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Comparative study of using blind (Landmark technique) and USG guided brachial plexus block

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Abstract
Background: Brachial plexus block (BPB) is a safe, effective anesthesia technique for surgeries of the lower arm, forearm, and hand. It ensures optimal surgical conditions with complete muscle relaxation, stable intraoperative hemodynamics, sympathetic block, and prolonged postoperative analgesia. Ultrasound guidance, now standard, enhances the accuracy and safety of BPB, offering higher success rates and fewer complications than traditional methods.
Aim of the study: This study aims to compare the effectiveness and success rate of blind (Landmark Technique) and ultrasound-guided approaches for supraclavicular brachial plexus block
Methods: This prospective observational study was conducted at the Department of Anesthesia in Satkhira Sadar Hospital, Satkhira Bangladesh from June 2023 to May 2024. Ninety patients, aged 18 to 65, scheduled for upper limb surgeries were included. Ethical approval and informed consent were obtained. Patients were randomly allocated into two groups: Group LM (Landmark) and Group US (Ultrasound) for supraclavicular brachial plexus block.
Result: The average age and gender distribution were similar between groups, but the LM group had a higher mean weight. Procedure time was significantly shorter in the LM group (324±73 seconds) than in the US group (606±121 seconds). Sensory and motor block onset were faster in the US group, which also had longer durations of both blocks. The US group achieved a 100% success rate compared to 86.67% in the LM group, with no complications reported in the US group versus 15.56% in the LM group.
Conclusion: The study finds ultrasound-guided supraclavicular brachial plexus blocks superior to the landmark technique, with a 100% success rate, faster sensory and motor block onset, longer anaesthesia duration, and no complications, compared to an 86.67% success rate and 15.56% complication rate in the landmark group, despite the longer procedural time.

Keywords: Landmark technique, USG guided and brachial plexus block

Introduction
Brachial plexus block (BPB) is a well-established, safe, and effective anesthesia technique for surgeries involving the distal upper limb, covering the lower arm, forearm, and hand [1]. It provides dense anesthesia of the brachial plexus, ensuring optimal surgical conditions by enabling complete muscle relaxation, stable intraoperative hemodynamics, sympathetic block, and prolonged postoperative analgesia [2]. Key benefits of this technique include excellent intraoperative anesthesia, effective muscle relaxation, improved pain scores in recovery, and lower incidences of nausea and vomiting [2]. Furthermore, it may offer greater cost-effectiveness when compared to general anesthesia [3]. Several approaches, including the supraclavicular, interscalene, infraclavicular, and axillary techniques, have been employed for brachial plexus blockade, each offering rapid onset and reliable anesthesia [4]. Among these, the supraclavicular approach is one of the most commonly utilized, as it provides consistent and predictable anesthesia across the entire upper extremity. Additionally, the supraclavicular approach is considered one of the easiest and most effective methods for achieving brachial plexus blockade [5]. Often referred to as the "spinal of the arm" due to its comprehensive anesthesia in this area, the supraclavicular method was first described by Kulenkampff in 1912 [6]. Recently, regional anesthesia techniques, favored for their affordability, effectiveness, safety, and postoperative advantages, have grown more popular than general anesthesia [6]. The interscalene brachial plexus block can be administered using various methods: the conventional blind technique, or ultrasound (US)-guided approaches.

In the traditional technique, commonly referred to as the landmark method, anesthesiologists use the paresthesia technique, inserting a needle at specific anatomical landmarks until the patient reports sensation in the relevant sensory distribution [7]. This conventional landmark technique for the supraclavicular block often requires multiple needle insertions, which can prolong the procedure, cause discomfort, and increase the risk of complications such as nerve and vascular injury [8]. In recent years, ultrasound guidance has become widely adopted for peripheral nerve blocks, allowing anesthesiologists to directly visualize the nerves, the needle tip, and the distribution of local anesthetic [7]. Moreover, ultrasound imaging provides clear visualization of surrounding structures, such as blood vessels and lungs [7]. As a result, ultrasound guidance has progressively established itself as the standard approach in regional anesthesia [8]. The advent of ultrasound technology and advancements in anatomical sonography have revolutionized regional anesthesia, enabling precise needle placement, clear visualization of nerve and plexus structures, and continuous monitoring of local anesthetic spread. These improvements enhance safety, reduce complication rates, and increase the success rate of ultrasound-guided supraclavicular brachial plexus blocks [10]. Studies have shown that ultrasound guidance yields higher success rates and faster sensory and motor blockade onset times. For instance, one study reported an 85% success rate for ultrasound-guided blocks, compared to 78% for nerve stimulation techniques, underscoring the benefits of visualizing anatomical structures during the procedure [11]. Furthermore, ultrasound-guided brachial plexus blocks not only enhance the accuracy of anesthetic delivery but also reduce the risk of accidental injury to nearby vascular and neural structures [11, 12]. Given the clear advantages of ultrasound guidance over conventional techniques, this study aims to compare the effectiveness and success rate of blind (Landmark Technique) and ultrasound-guided approaches for supraclavicular brachial plexus block.

