Randomized Trial

Could the Hanging Drop Technique Be an Alternative Method to Loss of Resistance in Cervical Epidural Injections?

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Free full article: www.painphysicianjournal.com **Background:** Cervical interlaminar epidural injections are usually performed with the loss-ofresistance (LOR) technique. Therefore, no studies have evaluated or compared the hanging drop (HD) technique with the LOR technique in the administration of cervical interlaminar epidural injections (ILESIs).

Objectives: This study aimed to evaluate the success of the HD technique when used with the LOR technique in cervical ILESIs.

Study Design: A prospective, randomized trial.

Setting: Department of Pain Medicine, Ege Hospital, Baku, Azerbaijan.

Methods: After obtaining ethical committee approval and initiating a randomization process, we allocated patients diagnosed with cervical herniated nucleus pulposus (CHNP) into LOR- and HD-method groups. The LOR group comprised 38 patients, and the HD group comprised 41 patients. All patients underwent interlaminar epidural steroid injections under C-arm fluoroscopy in contralateral oblique (CLO) safety view with an initial start angle of approximately 60 degrees. For the LOR group, the procedure was considered successful if there was a loss of pressure after slightly crossing the ventral spinolaminar line (VSLL) and the administered contrast material was in the epidural space. The procedure was considered successful if the saline in the needle's hub fell with negative pressure after slightly passing the VSLL and if the contrast administered was seen in the epidural space with fluoroscopy. In the HD group, there was no sensation of a drop in 3 patients, and the procedure was completed with LOR, so these patients were excluded from the study. Complications and pain scores on the VAS (visual analog scale) were questioned at the time of the procedure and at one hour and 3 weeks after the procedure, and successful injection ratios were recorded.

Results: The LOR and HD groups were similar in age, gender, body mass index (BMI), and side of ILESI. The successful injection ratio was higher in the right- and left-sided ILESI group than in the median ILESI group (P < 0.01). Therefore, no differences were found between the right and left ILESI groups. Binary logistic regression analysis found that age, gender, and BMI were not associated with successful injection in the HD group, while medial injection was associated with decreased successful injection risk (OR: 0.068, P = 0.034). The successful injection ratio was higher in the LOR group than in the HD group (P < 0.001).

Limitations: The study's limitations include the relatively small number of patients with CHNP and the lack of mention of the level of CHNP.

Conclusions: The LOR technique was superior to the HD for cervical ILESIs. More studies with larger sample sizes may provide more precise and detailed information.

Key words: Neck pain, intervertebral disc displacement, radiculopathy, interlaminar epidural steroid injections, loss-of-resistance, hanging drop, fluoroscopy, successful injection

Clinical trial registration number: 77238 (IRCT)

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eck pain is one of the most common causes of disability of musculoskeletal origin (1). Cervical radicular pain is one of the leading causes of neck pain, with an incidence of approximately 85 per 100,000 people (2). Disc herniations, spinal stenosis, or spondylosis may cause cervical radicular pain. Risk factors for cervical radicular disease include heavy lifting, driving, operating vibrating equipment, and chronic smoking. Cervical herniated nucleus pulposus (CHNP) is the most frequent cause of cervical radicular pain. The prognosis of CHNP is usually good, and patients improve with medications, physical therapy modalities, and the regulation of daily living activities. For resistant cases, epidural steroid injections (ESIs) may alleviate pain and improve functioning. The presence of mediators like IL-1 and spinal nerve irritation caused by inflammation have been the sources of the need for ESIs, which have been used as a treatment option for many years (3).

Cervical ESIs are performed mainly under fluoroscopy guidance, using the interlaminar or transforaminal routes. The transforaminal route allows direct injection around the dorsal root of the irritated nerve but can lead to severe complications such as embolisms, vascular injections, and infarctions (4,5). Thus, interlaminar ESIs (IL-ESIs) are among the most frequently performed epidural injections. ILESIs are mainly performed using the loss of resistance (LOR) technique under fluoroscopy guidance. However, false negative injections may occur, especially in the cervical region, because of that area's less well-defined ligamentous structures and thinner epidural space. According to the literature, methods such as the use of epidrum and the analysis of epidural waveform have been applied to improve the success of the LOR technique (6,7). The LOR technique is also the most commonly used method for epidural anesthesia. Another method used for epidural anesthesia is the hanging drop (HD) technique. In this method, described by Guttierez in 1933 as the "hanging drop" symptom, a drop of saline suspended in the hub of the needle is "aspirated" when the needle enters the epidural space (8). The HD technique was used in many studies of epidural anesthesia (9-11). However, we have little information on the success of the HD technique for epidural injections. The literature has also suggested that intrinsic negative pressure in the cervical and thoracic regions may facilitate epidural access when HD techniques are used. Therefore, we did not encounter any study comparing LOR and HD techniques for ESI. We thus aimed to compare the success of both of those techniques for cervical ILESIs.

