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ORIGINAL ARTICLE

Comparative Study of Ultrasound-Guided vs Landmark-Based Pudendal Nerve Block for Labour Analgesia

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ABSTRACT

Background: Pudendal nerve block (PNB) is a regional anesthetic procedure frequently performed in the second stage of labor to relieve perineal pain. Traditionally done with anatomical landmarks, ultrasound guidance is an alternative that is considered more accurate. The purpose of this study is to compare the efficacy and safety of ultrasound-guided and landmark-based PNB in parturients during labor.

Methods: Participants were randomly assigned to receive USG-PNB or LMR-PNB; a total of 180 parturients was recruited in the study. The onset time of analgesia, duration of analgesia and Visual Analog Scale (VAS) scores for pain relief were the main outcomes measured. Secondary outcomes were the rate of complications and patient satisfaction scores.

Results: Onset time of analgesia was significantly shorter and duration longer in the ultrasound-guided group than that in landmark-based. VAS of the ultrasound-guided group was lower than that of the landmarks-guided group, suggesting that pain relief was better. Complications were similar in both groups, and patient satisfaction was greater for the ultrasound-guided group.

Conclusion: Ultrasound-guided PNB results in better analgesia and patient satisfaction, without increase of the complication rate when compared with the conventional landmark-based approach.

Keywords: Pudendal Nerve Block, Ultrasound Guidance, Landmark-Based Technique, Labor Analgesia, Regional Anesthesia, Obstetric Pain Management

INTRODUCTION

It is essential to manage labor pain. Multiple regional techniques have been introduced over the years for labor pain relief and pudendal nerve block (PNB) has been one of the most widely used methods for perineal analgesia during the second stage of labour. The conventional, landmark-based PNB has long been regarded as being performed with the ischial spine: this technique represents a century-old tradition[1]. However, along with the advances made in ultrasound technology, the capability to observe anatomic structures has been translated into regional anesthesia practice leading to more precise and successful nerve localization[2,3].

Several reports on ultrasound guidance into regional anesthesia demonstrate the enhancement of nerve block precision, reduced complications, and better onset and duration of analgesia[4,5]. In contrast, there has been wide variability of success rates reported for landmark-based approaches secondary to challenges localizing the pudendal nerve, particularly in high body mass index (BMI) patients and/or those with anatomic variation[6,7].

Although the advantages of ultrasound-guided PNB have been demonstrated in different clinical fields, there are few studies comparing the use of ultrasound-guided and landmark-based techniques for labor analgesia[8,9]. As such, the current study aims to address this existing knowledge gap in the literature and to compare efficacy (measured by TTPN) and safety of USG versus landmark-based PNB for labor analgesia among parturients.

MATERIALS AND METHODS

Study Design: This prospective, randomized controlled trial was conducted at Arif Memorial Teaching Hospital Rashid Khan university, Lahore, Pakistan, from December 2022 to August 2023. The study was approved by the institutional ethics committee, and written informed consent was obtained from all participants.

Participants: A total of 180 parturients aged 18-35 years, with a singleton pregnancy at term, and in the second stage of labor, were included in the study. Exclusion criteria included known allergies to local anesthetics, contraindications to regional anesthesia, and refusal to participate.

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Randomization: Participants were randomly assigned to one of two groups:

- **Group A (Ultrasound-Guided PNB):** Ultrasound was used to locate the pudendal nerve at the level of the ischial spine. A 20-gauge spinal needle was inserted transvaginally, and 10 mL of 0.25% bupivacaine was injected.
- **Group B (Landmark-Based PNB):** The pudendal nerve was located using traditional anatomical landmarks. The same volume and concentration of bupivacaine was administered.

Outcome Measures:

- **Primary Outcomes:**
  - **Onset Time of Analgesia:** Time from injection to complete pain relief.
  - **Duration of Analgesia:** Time from injection to the return of pain.
  - **VAS Scores:** Pain scores recorded at 0, 30, 60, and 120 minutes post-injection.
- **Secondary Outcomes:**
  - **Complication Rates:** Incidence of hematoma, infection, or nerve injury.
  - **Patient Satisfaction:** Assessed using a 5-point Likert scale.

Statistical Analysis: Data were analyzed using SPSS version 25.0. Continuous variables were compared using independent t-tests, and categorical variables were analyzed using chi-square tests. A p-value of <0.05 was considered statistically significant. Logistic regression analysis was performed to evaluate the influence of various factors (such as age, BMI, and method of PNB) on patient satisfaction and analgesic outcomes.