Methodology & Materials

This prospective observational study was conducted at the Department of Anesthesia in Satkhira Sadar Hospital, Satkhira Bangladesh for one year from June 2023 to May 2024. Ethical approval was obtained from the institution's ethics committee, and informed consent was taken from every participant. Ninety patients scheduled for upper limb surgeries were included based on specific inclusion and exclusion criteria. All patients underwent routine pre-anesthetic evaluations and received premedication. Patients were randomly allocated into two groups, each consisting of 45 patients:

- **Group LM (Landmark):** Landmark technique of supraclavicular brachial plexus block.
- **Group US (Ultrasound):** Ultrasound-guided supraclavicular block.

Inclusion criteria

- Adults aged 18 to 65 years.
- Patients scheduled for elective upper limb surgeries requiring brachial plexus block.
- Patients classified as American Society of Anesthesiologists (ASA) I or II or III.
- Patients who have given informed consent to participate in the study.

Exclusion criteria

- Patients with known allergies to local anaesthetics (e.g., ropivacaine, lignocaine).
- Patients with bleeding disorders or on anticoagulant therapy.
- Patients with local infection at the site of needle insertion or systemic infection.
- Patients with pre-existing neuropathy or other neurological disorders affecting the upper limbs.
- Patients with severe respiratory disease or compromised lung function.
- Pregnant women.

Procedure

The supraclavicular brachial plexus block was performed under aseptic conditions using 25 ml of 0.5% ropivacaine as the local anesthetic. To reduce patient discomfort, a 2% lignocaine skin infiltration was administered at the site of the block needle puncture. Patients were positioned supine with their heads turned to the opposite side of the intended block, and their arms were abducted and gently pulled down. A pillow or folded sheet was placed below the shoulder to create a prominent field.

Landmark technique

The subclavian artery was palpated in the supraclavicular fossa, and a subcutaneous wheal was raised with 2% lignocaine using a 25G needle, slightly lateral to the artery. An 18G needle was then inserted through the skin wheal in a backward, inward, and downward direction. When paresthesia was elicited, the needle was withdrawn by 1 to 2 mm, and the drug was injected. In the absence of paresthesia, the drug was injected near the first rib using a walk-over technique.

Ultrasound technique

After positioning the patient, the skin was disinfected, and an ultrasound transducer was placed superior to the clavicle for a cross-sectional view of the subclavian artery. The brachial plexus appeared as hypoechoic oval structures lateral and superficial to the artery. An 18G block needle was inserted after local infiltration, guided in a lateral to medial direction. Upon feeling a palpable "pop" as the needle passed through the brachial plexus sheath, local anesthetic was injected in small aliquots. Procedure time, onset, and duration of sensory and motor blockade were recorded. Hemodynamic parameters were monitored intraoperatively, and post-surgery, patients' motor and sensory recoveries were assessed.

Data collection

The study recorded the following variables: age, gender, and weight of the patients. Additionally, several parameters related to the brachial plexus block procedure were meticulously documented. The time taken for the procedure was measured as the interval between the preparation of the parts and the administration of the total dose of the local anesthetic. The onset of sensory blockade was recorded as the interval between the injection of the test drug and the absence of pinprick sensation. Similarly, the onset of motor blockade was noted as the interval between the injection of the drug and the development of motor weakness in the blocked limb. The duration of sensory block was defined as the interval between the onset of sensory blockade and the first experience of sensation in the blocked limb, while the duration of motor blockade was the interval between the onset of motor blockade and the first movement in the

blocked limb. Cases of block failure, characterized by inadequate or patchy analgesia even after 30 minutes of drug administration, were also noted, and these patients were administered general anesthesia. Sensory blockade was graded on a scale from I to III, with I indicating no difference, II indicating some difference with pinprick sensation in the blocked arm, and III indicating no pinprick sensation in the blocked arm. Motor blockade was similarly graded from I to III, with I indicating normal power, II indicating reduced power, and III indicating complete loss of power.

