



Comparison Between Ultrasound and Anatomical Landmark Guided Technique for Nerve Block Anesthesia

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مقارنة بين تقنية التوجيه بالموجات فوق الصوتية والتوجيه بالعلامات التشريحية لتخدير حاجز الأعصاب

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Abstract

Background: Nerve block involves the injection of a local anesthetic near a specific nerve to alleviate pain in the corresponding body region, during or after surgery. This technique utilizes ultrasound guidance as the standard procedure for nerve localization. The simultaneous visualization of the target nerve, insertion needle, and local anesthetic injection, facilitated by ultrasound and anatomical landmarks, is a key advantage of this approach. This study aims to compare the efficacy and safety outcomes of ultrasound-guided nerve block anesthesia versus the anatomical landmark technique. Method: In a cross-sectional study, we surveyed 80 patients who underwent nerve block anesthesia. Participants were assigned to either ultrasound-guided technique (Group A) or anatomical landmark-guided technique (Group B). The patients' ages ranged from 25 to 80 years. The study was conducted at three healthcare facilities in Tajoura. Result: Results: Overall, 47.5% of patients experienced no side effects, 32.5% had nerve injury, and 8.8% had vascular injection. Compared to the landmark group (27.5%), the ultrasound group had a higher proportion of cases with no side effects (58.8%). However, the landmark group had a significantly higher rate of nerve injury (65%) than the ultrasound group (0%). The ultrasound group had a slightly higher rate of vascular injection (10%) than the landmark group (7.5%). Conclusion: Ultrasound-guided and anatomical landmark techniques for local anesthesia were equally effective in terms of anesthetic volume and onset time. However, the ultrasound approach demonstrated a significantly lower incidence of side effects, particularly nerve injury and vascular injection.

Keywords: Nerve block, anatomical landmark, upper limb nerve, ultrasound-guided.

الملخص

الخلفية: الحصار العصبي هو حقن مخدر موضعي بالقرب من عصب معين لتقليل الألم في تلك المنطقة من جسمك، سواء أثناء الجراحة أو بعدها، باستخدام التوجيه بالموجات فوق الصوتية كإجراء تقليدي لتحديد موقع العصب. يمكن تصور العصب المستهدف والإبرة وحقنة المخدر الموضعي في وقت واحد، وذلك بفضل الموجات فوق الصوتية والمعالم التشريحية للحصار العصبي. هدفت هذه الدراسة إلى مقارنة فعالية وسلامة تخدير كتلة الأعصاب الموجه بالموجات فوق الصوتية مقابل أسلوب المعالم التشريحية. الطريقة: في دراسة وصفية مقطعية أجريت على 80 مريضاً خضعوا لتخدير كتلة الأعصاب تم تقسيم المشاركين إلى مجموعتين: المجموعة أ (تقنية الموجات فوق الصوتية الموجهة) أو تقنية المعالم التشريحية الموجهة (المجموعة ب) تراوحت أعمارهم من 25 إلى 80 عامًا، وأجريت الدراسة في كل من مستشفى الخضراء الوقائي ومستشفى الزاوية التعليمي وعيادة الياشفين في تاجوراء. النتيجة: بشكل عام لم يعاني 47.5% من المرضى أي آثار جانبية، و32.5% أصيبوا بإصابة عصبية، و8.8% أصيبوا بحقن وعائي. وبالمقارنة مع المجموعة المعالم التشريحية (27.5%)، كان لدى مجموعة الموجات فوق الصوتية نسبة أعلى من الحالات التي لم تظهر عليها أي آثار جانبية بنسبة (58.8%). ومع ذلك، كان لدى المجموعة المعالم التشريحية معدل إصابة عصبية أعلى بشكل ملحوظ (65%) من مجموعة الموجات فوق الصوتية (0%). وكان لدى مجموعة الموجات فوق الصوتية معدل حقن وعائي أعلى قليلاً (10%) من المجموعة المرجعية (7.5%). الاستنتاج: كانت تقنيات الموجات فوق الصوتية والتقنيات الموجهة بالمعالم التشريحية للتخدير الموضعي فعالة بنفس القدر من حيث حجم التخدير ووقت ظهوره. ومع ذلك، أظهر نهج الموجات فوق الصوتية انخفاضاً كبيراً في حدوث الآثار الجانبية، وخاصة إصابة الأعصاب والحقن الوعائي.

