

Intraoperative Haemodynamic Stability, Postoperative Analgesia, and Complications After Ultrasound-Guided Versus Landmark-Based Superficial Cervical Plexus Block in Thyroidectomy

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ABSTRACT

Background: Bilateral superficial cervical plexus block improves analgesia after thyroidectomy however, whether the higher technical success associated with ultrasound guidance translates into superior clinical outcomes remains unclear. **Methods:** In this secondary analysis of a prospective randomized trial, 60 patients who received bilateral SCPB via either the landmark technique or ultrasound guidance were evaluated for intra-operative haemodynamics, postoperative pain scores (0-120 min), and block-related complications. **Results:** Heart rate, systolic blood pressure, and mean arterial pressure were significantly lower in the ultrasound group at multiple intra-operative time points post-induction. Postoperative visual analogue scale scores were consistently lower in Group U. Three patients in the landmark group experienced vascular puncture, compared to none in Group U; no cases of local-anaesthetic systemic toxicity, Horner syndrome, or phrenic-nerve palsy were observed in either group. **Conclusion:** Ultrasound-guided bilateral SCPB is associated with improved intra-operative haemodynamic stability, reduced early postoperative pain, and a more favourable safety profile than the landmark technique in patients undergoing thyroidectomy.

Keywords: *Superficial cervical plexus block, Ultrasound guidance, Haemodynamic stability, Postoperative analgesia, Thyroidectomy, Complications*

INTRODUCTION

Thyroidectomy is frequently associated with moderate postoperative pain and can precipitate substantial haemodynamic changes during the surgical manipulation of the thyroid gland. The administration of bilateral superficial cervical plexus block as an adjunct to general anaesthesia has been demonstrated to decrease opioid requirements, improve early postoperative analgesia, and mitigate the physiological stress response [1]. Although traditional landmark-based methods rely on anatomical palpation, these techniques are often limited by anatomical variations and the proximity of neurovascular structures, increasing the risk of procedural complications [2].

In a related randomized trial, we demonstrated that ultrasound guidance provides a superior block success rate and a more rapid onset of sensory blockade than the conventional landmark-based technique. However, the extent to which these technical advantages translate into measurable improvements in intra-operative

haemodynamic stability, postoperative analgesia, and clinical safety has not yet been comprehensively evaluated within the same study cohort [3].

Previous investigations regarding the clinical efficacy of SCPB have yielded inconsistent findings, largely attributable to heterogeneity in procedural methodology, local anaesthetic regimens, and criteria employed for outcome assessment. Consequently, this secondary analysis examines the clinical outcomes of these two modalities, specifically focusing on intra-operative haemodynamics, early postoperative pain scores, and potential complications within a rigorously controlled randomized framework[4,5]

MATERIALS AND METHODS

Study design and patients

This study constitutes a pre-planned secondary analysis of a single-center, prospective, randomized, double-blind trial conducted at the Prathima Institute

of Medical Sciences, Karimnagar, spanning from March 2022 to March 2024.

Ethical Approval

Ethical approval (IEC/PIMS/2022/85) and written informed consent was obtained for the primary study. Comprehensive details regarding inclusion and exclusion criteria, randomization, and blinding have been reported previously. Briefly, 60 adult patients scheduled for elective thyroidectomy were allocated to undergo either landmark-based or ultrasound-guided bilateral superficial cervical plexus block.

Sample Size Calculation

This study represents a pre-planned secondary analysis of a previously completed randomized controlled trial. All eligible patients enrolled in the primary study during the study period were included in the present analysis, resulting in a total sample size of 60 patients (30 in each group).

Outcomes

Primary Outcome

Intraoperative haemodynamic stability (HR, SBP, DBP, MAP).

Secondary Outcomes

Postoperative VAS score, rescue analgesic requirement, block-related complications, vascular puncture, Horner syndrome, phrenic nerve palsy and local anaesthetic systemic toxicity.

RESULTS

Baseline characteristics

The groups were comparable with respect to age, sex, anthropometric variables and duration of surgery (previously reported).

Intra-operative haemodynamics

Heart rate

Mean heart rate was similar at baseline but became significantly lower in Group U from the post-induction period onwards and remained so at nearly every subsequent time point (Table 1).

