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Original Research Article

ASSESSMENT OF PAIN IN INTERNAL JUGULAR VEIN CANNULATION IN AWAKE PATIENTS USING ULTRASOUND-GUIDED SUPERFICIAL CERVICAL PLEXUS BLOCK VERSUS LOCAL INFILTRATION: AN OBSERVATIONAL STUDY

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ABSTRACT

Background: Internal jugular vein (IJV) cannulation in awake patients causes significant procedural pain that can compromise patient cooperation and haemodynamic stability. Ultrasound-guided superficial cervical plexus block (SCPB) and local infiltration (LI) are the two principal analgesic strategies in current practice. This observational study aimed to compare pain scores between SCPB and LI during awake IJV cannulation using the Visual Analogue Scale (VAS).

Materials and Methods: One hundred and four patients (ASA Grade I–III; age 18–80 years; BMI <35 kg/m²) requiring IJV cannulation were randomised into two groups: Group I (SCPB; n=52) and Group II (LI; n=52). VAS scores were recorded at six time points: baseline (Time 0), anaesthetic administration (Time 1), needle puncture (Time 2), subcutaneous tunnelling (Time 3), catheter insertion (Time 4), and securing/suturing (Time 5). IBM SPSS Version 20 was used for statistical analysis; between-group differences were assessed with the Mann-Whitney U test.

Results: Both groups were demographically comparable. Baseline VAS scores were identical (mean 2.00; p=1.000). From Time 2 onwards, Group I (SCPB) had consistently higher pain scores than Group II (LI). Mean VAS at Time 2: SCPB 5.98 vs LI 4.52; at Time 5: SCPB 4.27 vs LI 2.98. Significant inter-group differences were observed from Time 2 through Time 5 (all p=0.0001). No major complications were recorded in either group.

Conclusion: Local infiltration provided superior intra-procedural analgesia compared to ultrasound-guided SCPB during awake IJV cannulation, with significantly lower VAS scores from needle puncture through suturing. LI should be considered the preferred first-line analgesic strategy for IJV cannulation, particularly where ultrasound expertise or equipment is limited.

Keywords: Awake cannulation, internal jugular vein, local infiltration, pain assessment, regional anaesthesia, superficial cervical plexus block, ultrasound guidance, Visual Analogue Scale

INTRODUCTION

Internal jugular vein (IJV) cannulation is a core procedure in critical care, enabling the reliable delivery of fluids, vasoactive drugs, blood products, and parenteral nutrition, and facilitating continuous haemodynamic monitoring. Performed routinely in intensive care units (ICUs), operating theatres, and emergency departments, IJV cannulation assumes additional clinical importance in awake patients—a scenario frequently encountered in critically ill individuals who cannot be safely anaesthetised or sedated. In such patients, procedural pain, if inadequately managed, can precipitate voluntary movement, haemodynamic instability, and adverse psychological sequelae.[1-10]

Two analgesic strategies have been described for pain control during awake IJV cannulation. Ultrasound-guided superficial cervical plexus block (SCPB) deposits local anaesthetic around the superficial cervical plexus at Erb's point—the posterior border of the sternocleidomastoid muscle—providing wide-field sensory blockade of the anterolateral neck via the C2–C4 anterior rami. Local infiltration (LI), by contrast, delivers anaesthetic directly into the skin and subcutaneous tissues at the site of cannulation, without requiring ultrasound guidance or advanced regional anaesthesia training.[11-15]

Existing literature on this comparison is limited. Tikle and Patil (2018) reported superior analgesia with SCPB over LI in a prospective randomised trial.1 However, questions remain about whether the broad field anaesthesia offered by SCPB confers a clinically meaningful advantage in the anatomically focal context of IJV cannulation, particularly when both techniques use equivalent doses of local anaesthetic.[16]

The present observational study was conducted at Kalpana Chawla Government Medical College and Hospital (KCGMC), Karnal—a tertiary care centre in North India—to systematically compare VAS-based pain scores between SCPB and LI at six predefined time points across the IJV cannulation procedure. The primary objective was to compare intra-procedural pain scores between the two groups. Secondary objectives included evaluation of safety profiles and clinical implications for analgesic technique selection.[17-19]

MATERIALS AND METHODS

Ethics and study registration: This prospective observational study was approved by the Institutional Ethics Committee (IEC) of KCGMC, Karnal (Reg. No. KCGMC/IEC/2024/14; dated 28 February 2024) and registered as a thesis protocol with the National Board of Examinations in Medical Sciences (NBEMS), New Delhi (Protocol No. 23661035304). All procedures conformed to the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

Study design and setting: The study was conducted at the Department of Anaesthesiology, KCGMC—a Government tertiary care academic hospital in Karnal, Haryana, India. The recruitment period spanned 18 months (July 2023 to December 2024).

