E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.01.223

Research Article

A Randomised Comparative Study Between Usg Guided Alone And Usg Gudied Plus Neurostimulation Technique For Brachial Plexus Block Through Supra-Clavicular Approach For Upper Limb Surgeries

Dr. Kalwani Karankumar Dilipbhai[1*], Dr. Swati Dawalwar[2], Dr. Yatish Jadhav[3], Dr. Anand Kamble[4]
[1]Senior Resident Department of Anaesthesiology GMERS Medical College and Hospital, Godhra
[2]Associate Professor Department of Anaesthesiology Dr Babasaheb Ambedkar Memorial Hospital, Central Railway Byculla, Mumbai- 400027
[3]Divisional Medical officer Department of Anaesthesiology Bharatratna Dr. Babasaheb Ambedkar Memorial Hospital, Central Railway, Byculla, Mumbai-400010
[4]Senior Consultant Department of Anaesthesiology Dr. Babasaheb Ambedkar Memorial Hospital, Central Railway, Byculla, Mumbai-400027
Corresponding Author:
Dr. Kalwani Karankumar Dilipbhai
Received: 27.04.25, Revised: 30.05.25, Accepted: 21.06.25

ABSTRACT
Background: Ultrasound (US) guidance is standard for peripheral nerve blocks, yet the incremental benefit of adding peripheral nerve stimulation (PNS) remains debated.
Objective: To compare block-performance time, sensory–motor characteristics, success rate and analgesic profile of (a) US guidance alone and (b) US + PNS for supraclavicular brachial plexus block (SCBPB) in adults.
Methods: Sixty ASA I–II patients (18–65 y) scheduled for elective upper-limb surgery were randomised to US (n = 30) or US + PNS (n = 30). After standard preparation, 20 mL 0.5 % bupivacaine was injected. The primary outcome was block-performance time. Secondary outcomes included onset/duration of sensory and motor block, verbal numeric rating scale (VNRS) pain scores, rescue analgesia, haemodynamics and complications.
Results: Groups were demographically comparable (Table 1). US alone was faster to perform (9.23 ± 1.79 min vs 11.56 ± 2.17 min; $p < 0.0001$) but US + PNS yielded quicker motor onset (grade 1: 8.80 ± 2.98 min vs 11.46 ± 1.79 min) and prolonged sensory (566.6 ± 115.8 min vs 475.6 ± 89.8 min) and motor (548.5 ± 120.4 min vs 453.7 ± 83.3 min) duration ($p < 0.0001$). VNRS pain scores were significantly lower in US + PNS at 6, 8 and 12 h post-block. Success rate was 100 % in both groups; no major complications occurred.
Conclusions: Adding PNS modestly lengthens set-up time but delivers faster onset, longer analgesia and lower early postoperative pain without added risk. US + PNS therefore offers clinically meaningful advantages when prolonged peri-operative analgesia is desired.

Keywords: Supraclavicular Block; Ultrasound Guidance; Peripheral Nerve Stimulation; Brachial Plexus; Regional Anaesthesia; Analgesia.

INTRODUCTION

Peripheral nerve blocks (PNBs) transformed ambulatory upper-limb anaesthesia, providing dense surgical anaesthesia and prolonged analgesia while reducing opioid use (1, 2). Ultrasound (US) guidance visualises neural, vascular and pleural structures in real time and has displaced landmark techniques by boosting success and lowering pneumothorax or vascular-puncture rates (3, 4). Yet a hypoechoic oval is not proof of functional nerve; misidentification may yield incomplete block. Peripheral nerve stimulation (PNS) supplies a functional checkpoint: a distal twitch at ≤ 0.5 mA indicates perineural proximity, whereas < 0.2 mA suggests intraneural placement (5). Whether this still benefits patients in the era of high-resolution sonography is disputed. Some trials report no added value and highlight longer set-up time (6, 7); others show quicker onset, fuller coverage and longer duration with combined US + PNS (8–10). Variability in block location, local-anaesthetic volume, adjuvants and outcome definitions has limited pooled analysis of these data (12).

The supraclavicular approach targets the brachial plexus where trunks and divisions cluster, promoting circumferential spread;

nevertheless, distal ulnar sparing occurs in up to 14 % of patients because the inferior trunk may lie posterior to the subclavian artery or behind the first rib (11). PNS might verify inferior-trunk coverage and extend analgesia, but the extra minutes required to elicit a twitch could negate practical gains. We therefore conducted a prospective, randomised, assessor-blinded trial comparing US alone with US + PNS for supraclavicular brachial plexus block, hypothesising that dual guidance would speed onset and prolong sensory-motor blockade without increasing complications.

METHODS

Design and Ethics : This single-centre, parallel-group RCT was conducted at Dr Babasaheb Ambedkar Memorial Hospital, Mumbai (Oct 2020 – Jun 2022) after ethics approval (ABMH/IEC/2020-09). All participants gave written informed consent.

