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Comparison of the Use of Peripheral Nerve Stimulator and Quincke Needle for Lumbar Transforaminal Epidural Steroid Injections

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ABSTRACT

AIM: To compare the procedural features of transforaminal epidural steroid injection (TFESI) performed using two different needles (Stimuplex® and Quincke) in terms of procedure time, exposed radiation dose and adverse effects and complications, thus providing preliminary data to aid needle selection for TFESI.

MATERIAL and METHODS: Patients who received fluoroscopy-guided single-level lumbosacral TFESI between September 2020 and September 2021 were retrospectively included in this study. The patients were divided into two groups with respect to the needle type used for the procedure – those treated with a Quincke needle were classified as Group Q and those treated with a Stimuplex® needle comprised Group S. Subsequently, the two groups were compared in terms of their demographic data, procedure time, radiation dose, amount of contrast use, first-hour numeric rating scale (NRS), intravascular flow and complication rates.

RESULTS: The number of patients recruited for Groups Q and S was 65 and 61, respectively. No significant difference was observed between the groups regarding their demographic data, preprocedural NRS scores, procedure time, exposed radiation dose and the amount of contrast dye used. Notably, the first-hour NRS scores were found to be significantly lower in Group S ($p=0.040$) after the procedure. Moreover, the intravascular contrast spread was significantly different between the two groups ($p<0.05$) – it was encountered during four procedures in Group Q, but was altogether absent in Group S.

CONCLUSION: The Stimuplex® needle may decrease the possibility of inadvertent intravascular leakages during TFESI and may also improve immediate pain scores after the procedure

KEYWORDS: Needles, Lower back pain, Epidural injections for back pain, transforaminal, needle types, pain management

INTRODUCTION

Epidural steroid injection (ESI) is a frequently performed, minimally invasive procedure for addressing lumbosacral radicular pain (2). It is an effective treatment option in selected cases and can be performed using transforaminal, interlaminar and caudal routes. In this context, transforaminal epidural steroid injection (TFESI) provides a significant advantage by delivering the injectate to the ventral epidural space, where pathologic changes after disc herniation usually occur (7,18).

The effect of TFESI is mainly thought to be due to the anti-inflammatory effects of steroids (4). Smith et al., in their systemic review, found strong evidence supporting the use of lumbar TFESI for addressing radicular pain (15). Manchikanti et al. also found substantial evidence to promote TFESI for managing radiculitis secondary to disc herniation (10). Notably, serious thromboembolic events resulting from

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inadvertent intravascular flow, especially to the artery of Adamkiewicz (1), although rare, may occur during TFESI. Therefore, traditional sharp-edged long-bevel (20 degrees) spinal Quincke (Egemen®) needles are often used for TFESI. Furthermore, pencil-point, blunt, short-bevel and catheter-extended needles may also be chosen for this purpose**.** Some studies have investigated the complication rates arising from injections with these needles to detect that the least vascular leakage occurs while using catheter-tipped needles for the procedure, followed by blunt needles (8,17). The use of Stimuplex® (B Braun, Melsungen, AG) needles, which usually have a 30-degree bevel angle (short-bevel) (13), are usually preserved for peripheral nerves and plane blocks. However, some practitioners occasionally prefer the Stimuplex® needle during TFESI because it is blunter than the Quincke needle and also offers an opportunity to stimulate the spinal nerve. However, needle prices vary, with the approximate costs of the Stimuplex® and Quincke needles being 15 € and 2 €, respectively. To date, no study has compared the procedural features of TFESI performed by Stimuplex® and Quincke needles. Addressing this gap in the literature, the current study aims to carry out a comparison of the procedural features of TFESI performed by the two different needles (Stimuplex® and Quincke) in terms of procedure time, exposed radiation dose, and adverse effects and complications, thus providing preliminary data to aid needle selection for TFESI.

