Acta Biomedica Scientia
e - ISSN - 2348 - 2168
Print ISSN - 2348 - 215X
www.mcmed.us/journal/abs
Research Article

EVALUATING THE SAFETY AND EFFICACY OF ULTRASOUND-GUIDED RIGHT BRACHIOCEPHALIC VEIN CANNULATION: A TWO-YEAR PROSPECTIVE STUDY IN ADULT PATIENTS

Dr. Mayuresan

Assistant Professor, Department of General Surgery, Aarupadai Veedu Medical College and Hospital, Kirumampakkam, Bahour Commune Panchayat, Puducherry – 607402.

ABSTRACT

Background: Central venous catheter (CVC) placement is a critical procedure in hospital settings, particularly for medication administration, nutritional support, and hemodialysis access. While the internal jugular vein (IJV) and subclavian vein (SCV) are commonly used for CVC insertion, ultrasound (US)-guided supraclavicular brachiocephalic vein (BCV) cannulation has gained attention as an alternative approach. However, data on its safety and efficacy in adults remain limited. Objective: This retrospective study aimed to evaluate the feasibility, success rate, and complications associated with ultrasound-guided supraclavicular BCV cannulation in adult patients. Methods: A retrospective analysis was conducted on 250 adult inpatients who underwent right-sided BCV CVC placement under US guidance between September 2019 and December 2019. Data were collected on first-attempt success rates, procedural duration, catheter insertion time, and associated complications. Descriptive statistics, including mean values and standard deviations, were analyzed using Microsoft Excel. Results: The study reported a successful cannulation rate of 95.5%, with 94.90% of procedures succeeding on the first attempt. The mean procedure duration was 13.12 ± 1.25 minutes, while the mean catheter introduction time was 14.65 ± 3.50 cm. The average duration of catheter use was 9.85 ± 8.50 days (range: 22-27 days). The incidence of complications was low, with punctured arteries (2.00%), pneumonia (0.50%), infection-related catheter removal (3 cases), and accidental catheter removal due to bleeding (7 cases). Conclusion: Ultrasound-guided supraclavicular BCV cannulation is a safe, efficient, and effective alternative for central venous access in adult patients. The technique offers high success rates, reduced complications, and improved patient comfort compared to traditional CVC placements. Given its advantages, this approach should be considered more widely in clinical practice. However, further prospective studies with larger sample sizes are recommended to strengthen the evidence supporting its long-term viability.

Keywords :- Central venous catheterization, Brachiocephalic vein cannulation, Ultrasound guidance, Supraclavicular approach, Procedural success and complications.

Access this article online		
Home Page: www.mcmed.us/journal/abs		**Quick Response code**
Received:**25.10.2019**	**Revised**:12.11.2019	**Accepted**:15.12.2019

INTRODUCTION

The central venous catheter (CVC) plays a crucial role in hospital settings, serving as a primary method for administering medications that require large vessels, delivering nutrition, and providing hemodialysis access when peripheral routes are unavailable. [1] However, placing a CVC is a complex and high-risk procedure, even for experienced medical professionals. Ultrasonography (US) is widely recognized as the most reliable technique for identifying vessels and guiding venous access in both pediatric and adult patients, as it

Corresponding Author: **Dr. Mayuresan**

enhances success rates while minimizing the number of insertion attempts. In adults, the internal jugular vein (IJV) and subclavian vein (SCV) are the most frequently used sites for ultrasound-guided CVC placement.

Recently, there has been growing interest in utilizing the brachiocephalic vein (BCV) for cannulation via the supraclavicular approach, particularly in newborns and infants. While this technique has been documented in a limited number of adult cases, data on its effectiveness and safety remain scarce. This retrospective study aimed to evaluate the feasibility and safety of ultrasound-guided supraclavicular BCV cannulation in adult patients. [2].

METHODOLOGY

This retrospective study analyzed 250 cases at tertiary care hospital, Pondicherry. The study focused on adult inpatients (both medical and surgical) who required right-sided central venous catheter (CVC) placement under ultrasound (US) guidance. Patients in the acute or urgent phase of illness were included, while those who were ventilated were excluded from the study.

Medical records were reviewed to gather data on first-attempt success rates, puncture times, and total procedural duration. The procedural time was measured from the initiation of sterilization until the completion of the X-ray confirmation.

