

Ultrasound guided vs. Landmark Based Superficial Cervical Plexus Block for Thyroid Surgery a Randomized Controlled Study

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ABSTRACT

Background: Bilateral superficial cervical plexus block is an efficacious regional anesthetic technique for providing intraoperative and postoperative analgesia in thyroid surgery. Although the traditional landmark-based approach remains standard, ultrasound guidance potentially improves the precision of local anesthetic deposition, thereby enhancing block efficacy and onset characteristics. **Methods:** Sixty adult patients scheduled for elective thyroid surgery were randomized to receive bilateral SCPB using either the landmark or ultrasound-guided technique. A volume of 10 ml of 0.25% bupivacaine was administered bilaterally. The primary outcome was blocking success, defined as complete loss of cold sensation across all four cutaneous branches of the superficial cervical plexus at 15 minutes. Secondary outcomes included onset latency, procedural duration, and patient-reported pain scores related to the block. **Results:** Block success was significantly higher in Group U (25/30, 83.3 %) than in Group L (20/30, 66.7 %) ($p = 0.046$). Mean onset time among successful blocks was shorter in Group U (11.12 ± 1.15 min) than in Group L (16.20 ± 2.20 min) ($p = 0.0013$). Performance time was longer with ultrasound guidance (119.83 ± 16.21 s versus 45.73 ± 9.44 s; $p < 0.0001$). Block-related discomfort (VAS 3–5) did not differ significantly between groups ($p = 0.178$). **Conclusion:** Ultrasound-guided bilateral SCPB demonstrates superior block success and more rapid sensory onset compared to the landmark-based approach in patients undergoing thyroid surgery, albeit requiring a marginally longer procedural duration.

Keywords: Superficial cervical plexus block, Ultrasound guidance, Landmark technique, Thyroidectomy, Regional anaesthesia, Bupivacaine

INTRODUCTION

Thyroidectomy is a prevalent procedure in endocrine surgery. Although general anaesthesia remains the conventional standard, the integration of a regional block can improve intraoperative haemodynamic stability, diminish opioid requirements, and facilitate superior postoperative analgesia. Bilateral superficial cervical plexus block targets the cutaneous branches of the cervical plexus innervating the anterolateral neck, rendering it a highly appropriate modality for thyroid surgical interventions[1]. Despite these advantages, the landmark technique relies on anatomical palpation, which may be susceptible to variations in patient morphology and operator experience, potentially increasing the risk of collateral tissue injury [2]. Conversely, real-time visualization afforded by

ultrasound allows for the precise deposition of local anesthetic around the nerve roots, which may optimize analgesic coverage and mitigate complications [3]. The superficial cervical plexus comprises four distinct nerves the lesser occipital, greater auricular, transverse cervical, and supraclavicular which emerge at the midpoint of the posterior border of the sternocleidomastoid muscle. While traditional landmark-based techniques rely on subcutaneous infiltration along this border, the method is inherently "blind" and may result in incomplete anesthetic spread or inadvertent deep injection[4]. Ultrasound guidance enables real-time visualization of the intermuscular plane between the sternocleidomastoid and underlying scalene muscles, facilitating precise local anesthetic deposition and potentially increasing block success

while reducing complications. Although Tran et al. performed the initial randomized comparison of ultrasound-guided versus landmark-based superficial cervical plexus block, reporting comparable success rates alongside longer performance times for the ultrasound approach, subsequent research in thyroidectomy patients has suggested superior clinical utility with ultrasound guidance; however, robust comparative data remain limited. Thus, the present prospective randomized trial was initiated to compare ultrasound-guided and landmark-based bilateral SCPB in patients undergoing elective thyroid surgery, specifically examining block success, onset latency, and procedural performance metrics [2,5]. The study also investigates the physiological implications of anesthetic volume, as dosages exceeding 5 mL within the prevertebral space may correlate with an increased incidence of inadvertent neurological complications.

MATERIALS AND METHODS

Study design and ethical approval

This single-centre, prospective, randomized, double-blind investigation was conducted within the Department of Anesthesiology at the Prathima Institute of Medical Sciences, Karimnagar, between March 2022 and March 2024. Following approval by the Institutional Ethics Committee (IEC/PIMS/2022/85), written informed consent was obtained from all participants. The study was performed in accordance with the Declaration of Helsinki and adhered to the CONSORT guidelines. Sixty consecutive adult patients scheduled for elective thyroid surgery under general anaesthesia were enrolled. Inclusion criteria required participants to be aged ≥ 20 years with a body mass index $< 30 \text{ kg m}^{-2}$, American Society of Anesthesiologists physical status I–III [6], Mallampati class I or II, and documented euthyroid status. Exclusion criteria comprised patient refusal, emergent surgical indications, anticipated difficult airway, pregnancy, a history of seizures or neurological deficits, coagulation disorders, retrosternal goiter, and significant pulmonary disease.