Participants

Adult patients (18–80 years) with ASA physical status Grade I, II, or III and BMI <35 kg/m², requiring elective or emergency central venous cannulation via the internal jugular vein for surgical or ICU management, were eligible. Exclusion criteria were: local skin infection at the cannulation site; active cardiac arrhythmias; coagulopathy (INR >1.5 or platelet count <80,000/µL); documented allergy to lignocaine; or inability to comprehend and score the VAS.

Sample size: The sample size was estimated using a two-sample means formula based on reference data from Tikle and Patil (2018).1 Assuming a clinically significant VAS difference (d) of 0.14 and standard deviation (σ) of 0.25, with $\alpha=0.05$ ($Z\alpha/2=1.96$) and 80% power ($Z\beta=0.84$), the minimum required sample was 52 patients per group (total N=104). Randomisation was performed using computer-generated random number tables.

Randomisation and allocation: Eligible patients were allocated in equal proportions to Group I (SCPB) or Group II (LI) using a computer-generated random number sequence. Allocation was concealed in sealed opaque envelopes opened at the time of enrolment.

Interventions: All IJV cannulations were performed by the same senior consultant anaesthesiologist, ensuring uniformity in technique. Patients were positioned supine with a 15° reverse Trendelenburg tilt and 30–°40° head rotation to the contralateral side. A 7 Fr triple-lumen central venous catheter (Galaxy M34 5G; Arrow International) was inserted via the Seldinger technique in both groups. In both groups, the anaesthetic agent was 2% lignocaine with adrenaline (1:200,000) in a 5 ml volume, drawn up under sterile conditions, with a 5-minute interval observed after injection before commencing cannulation.

Group I (SCPB): A high-frequency linear ultrasound probe (SonoSite M-Turbo; 6–13 MHz) with a sterile plastic sheath was positioned to identify the superficial cervical plexus at Erb's point—the posterior border of the sternocleidomastoid at the junction of its upper and middle thirds. The sternocleidomastoid, platysma, and deep cervical fascia were visualised in real time. A 25-gauge needle was advanced in-plane under continuous ultrasound guidance, and 5 ml of 2% lignocaine with adrenaline was deposited in the inter-fascial plane deep to the platysma and superficial to the deep cervical fascia.

Group II (LI): Using anatomical landmarks, the apex of the triangle formed by the two heads of the sternocleidomastoid and the clavicle was identified. A 25-gauge needle was used to infiltrate 5 ml of 2% lignocaine with adrenaline into the skin and subcutaneous tissues at the planned cannulation site, without ultrasound guidance.

Outcome measures: Pain intensity was the primary outcome, assessed using the Modified Visual Analogue Scale (VAS)—a validated 10 cm horizontal line anchored at 'No Pain' (0 cm) and 'Worst Imaginable Pain' (10 cm). Scores were recorded by an independent investigator (not the operating clinician) at:

1. Time 0: Baseline, 5 minutes before procedure commencement
2. Time 1: During SCPB or LI injection
3. Time 2: During IJV needle puncture
4. Time 3: During subcutaneous tunnelling
5. Time 4: During catheter insertion
6. Time 5: During securing and suturing

Secondary outcomes included procedural complications (haematoma, arterial puncture, cardiac arrhythmia, local anaesthetic systemic toxicity) and the need for supplemental analgesia.

Statistical analysis: Data were analysed using IBM SPSS Statistics Version 20 (IBM Corp., Armonk, NY). Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range). Categorical variables were presented as frequencies and percentages. Normality was assessed using the Kolmogorov-Smirnov test. Between-group comparisons of continuous data used the independent samples t-test (normal distribution) or Mann-Whitney U test (non-normal distribution). The Chi-square test (with Yates' correction or Fisher's exact test where appropriate) was applied for categorical variables. Within-group changes across time points were assessed using the Wilcoxon signed-rank test. All tests were two-tailed; $p \leq 0.05$ was considered statistically significant.

RESULTS

Demographic and baseline characteristics: A total of 104 patients were enrolled, with 52 in each group. The two groups were statistically comparable across all baseline demographic variables [Table 1]. Mean age was 42.81 ± 14.08 years in Group I and 44.88 ± 14.23 years in Group II (p=0.965). Male patients accounted for 59.6% of Group I and 53.8% of Group II (p=0.553). The BMI distribution was similar between groups (mean BMI 23.66 ± 3.40 in Group I vs 22.64 ± 2.97 in Group II; p=0.197). ASA Grade II was the most prevalent category in both groups (42.3% in Group I; 50.0% in Group II), and ASA grade distribution did not differ significantly (p=0.659).