METHODS

Study Design and Patients

The clinical trial registry number for the study was 77238 (IRCT) (obtained from ClinicalTrials.gov). After obtaining ethical committee approval from Azerbaijan Medical University (ethical committee approval: 33), patients diagnosed with CHNP were randomized and then allocated into LOR and HD method groups. We used a simple randomization with a computerized program (www.randomizer.org), ensuring fairness and objectivity in the study.

Interventions

The LOR group comprised 38 patients, and the HD group comprised 41 patients. All patients underwent ILESIs. Before the procedure, all patients also underwent the opening of the intravenous route. The patients were monitored during the procedure, which was performed under C-arm fluoroscopy with the patients in the prone position and without sedation. Following skin sterilization and the administration of local anesthesia, the needle tip position (median, left, or right paramedian) was confirmed on AP view, and an 18 G Touhy needle was inserted between the C7-T1 laminae according to the area of pain radiation. C-arm fluoroscopy was positioned in the contralateral oblique (CLO) safety view, and the initial start angle was adjusted to approximately 60 degrees.

In the LOR technique, the Tuohy needle was used to approach the ventral spinolaminar line (VSLL), and then 2 mL of saline and 2 mL of air (air on top, liquid on bottom) were advanced using intermittent pressure. The procedure was considered successful if a loss of pressure ensued after the ventral spinolaminar line (VSLL) was crossed slightly and the administered contrast material was in the epidural space. The procedure was considered unsuccessful if the administered contrast material was in the epidural space without pressure loss after the VSLL was crossed slightly or if the administered contrast material was not in the epidural space despite pressure loss, or if suspicious epidural distribution occurred.

In the HD technique, the hub of the Tuohy needle was filled with saline after the VSLL was approached. Then, the needle was slowly advanced by holding its "wings" with both hands. The procedure was considered successful if the saline in the needle's hub fell with negative pressure after passing the VSLL slightly and if the contrast administered was seen in the epidural space with fluoroscopy. The procedure was considered unsuccessful if the contrast spread to the epidural space while there was no drop, if the contrast did not spread in the epidural space while there was a drop, or if suspicious epidural spread occurred. Three of the patients experienced no drop sensation during the procedure, which was completed with LOR; those patients were excluded from the study. All patients received a mixture of 2 mL (8 mg) of dexamethasone, 1 mL of 2% lidocaine, and 2 mL of SF. Complications and pain scores on the visual analog scale (VAS) were asked about at the time of the procedure, one hour and 3 weeks after the procedure. Complications related to medications or injections were recorded.

Sample Size

The sample size was calculated using the program G*Power 3.1.9.4. We could not find any study that examined pain treated by the LOR and HD techniques. According to the specificity of the Queckenstedt-test procedure for epidural injection (92%) with the LOR technique, in the study named "The Queckenstedt-test procedure can confirm epidural puncture in patients with cervical spinal canal stenosis", by Yokohama et al. (12) it was calculated that a total of 38 patients, 19 in each group, should be included in the study with a power of 80% and a margin of error of 0.05.

Statistical Analysis

Recorded data were analyzed using the IBM Statistical Package for Social Sciences 25.0 (IBM Corporation). The normality of numerical data distribution was examined using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Normally distributed continuous variables were presented as mean and SD, while non-normally distributed variables were presented with median and interquartile range (IQR; 25th-75th percentiles), and qualitative data were expressed as frequencies and percentages. The categorical variables were compared with Fischer's Exact test, Pearson chi-square, or continuity correction, according to the expected counts. The numerical variables were compared with the Mann-Whitney U or independent samples t-test. Binary logistic regression analysis was performed to determine variables associated with successful injection. The confidence interval was 95%, and the margin of error accepted was set to 5%. Therefore, the P-value was considered significant when P was greater than 0.05.

