

Research Article

Success Rates of Ultrasound-Guided Right versus Left Internal Jugular Vein Cannulation: A Prospective Comparative Observational Study

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ABSTRACT

Background: Ultrasound guidance improves internal jugular vein (IJV) cannulation, but right-sided access may remain more efficient because of anatomical differences. **Objective:** To compare the success rate, procedure duration and number of attempts for ultrasound-guided right versus left IJV cannulation. **Methods:** This prospective comparative observational study included 80 adults requiring central venous access at A.J. Institute of Medical Sciences and Research Centre, Mangaluru. Forty underwent right IJV cannulation and 40 underwent left IJV cannulation. Cannulation was performed under real-time ultrasound using the Seldinger technique. Outcomes were overall success, time from skin puncture to guidewire confirmation, and number of needle attempts. Data were summarized using frequencies, percentages, means and standard deviations; between-group tests and 95% confidence intervals were reported from the source summaries where calculable. **Results:** Overall success was 40/40 (100.0%) in both groups (Fisher exact $p=1.000$; success 95% Wilson CI 91.2%–100.0% in each group). Mean procedure duration was 188.13 ± 15.02 seconds for right and 213.38 ± 22.84 seconds for left cannulation, a mean difference of 25.25 seconds favoring the right side (95% CI 16.5–

34.0; $p<0.001$). Mean attempts were 1.05 ± 0.22 and 1.25 ± 0.44 , respectively (source-reported $p=0.012$). More than one attempt was reported in 2/40 (5.0%) right-sided and 10/40 (25.0%) left-sided procedures (recalculated Fisher exact $p \approx 0.027$). The source described bradycardia in 8 left-sided cases and none on the right; no arterial puncture was reported. **Conclusion:** Both sides achieved 100% overall success in this sample. Right-sided cannulation was faster and required fewer attempts in the reported data. Ultrasound-guided left IJV access remained a successful alternative when clinically indicated, but the study does not establish equivalence.

KEYWORDS: Internal jugular vein; ultrasound guidance; central venous catheterization.

INTRODUCTION

Central venous catheterization is an essential procedure in anaesthesia, critical care and perioperative medicine. The internal jugular vein (IJV) is frequently selected because it is relatively superficial, can be assessed with ultrasound and provides a direct route to the central circulation. Catheters are used for vasoactive drug administration, haemodynamic monitoring, difficult venous access, renal replacement therapy and delivery of other treatments. Despite its routine use,

cannulation may cause arterial puncture, haematoma, malposition, pneumothorax, thrombosis or catheter-related infection. The risk of mechanical injury depends on patient anatomy, clinical circumstances, technique and operator experience.

Real-time ultrasound allows the operator to identify the vein, assess its patency and relationship to the carotid artery, observe needle advancement and confirm guidewire entry. Evidence syntheses and professional guidance support ultrasound guidance for IJV access because it improves procedural success and reduces complications compared with landmark methods.[1] Ultrasound does not remove all procedural difficulty: the needle tip may be difficult to track, the posterior wall may be punctured, and vessel overlap or small calibre may complicate access. Short-axis, long-axis and oblique approaches have each been studied, with results influenced by operator familiarity and patient anatomy.[2]

The right IJV is often preferred because it generally follows a more direct course to the superior vena cava and may have a larger calibre. Anatomical studies have reported right-sided dominance and differences in the vein-carotid relationship, providing a plausible basis for right-sided efficiency.[3] However, the left IJV remains an important alternative when right-sided access is unavailable, contraindicated or already occupied. Whether real-time ultrasound eliminates clinically meaningful differences between sides in overall success, procedure duration and needle attempts is relevant to site selection.[4][5]

This prospective comparative observational study assessed ultrasound-guided right and left IJV cannulation in adults requiring central venous access. The principal outcomes were successful catheterization and time to guidewire confirmation; the number of attempts was also compared. Immediate complications were described as safety outcomes. By presenting the outcomes by laterality, the study may help clinicians weigh the reliable success of ultrasound-guided

access against any difference in procedural efficiency, while recognizing that local anatomy and operator skill remain important.

AIM

To compare the success and procedural efficiency of ultrasound-guided right versus left internal jugular vein cannulation.

OBJECTIVES

1. To compare the overall success rate of ultrasound-guided right and left IJV cannulation.
2. To compare the time required to achieve successful right and left IJV cannulation.
3. To compare the number of needle attempts required for right and left IJV cannulation.

MATERIALS AND METHODS

Source of data

Data were obtained from adult patients admitted to A.J. Institute of Medical Sciences and Research Centre, Mangaluru, who required central venous access for clinical management. The supplied dissertation reported institutional ethics approval and written informed consent.