Sample Size Calculation

The sample size was calculated based on the anticipated difference in successful block rates between the landmark-based and ultrasound-guided superficial cervical plexus block techniques. Assuming a 20% improvement in block success with ultrasound guidance, a confidence level of 95%, and a study power of 80%, a minimum of 27 participants was required in each group. To compensate for potential dropouts and protocol deviations, 30 patients were enrolled in each group, resulting in a total sample size of 60 participants.

Randomization and blinding

Participants were allocated using sealed opaque envelopes to one of two equal cohorts: Group L

(landmark-based bilateral SCPB) or Group U (ultrasound-guided bilateral SCPB). To ensure blinding, an independent anesthesiologist prepared standardized syringes containing 0.25% bupivacaine. The patients, operating surgeons, and the investigator assessing block characteristics remained blinded to group assignment.

Anaesthetic management

All patients received intramuscular glycopyrrolate ($10 \mu\text{g kg}^{-1}$) as premedication. Following the application of standard monitoring and insertion of an 18-G intravenous cannula, bilateral SCPB was performed by an experienced anesthesiologist, proficient in both techniques, prior to the induction of general anaesthesia.

Landmark technique (Group L)

With the patient in the supine position and the head rotated slightly to the contralateral side, the midpoint of the posterior border of the sternocleidomastoid muscle was identified. Following aseptic preparation, a 25-G needle was inserted to infiltrate 2–3 mL of 0.25% bupivacaine, establishing a cutaneous wheal. The needle was then advanced cephalad along the posterior border, where 4–5 mL of the anesthetic solution was deposited during withdrawal; an additional 4–5 mL was subsequently injected in a caudal direction toward the clavicle [7]. This procedure was replicated on the opposite side.

Ultrasound-guided technique (Group U)

Patients were placed in the lateral decubitus position, with the operative side directed superiorly. A high-frequency linear ultrasound transducer was positioned in the coronal plane at the midpoint of the posterior border of the sternocleidomastoid muscle to identify the intermuscular plane situated between the sternocleidomastoid and the underlying scalene musculature. Utilizing an in-plane approach, a 25-G needle was advanced into the target plane following negative aspiration, 10 mL of 0.25% bupivacaine was administered under continuous ultrasound visualization [8]. This procedure was subsequently replicated on the contralateral side.

General anaesthesia was induced with fentanyl $2 \mu\text{g kg}^{-1}$ and thiopentone 5 mg kg^{-1} . Following confirmation of mask ventilation, atracurium 0.5 mg kg^{-1} was administered, and the trachea was intubated with an appropriately sized flexometallic tube. Anaesthesia was maintained using nitrous oxide–oxygen and sevoflurane. Upon conclusion of the surgical procedure, neuromuscular blockade was reversed with neostigmine $50 \mu\text{g kg}^{-1}$ and glycopyrrolate $10 \mu\text{g kg}^{-1}$ [9].

Outcomes

Primary Outcome

- **Block success:** Complete absence of cold sensation in all four cutaneous branches of the superficial cervical plexus, assessed 15 minutes after completion of the bilateral block.

on the skin to completion of local anesthetic injection.

- **Block-related pain score:** Patient discomfort during block performance measured using a 10-cm Visual Analogue Scale (VAS; 0 = no pain, 10 = worst imaginable pain).

Secondary Outcomes

- **Onset time:** Interval from completion of local anesthetic injection to complete loss of cold sensation in all four cutaneous branches (assessed only in patients with successful blocks).
- **Block performance time:**
 - *Landmark group:* Time from needle insertion to completion of local anesthetic injection.
 - *Ultrasound group:* Time from initial ultrasound probe placement

Statistical analysis

Continuous variables are presented as mean $\pm$ standard deviation and were compared using the unpaired Student's t-test. Categorical data are expressed as frequencies and were analyzed using the chi-square or Fisher's exact test, as appropriate. A two-tailed p-value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS version 16.0. The study power was calculated to detect a clinically meaningful difference in block success rates between the two cohorts, assuming a 20% improvement with the ultrasound-guided technique.