MATERIAL and METHODS

Design and Study Population

After approval from the Marmara University Faculty of Medicine institutional ethics committee (09.2021.1108), patients aged between 18–65 years who received fluoroscopy-guided single-level lumbosacral TFESI for disc herniation between September 2020 and September 2021 in the pain management centre of a tertiary hospital were retrospectively analysed (Figure 1). The injections were performed using either a Stimuplex® needle or a Quincke needle. The selection of the needle type was arbitrary and mainly based on availability. Generally, the Stimuplex® needle was the first choice, while the Quincke needle was used when the former was not available. Exclusion criteria for the study participants were patients receiving multi-level injections and those with a history of lumbar surgery, spinal stenosis, scoliosis, transitional vertebra and spondylolysis-spondylolisthesis. The patients' demographic data were collected from the hospital's medical record system. Procedure time and radiation dose were noted in seconds and mGy, respectively, from the C-arm fluoroscopy device records. The duration of the procedure was estimated in terms of the shooting time of the fluoroscopy device. Furthermore, a numeric rating scale (NRS) was used to grade the pain intensity of the patients before and one hour after the procedure, as mentioned in the nursery notes. Additionally, the procedure level and the amount of contrast dye (ml) used were noted. The intravascular flow and complication rates were retrieved from our previous study (12). All data related to the procedures were recorded either during or after the process. Subsequently, all records were transferred to the clinical data system on the same day. The patients were then divided into two groups with respect to the needle type used for their TFESI, patients treated with a Quincke needle were classified as Group Q, while those treated with a Stimuplex® needle were classified as Group S.

Procedure

All procedures were performed under fluoroscopy guidance by a pain medicine specialist with at least 10 years of experience in interventional pain management. The patients were placed prone and a pillow was positioned under their belly to flatten the lumbar lordosis. Following this, the injection site was cleaned three times with povidone-iodine solution and covered with a sterile drape. The fluoroscopy device was provided with adequate angles to visualize the relevant foramen clearly. The skin at the needle entry point was anesthetized (5 cc 2% prilocaine) prior to advancing the tip of a 22-gauge 3.5-in Quincke needle or a 22-gauge 10-cm Stimuplex® needle in a 6 o'clock direction against the concerned pedicle under intermittent fluoroscopic guidance. When the Quincke needle approached the epidural space, the lateral view confirmed whether the needle had reached the target point. For the Stimuplex® needle, the nerve stimulator was switched on and the amplitude was increased from 0.5 mAh up to 2.5 mAh until a response was observed in the AP view. After confirming the epidural spread using 1 ml of contrast dye, 3 cc of a drug mixture (8 mg of betamethasone, 1 cc of 0.5% bupivacaine and 1 cc of saline) was injected (Figures 2 and 3). Patients were discharged an hour after the injection in case of any adverse effects.

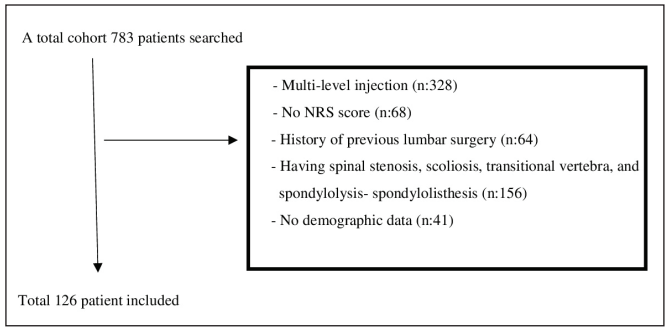

Figure 1: Participant flow diagram.

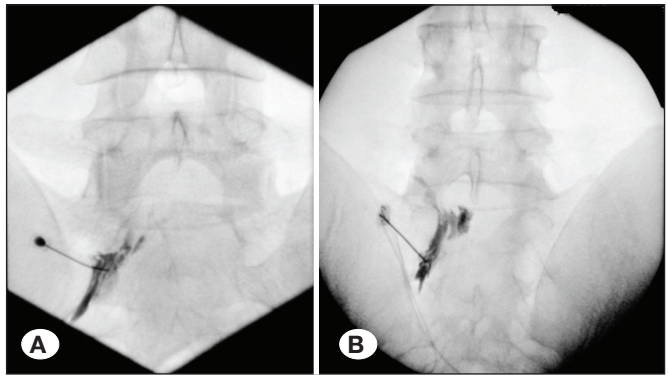

Figure 2: Left S1 TFESI procedure was done with a Quincke needle **(A)** and a Stimuplex® needle **(B)**.