RESULTS

The demographic characteristics of the two groups were comparable, with no significant differences in age, BMI, parity, or gestational age at the time of delivery. The mean age of participants in the ultrasound-guided group was 28.3 ± 4.2 years, while in the landmark-based group, it was 29.1 ± 4.1 years. BMI

was similar between the groups, with a mean of 25.6 ± 3.2 kg/m² in the ultrasound-guided group and 25.9 ± 3.5 kg/m² in the landmark-based group.

Table 1: Demographical details of included patients

Demographic Characteristic	Ultrasound-Guided PNB (n=90)	Landmark-Based PNB (n=90)	p-value
Age (years)	28.3 ± 4.2	29.1 ± 4.1	0.332
BMI (kg/m²)	25.6 ± 3.2	25.9 ± 3.5	0.413
Parity (Nulliparous) (%)	60%	62%	0.789
Gestational Age (weeks)	39.2 ± 1.1	39.1 ± 1.2	0.459

The ultrasound-guided PNB group demonstrated significantly better outcomes compared to the landmark-based group. The onset time of analgesia in the ultrasound-guided group was 5.2 ± 1.1 minutes, which was significantly shorter than the 8.7 ± 1.5 minutes observed in the landmark-based group ($p < 0.001$). Additionally, the duration of analgesia was longer in the ultrasound-guided group (3.8 ± 0.9 hours) compared to the landmark-based group (2.4 ± 0.8 hours, $p < 0.001$).

VAS scores were significantly lower in the ultrasound-guided group, indicating better pain relief. At 30 minutes post-injection, the VAS score was 2.3 ± 0.7 in the ultrasound-guided group, compared to 3.5 ± 0.9 in the landmark-based group ($p < 0.001$). Similarly, VAS scores at 60 and 120 minutes were lower in the ultrasound-guided group (1.0 ± 0.4 and 0.3 ± 0.2, respectively) compared to the landmark-based group (2.2 ± 0.8 and 1.1 ± 0.6, respectively).

The complication rates were comparable between the two groups, with no significant difference in the incidence of hematoma, infection, or nerve injury. However, patient satisfaction was significantly higher in the ultrasound-guided group (95.6%) compared to the landmark-based group (89.0%, $p = 0.023$).

Table 1: Comparison of Primary and Secondary Outcomes

Outcome Measure	Ultrasound-Guided PNB (n=90)	Landmark-Based PNB (n=90)	p-value
Onset Time (minutes)	5.2 ± 1.1	8.7 ± 1.5	<0.001
Duration of Analgesia (hours)	3.8 ± 0.9	2.4 ± 0.8	<0.001
VAS Score at 0 min	8.9 ± 0.5	8.8 ± 0.6	0.345
VAS Score at 30 min	2.3 ± 0.7	3.5 ± 0.9	<0.001
VAS Score at 60 min	1.0 ± 0.4	2.2 ± 0.8	<0.001
VAS Score at 120 min	0.3 ± 0.2	1.1 ± 0.6	<0.001
Complication Rate (%)	2.2	3.3	0.452
Patient Satisfaction (%)	95.6	89.0	0.023

Logistic regression analysis showed that the method of PNB (ultrasound-guided vs. landmark-based) was a significant predictor of patient satisfaction ($p < 0.05$). The model indicated that ultrasound guidance was associated with higher odds of improved satisfaction and better pain relief compared to the landmark-based technique.

Table 3: Logistic Regression Analysis:

Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Ultrasound-Guided PNB	2.58	1.32–5.02	0.002
Age (per year)	1.03	0.97–1.09	0.357
BMI (per unit)	1.05	0.96–1.15	0.285
Parity (Nulliparous vs. Parous)	1.12	0.68–1.83	0.631

DISCUSSION

The present study confirms that UGP subjected PNB offers certain advantages over the landmark based technique, and that it is superior in onset of action, duration of analgesia and patient's satisfaction. The US-guided technique allows more accurate visualization of the pudendal nerve and surrounding structures, leading to a given higher success rate of block. This is consistent with previous reports that have indicated the benefits of ultrasound guidance in regional anesthesia practice, particularly for enhanced block onset and prolonged duration[1,2].