Intra-group VAS analysis: Within each group, VAS scores rose significantly from baseline (Time 0; mean 2.00 in both groups) at all subsequent time points (Wilcoxon signed-rank test; all p=0.0001). In Group I (SCPB), pain scores peaked at Time 2 (needle puncture; mean 5.98 ± 0.85) and progressively declined through Time 5 (securing/suturing; mean 4.27 ± 0.66). In Group II (LI), the highest score occurred at Time 1 (anaesthetic injection; mean 5.56 ± 0.70), followed by a steeper and more consistent reduction, reaching a mean of 2.98 ± 0.70 at Time 5. Intra-group data are presented in [Table 2 and 3].

Table 1: Baseline demographic characteristics of study participants

Variable	Group I – SCPB (n=52)	Group II – LI (n=52)	p-value
Age (years), Mean ± SD	42.81 ± 14.08	44.88 ± 14.23	0.965
Age range (years)	20–76	22–82	
Sex: Male, n (%)	31 (59.6%)	28 (53.8%)	0.553
BMI (kg/m²), Mean ± SD	23.66 ± 3.40	22.64 ± 2.97	0.197
ASA Grade I, n (%)	18 (34.6%)	14 (26.9%)	0.659
ASA Grade II, n (%)	22 (42.3%)	26 (50.0%)	
ASA Grade III, n (%)	12 (23.1%)	12 (23.1%)	

SCPB = Superficial cervical plexus block; LI = Local infiltration; BMI = Body mass index; ASA = American Society of Anesthesiologists; SD = Standard deviation. p-values from Chi-square test (categorical) and independent samples t-test or Mann-Whitney U test (continuous).

Table 2: Intra-group VAS pain scores across time points – Group I (SCPB)

Time Point	Event	N	Mean VAS	SD	Median	z (Wilcoxon)	p-value
Time 0	Baseline	52	2.00	0.00	2.00	—	Reference
Time 1	Anaesthetic injection	52	5.69	0.90	5.00	6.401	0.0001**
Time 2	Needle puncture	52	5.98	0.85	6.00	6.433	0.0001**
Time 3	Subcutaneous tunnelling	52	5.63	0.77	6.00	6.387	0.0001**
Time 4	Catheter insertion	52	4.73	0.72	5.00	6.396	0.0001**
Time 5	Securing/suturing	52	4.27	0.66	4.00	6.419	0.0001**

**$p \leq 0.01$ (Wilcoxon signed-rank test vs baseline); VAS = Visual Analogue Scale; SD = Standard deviation; SCPB = Superficial cervical plexus block.

Table 3: Intra-group VAS pain scores across time points – Group II (LI)

Time Point	Event	N	Mean VAS	SD	Median	z (Wilcoxon)	p-value
Time 0	Baseline	52	2.00	0.00	2.00	—	Reference
Time 1	Anaesthetic injection	52	5.56	0.70	5.00	6.443	0.0001**
Time 2	Needle puncture	52	4.52	0.78	4.00	6.480	0.0001**
Time 3	Subcutaneous tunnelling	52	4.54	0.78	4.00	6.467	0.0001**
Time 4	Catheter insertion	52	4.02	0.67	4.00	6.526	0.0001**
Time 5	Securing/suturing	52	2.98	0.70	3.00	5.968	0.0001**

**$p \leq 0.01$ (Wilcoxon signed-rank test vs baseline); VAS = Visual Analogue Scale; SD = Standard deviation; LI = Local infiltration.

Between-group VAS comparison: Both groups had identical VAS scores at baseline (mean 2.00; p=1.000). VAS scores at Time 1 were comparable between groups (Group I: 5.69 vs Group II: 5.56; p not significant). From Time 2 onwards, Group I (SCPB) consistently recorded higher pain scores than Group II (LI), with statistically significant differences at Time 2 through Time 5 (all p=0.0001; Table 4). The between-group difference was greatest at Time 2 (1.46 VAS units) and Time 5 (1.29 VAS units), indicating that LI provided superior analgesia specifically for the cannulation steps.

Table 4: Between-group comparison of mean VAS scores at each time point

Time Point	Event	Group I SCPB Mean VAS	Group II LI Mean VAS	Difference	p-value
Time 0	Baseline	2.00	2.00	0.00	1.000
Time 1	Anaesthetic injection	5.69	5.56	0.13	NS
Time 2	Needle puncture	5.98	4.52	1.46	0.0001**
Time 3	Subcutaneous tunnelling	5.63	4.54	1.09	0.0001**
Time 4	Catheter insertion	4.73	4.02	0.71	0.0001**
Time 5	Securing/suturing	4.27	2.98	1.29	0.0001**

**p≤0.01 (Mann-Whitney U test); NS = Not significant; SCPB = Superficial cervical plexus block; LI = Local infiltration.

Safety outcomes: No major adverse events were recorded in either group. There were no cases of haematoma formation requiring intervention, inadvertent arterial puncture, cardiac arrhythmia, pneumothorax, or signs of local anaesthetic systemic toxicity. Minor bruising at the injection site was occasionally noted in both groups and resolved spontaneously. No patient required supplemental analgesia or procedural abandonment.