RESULTS

Baseline characteristics

The two groups were comparable with respect to age, sex distribution, height, weight, BMI and duration of surgery (Table 1).

Table 1. Demographic and surgical characteristics

Variable	Landmark (n = 30)	Ultrasound (n = 30)	p-value
Age (years)	46.17 $\pm$ 13.34	41.47 $\pm$ 8.32	0.108
Sex (male/female)	11/19	12/18	0.791
Height (cm)	152.60 $\pm$ 10.62	154.67 $\pm$ 5.11	0.233
Weight (kg)	56.73 $\pm$ 7.71	57.97 $\pm$ 7.43	0.531
BMI (kg m ⁻²)	24.63 $\pm$ 2.78	24.10 $\pm$ 1.83	0.068
Duration of surgery (min)	96.83 $\pm$ 15.51	97.50 $\pm$ 16.54	0.873

Block success

Complete sensory block of all four branches at 15 minutes was achieved in 25 of 30 patients (83.3 %) in the ultrasound group and in 20 of 30 patients (66.7 %) in the landmark group (p = 0.046) (Table 2).

Table 2. Block success rate

Outcome	Landmark (n = 30)	Ultrasound (n = 30)	p-value
Successful	20 (66.7 %)	25 (83.3 %)	0.046
Unsuccessful	10 (33.3 %)	5 (16.7 %)	

Onset and performance times

Among patients with successful blocks, mean onset time was significantly shorter with ultrasound guidance (11.12 $\pm$ 1.15 min versus 16.20 $\pm$ 2.20 min; p = 0.0013). Conversely, performance time was longer in the ultrasound group (119.83 $\pm$ 16.21 s versus 45.73 $\pm$ 9.44 s; p < 0.0001) (Table 3).

Table 3. Onset and performance times

Parameter	Landmark	Ultrasound	p-value
Onset time (min)*	16.20 $\pm$ 2.20 (n = 20)	11.12 $\pm$ 1.15 (n = 25)	0.0013
Performance time (s)	45.73 $\pm$ 9.44	119.83 $\pm$ 16.21	<0.0001

*Assessed only in successful blocks.

Block-related pain

Patient-reported discomfort during block performance was modest (VAS 3–5) and did not differ significantly between groups (p = 0.178) (Table 4).

Table 4. Block pain score (VAS)

VAS score	Landmark (n = 30)	Ultrasound (n = 30)	p-value
3	8 (26.7 %)	15 (50.0 %)	0.178
4	13 (43.3 %)	9 (30.0 %)	
5	9 (30.0 %)	6 (20.0 %)	

DISCUSSION

This randomized trial demonstrates that ultrasound-guided bilateral SCPB is superior to the conventional landmark technique for patients undergoing elective thyroid surgery, characterized by higher block success rates and a more rapid onset of sensory blockade. Although the ultrasound-guided approach requires a longer performance time, it maintains patient comfort comparable to that of the landmark-based method[5]. These findings align with prior research indicating that while ultrasound guidance enhances technical precision, it necessitates a longer procedural duration compared to traditional anatomical palpation [11].

Our success rates align with the trends documented by Tran et al., although the magnitude of difference observed in the current study exceeds that reported in their series. This disparity likely stems from variations in patient cohorts, the stringent criteria employed for defining complete anesthesia across all four cutaneous branches, and the utilization of a reduced local anesthetic concentration[12]. Furthermore, preceding research supports the enhanced reliability of ultrasound-guided superficial cervical plexus block when the intermuscular plane is distinctly visualized. However, the lack of significant variance in intraoperative analgesic consumption or postoperative pain scores between groups suggests that these technical advantages may be less pronounced in routine clinical practice [13].

The accelerated onset time associated with ultrasound guidance is clinically significant, enabling the block to be fully established prior to surgical incision. This may contribute to greater intraoperative hemodynamic stability and reduced opioid requirements benefits that align with documentation in existing thyroidectomy literature. Nonetheless, the observed disparity in procedural duration highlights a trade-off between the increased technical accuracy offered by ultrasound visualization and the time-efficiency of the landmark-based approach [14,15].

The increased performance time associated with ultrasound guidance is anticipated and consistent with the findings reported by Tran et al. In the setting of elective surgery, this additional duration is of minimal practical consequence and is outweighed by the improvements in block success and onset speed. Furthermore, the ultrasound-guided technique did not increase patient discomfort, confirming its clinical acceptability. Despite these clinical benefits, it remains critical to note that existing literature presents inconsistent findings regarding the overall impact of ultrasound guidance on final postoperative analgesic

consumption, as variations in drug regimens and injection techniques may obfuscate potential advantages [16].

