Retrospective Study

Comparison of Radiation Doses of Contralateral Oblique and Lateral View for Fluoroscopy-Guided Lumbar Interlaminar Epidural Steroid Injection

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Background: Despite newly developing technologies and techniques, the use of fluoroscopic guidance in spinal interventional treatments remains popular. Therefore, it is essential to set reference standards and techniques for reducing radiation exposure in fluoroscopy-guided procedures.

Objective: The aim of this study was is to compare the radiation doses and procedure time of the contralateral oblique (CLO) view to lateral view imaging during fluoroscopy-guided spinal procedures.

Study Design: A retrospective study.

Setting: Pain management unit of a tertiary care center.

Methods: An evaluation of patients who received epidural steroid injections between May 2021 and May 2023 in a university hospital interventional pain management center was performed. This observational study was conducted with 248 patients aged 18 and older who underwent lumbar interlaminar epidural injections (ILESI) confirmed by CLO or lateral oblique imaging. The primary outcomes were the comparison of radiation dose and procedure time between the 2 groups. The secondary outcome was the comparison of complication rates.

Results: There were no significant differences between the two groups in terms of age, gender, diagnosis, body mass index, procedure level, Numeric Rating Scale, and procedure time. Although the radiation dose was lower in the CLO group, there was no significant difference between the 2 groups. However, there was a significant difference between the 2 groups in terms of complications ($P < 0.001$).

Limitations: The study was designed in a single center and performing all the procedures with the same fluoroscopy device makes it difficult to generalize our results.

Conclusions: Although there was no difference in terms of radiation dose and duration of procedure between lumbar ILESI conducting using the CLO or lateral view fluoroscopy imaging, there was a significant difference in terms of complications. Therefore, conducting lumbar ILESI using a CLO view minimizes the complication rate.

Key words: Epidural injection, interlaminar injection, radiation dose, fluoroscopy, contralateral oblique

Ethical Approval: This study was approved by the Marmara University Ethics Committee with the Approval No: 02.06.2023.758

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Low back pain (LBP) is a prevalent health problem all over the world, which many people face at least once in their lives. LBP is becoming more common due to the increasing and aging world population, due to which it is becoming an economic burden (1,2). Lumbar interlaminar epidural steroid injections (ILESI) are one of the interventional pain procedures frequently used to treat LBP which is unresponsive to conservative treatment (3). The ILESI allows the drug to spread over a wider area in the epidural space and has been an effective treattment in the short and medium-term for patients with multilevel spinal pathology (4).

Fluoroscopy-guided imaging is frequently used in ILESI for procedural safety and accuracy. The purpose of using fluoroscopy in spinal procedures is to ensure that the injected drug reaches the correct target, to prevent the needle from damaging other structures, and for intravenous injections; thus it increases the success of the procedure (5,6). As the frequency of these procedures increases, health care professionals, patients, and even indirectly the public may be exposed to ionizing radiation from the imaging and may face the associated harmful side effects such as cataracts, skin lesions, and cancer (7,8). Cumulative radiation dose exposure varies depending on the experience of the administrator, type of procedure, imaging techniques (such as collimation, and magnification), patient's body mass index (BMI), and proximity to the device (9). As low as reasonably achievable (ALARA) principles should be followed to minimize the destructive risk of radiation from imaging (10,11).

Sacaklidir et al (12) compared radiation doses in lumbar epidural steroid injection methods, and the highest and lowest radiation doses were found during the caudal and transforaminal approaches, respectively. Yoo et al (13) compared lateral and anteroposterior imaging in fluoroscopy during transforaminal epidural steroid injection and found that the doses were lower in anteroposterior imaging. Meanwhile, the entire causal injection procedure is performed with a lateral view (12). When the physician performed lumbar ILESI, a lateral or contralateral oblique (CLO) view was taken to define needle depth. Although this depends on the clinician's choice, it is not known which method is better and more reliable. In the present study, our aim is to compare the CLO and lateral view in terms of radiation dose, procedure time, and complication rates during ILESI and to determine the procedure technique that is better to use.

Methods

Study Design and Study Population

This study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients. After approval from the institutional ethics committee (Ethic number: 02.06.2023.758), a retrospective evaluation of patients who received fluoroscopy-guided lumbar ILESI between May 2021 and May 2023 was conducted in a tertiary hospital pain management center.