الكلمات المفتاحية: حاجز عصبي، علامة تشريحية، عصب الطرف العلوي، توجيه بالموجات فوق الصوتية.

Introduction

Neuro anesthesia entails administering a local anesthetic near a specific nerve to reduce pain in a targeted body region during or after surgery. For certain procedures, an anesthesiologist might insert a "neuro catheter" to provide continuous anesthetic infusion into the nerves for two to three days post-surgery. However, not all patients are suitable candidates for this technique, and the anesthesiologist will assess its appropriateness individually. [1]

Ultrasound guidance is a conventional technique employed for the localization of nerves during the neuroanaesthetic procedure. Through the utilization of ultrasound, the target nerve, the needle, the local anesthetic injectate, and the surrounding anatomical structures can all be visualized simultaneously. The success of the nerve block operation is dependent on the precise placement of the local anesthetic agent adjacent to the target nerve. [2,3] However, due to limitations in the visibility of both the nerve surface and the needle tip, the exact relationship between the needle tip and the target nerve may not be known at the time of injection. It is important to note that improper placement of either the needle or the local anesthetic agent can potentially lead to nerve damage. [4,5,6] For the safe performance of a peripheral nerve block, the distance between the target nerve and the block needle tip is a critical factor. One of the landmarks used to identify the needle insertion location is the inguinal ligament [7].

Anatomical landmarks serve as crucial references for the placement of nerve blocks. The needle insertion location (X) is situated 1-2 cm lateral to the palpable pulse of the artery, directly inferior to the inguinal crease. [8] This anatomical marker is particularly significant for procedures targeting the genicular nerves. One objective was to identify the appropriate anatomical marker for these nerves [9]. The target nerves included the superomedial (SM), superolateral (SL), and inferomedial (IM) genicular nerves, which traverse the periosteal regions, connecting the femoral shaft to the bilateral epicondyles and the tibial shaft to the medial epicondyle [10,11].

Our study aims to compare the efficacy and safety outcomes of two different techniques the ultrasound guidance approach and anatomical landmark technique in nerve block anesthesia.

Material and methods

This study was approved by the Department of Anesthesia, Faculty of Medical Technology- Al Zahra, Al Jafara University, Libya and written informed consent was obtained from all participants.

Study design:

This was a cross-sectional descriptive study. The study method involved surveying a sample of patients who underwent neuraxial anesthesia, and the participants were divided into two groups; using two techniques, group A (ultrasound) and group B (land mark). Questionnaires collected data on the demographic characteristics of the patients, and their consequences when exposed to neuraxial anesthesia.

Population and sample:

The study population comprised a total of eighty (80) patients of both genders, who were evenly divided into two groups, each consisting of forty (40) participants. The age range of the study subjects was between 25 and 80 years. All participants underwent nerve anesthesia procedures at Al-Khadhra Hospital, Al-Zawiya Teaching Hospital, and Al-Yashfin Clinic in Tajoura.

Data analysis:

Data analysis was conducted using the IBM SPSS Statistics 21 software. Descriptive statistics, including frequencies and percentages, were calculated. Pearson correlation analysis was performed to assess the relationships between variables. To evaluate the statistical significance of the findings, independent t-tests, and chi-square tests were utilized. A p-value less than 0.05 was considered evidence of statistical significance.

Results and discussion

The study population had a mean age of 54.56 ± 15.81 years, with a relatively balanced gender distribution 57.5% male and 42.5% female (See Table 1). Comparing the two groups in this study, it was found that the mean age for the landmark group was 57.93 ± 15.12 years compared to 51.20 ± 15.95 years for the ultrasound group. The gender distribution of these groups was almost equal with a male percentage of 55% and females at 45% percent in the ultrasound group while males were 60% and females accounted for the remaining 40%.

Table 1 The demographic characteristics of participants.