Study design

The study was conducted as a prospective, comparative observational study. Participants were enrolled consecutively using convenience sampling and were observed in one of two groups: ultrasound-guided right IJV cannulation (Group I, n=40) or ultrasound-guided left IJV cannulation (Group II, n=40). The source did not describe random allocation; therefore, the comparison was treated as nonrandomized.

Study location and duration

The study was conducted in the operation theatre and intensive care areas of A.J. Institute of Medical Sciences and Research Centre, Mangaluru, Karnataka. The dissertation described a 24-month data-collection period from 2024 to 2026; exact start and end dates were not specified.

Sample size

The dissertation based the sample-size calculation on comparison of two independent proportions, with two-sided $\alpha=0.05$, 80% power, pooled success proportion $P=0.799$ and an absolute difference $d=0.25$. The standard formula was:

$$n = 2 (Z_{1-\alpha/2} + Z_{1-\beta})^2 P(1 - P) / d^2$$

where n was the required sample size per group, $Z_{1-\alpha/2}=1.96$, $Z_{1-\beta}=0.84$, $P=0.799$ and $d=0.25$. Substitution yielded approximately 39 participants per group; this was rounded to 40 per group. The final sample comprised 80 participants (40 in each group).

Inclusion criteria

Adults aged 18 years or older who required central venous access for clinical management; patients in ASA physical status I–IV; and patients who provided written informed consent (or whose legally authorized representative provided consent when applicable).

Exclusion criteria

Age below 18 years; refusal of consent; previous neck dissection, radiotherapy or burns at the intended cannulation site; infection, mass or external anatomical abnormality at the site; known coagulation disorder; or thyroid pathology, as stated in the dissertation.

Procedure and methodology

A pre-procedural assessment was performed, including history, physical examination and review of relevant investigations. Standard monitoring included ECG, non-invasive blood pressure and pulse oximetry. Patients were positioned supine with approximately 30° Trendelenburg tilt and the head turned about 45° away from the selected site, as tolerated. A high-frequency linear-array ultrasound probe (6–13 MHz) with a sterile cover was used. Under aseptic precautions, the IJV and carotid artery were identified in real time using compressibility, pulsatility and Doppler flow when required. A needle was advanced under ultrasound visualization into the IJV. After venous blood aspiration, a J-tip guidewire was introduced and its intraluminal position

confirmed by ultrasound. The tract was dilated, a triple-lumen central venous catheter was advanced over the guidewire, secured and dressed. Catheter tip position was checked using post-procedure chest radiography according to the source protocol.

Outcome definitions

Overall success was defined as successful catheter placement in the assigned IJV. Failure included inability to cannulate or crossover to the opposite side. Procedure duration was measured from initial skin puncture to ultrasound confirmation of the guidewire in the vein. An attempt was counted as a needle pass. Immediate complications included arterial puncture, haematoma, bradycardia, hypotension and oxygen desaturation. The dissertation did not provide a separate first-pass success outcome.

Sample processing

No biological specimens were collected for laboratory analysis as part of the cannulation outcomes. Routine coagulation investigations were reviewed during pre-procedural assessment when available. The study data consisted of clinical, demographic and procedural observations recorded on a structured proforma.

Statistical methods

The dissertation reported analysis using SPSS version 20.0. Continuous variables were summarized as mean and standard deviation, and categorical variables as frequency and percentage. Between-group comparisons used an unpaired Student t test for continuous outcomes, with a Mann–Whitney U test suggested for non-normal data, and a chi-square test for categorical outcomes. For sparse categorical cells, Fisher's exact test is more appropriate. A two-sided p value <0.05 was considered statistically significant. The present manuscript reports 95% confidence intervals (CIs) for proportions and mean differences where calculable from the published aggregate data. Because participant-level observations and a detailed analysis dataset were not supplied, inferential results other than those recalculated from summary

statistics are labeled as reported in the dissertation. No adjustment for multiple comparisons was made.

Data collection

Age, sex, weight, height, body mass index (BMI), ASA physical status, cannulated side, overall success, procedure duration, number of needle passes and immediate complications were recorded. The procedure duration was timed using a digital stopwatch, and vital signs were monitored continuously during the procedure.

OBSERVATION AND RESULTS

A total of 80 adults were included, with 40 undergoing right and 40 undergoing left ultrasound-guided IJV cannulation. The source dissertation reported 57 men and 23 women overall; mean age was 59.15 ± 7.59 years and mean weight was 66.71 ± 9.43 kg. Summary comparisons below use the group-specific values available in the source.