Statistical Analysis

Statistical analyses were performed using SPSS version 22.0 software (IBM Corp., Armonk, NY). The continuous variables were expressed in mean (standard deviation) and median (interquartile range), while the categorical variables were expressed in number and frequency. A chi-square test was employed to compare the categorical variables. Additionally, the Shapiro-Wilk test was conducted to analyse the distribution of the quantitative data. Furthermore, the Mann–Whitney U test was performed to compare the non-normally distributed data, while the independent t-test was used to compare the normally distributed data. A p-value <0.05 was considered statistically significant.

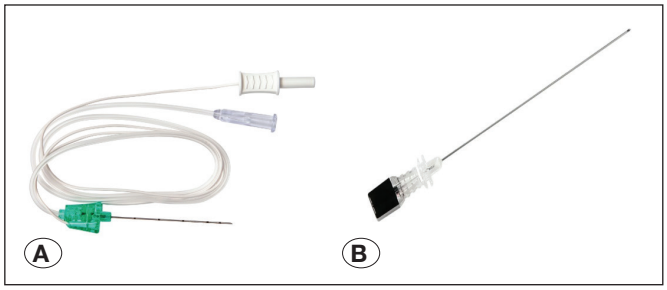

Figure 3: The Stimuplex® needle **(A)** is on the left, and the Quincke needle is on the right side **(B)**.

Table I: Comparison of Demographics Between the Two Groups

	Group Q (n=65)	Group S (n=61)	p-value
Age (years)	48.53 ± 13.78	48.18 ± 12.05	0.877 *
BMI (kg/m^2)	27.24 ± 5.46	27.68 ± 4.33	0.630 **
Pre NRS	8.40 ± 1.15	8.09 ± 1.19	0.144 **
Gender			
Male	36 (55%)	30 (%49)	0.486 ***
Female	29 (45%)	31 (%51)	
Procedure level			
L3	2	1	
L4	5	8	0.633***
L5	33	33	
S1	25	19	

*Values are presented as mean ± standard deviation (median), or n (%). **BMI:** Body mass index, **NRS:** Numeric Rating Scale,. *Independent t test; **Mann-Whitney U test; ***Chi-square test.*

RESULTS

The mean ages of Groups Q and S were 48.53 and 48.18, respectively, indicating no significant difference between the two. The Body Mass Index (BMI), gender and pre-procedural NRS scores of the patients were also similar. The targeted nerve roots in this study were L3, L4, L5 and S1, distributed similarly between the groups. Notably, the most common level was the L5 nerve root in both groups (Table I).

The first-hour NRS scores after the procedure were found to be significantly lower in Group S (p=0.040). The procedure time and radiation dose in Group Q were 35.04 seconds and 4.93 mGy, respectively, while they were 30.37 seconds and 4.62 mGy, respectively, for Group S. Furthermore, the mean amount of contrast dye used was 1.60 ml for Group Q and 1.76 ml for Group S. There was no significant difference between the groups in terms of their procedure time, exposed radiation dose and the amount of contrast dye used. However, the intravascular contrast spread was significantly different between the two groups – it was encountered during four procedures in Group Q, while it was altogether absent in Group S. Additionally, the number of complications in Groups Q and S was five and two, respectively. In Group Q, three patients underwent vasovagal syncope and one patient had transient motor block, while subdural spread was observed in the case of one patient. Meanwhile, in Group S, one patient exhibited vasovagal syncope, while another had a temporary motor block. Notably, there was no significant difference between the two groups in terms of adverse reactions and complications (Table II).

DISCUSSION

The primary finding of the current study is that the incidence of accidental intravascular flow in the case of the Quincke needle is significantly higher than the Stimuplex® needle. Moreover, first-hour NRS scores were significantly lower in the Stimuplex® needle group.