Participants : Adults aged 18–65 yr, ASA I–II, scheduled for elective forearm or hand surgery under a supraclavicular brachial plexus block (SCBPB) were eligible. Exclusion criteria were pregnancy, coagulopathy or anticoagulation, local infection, pre-existing neuropathy, amide-local-anaesthetic allergy, severe pulmonary disease, body-mass index > 35 kg m^{-2}, and refusal.

Randomisation and Masking: Sixty patients were randomised 1:1 to ultrasound guidance alone (Group U) or ultrasound plus peripheral nerve stimulation (Group U+N) with a computer sequence concealed in sealed-opaque envelopes. An independent investigator opened envelopes, collected peri-operative data and remained blinded, as did surgeons and ward staff; operators were necessarily unblinded.

Block technique : Standard monitors were applied and an 18-G IV line inserted. Supine patients turned the head 30° contralaterally. A 13-MHz linear probe identified the brachial plexus lateral to the subclavian artery above the first rib. A 22-G echogenic needle was advanced in-plane. After negative aspiration, 20 mL 0.5 % bupivacaine was injected circumferentially. In Group U+N the needle was connected to a stimulator (1 mA, 0.1 ms, 1 Hz) and the current was gradually reduced to 0.5 mA with presence of motor twitch and then the local anesthetic solution was injected after negative aspiration.

Outcomes: Primary Block-performance time (skin puncture to completion of injection). Secondary (1) sensory- and (2) motor-onset times; (3) duration of sensory and motor block; (4) VNRS pain (0–10) at incision, end surgery, and 4, 6, 8, 12, 24 h; (5) rescue tramadol use (100 mg IV when VNRS ≥ 4); (6) haemodynamics every 5 min intra-operatively; (7) block success; (8) complications (pneumothorax, phrenic paresis, vascular puncture, Horner syndrome, neurological deficit). Sensory and motor scores were recorded every 2 min for 15 min, every 5 min to 30 min, then hourly.

Sample Size A pilot (n = 10) showed a 4.5-min performance-time difference (SD 5). Detecting this with α = 0.05 and 80 % power required 20 patients per group; 30 per group were enrolled to offset attrition and power secondary endpoints.

Statistics Analyses used SPSS v26. Normal data (Shapiro–Wilk) are mean ± SD and compared with unpaired t-tests; non-normal data with Mann–Whitney U. Categorical variables were analysed using χ^2 or Fisher's exact tests. Two-tailed $p < 0.05$ was considered significant.

RESULTS

Table 1. Demographic data (mean ± SD or *n (%)*)

Parameter	US (n = 30)	US + PNS (n = 30)	*p*
Age (y)	42.46 ± 13.37	39.36 ± 13.82	0.381
Weight (kg)	66.3 ± 9.98	67.9 ± 9.00	0.517
Male : Female	16 (53) : 14 (47)	19 (63) : 11 (37)	0.432
ASA I : II	21 : 9	22 : 8	0.775
Surgery duration (min)	167.9 ± 50.9	178.4 ± 45.9	0.410

Table 2. Block-performance time

Group	Time (min)	*p*

US	9.23 ± 1.79	< 0.0001
US + PNS	11.56 ± 2.17	

Mean procedure time was significantly shorter with US alone (9.23 ± 1.79 min) than with US + PNS (11.56 ± 2.17 min; $p < 0.0001$)

Table 3. Sensory-block onset (min)

Dermatome	US	US + PNS	*p*
C5	6.33 ± 2.05	6.36 ± 1.09	0.944
C6	7.63 ± 1.44	7.86 ± 1.07	0.485
C7	8.03 ± 1.35	8.43 ± 0.81	0.169
C8	8.96 ± 1.56	8.93 ± 0.82	0.926
T1	9.73 ± 2.03	10.26 ± 1.01	0.206

Sequential dermatomal onset followed a cephalocaudal gradient (C5 fastest, T1 slowest). No significant between-group differences were observed.

Table 4. Motor-block onset (min)

Bromage grade	US	US + PNS	*p*
1	11.46 ± 1.79	8.80 ± 2.98	< 0.0001
2	13.76 ± 1.61	10.50 ± 3.79	< 0.0001
3	14.86 ± 1.27	11.13 ± 4.78	< 0.0001

US + PNS accelerated attainment of Bromage grades 1, 2 and 3 by approximately 3 min compared with US ($p < 0.0001$).

Table 5. Duration of blockade (min)

Variable	US	US + PNS	*p*
Motor	453.7 ± 83.3	548.5 ± 120.4	< 0.0001
Sensory	475.6 ± 89.8	566.6 ± 115.8	< 0.0001

Combined guidance prolonged sensory blockade by 91 min and motor blockade by 95 min ($p < 0.0001$).