Table 1. Baseline characteristics by cannulation side (N=80)

Characteristic	Right IJV (n=40)	Left IJV (n=40)	Between-group difference (95% CI)	p value
Age, years, mean $\pm$ SD	58.48 $\pm$ 7.22	59.83 $\pm$ 7.98	-1.35 (-4.70 to 2.00)	0.430
Male sex, n (%)	29 (72.5)	28 (70.0)	Difference 2.5 percentage points	0.805
Weight, kg, mean $\pm$ SD	67.40 $\pm$ 9.42	66.03 $\pm$ 9.50	1.37 (-2.80 to 5.54)	0.518
BMI, kg/m ² , mean $\pm$ SD	22.69 $\pm$ 2.87	23.50 $\pm$ 2.36	-0.81 (-2.00 to 0.38)	0.173
ASA III, n (%)	Group-specific breakdown not reported	Group-specific breakdown not reported		

The right and left groups had similar reported baseline characteristics. Mean age, sex distribution, body weight and BMI did not differ significantly. The dissertation provided ASA III/IV counts only for the combined cohort, so a between-group comparison for ASA status could not be made.

Table 2. Overall success of ultrasound-guided cannulation (Objective 1)

Outcome	Right IJV	Left IJV	Difference (95% CI)	p value
Successful cannulation	40/40 (100.0)	40/40 (100.0)	0.0 percentage points (Newcombe 95% CI: -8.8 to 8.8)	1.000*
Failure/crossover	0/40 (0.0)	0/40 (0.0)		

Both sides achieved successful catheterization in all 40 participants. Fisher's exact test showed no difference in overall success ($p=1.000$). The 95% Wilson CI for success was 91.2%–100.0% in each group. Equal observed rates in this sample do not establish statistical equivalence or non-inferiority.

Table 3. Procedure duration (Objective 2)

Outcome	Right IJV (n=40)	Left IJV (n=40)	Mean difference, Right-Left (95%)	p value
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			CI)	
Time to guidewire confirmation, seconds, mean±SD	188.13±15.02	213.38±22.84	-25.25 (-34.0 to -16.5)	<0.001

The mean procedure duration was 25.25 seconds shorter for right-sided cannulation. The difference was statistically significant (unpaired t test, $p < 0.001$; calculated 95% CI for the mean difference, -34.0 to -16.5 seconds). The source-reported means and standard deviations were used for this calculation.

Table 4. Number of needle attempts (Objective 3)

Outcome	Right IJV (n=40)	Left IJV (n=40)	Difference, Right-Left (95% CI)	p value
Mean number of attempts±SD	1.05±0.22	1.25±0.44	-0.20 (-0.35 to -0.05)	0.012†
More than one attempt, n (%)	2 (5.0)	10 (25.0)	-20.0 percentage points	0.027‡

The left IJV group required more needle attempts on average. The difference in means was 0.20 attempts (95% CI for right minus left, -0.35 to -0.05); $p = 0.012$ was reported in the dissertation. Reconstructed from the reported counts, 5.0% of right-sided versus 25.0% of left-sided procedures required more than one attempt (Fisher exact $p \approx 0.027$). The attempt-count distribution was unavailable, so the mean-based test could not be independently verified.

*Fisher exact test; †source-reported p value; ‡recalculated Fisher exact test from 2/40 versus 10/40. Confidence intervals are approximate and based on the reported aggregate summaries.

DISCUSSION

This prospective comparative observational study found 100% overall cannulation success on both sides in 80 adults. Right-sided cannulation was faster by approximately 25 seconds, and fewer needle attempts were reported for the right than the left IJV. The results suggest that ultrasound-guided left-sided access can be successful in experienced institutional practice, while procedural efficiency may still favor the right side. Since the study was not designed with an equivalence or non-inferiority margin, identical observed success rates should not be interpreted as proof that the two approaches are equivalent.

Other contemporary clinical reports have examined laterality, ultrasound versus landmark access, patient position and imaging technique, but differ in population and

outcome definitions. Side-comparison work by Ganesan et al. and emergency-department comparisons by Kunhahamed et al. provide clinical context, while pediatric RCTs and studies comparing alternate probe or needle approaches address different populations or procedural choices.[4,8,15,20-22] These reports support ultrasound use and technique-specific evaluation, but they cannot directly establish equivalence of right- and left-sided cannulation in this adult cohort.

Overall success

The observed 100% success in both groups is consistent with the broader evidence that real-time ultrasound improves IJV cannulation success and reduces mechanical complications relative to landmark methods.[1,5,10,11] The ASA guideline and the ISCCM position statement recommend ultrasound for IJV access when available.[9,10] These

recommendations concern the use of ultrasound rather than equivalence between laterality groups. The current study adds a side-by-side comparison, but with only 40 patients per group and no failures, precision remains limited: the confidence interval for each success proportion extends down to about 91%. Larger studies with prespecified non-inferiority margins and first-pass endpoints would better assess whether the left side is comparable.