Dara analysis

Data was tabulated in Microsoft excel and later SSPS (Version 26.0) software was used for analysis of data. Continuous measurements are presented as mean±SD, and categorical measurements are presented as numbers (%). Significance was assessed at a 5% level of confidence using the chi-square test and independent sample t-test.

Result

The average age was 32.07 ± 12.34 years in the landmark (LM) group and 37.77 ± 17.72 years in the US group, with no statistically significant difference between the groups. The mean weight was higher in the LM group (58.9 ± 5.5 kg) compared to the US group (52.8 ± 8.8 kg). In terms of gender distribution, the LM group had 53.33% males and 46.67% females, while the US group had 62.22% males and 37.78% females with no significant difference (Table 1). The time required for the procedure was notably shorter in the LM group (323.95 ± 72.51 seconds) compared to the US group (606.33 ± 121.13 seconds). The onset of sensory and motor block was faster in the US group, with sensory onset at 7.43 ± 2.87 seconds and motor onset at 14.76 ± 0.11 seconds, in comparison with 10.88 ± 4.66 seconds and 16.17 ± 2.77 seconds in the LM group, respectively. Additionally, the duration of motor blockade was longer in the US group (517.33 ± 95.79 seconds) versus the LM group (430.72 ± 80.9 seconds), as was the duration of sensory blockade (580 ± 97.49 seconds in US vs. 505.33 ± 92.13 seconds in LM) (Table 2). In terms of effectiveness, the US-guided method achieved a 100% complete block success rate, and the LM group had a slightly lower success rate, with 86.67% complete and 13.33% incomplete blocks. Complication rates were also significantly different; 15.56% of participants in the LM group experienced complications, while no complications were reported in the US group (Table 3).

Table 1: Baseline characteristics of the study population

Variables	LM (n=45)		US (n=45)		P-value
	n	%	n	%	
Age	32.07±12.34		37.77±17.72		>0.05
Weight (kg)	58.9±5.5		52.8±8.8		
Gender					
Male	24	53.33	28	62.22	>0.05
Female	21	46.67	17	37.78	

Table 2: Characteristics related to procedure

Variables	LM (Mean± SD)	US (Mean± SD)	P-value
Time taken for procedure (in seconds)	323.95±72.51	606.33±121.13	<0.05
Onset of sensory	10.88±4.66	7.43±2.87	<0.05
Onset of Motor	16.17±2.77	14.76±0.11	<0.05
Duration of motor blockade	430.72±80.9	517.33±95.79	<0.05
Duration of Sensory blockade	505.33±92.13	580±97.49	<0.05

Table 3: Outcome of the study among participants

Variables	LM (n=45)		US (n=45)		P-value
	n	%	n	%	
Effectiveness					
Incomplete	6	13.33	0	0	<0.05
Complete	39	86.67	45	100	
Complications					
Present	7	15.56	0	0	<0.05
Absent	38	84.44	45	100	

Discussion

Regional anesthesia, especially brachial plexus blocks, plays a crucial role in modern anesthesiology for managing pain during upper limb surgeries. The supraclavicular approach to this block is especially preferred because it reliably provides complete anesthesia to the upper limb with a quick onset and consistent nerve coverage. Traditionally, this block is performed using anatomical landmarks, a technique often referred to as the "blind" or landmark-based approach. Although generally effective, the landmark technique presents challenges due to its reliance on indirect guidance. It is susceptible to inaccuracies, especially with anatomical variations or difficulty locating the interscalene groove, which may lead to block failure or require multiple needle passes [7]. The success of a brachial plexus block relies on multiple factors, including the chosen technique, the anesthetist's experience, the patient's body composition, and the dosage and type of anesthetic used. Recently, real-time ultrasound guidance has emerged as a valuable tool for peripheral nerve blocks and is quickly gaining importance in regional anesthesia. This advancement has enhanced the success rate of supraclavicular brachial plexus blocks by allowing visualization of the brachial plexus, subclavian artery, first rib, and pleura, leading to more precise and effective blocks [13]. This prospective observational study examined the efficacy, safety, and procedural characteristics of blind landmark-guided (LM) versus ultrasound (US)-)-guided supraclavicular brachial plexus blocks in patients undergoing elective upper limb surgeries. The average age was slightly higher in the US group (37.77±17.72 years) than in the LM group (32.07±12.34 years), though this difference was not statistically significant. Gender distribution was also similar, with 53.33% males and 46.67% females in the LM group and 62.22% males and 37.78% females in the US group. Although average weight differed between groups, this difference was not statistically