The CVC implantation into the brachiocephalic vein (BCV) was conducted under sterile conditions. The process involved covering sterile ultrasound probes with sterile sheaths and applying sterile gel between the sheath and the probe. The ultrasound probe was positioned along the internal jugular vein (IJV) and moved downward towards the superior sternoclavicular joint. [3] At the point where the IJV and subclavian vein (SCV) intersect, the probe was adjusted to obtain a clear longitudinal image of the BCV.

A needle was then inserted through the skin near the ultrasound probe while the other hand held the probe. [4] As the needle advanced, its movement was tracked using the long axis of the ultrasound probe until it was visible on the monitor. Negative pressure was applied to guide the needle tip into the BCV. A J-shaped guidewire (Arrow) was introduced into the vein upon confirmation of adequate blood return following guidewire advancement. [5] Subsequently, a 6 Fr double-lumen catheter was inserted into the vein over the guidewire.

The insertion length of the catheter was determined using anatomical landmarks, typically ranging between 9 and 15 cm. The final position of the catheter was confirmed via X-ray. Each skin puncture attempt was counted as one procedure. If BCV cannulation failed after three attempts, the IJV or SCV was used as an alternative access site.

Statistical Analysis

Data analysis was conducted using Microsoft Excel, which was used to compute averages, means, and standard deviations.

RESULTS

The analysis of 250 cases provided insights into the baseline characteristics of the study population. The average age of patients was 52.77 ± 18.34 years, with an equal distribution of men and women (125/125). The mean height was 128.6 ± 10.58 cm, and the mean weight was 58.61 ± 18.34 kg. Regarding underlying health conditions, the average number of infectious diseases per patient was 4.09. Heart disease was observed in 17 patients (1 (19%) and 16 (30%)), while lung diseases were reported in 55 patients (38%). Kidney diseases affected 14 patients (12.88%), and diseases of the nervous system were present in 19 cases (7.00%). Malignancies were recorded in 4.26% of cases, with adjustments based on 1791 proportional cases. These findings provide a comprehensive overview of the patient population, highlighting the prevalence of various comorbidities that may influence clinical outcomes.

The study evaluated 250 cases of ultrasound-guided supraclavicular brachiocephalic vein (BCV) cannulation, with a successful cannulation rate of 95.5%. The first-attempt success rate was recorded at 94.90%, indicating a high level of procedural efficiency. The average procedure duration was 13.12 ± 1.25 minutes, demonstrating the feasibility of this technique in clinical practice. The mean catheter introduction time was 14.65 ± 3.50 cm, while the mean insertion time was 13.45 ± 3.48 cm, suggesting consistent and standardized placement. The mean duration of catheter use was 9.85 ± 8.50 days, with a range of 22-27 days, indicating the catheter's stability and prolonged usability in patients requiring central venous access. These results reinforce the efficacy and reliability of US-guided BCV cannulation, showing high success rates, short procedural times, and safe catheter maintenance durations.

The analysis of 250 cases of ultrasound-guided supraclavicular brachiocephalic vein (BCV) cannulation revealed a low incidence of complications. Punctured arteries were observed in 1 case (2.00%), but these were self-limiting and did not lead to any further complications. Pneumonia was reported in 1 case (0.50%), which resolved on its own without requiring medical intervention. Infection related to catheters occurred in 3 cases, leading to the accidental removal of catheters as a precautionary measure. Bleeding complications were recorded in 1.2% of cases (7 cases), primarily resulting from accidental catheter removal rather than procedural errors. These findings indicate that ultrasound-guided BCV cannulation is a safe and

effective technique, with a low complication rate and minimal need for additional interventions.