The shorter onset time observed in the ultrasound-guided group (5.2 ± 1.1 minutes) compared to the landmark-based group (8.7 ± 1.5 minutes) is consistent with studies by Joo et al.[3] and Gupta et al.[4], who also found that ultrasound-guided blocks achieved faster analgesia. The increased speed of onset can be attributed to the real-time visualization of the nerve, which allows for precise needle placement and immediate delivery of anesthetic agents directly to the target area[5]. Furthermore, the longer duration of analgesia in the ultrasound-guided group (3.8 ± 0.9 hours) is also a significant finding, suggesting that more effective and precise nerve block placement results in prolonged pain relief, as shown in similar studies by Zhang et al.[6] and Yang et al.[7].

The lower VAS scores at 30, 60, and 120 minutes post-injection in the ultrasound-guided group indicate better pain control, which is a crucial component of labor analgesia. These findings corroborate with those of Li et al.[8] and Zhang et al. [9], who demonstrated that ultrasound-guided nerve blocks resulted in superior pain relief compared to traditional techniques. The precision provided by ultrasound guidance ensures that the anesthetic is delivered more effectively to the pudendal nerve, which is responsible for the perineal pain during labor.

Higher patient satisfaction march is one of the most important results reached in this study. This finding is in accordance with other previous studies which have demonstrated that the ultrasound-guided approach to hypogastric nerve block is more tolerable than the classic one for patients, facilitating better acceptance of ultrasonography and less anxiety in labour [10], [11]. Being able to see the nerve and adjacent structures probably makes participants more reassured, making their overall experience from the procedure better[12].

In the study by Kim et al.[13] and Li et al.[14] also emphasize that the application of ultrasound guidance does not only positively affect clinical results but also has an impact on psychosocial aspects of patients through reducing fears and making the anesthesia appear more effective. On the other hand, the aforementioned landmark-based method has been efficient but inducing patient concerns because it is less predictive in its treatment results and has an inevitable difficulty to accurately identify the nerve (especially when treating patients with higher BMI or complicated anatomical condition)[15,16].

The incidence of complications was low and similar for the two groups, a finding that is in agreement with those reported in several other investigating ultrasound (US)-guided nerve blocks studies. There were no significant complications of hematoma, infection, or nerve injury in either group and the procedure was considered as safe as other US-guided PNB. This is consistent with the findings of Singh et.[17] and Kim et al.[18], who also observed similar results in their investigations. Sonographic monitoring can minimize complications by accurate needle placement, which reduces the possibility of puncture to surrounding organs[19].

Although US guidance is usually considered as a safer and more accurate method, some studies highlighted the possibility of rare but serious complications due to incorrect placement of probe or use of inappropriate settings. However, these are more related to the ability of the individual operator and his/her experience on ultrasound rather than for a lack of its safety[20]. The risks of those abnormalities were effectively reduced by the experienced and trained observers in our study, showing a low rate of complications.

The cost and learning curve of equipment has been a common complaint in regard to sonographically guided interventions. These issues have been readdressed by Gupta et al.[21] and Joo et al.[22], who claimed that despite the expensive cost of ultrasound device, which also requires a learning curve, long-term advantages including increase efficacy, decrease requirement for additional analgesia and reduction in procedural time are worthwhile. Moreover, accompanying progress in technology and

training programs, the cost-effectiveness of ultrasound-guided nerve blocks is likely to be much better in future.

Logistic regression revealed that US guidance was an independent significant predictor for better patient satisfaction, with an odd ratio of 2.58 (95% CI 1.32–5.02). This is consistent with the findings of Zhang et al.[23] and Singh et al.[24] who also reported ultrasound guidance resulted in increased success rates and patient satisfaction. The contribution of ultrasound to the overall labour analgesia experience for parturients highlights the necessity of accuracy and predictability in labour analgesia.

Limitations: While this study has important implications regarding the comparative efficacy of ultrasound versus landmark PNB, there are limitations to be considered. Firstly, the number of patients recruited into this study is such that significant differences in analgesic outcomes can be detected but not necessarily rare complications. Furthermore, in a single institution the results may not be widely generalized. Prospective, larger multicenter studies are required to confirm these findings and investigate the costeffectiveness and long-term benefits of US-guided PNB during labor.

CONCLUSION

To conclude, ultrasound-guided pudendal nerve block has been found to be superior over the conventional landmark-based pudendal block in reduced onset of analgesia, prolonged duration of action and better patient satisfaction. This research adds further robust evidence for the utility of ultrasonography in improving the efficacy and safety of PNB for labor analgesia, with a significant role in obstetric anesthesia practice. While there may be concerns about upfront costs of ultrasound equipment and training, the long-term benefits in terms of better patient outcomes and experience justify more widespread use of this approach.

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