tested. Variations in weight could influence needle depth and anesthetic spread, particularly in landmark-guided techniques, as anatomical landmarks may be affected by body composition. However, ultrasound guidance allows the operator to visualize nerve structures directly, thereby minimizing the effect of weight differences on procedural accuracy. This demographic distribution is consistent with the general patient population receiving brachial plexus blocks, supporting the sample's representativeness [7, 11, 14, 15]. In terms of procedural characteristics, the time required for the US-guided block was significantly longer compared to the LM technique. Both techniques were performed by consultants, who were more accustomed to the landmark approach, which contributed to the shorter block time for this method. In contrast, ultrasound guidance was a relatively newer skill, requiring additional time. Routine use of ultrasound guidance in clinical practice demands advanced ultrasonographic equipment and extensive training to achieve proficiency [16]. Williams *et al*. conducted a study to determine the number of brachial plexus blocks required to achieve a satisfactory level of proficiency with the technique. They estimated that performing at least 62 blocks is necessary to reach a success rate of 87% [10]. The extended time required for block performance in the US group can be attributed to moderate proficiency in ultrasound use. Our study demonstrated that the onset of both sensory and motor blockade was significantly quicker in the US-guided group compared to the LM group. Similarly, a study by Raghove *et al*. also found that sensory and motor block onset occurred earlier in the US-guided group than in the conventional group [17]. The delayed onset observed in the landmark technique can be attributed to its blind approach, where the anesthetic is injected perivascularly with the expectation that it will diffuse around the nerves. In contrast, ultrasound guidance allows precise deposition of the anesthetic near the nerve plexus under direct visualization, accelerating the block's onset. The onset of motor blockade was closely aligned with that of sensory blockade, consistent with findings from studies by Williams *et al*., Honnannavar *et al*., and Veeresham *et al*. [10, 11, 18]. In our study, both sensory and motor blockade durations were notably longer in the ultrasound-guided group compared to the landmark group. Specifically, sensory blockade lasted 505.33±92.13 minutes in the landmark group and 580±97.49 minutes with ultrasound guidance. Likewise, motor blockade duration was 413.92±79.66 minutes in the landmark group and extended to 518.33±94.79 minutes in the ultrasound group, a statistically significant difference. This increased duration can be attributed to the precise deposition of anesthetic closer to the plexus, resulting in a denser blockade. Similarly, Dureja *et al*. observed longer durations of analgesia in both ultrasound and nerve stimulator groups compared to the conventional approach [15]. The block was successful in 86.67% of patients in group LM and was 100% in the US group. Total failure of block occurred in 13.33% of the LM group. Vincent W S Chan *et al*. found that the block was successful in 95% of cases after one attempt in a guided block [6]. The high success rate with USG can be explained by direct visualization of the plexus under ultrasound and drug injection around the plexus under real-time monitoring. None of our study groups had nerve injury, pneumothorax or local anaesthetic toxicity. Vessel puncture was 15.56% in the LM group whereas it was nil in the US group, and this was statistically significant. Karpal *et al*. had no complications in their study of ultrasound-guided supraclavicular brachial plexus block [19]. In a study conducted by Veeresham *et al*., they observed vessel puncture in 16.67% of cases in a conventional group with no complications in the ultrasound-guided technique [18]. The use of ultrasound allows for better identification and avoidance of vascular structures, reducing the risk of vessel puncture. The study has several limitations. The anesthesiologists' experience level with the ultrasound technique varied, possibly impacting the procedure time and success rates. The study did not account for the learning curve associated with ultrasound guidance. Also, the follow-up period was short, restricting the assessment of long-term outcomes and complications associated with each technique.

Conclusion

The study concludes that ultrasound (US)-guided supraclavicular brachial plexus blocks offer significant advantages over the traditional blind landmark (LM) technique. Key findings include a higher success rate (100% vs 86.67%), faster onset of sensory and motor blocks, and longer durations of anaesthesia and motor blockade with the US method. Additionally, the US group experienced no complications, whereas the LM group had a 15.56% complication rate, primarily vessel punctures. Despite the longer procedural time for US-guided blocks, the increased precision, effectiveness, and safety make it a superior method for performing brachial plexus blocks in upper limb surgeries.

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