

ORIGINAL ARTICLE

Incidence of Pneumothorax following Supraclavicular Brachial Plexus Block

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Abstract:

*Background:*The supraclavicular brachial plexus block is a widely used technique for upper limb anesthesia due to its rapid onset and reliable coverage. This study aims to assess the incidence of pneumothorax following supraclavicular brachial plexus block. *The aim of the study was to determine the incidence of pneumothorax following supraclavicular brachial plexus block.* *Methodology:*This prospective observational study was conducted from January 2022 to December 2024 at Holy Family Red Crescent Medical College and Kalatia Central Hospital Pvt. Ltd., Keranigonj, Dhaka, Bangladesh in the Department of Anesthesia, Analgesia & Intensive Care Unit. 200 patients undergoing supraclavicular brachial plexus block were enrolled. Blocks were done via ultrasound or landmark technique; needle angle and attempts were recorded. Patients were monitored for pneumothorax, confirmed by chest X-ray if suspected. Incidence and risk factors were analyzed descriptively. *Results:*The study included 200 patients (mean age 38.2 ± 19.1 years), with 55% males and an average BMI of 23.5 ± 3.8 kg/m². Most were ASA Grade I (63.5%), and 90% received ultrasound-guided blocks. Pneumothorax occurred in 4 cases (2.0%), with a higher incidence in the landmark group (15%) compared to the ultrasound group (0.6%). Among pneumothorax cases, 50% had preexisting pulmonary conditions, 25% were obese, and 75% had a needle angle $\geq 45^\circ$, suggesting these as contributing risk factors. *Conclusion:*Ultrasound-guided supraclavicular brachial plexus block is associated with a lower risk of pneumothorax, highlighting the importance of careful technique and patient risk assessment.

Key words: Pneumothorax, Supraclavicular Block, Brachial Plexus.

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Introduction:

An established, reliable, and efficient anesthetic method frequently used for surgeries involving the distal upper limb, such as the hand and forearm, is the brachial plexus block¹. Because of its wide range of sensory coverage, the supraclavicular brachial

plexus block (SCBPB), sometimes known as the “Spinal of the arm,” is a particularly successful method for producing anesthesia below the elbow². This method, which was initially reported in the early 1900s, provides quick onset and reliable anesthesia by targeting the brachial plexus at the level of the trunks and divisions close to the first

rib^{3,4}. The conventional approach entails pushing the needle toward the pleural dome almost parallel to the neck, which inevitably raises the possibility of problems like pneumothorax^{4,5}.

With SCBPB patient safety is still a major concern in spite of these developments^{6,7}. Despite being uncommon, pneumothorax which can result in respiratory compromise and increased morbidity is one of the most dangerous consequences of an unintentional pleural puncture. Because landmark-based procedures are blind, they frequently call for several needle attempts, which increases the possibility of pleural damage. Therefore, it is crucial to communicate these risks clearly during the informed consent procedure. Although real-time needle visualization made possible by ultrasound guiding has greatly improved safety, the danger of pleural damage is still present because sporadic cases are still being reported¹⁰.

Pneumothorax rates after SCBPB range substantially, from 0.5% to 6.1%, especially when operations are carried out without imaging guidance¹¹. Possibly with imaging, there are still occasional cases of pneumothorax, despite extensive research suggesting ultrasound may greatly lessen or possibly avoid this complication^{12,13}. Risk factors that have been identified include elevated BMI, multiple tries, steep needle trajectory, and underlying pulmonary diseases. Nonetheless, discrepancies in the literature underscore the necessity for additional research. The purpose of this study is to evaluate the prevalence of pneumothorax after supraclavicular brachial plexus block. Finding the prevalence and risk factors for pneumothorax after supraclavicular brachial plexus block was the study's main objective.

Materials and method:

This prospective observational study was conducted in the Department of Anesthesia, Analgesia &

Intensive Care Unit at Holy Family Red Crescent Medical College and Kalatia Central Hospital Pvt. Ltd., Keranigonj, Dhaka, Bangladesh, over three years from January 1, 2022, to December 31, 2024. A total of 200 patients scheduled for supraclavicular brachial plexus block were consecutively enrolled during the study period.

Inclusion Criteria:

- Patients aged 18 years and above
- Scheduled for supraclavicular brachial plexus block for upper limb surgery
- ASA physical status I or II

Exclusion Criteria:

- Known coagulopathy or bleeding disorders
- Local infection at the block site
- Severe pulmonary disease contraindicating the block
- Allergy to local anesthetics

Age, gender, body mass index (BMI), and ASA physical status were among the baseline demographic information that was documented. Depending on the anesthesiologist's preference and the availability of equipment, blocks were carried out either under ultrasound guidance or utilizing the landmark-based technique. During the operation, the number of attempts and the needle angle were recorded. Pneumothorax symptoms were observed in patients both during and after surgery, and chest radiography was used to confirm probable cases. Pneumothorax incidence was compared between the two methods, and among patients who experienced pneumothorax, risk factors such obesity (BMI >30), prior lung diseases, and needle angle ($\geq 45^\circ$ to skin) were examined. Descriptive statistics were used to examine the data, and the results were displayed as means, standard deviations, frequencies, and percentages.