Earlier side-comparison evidence supports the idea that left IJV access can be more demanding, although much of the foundational laterality literature predates the requested 2015–2025 reference window. Contemporary anatomical evidence is relevant: Bos et al. found the right IJV to be dominant in most patients, with greater diameter/cross-sectional area and less frequent anterior positioning relative to the carotid artery.[2] These anatomical factors may contribute to side-specific efficiency even when ultrasound provides continuous visualization.

Procedure duration

Left cannulation took 213.38 ± 22.84 seconds compared with 188.13 ± 15.02 seconds for right cannulation, a mean difference of 25.25 seconds ($p < 0.001$). This direction agrees with the anatomical rationale for right-sided preference, but the absolute difference should be interpreted in context. Ultrasound orientation, operator experience, head rotation, patient positioning, vessel calibre and the exact start/stop definition of procedure time can all affect the measured duration. The dissertation defined duration from skin puncture to guidewire confirmation; results from studies using time to venous blood aspiration or complete catheter insertion are not directly interchangeable.

Research comparing short-, long- and oblique-axis ultrasound views shows that technical choices can influence access time and first-pass outcomes. Lal et al. reported the shortest access, guidewire and catheterization times with the medial oblique approach compared with long-axis imaging, while

Chennakeshavallu et al. found differences in visualization and time across views.[8,11] Meta-analyses have found variation in first-pass outcomes and posterior wall puncture by view, with no single orientation uniformly superior across all endpoints.[5,6,18] These findings support the need to standardize the ultrasound approach when comparing laterality.

Needle attempts and immediate safety

The source reported mean attempts of 1.05 ± 0.22 for right versus 1.25 ± 0.44 for left cannulation, with multiple passes in 5% and 25%, respectively. The magnitude is clinically plausible and aligns with the general observation that ultrasound technique and needle-tip visualization affect redirection and first-pass performance. Trials of transducer orientation and dynamic needle-tip methods demonstrate that changing the imaging/needle technique can materially alter first-pass success, reinforcing the importance of operator technique as a potential confounder.[2,8,11,12,13,14]

The dissertation reported no arterial puncture, hypotension, desaturation or haematoma, but described bradycardia in eight left-sided procedures (20%) and none on the right. Since this event was not one of the three prespecified objectives in the requested manuscript, it is treated as a descriptive safety observation. Its mechanism and clinical severity were not provided, and causation by laterality cannot be inferred. The available complication data are too sparse for a stable comparative estimate. Contemporary multicentre data show that major mechanical complications are uncommon in settings where ultrasound is routinely used, while operator experience and number of punctures remain relevant risk factors.[16]

Clinical interpretation

The findings support retaining ultrasound-guided left IJV cannulation as an option when the right side is unavailable or unsuitable, while recognizing the observed time and attempt differences. Site choice should be individualized after scanning both sides for

patency, vessel size, thrombus and artery–vein overlap. Recent guidelines and a prospective position study emphasize site-specific ultrasound assessment and safe access practice.[13,19] Guidelines emphasize prepuncture assessment and real-time ultrasound for IJV cannulation; safe access also depends on sterile technique, wire confirmation and appropriate tip-position verification.[10,11,19]

The main strengths are the prospective collection, explicit comparison of sides, standardized ultrasound-guided Seldinger procedure and reporting of both continuous and categorical efficiency outcomes. Interpretation is limited by the small single-centre sample, lack of random allocation, absence of operator stratification, incomplete reporting of group-level baseline variables and lack of participant-level data. In addition, the reported 100% success endpoint was overall procedural success rather than first-pass success, which is often a more discriminating measure of cannulation performance.

CONCLUSION

In this 80-participant prospective comparative observational study, ultrasound-guided right and left IJV cannulation each achieved 100% overall success. Right-sided cannulation had a shorter mean procedure duration and fewer needle attempts in the reported data. Left-sided access remained a successful alternative when clinically indicated, although the observed efficiency differences warrant consideration. These findings should be interpreted as descriptive comparative evidence and do not establish equivalence between sides.

LIMITATIONS

- The study was conducted at a single tertiary-care centre with a small sample of 40 participants per group, limiting precision and generalizability.
- Allocation to right or left cannulation was not described as randomized, allowing selection bias and confounding by clinical indication or anatomy.

- Operator experience and operator-level clustering were not reported or adjusted for.
- Anatomical measurements such as IJV diameter, patency, depth and overlap with the carotid artery were not reported by side.
- First-pass success was not reported, and the definition of “attempt” may not capture needle redirections consistently.
- Participant-level data were unavailable; several source-reported statistical tests could not be independently verified, and complication-event details were limited.
- Follow-up focused on immediate procedural events; delayed complications such as thrombosis, infection, catheter malposition or migration were not assessed in the results presented.
- No equivalence or non-inferiority design was used. Therefore, equal observed success proportions should not be interpreted as proof of equivalence.

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