Several limitations warrant consideration regarding this investigation, specifically its single-center design, the relatively modest sample size, and the execution of all procedures by a single experienced practitioner. Consequently, the generalizability of these findings to less experienced clinicians remains to be established [17,18]. Furthermore, this study did not evaluate the duration of analgesia or secondary clinical outcomes, which are addressed in a companion analysis. Notwithstanding these factors, the marked superiority of ultrasound guidance concerning primary technical endpoints strongly supports its adoption as the preferred approach for bilateral SCPB in patients scheduled for thyroid surgery.

Strengths of the Study

The present study has several strengths. It was designed as a prospective, randomized, double-blind clinical trial with standardized anesthetic and surgical protocols, thereby minimizing selection and observer bias. Both superficial cervical plexus block techniques were performed by an experienced anesthesiologist, ensuring procedural consistency. Objective outcome measures, including block success rate, onset time, performance time, and patient-reported discomfort, were systematically evaluated. The study provides clinically relevant evidence supporting the use of ultrasound guidance in superficial cervical plexus block for thyroid surgery.

Limitations of the Study

This study has certain limitations. It was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. All blocks were performed by a single experienced anesthesiologist; therefore, the results may not be directly applicable to clinicians with varying levels of expertise. The study primarily evaluated technical block characteristics and did not assess postoperative analgesic consumption, duration of analgesia, patient satisfaction, cost-effectiveness, or long-term postoperative outcomes. Furthermore, block-related complications such as diaphragmatic paresis, Horner syndrome, recurrent laryngeal nerve palsy, or local anesthetic systemic toxicity were not specifically evaluated because of the limited sample size.

Future Directions

Future multicenter randomized controlled trials involving larger patient populations are warranted to validate the present findings. Further research should compare different local anesthetic volumes and concentrations, evaluate postoperative analgesic consumption, duration of analgesia, patient satisfaction, quality of recovery, and cost-effectiveness of ultrasound-guided superficial cervical plexus block. Long-term follow-up studies assessing block-related complications and functional recovery would further strengthen the available evidence.

Practical Implications

The findings of this study suggest that ultrasound-guided superficial cervical plexus block provides a higher success rate and faster onset of sensory blockade than the conventional landmark-based technique while maintaining comparable patient comfort. Although the ultrasound-guided technique requires a slightly longer procedural time, the improved block reliability may contribute to better perioperative analgesia and greater procedural safety. Therefore, ultrasound guidance should be considered the preferred technique whenever appropriate equipment and trained personnel are available.

CONCLUSION

For patients undergoing elective thyroid surgery, ultrasound-guided bilateral superficial cervical plexus block demonstrates a superior success rate and a significantly more rapid onset of sensory anaesthesia compared to traditional landmark-based techniques. Although the procedural duration is extended, patient comfort remains comparable between the two modalities. Accordingly, ultrasound-guided SCPB should be considered the preferred approach for this regional anaesthetic procedure.

Ethical Approval

The study protocol was reviewed and approved by the Institutional Ethics Committee of Prathima Institute of Medical Sciences, Karimnagar (Approval No. IEC/PIMS/2022/85). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Conflict of Interest

The authors declare that they have no conflict of interest related to this study.

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Informed Consent

Written informed consent was obtained from all participants prior to enrolment in the study.

Author Contributions

B. Jayaprakash: Conceptualization, methodology, patient recruitment, data collection, investigation, and manuscript drafting.

D. Rajeshwari: Study design, supervision, manuscript review, and critical revision.

Maduguri Srinivas Reddy: Data collection, clinical monitoring, and literature review.

N. Ashok Vardhan: Statistical analysis, data interpretation, and manuscript editing.

M. Bhanu Lakshmi: Conceptualization, supervision, manuscript review, final editing, and overall responsibility for the integrity of the study.

All authors read and approved the final version of the manuscript.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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Abbreviation Full Form

SCPB	Superficial Cervical Plexus Block
US	Ultrasound
GA	General Anaesthesia
VAS	Visual Analogue Scale
BMI	Body Mass Index
ASA	American Society of Anesthesiologists
IEC	Institutional Ethics Committee
SPSS	Statistical Package for the Social Sciences
RCT	Randomized Controlled Trial
SCM	Sternocleidomastoid Muscle
SD	Standard Deviation
CI	Confidence Interval

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