A total of 2,824 interventional procedures were scanned from the hospital database system. After applying the exclusion and inclusion criteria, this study was conducted with 248 patients who had been administered lumbar interlaminar epidural injections. The inclusion criteria were patients over 18 years of age who underwent lumbar ILESI confirmed by CLO or lateral imaging. Patients with a history of lumbar spine surgery and scoliosis, and patients without a procedure time and cumulative radiation dose from a C-arm report were excluded from the study (Fig. 1). Patients were divided into 2 groups according to the confirmatory imaging technique used (CLO or lateral imaging).

Procedures

The patients were placed in the prone position, and a pillow was placed under their abdomen to reduce lumbar lordosis. The injection area was cleaned three times with povidone iodine solution and then covered with a a sterile cover. In fluoroscopy, the interlaminar space was visualized by determining the required craniocaudal angle during anterioposterior imaging. Local anesthetic (3 mL of 2% prilocaine) was injected into the skin (subcutaneous tissue) and then the tip of an 18-gauge 10 cm Tuohy needle was slowly advanced towards interlaminar space under the intermittent fluoroscopic guidance using the loss of resistance (LOR) technique. Later, a CLO or lateral image (with an average of 50-60 degree) was taken for needle depth detection (Figs. 2,3). Then, 1-2 mL of contrast material was given. Having observed that an epidural spread occurred followed by no vascularity, a 5 mL drug mixture of 12 mg betametazon asetat, 1 mL of 0.5% bupivacaine, and 2 mL saline, was injected. The patients were then observed for potential complications for 2 hours after the injection.

All procedures were performed by a pain medicine specialist with at least 10 years of experience, with the same fluoroscopy unit (Ziehm Vision R) performing intermittent imaging. Linear and circular collimation

were used in all procedures to minimize radiation exposure, in accordance with the ALARA principle. We used personal protective equipment, and attention was paid to staying at the maximum distance to the radiation source, keeping the exposure time short.

Data Collection

The cumulative radiation dose and procedure time (in seconds) for each procedure were obtained from the C-arm report calculated by the instrument's software after the final image was acquired. Doses are given in units of milligray square meters (mGy·m^2). The demographic data, pre- and post-procedure first hour numeric rating scale (NRS) scores of the 2 groups were compared. In addition, the diagnoses of the patients and the procedure levels were compared. In addition, complications observed immediately during and 2 hours after the procedure were also noted.

Statistical Analysis

Statistical analyses were performed using the SPSS version 22.0 software (IBM Corp.). Continuous variables were expressed in mean (with SD) and median (with interquartile range), while categorical variables were expressed in number and frequency. The chi-square test was used to compare categorical variables. The Mann–Whitney U test was performed for the comparison of non-normally distributed data, while the independent t-test was used to compare normally distributed data. The Shapiro-Wilk test was used to analyze the normal distribution of quantitative data. A P value < 0.05 was considered statistically significant.

Results

A total of 248 patients were included in the study. The patients' age ranged from 18 to 97 years old and the mean age was 56.75. Of all patients, 185 (74.6%) were women. One hundred twenty-three patients (49.6%) were diagnosed with lumbar disc herniation (LDH) and 125 patients (51.4%) were diagnosed with lumbar spinal stenosis (LSS). L5-S1 was found to be the most frequent procedure level with 128 patients (51.6%). The average radiation dose (mGy) and procedure time (s) of all patients were found to be 6.33 and 30.64, respectively (Table 1).

There was no significant difference between the 2 groups in terms of age, gender, diagnosis, BMI, procedure level, NRS, and procedure time. Although the radiation dose was lower in the CLO group, there was no significant difference between the 2 groups.

