that this is guideline discordant practice.

Regarding volume of contrast, evidence suggests there is similar spread pattern and subsequent pain relief at contrast volumes of 3–6 mL [26]. Our study shows that 86.2 % and 93 % of the respondents performing LIESIs and CIESIs use 2 ml or less of contrast. Further research is needed to better elucidate the lowest end of total volume necessary to provide adequate safety epidurogram.

4.5. Steroid

The benefits of steroids are weighed carefully against their complications including rare neurologic sequelae (steroid-induced myopathy), iatrogenic Cushing's, epidural lipomatosis, steroid-induced mood symptoms, and more common effects like hyperglycemia, facial flushing and other transient HPA axis sequelae from systemic absorption [27]. Ninety reports of catastrophic neurologic events or death have been reported to the FDA Adverse Event Reporting System from 1997 to 2014 from epidural steroid injections [28]. It is generally perceived that vascular complications can be heightened with use of particulate steroids (e.g. methylprednisolone, triamcinolone, betamethasone), however these considerations are primarily for transforaminal epidural steroid injections as vascular complications have rarely been reported for ILESIs secondary to steroid choice [29].

With emerging literature demonstrating non-particulate steroids are non-inferior to particulate steroid for pain relief and functional improvement [30–32], many providers preferentially use dexamethasone as their steroid of choice, especially for cervical level injections. In 2019, there was a preservative-free dexamethasone shortage, prompting IPSIS to release updated guidelines which stated that particulate steroids could equally be considered for ILESIs at any level [33]. Our results show that, most (52.4 %) of providers use dexamethasone as their steroid of choice for CIESIs, while for LIESIs, methylprednisolone was the steroid of choice for 44.2 % of providers, followed closely by dexamethasone. This is in contrast to a 2018 study where the proceduralists surveyed reported dexamethasone for CIESI at 24.6 % and LIESI at 10.5 %.

There are few consensus guidelines on dosing recommendations. In 2019, Benelux Work Group recommended using the lowest possible dose of a glucocorticoid for ESIs. The task force considered effective doses for methylprednisolone to be 40 mg, triamcinolone 10–20 mg and dexamethasone 10 mg. A 2020 randomized control trial assessing HPA suppression, adrenal insufficiency (AI) and pain levels using 20 versus 40 mg of triamcinolone demonstrated that there was no statistically significant differences in pain or AI according to the ESI dose, but the hypothalamic-pituitary-adrenal suppression is prolonged and recovery is slower with 40 mg when compared to 20 mg [34]. Our results show that the majority of providers use 80 mg for LIESIs and CIESIs when using methylprednisolone and triamcinolone, which is higher than

known effective doses. However, 70.5 % use the recommended effective dose for dexamethasone at 10 mg. Given the known adverse effects of using corticosteroid at higher doses, it is prudent that providers use the least necessary dose for effectiveness or mitigate the effects by prolonging the interval between subsequent injections.

4.6. Limitations

To improve provider responses, we were mindful of survey length and omitted questions inquiring about rationale for practice patterns, geographic location and practice-setting. Having this information in future studies could help provide insight into factors that may contribute to variability in practice. Furthermore, given the voluntary and cross-sectional nature of survey study design, responses are subject non-response bias and recall bias. Though we tried to mitigate these effects by soliciting responses from academic and private practices, the relatively small sample size may not capture all practice patterns or all settings in which care is delivered and therefore may not be representative of the population.

5. Conclusion

Our survey of practicing interventional pain physicians suggests that despite updated consensus recommendations, variability continues to exist in procedural practice. More research is needed to provide further clarity into factors that may influence interventionalists practice pattern preferences. Though our study was conducted during the COVID-19 pandemic, it is unclear what effect supply chain shortages may have had in posing a barrier in adherence to consensus statements.

Financial disclosures

None.

Declaration of competing interest

None.

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