RESULTS

Table 1 contains the demographic data, side of performed ILESI, and false positivity ratio of patients in LOR and HD groups. The groups were similar in age, gender, body mass index (BMI), and side of ILESI (P > 0.05). The only complication was dizziness experienced by a patient to whom ILESI was applied with the LOR technique. The successful injection ratio was higher in the right- and left-sided-ILESI group than in the median-ILESI group (P < 0.01). Therefore, no differences were found between the right- and left-ILESI groups (Table 2). Binary logistic regression analysis found that age, gender, and BMI were not associated with successful injection in the HD group, while medial injection was associated with a decreased likelihood that the injection would be successful (OR: 0.068, P = 0.034). The successful injection ratio was higher in the LOR group than in the HD group (P < 0.001) (Table 3).

DISCUSSION

Cervical ILESIs are commonly applied in the treatment of CHNP. They are recommended because of their effectiveness and safety (13). When ILESIs are performed, the CLO view or lateral view may be used.

Table 1. Age, gender,	body mass	index,	side of	injection,	and
methods of the patien	ts.				

	LOR (n = 38)	HD (n = 38)	P value
Age	49.4 ± 11.7	49.2 ± 11.9	0.946
Gender Female Male	18 (47.4) 20 (52.6)	19 (50.0) 19 (50.0)	0.818
BMI	26.5 ± 4.3	25.8 ± 3.8	0.422
Side of ILESI Right Left Medial	20 (52.6) 13 (34.2) 5 (13.2)	18 (47.4) 12 (31.6) 8 (21.1)	0.658
Complication	1 (2.6)	-	NA

BMI: body mass index, ILESE: interlaminar epidural steroid injection, LOR: loss of resistance, HD: hanging drop, NA: not analyzed.

Table 2. Comparison of successful injection ratios in terms of side of interlaminar epidural steroid injections.

	Right-sided (n = 38)	Left-sided (n = 25)	Median (n = 10)	P value*	
Successful injection	35 (92.1)	25 (100.0)	9 (69.2)	. 0.01	
Unsuccessful injection	3 (7.9)	-	4 (30.8)	< 0.01	

*Pearson chi-square test.

	LOR group (n = 38)	HD group (n = 38)	P value*	
Successful injection	38 (100.0)	31 (81.6)	< 0.01	
Unsuccessful injection	-	7 (18.4)	< 0.01	

Table 3. Comparison of successful injection ratios in terms of method of interlaminar epidural steroid injections.

LOR: loss of resistance, HD: hanging drop.

Therefore, the CLO view has a greater clinical practicality (14). We also used the CLO view for cervical ILESIs. In this study, we applied ILESIs to the right side, the left side, or the median, according to each patient's symptoms. Right- and left-sided injections were more successful than median injections. This finding may be expected because ligamentous structures may not always converge in the midline, making it difficult for ILESIs to penetrate. Therefore, paramedian injections were shown to be more effective than median injections, with the former showing better distribution of the injectate to the ventral epidural space (15,16). In accordance with the literature, the median injections were associated with a greater risk of an unsuccessful outcome in this study.

Although HD has been previously performed for epidural anesthesia for various operations, no information could be found about the use of HD for epidural injections. The spring-loaded, LOR, and HD techniques were evaluated in a study of lumbar epidural blocks by Güven et al (17), who found that the 3 techniques were similar in terms of the number of attempts and the incidence of dural puncture; therefore, the spring-loaded technique provided a shorter amount of time to reach epidural space than did the other techniques. The epidural space in the lower thoracic and lumbar regions is subjected to minimal transmission of negative thoracic pressure, which hinders the reliability of the HD technique (18,19). The lower successful injection ratio and absence of drop sensation in 3 patients in our study suggest that the HD technique may not be an alternative to LOR for cervical ILESIs. Therefore, despite these disadvantages, the HD technique may be an alternative method when an epidural block or catheter replacement is planned and a LOR syringe is absent.

Limitations

This study's limitations include the relatively small number of patients with CHNP and the lack of mention of the level of CHNP.

CONCLUSION

The LOR technique was superior to the HD technique for cervical ILESIs. More studies with large sample sizes may provide more precise and detailed information.

Author Contributions

Shahin Azizov was responsible for the conception and design, data collection, and manuscript revision. Mehmet Okçu was responsible for the conception, design, data collection, and interpretation. Hamit Göksu drafted the article and revised it critically for important intellectual content. All authors were responsible for the final approval of the manuscript.

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