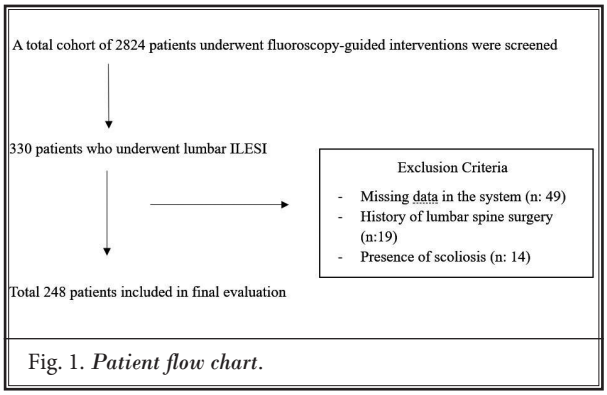

Fig. 1. *Patient flow chart.*

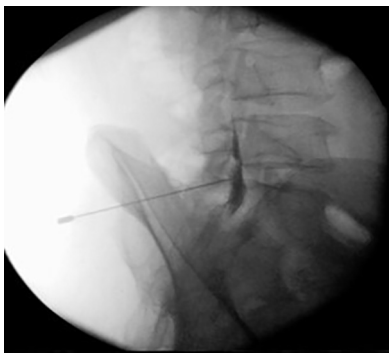

Fig. 2. *Contralateral oblique view after contrast agent injection.*

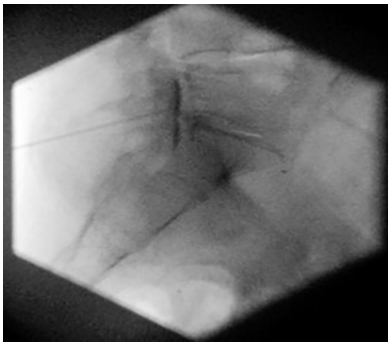

Fig. 3. *Lateral view after contrast agent injection.*

However, there was a significant difference between the groups in terms of complications (P < 0.001) (Table 2). Among patients who underwent CLO imaging, vasovagal reactions were detected in 2 patients and an intrathecal spread was detected in one patient. In the lateral group, vasovagal reactions were detected in 6 patients, an intrathecal spread in one patient, and a subdural spread in one patient.

Discussion

Epidural steroid injections have been found to be an effective and safe treatment option for LBP (14). ILESI is an effective treatment method, especially in multilevel pathologies, due to its high volume injectate (15). Fluoroscopy is used during interlaminar injection, and a lateral or CLO view is taken to determine the depth of the needle. The present study compared radiation dose, procedure time, and complication rates between the CLO and lateral view imaging during lumbar ILESI. This study found that radiation dose and procedure time were similar between the CLO and lateral groups. However, there were fewer complications in the CLO group. We think we acquired such a result because the CLO view provides better visualization of the needle tip and anatomical landmarks.

During ILESI, real-time fluoroscopy is mandatory and is used to confirm needle position and target site, as well as to prevent misinjections such as dural punctures and intravascular injections, which can cause life-threatening adverse side effects such as cerebral infarction, paraplegia, and even a stroke (13). However, a disadvantage of fluoroscopy is that it emits radiation to the environment and long-term radiation exposure, even at low doses, has many negative side effects. Radiation can damage almost all systems and organs in the human body, including the sensory organs, nervous system, cardiovascular, and hematological systems (16). Therefore, it is very important to reduce the radiation exposure of both healthcare workers and patients. Factors such as distance, backscatter radiation, collimation, mode, and procedure time can affect radiation exposure (17). Radiation-shielding, such as personal protective equipment, fluoroscopic collimation method, a bedside curtain shield, and an x-ray tube filter, can be

Table 1. *Demographic and procedural characteristics*.

Variable		Value (n = 248)
Age (years)		56.75 (18-97)
BMI (kg/m^2)		26.16 ± 4.17
Radiation dose (mGy·m^2)		6.33 (0.53-34.1)
Procedure time (s)		30.64 (12-106)
Complication		11 (4.43%)
Gender (n)	Men	63 (25.4 %)
	Women	185 (74.6 %)
Confirmation	Lateral	167 (67.3 %)
	Contralateral-oblique	81 (32.7 %)
NRS	Pre	8.16 ± 1.39
	First hour	0.94 ± 0.37
Diagnosis	LDH	123 (49.6 %)
	LSS	125 (51.4 %)
Procedure level	L2-3	3 (1.2 %)
	L3-4	28 (11.3 %)
	L4-5	89 (35.8 %)
	L5-S1	128 (51.6 %)

BMI: body mass index, NRS: numeric rating scale, LDH: lumbar disc herniation, LSS: lumbar spinal stenosis

Table 2. *Comparison of the characteristics of the two groups*.