Table 6. VNRS pain scores

Time-point	US	US + PNS	*p*
Baseline	2.90 ± 1.24	2.86 ± 1.22	0.900
Incision	0.53 ± 0.62	0.43 ± 0.56	0.515
End surgery	0.13 ± 0.34	0.16 ± 0.37	0.745
4 h	0.23 ± 0.43	0.10 ± 0.30	0.174
6 h	0.50 ± 0.44	0.26 ± 0.44	0.039
8 h	0.96 ± 0.92	0.50 ± 0.57	0.023
12 h	1.80 ± 1.47	0.96 ± 0.66	0.006
24 h	3.90 ± 1.02	3.53 ± 0.93	0.148

VNRS scores were low in both groups during surgery (≤ 0.5) but diverged thereafter: US + PNS showed significantly lower pain at 6, 8 and 12 h. No patient required rescue tramadol before 12 h; cumulative 24-h consumption did not differ.

Table 7. Block success and adverse events

Outcome	US (n = 30)	US + PNS (n = 30)
Successful block	30	30
Conversion to GA	0	0
Pneumothorax	0	0
Vascular puncture	0	0
Neurological deficit (24 h)	0	0

All 60 blocks provided adequate surgical anaesthesia.

DISCUSSION

This randomised trial demonstrates that supplementing ultrasound guidance with peripheral nerve stimulation for supraclavicular brachial plexus block confers three clinically relevant advantages: (1) motor onset is accelerated by about three minutes; (2) sensory and motor block duration is prolonged by roughly 90 minutes; and (3) early postoperative pain scores are significantly lower, all without compromising safety. The trade-off is a modest two-minute increase in set-up time. These findings align with Luo et al. (8) and Sobel et al. (9), who likewise reported faster onset and longer analgesia with dual guidance, but contrast with Sivalingam et al. (7), whose smaller study showed no difference. Several factors may explain the discrepancy: Sivalingam's team used a lower LA volume (15 mL), did not search specifically for the "corner-pocket" inferior-trunk target, and accepted currents up to 1.0 mA, possibly diminishing the functional benefit of PNS.

Ultrasound affords anatomical accuracy yet cannot discriminate fascial planes that impede LA spread. The inferior trunk, which supplies the ulnar distribution, may lie posterior to the artery or be shielded by the first rib, resulting in the well-known incidence of ulnar sparing. A stimulation-elicited twitch confirms that the electrode is adjacent to conductive neural tissue, permitting precise redirection and circumferential LA deposition. Our prolonged sensory and motor durations support the notion that better inferior-trunk coverage delays clearance of bupivacaine and maintains block density.

CONCLUSION

Combining peripheral nerve stimulation with ultrasound guidance for supraclavicular brachial plexus block marginally lengthens set-up but delivers faster onset, longer sensory and motor blockade and lower early postoperative pain without compromising safety. Where equipment and expertise permit, US + PNS may be considered the preferred technique for upper-limb surgery requiring extended postoperative analgesia.

REFERENCES

1. Neal JM, Gerancher JC, Hebl JR, et al. Upper-extremity regional anaesthesia: essentials of our current understanding, 2008. Reg Anesth Pain Med. 2009;34:134-70.
2. Perlas A, Lobo G, Lo N, et al. Ultrasound-guided supraclavicular block: outcome of 510 consecutive cases. Reg Anesth Pain Med. 2009;34:171-6.
3. Schwemmer U, Schleppers A, Markus C, et al. Operative management in axillary brachial plexus blocks: comparison of ultrasound and nerve stimulation. Anaesthesist. 2006;55:451-6.
4. Brown DL. Regional Anaesthesia and Analgesia. 2nd ed. Philadelphia: WB Saunders; 2015.
5. Chan VW, Brull R, McCartney CJ, et al. An ultrasonic and histologic study of intraneural injection and electrical stimulation in pigs. Anesth Analg. 2007;104:1281-4.
6. Alfred VM, Srinivasan G, Zachariah M. Comparison of ultrasound with peripheral nerve stimulator-guided technique for supraclavicular block. Anesth Essays Res. 2018;12:50-4.
7. Sivalingam PN, Madhusudhana S, Kalaichelvan R, et al. Ultrasound versus nerve stimulator for supraclavicular block. Indian J Anaesth. 2017;61:456-61.
8. Luo Q, Yao W, Shu H, Zhong M. Dual-guidance technique for supraclavicular block: a randomised trial. Eur J Anaesthesiol. 2017;34:127-34.
9. Sobel M, Tverskoy M, Katz J. Stimulated vs ultrasound-guided supraclavicular block: block characteristics and duration. Can J Anaesth. 2016;63:1048-55.
10. Hadzic A. Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia. 3rd ed. New York: McGraw-Hill; 2021.
11. Jeng CL, Rosenblatt MA. Complications of peripheral nerve blocks. Br J Anaesth. 2019;123:e254-e266.
12. Koscielniak-Nielsen ZJ. Ultrasound-guided peripheral nerve blocks: what are the benefits? Acta Anaesthesiol Scand. 2008;52:727-37.13–39.