In this context, Hong et al. demonstrated that using a long-bevel Quincke needle tripled the chances of intravascular

Table II: Comparison of Procedural Features Between the Two Groups

	Group Q (n=65)	Group S (n=61)	p-value
Post NRS (1st hour)	1.28 (0-7)	0.66 (0-4)	**0.040 ** **
Procedure time (second)	35.04 ± 24.61	30.73 ± 13.50	0.233 **
Radiation dose (mGy)	4.93 ± 2.05	4.62 ±1.59	0.713 **
Contrast use (ml)	1.60 ± 0.60	1.76 ± 0.48	0.110 *
Vascular penetration (+/ -)	4 / 61	0 / 61	**0.049 *** **
Immediate complication (+/ -)	5 / 60	2 / 59	0.280 ***

*Values are presented as mean ± standard deviation (median), or n (%). **NRS:** Numeric Rating Scale, **mGy:** milliGray. *Independent t test; ** Mann-Whitney U test; *** Chi-square test.*

injection during TFESI in comparison to a pencil-point tip Whitacre needle (5). Furthermore, Smuck et al. did not observe any benefit in using a short-bevel needle over a long-bevel needle regarding inadvertent intravascular flow (16). Likewise, Hong et al. reported similar rates of intravascular injection when using short- and long-bevel needles for TFESI (6).

The results of the abovementioned studies differ from ours. This discrepancy might be explained by the fact that almost all of the above studies involved injections performed using a Chiba needle with a 35-degree bevel angle. In contrast, the Stimuplex® needle is, in fact, a nerve stimulator with a short bevel angle (30 degrees). This study premised that the opportunity for spinal nerve stimulation might decrease the procedural time of TFESI since the needle has the chance to advance without taking shots until a response is observed in the form of nerve stimulation. However, the results of this study did not support this hypothesis. In contrast, the Quincke needle demonstrated better steering ability, which may contribute to shortening the time required to reach the target point (14).

Previous research has established that catheter-extension and pencil-point tip needles ensure the lowest possibility of intravascular uptake during TFESI. However, the safest needles also have their own technical pitfalls, precluding assertive recommendations (8,17). Our results demonstrate that utilizing the short-bevel Stimuplex® needle may have a beneficial effect compared to the Quincke needle. Furman et al. reported 19.4% and 11.2% intravascular injection rates for cervical and lumbosacral TFESIs, respectively. In the same study, among the lumbosacral levels, the highest rate of intravascular injection was observed in the case of the S1 nerve root injection (3). In the present study, the frequency of S1 nerve root injection was similar between Groups Q and S.

Interestingly, first-hour pain scores were significantly lower in the Stimuplex® needle group, in addition to the absence of inadvertent intravascular flow. These lower first-hour NRS scores might be associated with lesser assumed physical irritation of the spinal nerve during the procedure when using a short-bevel needle (11).

Another complication related to TFESI is dural puncture, which may lead to post-dural puncture headache (PDPH). We encountered one case of subdural spread on using the Quincke needle, which fortunately did not progress to PDPH. It should be noted that a pencil-point tip needle is believed to reduce the chances of PDPH in comparison to the Quincke needle in the case of a dural puncture (9).

The limitations of the present study include its retrospective design and relatively low sample size. However, a substantial number of variables, such as radiation exposure, procedure time, amount of contrast dye used, first hour pain scores and the distribution of procedure levels between the groups, were thoroughly analysed to strengthen our results.

CONCLUSION

To our knowledge, this is the first study to carry out a comparison of the procedural features of TFESI performed using a traditional spinal Quincke needle and a peripheral nerve stimulator (Stimuplex®). We conclude that the Stimuplex® needle may decrease the possibility of inadvertent intravascular leakage during TFESI, and, additionally, may improve immediate pain scores after the procedure. However, in contrast to the first hypothesis, it does not seem advantageous in terms of decreasing procedure time and radiation exposure. Further prospective research is recommended to support or oppose the preliminary results of this study.

AUTHORSHIP CONTRIBUTION

Study conception and design: RS, HY, ECO, SS, OHG
Data collection: RS, ECO, SS
Analysis and interpretation of results: RS, HY, ECO, SS, OHG
Draft manuscript preparation: RS, ECO, SS
Critical revision of the article: RS, HY, ECO, SS, OHG
All authors (RS, HY, ECO, SS, OHG) reviewed the results and approved the final version of the manuscript.

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