		Lateral (n = 167)	Contralateral oblique (n = 81)	*P*-value
Age (years)		57.95 ± 20.42	52.77 ± 23.83	0.102
BMI (kg/m^2)		26.01 ± 2.98	25.53 ± 1.99	0.798
Radiation dose (mGy·m^2)		6.38 ± 4.71	6.23 ± 3.95	0.807
Procedure time (s)		30.06 ± 14.01	31.85 ± 14.05	0.350
Pre NRS		8.25 ± 1.37	7.99 ± 1.43	0.181
First Hour NRS		1.02 ± 0.42	0.75 ± 0.35	0.244
Complication		8 (4.79%)	3 (3.70%)	< 0.001
Gender	Men	38 (22.7%)	25 (30.8%)	0.112
	Women	129 (77.3%)	56 (69.2%)	
Diagnosis	LDH	87 (52.1%)	36 (44.5%)	0.110
	LSS	80 (47.9%)	45 (55.5%)	
Procedure level	L2-3	2 (1.1%)	1 (1.3%)	0.729
	L3-4	19 (11.5%)	9 (11.1%)	
	L4-5	56 (33.5%)	33 (40.7%)	
	L5-S1	90 (53.9%)	38 (46.9%)	

used to reduce radiation exposure. Additionally, being at the maximum distance from the radioactive source, keeping the exposure time short, increasing the use of collimation, avoiding the continued use of fluoroscopy, and using subtraction and magnification techniques can also reduce radiation exposure (18). Furthermore, Yoo et al (13) determined that the radiation dose was lower in anteroposterior imaging compared to lateral imaging during transforaminal epidural steroid injection, however, a statistical comparison of the imaging methods was not made. In the present study, although the radiation dose was lower during CLO imaging, no difference was found between the 2 groups. In fact, we expected the radiation dose to be statistically high during lateral imaging, since a previous study detected the highest radiation in the caudal group, which used a lateral view for the procedures (12). However, Sim et al (19) found that the radiation doses were similar using CLO and lateral imaging during cervical ILESI, which supports the present study.

The present study shows the estimated radiation dose levels and procedure time for CLO and lateral imaging for lumbar ILESI. However, radiation doses are lower than those in previous studies (20). The fact that radiation doses in this study are lower than those in Cohen et al's (20) study may be explained by the difference in fluoroscopy units or the use of intermittent imaging and collimation.

There is no significant difference found between the two groups in terms of the duration of the procedure. Furthermore, the procedure time of lumbar ILESI in the study of Cohen et al (20) is similar to the present study. On the other hand, the procedure time in this study is shorter than those of Sacaklidir et al (12), which may be because the patients who had undergone back surgery and had significant scoliosis were excluded in our study.

Sencan et al (21) scanned 5 years of data and found the immediate adverse event rate for ILESI to be 0.7%. McGrath et al (22) also found the complication rate during ILESI to be 6%. In the present study, the overall complication rate was found to be 4.4%. The rate in present study was determined as a value between 2 previous studies and is compatible with the literature (21,22). In addition, the complication rate was found to be statistically lower in the CLO group. We believe that this result is due to the clearer visualization of the interlaminar space through CLO imaging.

Limitations

This study had some limitations which need to be accounted for contextualizing these results. First, the study was designed at a single center. Performing all the procedures with the same fluoroscopy device makes it difficult to generalize our results. Although we performed most of the procedures with radiation reduction strategies, such as avoidance of magnification and application of collimation, the exact percentage of this cannot be noted. Although these are single center results, we think that it will guide doctors in terms of choosing imaging techniques based on radiation exposure and procedure time. Despite these limitations, this is the first study to compare CLO and lateral imaging during lumbar ILESI therapy.

Conclusions

Although CLO imaging does not provide a significant advantage in terms of radiation doses and procedure times during lumbar ILESIs, it allows for a lower complication rate since it provides clearer imaging of the interlaminar space. However, multicenter studies are needed to generalize the procedure time, radiation dose, and complication rate recorded in this study.