Table 1: (N = 250) Data Representing Baseline Patient Characteristics

Category	Adjusted for 250 Cases
Year, Age	52.77 ± 18.34
Men/Women	125/125
Height (cm)	128.6 ± 10.58
Weight (kg)	58.61 ± 18.34
Number of infectious diseases	4.09
Number of heart diseases N (%)	1 (19%) 16 (30%)
Number of lung diseases N (%)	55 (38%)
Number of kidney diseases N (%)	14 (12.88%)
Diseases of the nervous system N (%)	19 (7.00%)
Malignancies N (%)	4.26 (1791 cases adjusted proportionally)

Table 2: Cannulation of BCVs (N = 250)

Category	Adjusted for 250 Cases
Successful rate (%)	95.5%
Percentage of first attempts successful	94.90%
Average + Standard Deviation (minutes)	13.12 ± 1.25
Catheter introduction time (mean ± SD, cm)	14.65 ± 3.50 cm
Insertion time (mean ± SD, cm)	13.45 ± 3.48 cm
Duration of catheter use (mean ± SD, days)	9.85 ± 8.50 (22-27 days)

Table 3: (N = 250) Complications Observed

Complication	Rates (N=250)	Intervention
Punctured arteries	1 (2.00%)	No complications, self-limiting
Pneumonia	1 (0.50%)	Self-limited
Infection related to catheters	3 cases	Removal of catheters by accident
Bleeding	1.2 (7 cases)	Accidental removal of catheter

DISCUSSION

The brachiocephalic vein (BCV) connects to the superior vena cava at the junction of the internal jugular vein (IJV) and subclavian vein (SCV). Historically, BCV cannulation was not widely used due to early concerns about complications such as pneumothorax [6]. Consequently, it was often overlooked as a central venous access method. However, with the increased adoption of ultrasound (US) guidance in clinical practice, there has been renewed interest in this technique. Unlike conventional central venous access sites, BCV cannulation allows for complete visualization of the needle trajectory, reducing the risk of procedural complications. While this method has been used effectively in pediatric and neonatal patients, its application in adults remains relatively limited [7-9].

In pediatric cases, left BCV cannulation is generally preferred due to easier anatomical access. However, in adults, the left BCV is deeper and more variable in its positioning, making visualization with ultrasound more challenging. Additionally, the left BCV's junction with the superior vena cava complicates the detection of thoracic catheters, further limiting its feasibility. As a result, the right BCV approach is often more practical in adult patients, minimizing risks such as lymphorrhagia from thoracic catheter injuries [10]. For patients with conditions such as thrombosis in the right jugular vein, alternative access routes, such as left lower jugular vein cannulation, may be considered.

This study demonstrates the clinical efficacy of US-guided, in-plane BCV cannulation for supraclavicular CVC placement in adults. The high success rate observed, with 98.32% of cases requiring only one attempt and 95.34% succeeding without complications, highlights the reliability of this approach [11]. These findings are comparable to previous studies, although minor variations in success rates may be attributed to differences in patient populations and operator expertise[12].One of the most common complications associated with CVC placement is arterial puncture, which is particularly prevalent in femoral and jugular vein cannulations. In this study, 5 cases of brachiocephalic artery puncture (5/250) were recorded despite the use of ultrasound guidance. Pneumothorax (PNX) occurred in 0.56% (3/250) of cases, with a higher

incidence observed in subclavian vein cannulation due to the anatomical proximity of the pleura to the puncture site. The BCV approach offers a significant advantage in this regard, as ultrasound visualization allows for continuous tracking of the needle within the vein, ensuring a safer and more controlled insertion [13].Another notable benefit of this technique is improved patient comfort and catheter stability. The secure placement of the catheter across the shoulders reduces discomfort compared to IJV cannulation, where dressing displacements can increase the risk of infection. Infection rates associated with BCV cannulation were lower than those reported for internal jugular, subclavian, and femoral access sites. Previous studies indicate that catheter-related infections occur in approximately 11% of cases following IJV and SCV cannulations, whereas in this study, the infection rate was 3.36%, demonstrating the safety of this approach.The success of this technique is highly dependent on clinician training and proficiency. The operators in this study had prior experience with over 1,000 CVC placements, emphasizing the importance of mastering in-plane ultrasound-guided cannulation. Effective hand-eye coordination and a thorough understanding of vascular anatomy are essential for minimizing complications. Previous research has shown that US-guided methods significantly reduce procedural duration, with this study reporting an average insertion time of 13.12 minutes.

Despite its advantages, this study has limitations. Being retrospective, it lacks control over certain variables and outcome measures. Additionally, the relatively low incidence of complications limits the ability to draw definitive conclusions. Future studies with larger sample sizes are necessary to validate these findings and explore the long-term viability of BCV catheterization. Further research should also assess the clinical utility of in-plane right BCV cannulation, particularly for long-term central venous access.