Table 1. Heart rate (beats min⁻¹)

Time point	Landmark (n=30)	Ultrasound (n=30)	p-value
Baseline	100.37 ± 13.43	100.07 ± 11.81	0.927
After induction	107.67 ± 12.60	77.80 ± 8.66	<0.001
5 min	91.37 ± 14.21	76.87 ± 10.01	<0.001
15 min	85.23 ± 14.04	74.30 ± 8.07	0.001
30 min	83.50 ± 15.27	73.57 ± 8.62	0.003
60 min	82.40 ± 15.76	73.83 ± 9.89	0.015
120 min	84.91 ± 14.18	73.50 ± 9.80	0.002

Systolic blood pressure

Systolic pressure tended to be higher in Group L; differences reached statistical significance at 15, 90 and 120 minutes (Table 2).

Anaesthetic protocol

All regional anaesthetic blocks were performed prior to the induction of general anaesthesia, during which standard perioperative monitoring was employed. Anaesthesia was induced with fentanyl (2 µg kg⁻¹) and thiopentone (5 mg kg⁻¹), followed by the administration of atracurium (0.5 mg kg⁻¹) to facilitate tracheal intubation [6]. Maintenance of anaesthesia was achieved using nitrous oxide–oxygen and sevoflurane. Haemodynamic parameters were systematically recorded at predefined intervals: baseline, post-induction, and at 5, 10, 15, 30, 45, 60, 90, and 120 minutes following induction[6,7]

Post-operatively, pain intensity was evaluated using a 10-point visual analogue scale at 0, 30, 60, 90, and 120 minutes following admission to the post-anaesthesia care unit. Rescue analgesia was provided for patients reporting a VAS score exceeding 4. Furthermore, patients were systematically monitored for potential block-related complications[8].

Statistical analysis

Continuous variables are summarized as mean ± standard deviation and compared using the unpaired Student's t-test, while categorical variables are reported as frequencies and analyzed via the chi-square and Fisher's exact test. Statistical significance was established at a two-tailed p-value < 0.05. All analyses were conducted using SPSS version 16.0.

Table 2. Systolic blood pressure (mm Hg)

Time point	Landmark	Ultrasound	p-value
Baseline	139.10 ± 17.03	142.93 ± 10.03	0.294
15 min	120.90 ± 17.65	112.73 ± 9.51	0.031
90 min	124.22 ± 12.97	117.77 ± 9.10	0.037
120 min	128.61 ± 14.45	118.68 ± 10.97	0.010

Diastolic blood pressure and mean arterial pressure

Diastolic pressure showed a consistent trend toward higher values in Group L, although most differences did not reach statistical significance. Mean arterial pressure was significantly higher in Group L at 15 and 120 minutes (overall mean approximately 97 mm Hg versus 92 mm Hg).

Postoperative pain scores

VAS scores were significantly lower in the ultrasound group at every assessment point from arrival in the recovery room to 120 minutes (Table 3). The overall mean VAS across the observation period was 2.49 in Group L and 1.73 in Group U.

Table 3. Postoperative visual analogue scale scores

Time (min)	Landmark (n=30)	Ultrasound (n=30)	p-value
0	2.10 ± 0.76	1.40 ± 0.67	<0.001
30	2.20 ± 0.71	1.53 ± 0.73	0.001
60	2.53 ± 0.78	1.53 ± 0.73	<0.001
90	2.73 ± 1.05	1.87 ± 0.78	0.001
120	2.87 ± 0.97	2.33 ± 0.48	0.010

Complications

Vascular puncture was documented in three patients within the landmark-guided cohort, whereas no such events were observed in the ultrasound-guided group. Furthermore, neither group exhibited local-anaesthetic systemic toxicity, Horner syndrome, phrenic-nerve palsy, or clinically apparent brachial-plexus involvement.

