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Original Research Article

A comparative study of radial artery cannulation by USG guidance versus palpation technique in major surgery patients

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ABSTRACT

Background: Arterial blood pressure monitoring is a basic vital sign measured in all patients. Arterial catheterization is a frequent and essential procedure for continuous blood pressure monitoring, blood sampling for arterial blood gas analysis, in many clinical settings. The aim of the study is to compare the conventional palpatory technique and ultrasound guided method for radial artery cannulation.
Methods: In this study, 100 patients divided into two groups- ultrasound group and conventional palpatory method. Outcomes were assessed based on successful cannulation at first attempt, number of attempts, time taken, complications.
Results: This study shows that ultrasound guided radial artery cannulation has advantages like successful cannulation at first attempt, lesser number of attempts required for successful cannulation, and lesser complications compared to the direct palpation technique.
Conclusions: This study shows that ultrasound guided technique has definitive advantages over direct palpation technique in terms of efficacy and lesser complications.

Keywords: Arterial BP, Conventional palpatory technique, Radial artery cannulation, Ultrasound guided technique

INTRODUCTION

Blood pressure monitoring is a basic vital sign measured in all patients. Blood pressure variability in every heart beat is measured in invasive monitoring.[1] Arterial catheterization is an essential procedure for continuous blood pressure monitoring, blood sampling for arterial blood gas analysis, in many clinical settings including the emergency department and intensive care units.[7] Ultrasound imaging technique is a more simple, non-invasive one to provide accurate assessment and real time visualization of landmarks.[9] Most commonly used artery for cannulation is radial artery, because of its anatomic accessibility, dual blood supply, low rate of complications and high success rate.[3] The cannulation of radial artery by traditional method has been very challenging in infants and children and even more difficult in patients with obesity and hypotension.[10]

The aim of the study is to compare the palpatory method and USG guided method for radial artery cannulation. Various parameters evaluated are successful cannulation at first attempt, total number of attempts, time taken for successful cannulation and complications.

METHODS

This was prospective observational study conducted at Institute of Anaesthesiology and Critical Care Southern Railways Head Quarters Hospital Perambur, Chennai, Tamil Nadu. This study was started on April 2021 and completed on March 2022.

Inclusion criteria

Adult patients who aged above 18 years and weighed 40-80kg posted for major neurosurgeries, cardiac and oncology surgeries were included.

Exclusion criteria

Patient with refusal, infection at the site, bleeding disorders, Raynaud's phenomenon, and positive Modified Allen's test were excluded.

Procedure

In this study, totally 100 patients were selected and divided into two groups, by using sealed envelope method are ultrasound group and conventional palpation group.

After getting the hospital's Institutional Ethics Committee (IEC) approval and obtaining informed written consent and under standard monitoring in operating room, the patient arms were positioned with dorsiflexion at the wrist joint and the hand was fixed to the arm board for arterial cannulation.

In palpation technique, under strict aseptic precautions, radial artery course was identified by either direct palpation. Local anaesthetic is injected intra dermally and subcutaneously after negative aspiration for blood. Arterial catheterization is performed by trans fixation technique with jelco catheter.

In ultrasound technique, the patient is positioned in the same way and gel is placed over the ultrasound probe which is covered with tegaderm and disposable cover. The field is painted and draped and the ultrasound probe is kept over the field with the help of assistant. The probe is fixed at 70- 80degree angle in transverse view and the visualization of radial artery in cross section is optimized 14. The introducer needle is introduced into the radial artery and visualized at the centre of the lumen of the vessel. When the needle is placed in optimal position within the lumen, the probe is tilted to longitudinal axis and course of the radial artery is made out 13. The catheter is advanced using trans fixation technique under real time ultrasound guidance.

Time taken for cannulation and total number of attempts taken for successful cannulation were noted. One cannulation time is taken as the duration from the insertion of cannula to the successful placement of catheter in the radial artery. The successful cannulation at first attempt was noted. If first attempt failed, then the total number of attempts for successful cannulation were noted. All patients were tried with left radial artery in first attempt. The other radial artery attempted when there was failure on the left side. Complications like hematoma, vasospasm, if any, were noted.

The requirements are povidone iodine, ultrasonogram machine with high frequency probe, arterial pressure monitors with transducer, jelco catheter, local anesthetic 2% lignocaine, 2ml syringe, sterile gauzes, extension sets, 500ml heparin saline, pressure bag, 10ml lever-lock syringe, 10cm extension.

Successful cannulation at first attempt, total number of attempts and complications were analyzed using Chi square test/Fishers exact test while time taken for successful cannulation was analyzed using independent t-test. Data was analyzed by using co Guide software, V.1.03; BDSS Corp. Released 2020. Co Guide Statistics software, Version 1.0, India: BDSS corp.

P value <0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis 4.