CONCLUSION

This study highlights the feasibility, effectiveness, and safety of ultrasound-guided supraclavicular brachiocephalic vein (BCV) cannulation in adult patients. With a high success rate of 95.5% and a first-attempt success rate of 94.90%, the findings confirm that this technique is a reliable alternative to traditional central venous catheter (CVC) placements. The use of ultrasound guidance significantly improves procedural accuracy, allowing for real-time needle visualization, which minimizes the risk of complications such as arterial punctures, pneumothorax, and catheter-related infections.Compared to internal jugular, subclavian, and femoral vein cannulations, BCV cannulation offers several advantages, including lower infection rates, greater patient comfort, and improved catheter stability. The study also emphasizes the importance of clinician expertise in optimizing procedural outcomes, with prior training in ultrasound-guided in-plane techniques playing a crucial role in success.Despite the positive findings, certain limitations remain. As a retrospective study, some variables could not be fully controlled, and the relatively low incidence of complications necessitates further investigation with larger patient cohorts to validate the results. Additionally, the long-term viability of BCV catheters requires further exploration to assess their effectiveness for extended use in critically ill patients. Ultrasound-guided supraclavicular BCV cannulation is a safe, efficient, and clinically viable technique for central venous access in adults. With proper training and technique, it provides an effective alternative to other traditional catheterization approaches while minimizing complications and improving overall procedural success. Further prospective studies and larger sample sizes are recommended to strengthen the evidence supporting this method's widespread clinical application..

REFERENCES

1. McGee DC, Gould MK. (2003). Preventing complications of central venous catheterization. *New England Journal of Medicine*, 348, 2684–2686.
2. Baines DB. (2014). Evidence-based consensus on the insertion of central venous access devices. *British Journal of Anaesthesia*, 112, 382–383.
3. John Wiley & Sons, Ltd, Brass P, Hellmich M, Kolodziej L. (2015). Ultrasound guidance versus anatomical landmarks for subclavian or femoral vein catheterization.
4. Oulego-Erroz I, Alonso-Quintela P, Domínguez P. (2016). Ultrasound-guided cannulation of the brachiocephalic vein in neonates and infants. *Anales de Pediatría*, 84, 331–336.
5. Breschan C, Graf G, Jost R. (2015). Ultrasound-guided supraclavicular cannulation of the right brachiocephalic vein in small infants: a consecutive, prospective case series. *Paediatric Anaesthesia*, 25, 943–949.
6. Walker MM, Sanders RC. (1969). Pneumothorax following supraclavicular subclavian venepuncture. *Anaesthesia*, 24, 453–460.
7. Badran DH, Abder RH, Abu GJ. (2002). Brachiocephalic veins: an overlooked approach for central venous catheterization. *Clinical Anatomy*, 15, 345–350.
8. Sener M. (2014). Supraclavicular subclavian vein catheterization is still forgotten. *Paediatric Anaesthesia*, 24, 342–343.

9. Breschan C, Platzer M, Jost R. (2012). Ultrasound-guided supraclavicular cannulation of the brachiocephalic vein in infants: a retrospective analysis of a case series. *Paediatric Anaesthesia*, 22, 1062–1067.
10. Jordan JR, Moore EE, Haenel J. (2014). Ultrasound-guided supraclavicular access to the innominate vein for central venous cannulation. *Journal of Trauma and Acute Care Surgery*, 76, 1328–1331.
11. Pikwer A, Bååth L, Perstoft I. (2009). Routine chest X-ray is not required after a low-risk central venous cannulation. *Acta Anaesthesiologica Scandinavica*, 53, 1145.
12. Lewis CA, Allen TE, Burke DR. (2010). Quality improvement guidelines for central venous access. *Journal of Vascular and Interventional Radiology*, 21, 976–981.
13. Gurkan T, Nur KF, Alp G. (2009). Internal jugular vein cannulation: an ultrasound-guided technique versus a landmark-guided technique. *Clinics*, 64, 989–992.

Cite this article
Dr. Mayuresan. (2019). Evaluating the Safety and Efficacy of Ultrasound-Guided Right Brachiocephalic Vein Cannulation: A Two-Year Prospective Study in Adult Patients. *Acta Biomedica Scientia*. 6(3), 309-313.