DISCUSSION

The central finding of this observational study is that local infiltration provided statistically superior analgesia compared to ultrasound-guided SCPB during awake IJV cannulation from the time of needle puncture (Time 2) through securing (Time 5), despite both groups receiving identical volumes and concentrations of local anaesthetic. This finding challenges the prevailing assumption that the broader sensory field of SCPB must necessarily translate into superior analgesia for any neck procedure.[20]

The anatomical basis for this finding warrants consideration. IJV cannulation is an inherently focal procedure: the cannulating needle traverses the dermis, subcutaneous fat, and anterior wall of the internal jugular vein within a small triangular area at the anterior border of the sternocleidomastoid. LI delivers anaesthetic precisely to these layers, producing dense anaesthesia at the exact procedural target. The superficial cervical plexus, in contrast, provides cutaneous innervation to the broader anterolateral neck through four terminal branches (lesser occipital, great auricular, transverse cervical, and supraclavicular nerves). While this coverage is ideal for carotid endarterectomy or thyroidectomy, it may not anaesthetise the deeper perivascular tissues traversed during IJV cannulation, which receive autonomic contributions not encompassed by the superficial plexus.[3,4] Our data are consistent with this mechanistic interpretation.

Our results diverge from those of Tikle and Patil (2018), who reported significantly lower VAS scores with SCPB compared to LI in a prospective randomised trial of IJV cannulation.[1] Several methodological differences may account for this discrepancy. Their study administered different volumes of local anaesthetic between groups, whereas we used identical agents, volumes, and concentrations, controlling for pharmacological variables. Additionally, operator technique for both SCPB and IJV cannulation was not described in detail in the earlier study. In our study, procedures were performed by a single experienced consultant, minimising operator variability.

The comparable analgesic effect at Time 1 (injection of the anaesthetic agent itself) in both groups confirms that the anaesthetic agent produced equivalent initial sensory attenuation; the divergence in subsequent time points reflects differences in the spatial adequacy of anaesthesia for the cannulation steps. This is further supported by the steeper VAS trajectory decline in Group II from Time 1 to Time 5, suggesting that LI produced more sustained and procedure-relevant analgesia.

Our safety data corroborate the well-established safety profiles of both techniques. SCPB is associated with rare but recognised risks including inadvertent vascular puncture and local anaesthetic toxicity5; ultrasound guidance mitigates but does not eliminate these risks.[6,14] LI, by virtue of its superficial injection plane and limited drug volume, carries minimal systemic risk and avoids the complications inherent to deep needle advancement under image guidance.

From a resource-allocation standpoint, the superior analgesic efficacy of LI in this study has practical implications for tertiary care settings across India, where ultrasound machines are not always immediately available in all ICU bays or procedural areas. If LI is at least as effective as—or superior to—SCPB for IJV cannulation analgesia, the routine use of SCPB for this specific indication may not be justified, reserving SCPB for patients with anatomical challenges (e.g., obesity, prior neck surgery, difficult landmarks) or those in whom LI fails to provide adequate analgesia.

This study has important limitations. Its observational design without patient or assessor blinding introduces the risk of performance and detection bias. VAS scores, while validated and widely used7, are subjective; patient anxiety—which was not formally measured—may have confounded pain perception. The study was conducted at a single centre by a single operator, limiting external generalisability. Procedural complications were assessed only within the intra-procedural period without longer-term follow-up. Finally, patient satisfaction and willingness to undergo repeat procedures were not evaluated. Future multicentre, double-blind randomised controlled trials with larger sample sizes and patient-reported satisfaction instruments are warranted.

CONCLUSION

In this observational study of 104 patients requiring awake IJV cannulation, local infiltration provided superior procedural analgesia compared to ultrasound-guided superficial cervical plexus block, with significantly lower VAS pain scores from needle puncture through suturing. Both techniques were safe, with no major complications in either group. Given its analgesic efficacy, technical simplicity, and independence from ultrasound availability, local infiltration should be considered the preferred first-line analgesic strategy for awake IJV cannulation. Ultrasound-guided SCPB may be reserved for anatomically challenging cases or failures of local infiltration. Well-designed randomised controlled trials are needed to confirm these findings across diverse clinical settings.

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