Items		All cases	Group A	Group B
Number of cases		80	40	40
Gender	Male n (%)	46 (57.5)	22 (55.0)	24 (60.0)
	Female n (%)	34 (42.5)	18 (45.0)	16 (40.0)
Age (yr) (Mean \pm Std)		54.56 ± 15.81	51.20 ± 15.95	57.93 ± 15.12

The mean dose of local anaesthetic in the ultrasound-assisted group was 23.025 ± 3.01 ml. At the same time, it was 23.78 ± 4.32 ml in the landmark-guided group showing no statistical significance between the two groups (see Table 2). These results suggest that there is no significant difference between ultrasound and landmark techniques regarding local anaesthesia doses in this patient population. Though ultrasound has certain advantages over landmarks when used for blocking nerves, it seems that quantities of local anesthetics may not be significantly different depending on how they have been administered.

Table 2 Dose of local anaesthetic distribution into groups for all participants.

Items	All cases	Group A	Group B	p-value
Dose of local anaesthesia (ml) (Mean \pm Std)	23.40 ± 3.72	23.025 ± 3.01	23.78 ± 4.32	0.370

Independent t- Test

It is important to note that the time to onset spinal anaesthesia between ultrasound-assisted and landmark groups did not differ significantly ($p=1.000$) as times were recorded as 22.57 ± 4.58 and 22.57 ± 3.45 minutes respectively (see Table 3). This means that despite ultrasound guidance being effective in terms of improving procedural aspects, there may not be much difference in their actual onset time between the two procedures involved in performing spinal anaesthesia. Therefore, while ultrasound assistance offers various advantages, the time to achieve spinal anaesthesia onset remains comparable to the traditional landmark-guided approach. In contrast, the previous report had a shorter ultrasound-assisted technique than the landmark group [12-15]. These discrepancies in onset times suggest that the effectiveness of ultrasound-assisted spinal anaesthesia may vary depending on the specific technique used and the patient population, different settings and patient demographics.

Table 3 Onset of time in groups for all participants.

Items	All cases	Group A	Group B	p-value
Onset of time (minute) (Mean ± Std)	22.57 ± 4.03	22.57 ± 4.58	22.57 ± 3.45	1.000

Independent t-Test

In the All Cases category, 47% of patients experienced no side effects, 32.5% reported nerve injury, and 8.8% experienced vascular injection (see Table 4).

Table 4 Destruction side Effects into groups for all participants.

Items	All cases	Group A	Group B	p-value
None	47 (58.8%)	36 (90.0%)	11 (27.5%)	0.000
Nerve injury	26 (32.5%)	0 (0.0%)	26 (65%)	
Vascular injection	7 (8.8%)	4 (10.0%)	3 (7.5%)	

In comparison, the study identified a significant difference in safety profiles between ultrasound-guided and landmark-based techniques for administering local anesthesia. Patients in the ultrasound-guided category experienced no side effects, unlike those treated using anatomical landmarks [12, 13]. This suggests a higher success rate in needle insertion with ultrasound, consistent with previous findings [14, 16, 17]

A notable finding is the complete absence of nerve injury in the ultrasound group, whereas the landmark group experienced a disturbing 65% of this problem. This remarkable difference highlights the high accuracy and precision of object placement delivered using ultrasound guidance, effectively reducing the risk of inadvertent tissue damage.

Vascular injection rates were relatively low in both groups, 10% in the ultrasound group and 7.5% in the landmark group. This suggests that both techniques can be successfully used to avoid vascular complications, although ultrasound imaging may offer advantages in identifying and avoiding blood vessels during injection procedure.

The distribution of side effects differed significantly between the ultrasound group and the landmark group suggesting that the location of the limb and the associated ultrasound technique versus landmarks have a significant influence on the occurrence of different side effects.

Conclusion

The ultrasound-guided and anatomical landmark techniques were equally effective in administering local anesthesia. However, the ultrasound approach demonstrated a significantly lower incidence of side effects, particularly nerve injury and vascular injection, compared to the landmark technique. These findings suggest that the ultrasound-guided method may be the preferred choice, especially in situations where minimizing the risk of adverse outcomes is a priority.