DISCUSSION

This secondary analysis indicates that the technical advantages of ultrasound-guided SCPB, as observed in the primary study, translate into clinically significant improvements in intra-operative haemodynamic stability and early postoperative analgesia, in addition to a more favorable safety profile[9,10]

The sustained reduction in heart rate and the observed trend toward lower blood pressure within the ultrasound-guided cohort likely reflect a higher success rate in achieving complete sensory blockade. Effective deafferentation of the surgical field appears to attenuate the sympathetic response to surgical stimuli, a phenomenon consistent with established outcomes for cervical plexus blockade. Although disparities in diastolic pressure were marginal, the overarching haemodynamic profile indicates the superiority of the ultrasound-guided modality[11,12]. Postoperative VAS scores were significantly reduced at every measured interval during the first two hours following surgery. These data are consistent with meta-analyses demonstrating that effective bilateral SCPB mitigates early postoperative pain intensity and opioid requirements after thyroidectomy. In the clinical context of multimodal analgesia, this absolute difference is meaningful and may decrease the necessity for rescue analgesic interventions[13].

The absence of vascular puncture within the ultrasound-guided cohort, contrasted with a 10%

incidence in the landmark group, highlights the safety benefits inherent in real-time visualization. Although this difference did not reach conventional statistical significance, it demonstrates the clinical utility of ultrasound in minimizing the risk of inadvertent vascular trauma. Furthermore, no major neurological complications were observed in either cohort, a finding consistent with the established safety profile of superficial cervical plexus blockade[14,15]

The current analysis is subject to limitations inherent in its post hoc design, including a restricted postoperative observation period and the lack of systematic quantification of total analgesic consumption beyond the immediate recovery phase. Future large-scale, multicenter investigations with extended follow-up intervals are warranted to corroborate and extend these observations[16,17]. Collectively, these findings encompassed improved technical efficacy, enhanced haemodynamic stability, reduced early postoperative pain scores, and a lower incidence of vascular complications underscore the advantages of employing ultrasound guidance as the preferred modality for bilateral superficial cervical plexus block in patients undergoing thyroid surgery[18].

Strengths of the Study

The present study has several strengths. It employed a prospective randomized double-blind study design,

thereby minimizing selection and observer bias. Standardized anaesthetic and surgical protocols were followed for all participants. The study simultaneously evaluated intraoperative haemodynamic stability, postoperative analgesia, and block-related complications, providing a comprehensive comparison between ultrasound-guided and landmark-based superficial cervical plexus block. The findings are clinically relevant and support evidence-based regional anaesthesia practice in thyroid surgery.

Limitations of the Study

This study has certain limitations. It was conducted at a single centre with a relatively small sample size, which may limit the generalizability of the findings. Postoperative follow-up was restricted to the early recovery period, and long-term analgesic outcomes, patient satisfaction, and quality-of-recovery scores were not assessed. In addition, postoperative opioid consumption beyond the immediate recovery period was not systematically evaluated.

Future Directions

Future multicentre randomized controlled trials involving larger patient populations are required to validate these findings. Further studies should evaluate long-term postoperative outcomes, opioid consumption, patient satisfaction, quality-of-recovery measures, and cost-effectiveness of ultrasound-guided superficial cervical plexus block. Comparative studies using different local anaesthetic agents and adjuvants may further optimize perioperative analgesia in thyroid surgery.

Practical Implications

Ultrasound-guided superficial cervical plexus block provides superior intraoperative haemodynamic stability, improved postoperative analgesia, and a lower incidence of vascular puncture compared with the landmark-based technique. Whenever ultrasound equipment and trained personnel are available, ultrasound-guided superficial cervical plexus block should be considered the preferred technique for patients undergoing thyroidectomy.

CONCLUSION

The utilization of ultrasound-guided bilateral superficial cervical plexus block confers significant advantages over the landmark-based technique, specifically regarding intra-operative haemodynamic stability, early postoperative analgesic efficacy, and a decreased frequency of vascular puncture in patients undergoing elective thyroidectomy. Consequently, these clinical outcomes advocate prioritization of ultrasound guidance as the standard of care for this regional anaesthetic intervention.

Informed Consent

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

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Conflict of Interest

The authors declare that they have no conflict of interest.

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All authors read and approved the final manuscript.

Data Availability Statement

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

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Abbreviations

SCP – Superficial Cervical Plexus Block

USG – Ultrasound Guidance

VAS – Visual Analogue Scale

MAP – Mean Arterial Pressure

SBP – Systolic Blood Pressure

DBP – Diastolic Blood Pressure

HR – Heart Rate

PACU – Post-Anaesthesia Care Unit

IEC – Institutional Ethics Committee

SPSS – Statistical Package for the Social Sciences

RCT – Randomized Controlled Trial

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