Results:**Table 1:** Baseline Characteristics of Study Population (N = 200)

Variables		Frequency	Percentage (%)
Age (in years)	<20	40	20.0
	20–39	65	32.5
	40–59	55	27.5
	≥60	40	20.0
	Total	200	100.0
	Mean ± SD	38.20 ± 19.08	
Gender	Male	110	55.0
	Female	90	45.0
Mean BMI (kg/m ²)		23.5 ± 3.8	
ASA grading	I	127	63.5
	II	73	36.5
Technique Used	Ultrasound	180	90.0
	Landmark	20	10.0

The study included 200 patients undergoing supraclavicular brachial plexus block. The majority of participants were between 20–39 years (65, 32.5%), followed by 40–59 years (55, 27.5%), those under 20 years (40, 20.0%), and those aged 60 years or above (40, 20.0%). The mean age of the study population was 38.20 ± 19.08 years. There was a slight male predominance, with 110 males (55.0%) and 90 females (45.0%). The average BMI was 23.5 ± 3.8 kg/m². In terms of ASA physical status, most patients were classified as ASA Grade I (127, 63.5%), while the remaining 73 (36.5%) were ASA Grade II. Ultrasound guidance was the predominant technique used for the block (180, 90.0%), whereas the landmark technique was used in only 20 cases (10.0%).

Table 2: Incidence of Pneumothorax According to Block Technique

Technique	Patients (n)	Pneumothorax Cases (n)	Incidence (%)
Ultrasound-Guided	180	1	0.6
Landmark-Based	20	3	15.0
Total	200	4	2.0

Pneumothorax occurred in 1 of 180 patients (0.56%) who underwent ultrasound-guided blocks, compared to 3 of 20 patients (15.0%) in the landmark-based group. The overall incidence across all patients was 2.0%.

Table 3: Risk Factors Associated with Pneumothorax Following SBPB

Risk Factor	Pneumothorax Cases (n=4)	Percentage (%)
Pre-existing Pulmonary Conditions	2	50.0
Obesity (BMI >30)	1	25.0
Needle Angle (≥45° to skin)	3	75.0

Among the four patients who developed pneumothorax, 2 (50%) had preexisting pulmonary conditions, indicating a higher risk in this subgroup. One patient (25%) was obese with a BMI greater than 30, suggesting obesity as a possible contributing factor. Notably, 3 patients (75%) had a needle angle of ≥45°.

Discussion:

This study highlights the incidence and contributing risk factors of pneumothorax following supraclavicular brachial plexus block (SCBPB) in patients undergoing upper limb surgery at two tertiary care hospitals in Bangladesh. SCBPB, though highly effective for regional anesthesia, carries the potential for serious complications, with pneumothorax being among the most concerning. The findings emphasize the influence of technical variables- particularly needle angle, number of attempts, and use of ultrasound guidance- alongside patient-related factors such as obesity and preexisting pulmonary conditions. These results underscore the importance of meticulous technique and patient selection in minimizing adverse outcomes associated with SCBPB.

In this study, the mean age was 38.20 ± 19.08 years, comparable to findings by Ali et al. (38.94 ± 20.37 years) and Suljević et al.¹⁴ (37.10 years), suggesting a similar age range of patients typically undergoing this procedure. A male predominance (55.0%) was observed, in agreement with the gender distribution in Ali et al.'s cohort¹⁵. The average BMI was 23.5 ± 3.8 kg/m², aligning with Royhan et al. who noted a predominance of patients under 25 kg/m² BMI¹⁶. Most patients were classified as ASA Grade I (63.5%), reflecting the low-risk profile seen in previous studies. Notably, ultrasound guidance was used in 90% of cases, supporting its growing preference in clinical practice due to its reduced complication rates, as emphasized by Stav et al. in their comparison of brachial plexus block approaches¹⁷. Establishing this demographic and procedural similarity with earlier studies strengthens the external validity of our findings related to pneumothorax incidence and underscores the importance of technique selection in minimizing complications.

In the present study, the overall incidence of pneumothorax following supraclavicular brachial plexus block was 2.0% (4 out of 200 patients), with a marked difference observed between techniques.

Among the 180 patients who received ultrasound-guided blocks, only one developed pneumothorax (0.6%), whereas three cases (15.0%) occurred in the 20 patients who underwent landmark-based blocks. These findings align with Gauss et al. who reported a significantly lower incidence of clinically symptomatic pneumothorax (0.06%) in a large series of over 6,000 ultrasound-guided brachial plexus blocks¹⁰. In contrast, our results reflect historical data that associate landmark-based techniques with a substantially higher risk of pneumothorax, reported as high as 6.1% in earlier literature. The stark contrast between the two methods in our study reinforces the established safety advantage of ultrasound guidance and highlights the continued relevance of technique selection in minimizing serious complications such as pneumothorax.

In this study, among the four pneumothorax cases, half of the patients had preexisting pulmonary conditions, reinforcing findings by Kumari et al. who reported a case of delayed pneumothorax in a patient with COPD following a supraclavicular block, highlighting the increased vulnerability in this population¹⁸. Obesity (BMI >30) was identified in 25% of cases, aligning with Abe et al.'s observation that obesity is a significant factor influencing anesthesia requirements and potentially complicating regional blocks¹⁹. Notably, a steep needle angle ($\geq 45^\circ$) was present in 75% of pneumothorax cases, suggesting that procedural factors such as needle trajectory play a critical role in the development of this complication. These results underscore the importance of both patient-specific risk factors and careful technique to minimize the incidence of pneumothorax during supraclavicular brachial plexus blocks.

Limitations of the study:

This study had some limitations as the sample was not randomly selected and the study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

Conclusion:

Pneumothorax was more frequently observed with landmark-based supraclavicular brachial plexus blocks compared to ultrasound-guided techniques, reinforcing the safety advantage of ultrasound guidance. Risk factors such as underlying pulmonary conditions, obesity, and steeper needle angles appeared to contribute to the occurrence of pneumothorax. These findings underscore the importance of patient evaluation and technique refinement to minimize complications associated with this regional anesthesia approach.

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