References

- [1] Hayek SM, Shah A. Nerve blocks for chronic pain. *Neurosurg Clin N Am*. 2014 Oct;25(4):809-17.
- [2] Marhofer P, Schrögendorfer K, Koinig H, Kapral S, Weinstabl C, Mayer N. Ultrasonographic guidance improves sensory block and onset time of three-in-one blocks. *Anesth Analg*. 1997 Oct;85(4):854-7.
- [3] Albrecht E, Kirkham KR, Taffé P, Endersby RV, Chan VW, Tse C, Brull R. The maximum effective needle-to-nerve distance for ultrasound-guided interscalene block: an exploratory study. *Reg Anesth Pain Med*. 2014 Jan-Feb;39(1):56-60.
- [4] Marhofer P, Schrögendorfer K, Wallner T, Koinig H, Mayer N, Kapral S. Ultrasonographic guidance reduces the amount of local anesthetic for 3-in-1 blocks. *Reg Anesth Pain Med*. 1998 Nov-Dec;23(6):584-8.

- [5] Perlas A, Brull R, Chan VW, McCartney CJ, Nuica A, Abbas S. Ultrasound guidance improves the success of sciatic nerve block at the popliteal fossa. *Reg Anesth Pain Med.* 2008 May-Jun;33(3):259-65.
- [6] Guay J, Suresh S, Kopp S. The use of ultrasound guidance for perioperative neuraxial and peripheral nerve blocks in children. *Cochrane Database Syst Rev.* 2019 Feb 27;2(2):CD011436.
- [7] Casati A, Danelli G, Baciarello M, Corradi M, Leone S, Di Cianni S, Fanelli G. A prospective, randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block. *Anesthesiology.* 2007 May;106(5):992-6.
- [8] Eichenberger U, Stöckli S, Marhofer P, Huber G, Willmann P, Kettner SC, Pleiner J, Curatolo M, Kapral S. Minimal local anesthetic volume for peripheral nerve block: a new ultrasound-guided, nerve dimension-based method. *Reg Anesth Pain Med.* 2009 May-Jun;34(3):242-6.
- [9] Kapral S, Greher M, Huber G, Willschke H, Kettner S, Kdolsky R, Marhofer P. Ultrasonographic guidance improves the success rate of interscalene brachial plexus blockade. *Reg Anesth Pain Med.* 2008 May-Jun;33(3):253-8.
- [10] Black KJ, Bevan CA, Murphy NG, Howard JJ. Nerve blocks for initial pain management of femoral fractures in children. *Cochrane Database Syst Rev.* 2013 Dec 17;(12):CD009587.
- [11] Saglam G, Alisar DÇ. A Comparison of the Effectiveness of Ultrasound-Guided Versus Landmark-Guided Suprascapular Nerve Block in Chronic Shoulder Pain: A Prospective Randomized Study. *Pain Physician.* 2020 Nov;23(6):581-588. PMID: 33185375.
- [12] Balakrishnan V, Saral JN, Kavitha M, Sureshbabu K, Shankar R. Comparison between ultrasound guided and landmark – based technique for superficial cervical plexus block in patients undergoing thyroid surgery. *J Med Sci Res.* 2023; 11(2):125-130.
- [13] Shilpashri A M, Chikkanagoudar S, Comparison of landmark technique versus ultrasound guided technique for supraclavicular brachial plexus block in upper limb surgeries: A prospective randomized trial. *Indian J Clin Anaesth* 2023;10(3):242-247.
- [14] Park SK, Yoo S, Kim WH, Lim YJ, Bahk JH, Kim JT. Ultrasound-assisted vs. landmark-guided paramedian spinal anaesthesia in the elderly: a randomised controlled trial. *European Journal of Anaesthesiology| EJA.* 2019 Oct 1;36(10):763-71.
- [15] Khan MA, Gupta M, Sharma S, Kasaudhan S. A comparative study of ultrasound assisted versus landmark technique for combined spinal-epidural anaesthesia in patients undergoing lower limb orthopaedic surgery. *Indian Journal of Anaesthesia.* 2022 Apr 1;66(4):272-7.
- [16] Park SK, Bae J, Yoo S, Kim WH, Lim YJ, Bahk JH, Kim JT. Ultrasound-assisted versus landmark-guided spinal anesthesia in patients with abnormal spinal anatomy: a randomized controlled trial. *Anesthesia & Analgesia.* 2020 Mar 1;130(3):787-95.
- [17] Chitrambika P, Gupta M, Khan M A, Comparative study of ultrasound assisted versus conventional surface landmark guided technique for combined spinal epidural anaesthesia in patients with increased body mass index and difficult surface anatomy of lower back and spinal deformity. *Indian J Clin Anaesth* 2022;9(2):247-253