References

1. Clark S, Horton R. Low back pain: A major global challenge. *Lancet* 2018; 391:2302.
2. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018; 392:1789-1858.
3. Hakim BR, Munakomi S. Interlaminar Epidural Injection, *StatPearls*. StatPearls Publishing Copyright© 2023, StatPearls Publishing LLC., Treasure Island (FL) ineligible companies, 2023.
4. Friedrich JM, Harrast MA. Lumbar epidural steroid injections: Indications, contraindications, risks, and benefits. *Curr Sports Med* Rep 2010; 9:43-49.
5. El-Khoury GY, Renfrew DL. Percutaneous procedures for the diagnosis and treatment of lower back pain: Diskography, facet-joint injection, and epidural injection. *Am J Roentgenol* 1991; 157:685-691.
6. Silbergleit R, Mehta BA, Sanders WP, et al. Imaging-guided injection techniques with fluoroscopy and CT for spinal pain management. *Radiographics* 2001; 21:927-939.
7. Hay JL, Gold GS, Baser RE, et al. Prevalence and correlates of worry about the health harms of medical imaging radiation in the general population. *J Prim Care Community Health* 2016; 7:219-225.
8. Mahesh M. Fluoroscopy: Patient radiation exposure issues. *Radiographics*

2001; 21:1033-1045.

9. Choi MH, Choi BG, Jung SE, et al. Factors related to radiation exposure during lumbar spine intervention. *J Korean Med Sci* 2016; 31:S55-S58.
10. Hricak H, Brenner DJ, Adelstein SJ, et al. Managing radiation use in medical imaging: A multifaceted challenge. *Radiology* 2011; 258:889-905.
11. Jones AK, Balter S, Rauch P, et al. Medical imaging using ionizing radiation: Optimization of dose and image quality in fluoroscopy. *Med Physics* 2014; 41:014301.
12. Sacaklidir R, Ozturk EC, Sencan S, et al. Radiation doses for different approaches of fluoroscopy-guided epidural injections: An observational clinical study. *Pain Physician* 2022; 25:e67-e72.
13. Yoo SH, Kim WJ, Jue MJ, et al. Comparison of radiation exposure to physicians between anteroposterior and lateral real-time fluoroscopy when performing lumbar transforaminal epidural steroid injections: A randomized controlled trial. *Medicine* 2022; 101:e29684.
14. Manchikanti L, Knezevic E, Knezevic NN, et al. A comparative systematic review and meta-analysis of 3 routes of administration of epidural injections in lumbar disc herniation. *Pain Physician* 2021; 24:425-440.
15. Hashizume K, Fujiwara A, Watanabe K, et al. A prospective comparison of CT-epidurogram between Th1-transforaminal epidural injection and Th1/2-parasagittal interlaminar epidural injection for cervical upper limb pain. *Pain Physician* 2019; 22:165-176.
16. Taylor J, Chandramohan M, Simpson KH. Radiation safety for anaesthetists. *Continuing Education in Anaesthesia, Critical Care & Pain* 2013; 13:59-62.
17. Butler RB, Poelstra KA. Techniques to minimize intraoperative radiation exposure. *Seminars in Spine Surgery* 2008; 20:181-185.
18. Ji YS, Park EK, Kwon HC, et al. Radiation-shielding devices: The best combination for spine interventional procedures. *J Vasc Interv Radiol* 2022; 33:225-232.
19. Sim JH, Kwon HJ, Kim CS, et al. Comparison of contralateral oblique view with the lateral view for fluoroscopic-guided cervical epidural steroid injection: A randomized clinical trial. *Reg Anesth Pain Med* 2022; 47:171-176.
20. Cohen SL, Schneider R, Carrino JA, et al. Radiation dose practice audit of 6,234 fluoroscopically-guided spinal injections. *Pain Physician* 2019; 22:e119-e125.
21. Sencan S, Sacaklidir R, Gunduz OH. The immediate adverse events of lumbar interventional pain procedures in 4,209 patients: An observational clinical study. *Pain Med* 2022; 23:76-80.
22. McGrath JM, Schaefer MP, Malkamaki DM. Incidence and characteristics of complications from epidural steroid injections. *Pain Med* 2011; 12:726-731.