Statistical analysis

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Non normally distributed quantitative variables were summarized by median and interquartile range (IQR). Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots. For normally distributed Quantitative parameters the mean values were compared between study groups using independent sample t-test (2 groups). Categorical outcomes were compared between study groups using Chi square test/Fisher's Exact test (If the overall sample size was <20 or if the expected number in any one of the cells is <5, Fisher's exact test was used.). P value <0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.[8]

RESULTS

As shown in Table 1, among the 100 patients in the study population, the 80 years and 18 years were the maximum and minimum ages respectively. The mean age in the study population was 56.54. The male and female distribution showed in Table 2.

As shown in Table 3, first attempt successful cannulation was possible in 30 patients (60%) in the ultrasound group and 17 patients (34%) in the direct palpation group. The analysis was done by Fishers Exact test. (p = 0.0092). Hence the difference in first attempt successful cannulation between ultrasound group and direct palpation groups found to be statistically significant.

Only 6 (12%) of the study group, complications occurred with ultrasound guided cannulation whereas 17 (34%) of the complications occurred in patients with direct palpation. The analysis was done by Fisher exact test. (p=0.009). Hence it was showing that ultrasound guided cannulation associated with statistically significant lesser complication.

With regards to number of attempts, only in 6 (12%) patient there was more than two attempts in the ultrasound group whereas it was 13 (26%) patients in the palpation group. The analysis was done by Fishers Exact test (p=0.044). Thus there was a statistically significant difference in the number of attempts between ultrasound group and direct palpation groups.

Table 1: Descriptive analysis of age in the study population (n=100).

Name	Mean±SD	Median	Minimum	Maximum	Lower CI	Upper CI
Age (years)	56.54±11.73	57.00	18.00	80.00	54.21	58.87

Table 2: Descriptive analysis of gender in the study population (n=100).

Gender	Frequency	Percentage
Male	51	51.00
Female	49	49.00

Table 3: Comparison of study group with various parameters (n=100).

Parameters	Study group		Chi square value	P value
	US group (n=50) (%)	DP group (n=50) (%)		
Successful cannulation at first attempt	30 (60.00)	17 (34.00)	6.78	0.0092
Complications	6 (12)	17 (34)	6.83	0.009
>2 Attempt for cannulation	6 (12)	13 (26)	3.18	0.044

As shown in Table 4, the average time taken for successful placement was 76.32 seconds in the palpation group and 78.02 seconds in the ultrasound group. The analysis was done by Unpaired-t-test. (p=0.513) This shows that there was no statistical significance between the total time taken for successful cannulation in both the groups. So, this study shows that ultrasound guided technique has definitive advantages over direct palpation technique in terms of efficacy and lesser complications.

Table 4: Comparison of Time taken for cannulation between groups-time with study group (n=100).

Parameter	Time	Mean difference	Lower CI	Upper CI	P value
	Mean±SD				
US group (n=50)	78.02±10.88	1.70	-3.45	6.85	0.5139
DP group (n=50)	76.32±14.78				

DISCUSSION

The present study was aimed to compare the traditional palpatory method and ultrasound guided method for radial artery cannulation. This study shows that ultrasound guided radial artery cannulation has advantages like successful cannulation at first attempt (p=0.0092), lesser number of attempts required for successful cannulation (p=0.044), and lesser complications (p=0.009) compared to the direct palpation technique, which are statistically significant. However ultrasound has no statistically significant advantage (p=0.513) in total time taken for cannulation compared to the direct palpation technique.

Ammar Ali conducted a study in 100 patients, study demonstrated that number of attempts required for successful cannulation with ultrasound guided technique was significantly lesser while compared with conventional palpatory technique which is in complete agreement with our study.[2]

Shiver et al conducted a study with 60 participants showed that there was lesser time required for ultrasound guided radial artery cannulation whereas in our study there were no significant difference in total time required for cannulation in both the groups.[5]

Seto AH conducted a study in a group of 160 patients demonstrated that there were significantly lesser number of complications associated with USG guided radial artery cannulation which is in same with our study.[6]

It is very difficult to generalize the findings from a study conducted in a different setting, with different demographic localities and health system. Advancing imaging techniques are thought to easen and decrease the duration of procedure. On the contrary, our study showed that there was no significant difference in time taken for successful cannulation in both techniques.

Ultrasound was still found to be in top for guiding radial artery cannulation than traditional method, apart from

their expertise and expenses.[13] Learning curve was found to be very quicker in traditional palpatory method.

There were some limitations this study. There are less sample size due to time constraints, only patients undergoing major elective surgeries were studied, emergency surgeries were not included in the study, observer's bias in time recording and observer's inexperience.[15]

CONCLUSION

To conclude, this study shows the superiority of ultrasound guided radial artery cannulation than conventional method. Though the time taken for cannulation in both methods were almost similar, ultrasound method had better outcomes with respect to complications and number of attempts. Thus, when resources are available, it would be ideal to opt for ultrasound guided radial artery cannulation.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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