

A RANDOMIZED COMPARISON OF ULTRASOUND GUIDED VERSUS BLINDLY PLACED RADIAL ARTERIAL CATHETERS

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ABSTRACT

Objective: To evaluate the effectiveness of ultrasound (US) guided radial artery cannulation as compared to the blind insertion of arterial line in intensive care unit of a tertiary care center.

Methodology: One hundred patients were divided into two equal groups. In group I, arterial line was inserted using the blind palpation technique. While in group II, arterial line was inserted with the help of ultrasound guidance. The primary endpoints were time of insertion in 1st attempt, number of first successful attempts and maximum number of attempts used for insertion of arterial line. Data was analyzed by using SPSS V23. Chi-square test was used for analysis of gender and successful insertion in 1st attempt. Independent sample t-test and Mann-Whitney U-test were used to compare quantitative variables.

Results: Mean baseline systolic blood pressure, mean diastolic blood pressure and mean pulse rate before surgery were also not significantly different between the groups. Arterial line was inserted in first attempt in 88.0% patients in ultrasound guided group and in only 70.0% patients in blind palpation group (p-value 0.027). Arterial line insertion time in 1st attempt was also significantly less in ultrasound guided group 77.68 ± 7.98 seconds versus 95.46 ± 15.53 seconds in blind palpation group (p-value <0.001). We also found less number of attempts 1.16 ± 0.37 in ultrasound guided group versus 1.44 ± 0.67 in blind palpation group (p-value 0.025).

Conclusion: Ultrasound guided radial artery cannulation is associated with higher rate of successful insertion and less time is required for arterial line insertion as compared to blind palpation method.

Key Words: Radial artery cannulation, Arterial line, Ultrasound guided arterial line placement

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INTRODUCTION

Arterial line is inserted in many hospital departments e.g. operating rooms, intensive care units and emergency departments in patients in whom there is a need for continuous invasive blood pressure monitoring and arterial blood gas analysis¹. The most frequently used site for arterial cannulation is radial artery because of its superficial location, presence of collateral blood flow through the ulnar artery and hence lower rate of complications.

Radial artery cannulation is usually performed blindly by using anatomic knowledge and palpating the artery. By using blind technique, arterial pulsation is felt with difficulty in hypotensive and obese patients that can result in cannulation failure². After failure of first attempt, artery may develop spasm making further cannulation attempts more challenging³. Recent literature

have suggested that ultrasound guided radial artery cannulation increases the rate of successful cannulation and decreases the rate of complications associated with arterial cannulation as compared to the traditional blind method⁴⁻⁶. The objective of this present study was to evaluate the effectiveness of ultrasound (US) guided radial artery cannulation as compared to the blind insertion of arterial line in intensive care unit of a tertiary care center.

METHODOLOGY

Randomized prospective study design was selected for this study. Institutional review board permission was taken before starting the study. One hundred patients were divided into two equal groups. In group I, arterial line was inserted using the blind palpation technique. While in group II, arterial line was inserted with the help of ultrasound guidance. Traditional informed consent

was taken from group I patients and a special informed consent was taken from group B patients, 1st briefing them about the efficacy of ultrasound guided arterial line insertion. The duration of this study was from December 2015 to July 2016.

All patients of age more than 20 years were included in this study. Main indications of arterial line catheterization was continuous monitoring of arterial blood pressure and need for frequent arterial blood gases (ABGs) analysis. Hemodynamically unstable patients in whom arterial line was inserted before taking informed consent, and patients with previous attempts of radial line insertion were excluded.

In all patients B-Braun Arteriofix 20G 80mm arterial line was used for radial artery access. Allen test was performed in every patient before insertion of radial line. Radial artery area disinfection and local anesthesia was given in every patient before insertion of radial line.

In group I patients, radial line was inserted using blind palpation technique according to the hospital protocols. After palpating the radial artery, the needle was inserted through the skin at 45° angle towards the anterior wall of the artery. Successful artery puncture was accessed through flashback of blood. Then a guidewire was inserted through the needle into the arterial lumen. After that needle was removed and arterial catheter was advanced over the guidewire into the arterial lumen and guidewire was removed after catheter insertion and catheter was secured into the artery.

Ultrasound guided radial line insertion was done using Toshiba Nemio 20 ultrasound machine with 7.5 MHz linear array transducer. A sterile cover and gel was used for ultrasound transducer. Image display settings of ultrasound machine was adjusted at minimum depth of two cm. The ultrasound probe was placed perpendicular to the artery. The artery was aligned on the centerline guide of the probe by moving the probe in exact position. The puncture needle was inserted in the skin following the centerline on the display at angle of 45°. After the needle punctured the arterial wall and pulsatile flow was seen in the needle, the guidewire was inserted into the artery and needle was removed. After that arterial catheter was advanced on the guidewire into the artery lumen, guidewire was removed and catheter was secured.

In the ultrasound group time zero was defined as time after the machine is turned on but after application of gel on the transducer and covering it with a sterile cover. For blind palpation technique, time zero was defined as the doctor's finger was placed on the patient's wrist to palpate the radial artery. The end time of arterial line placement was noted when the catheter was successfully placed into the vessel and total time taken for insertion was calculated using a stopwatch and

represented in seconds. A maximum number of three attempts for arterial puncture were decided to be used on same radial artery if failed then radial artery of the opposite hand was used for arterial line insertion.

The primary endpoints were time of insertion in 1st attempts, number of first successful attempts and maximum number of attempts used for insertion of arterial line.

Data was analyzed by using SPSS V23. Chi-square test was used for analysis of gender and successful insertion in 1st attempt. Independent sample t-test and Mann-Whitney U-test were used to compare quantitative variables.

RESULTS

One hundred patients were included in this study. There was no significant difference between age and gender of patients. Mean baseline systolic blood pressure, mean diastolic blood pressure and mean pulse rate before the procedure were also not significantly different between the groups. Out of hundred patients, 46 (92.0%) patients were cannulated in ultrasound guided arterial line insertion group and 42 (84.0%) patients were cannulated in blind palpation technique group (p-value 0.22). The number of patients in which main indication for arterial line insertion was continuous arterial blood gas analysis and continuous blood pressure monitoring were same between the two groups (Table 1).

There was significant difference regarding primary endpoints between the groups. Arterial line was inserted in first attempt in 88.0% patients in ultrasound guided group and in only 70.0% patients in blind palpation group (p-value 0.027). Arterial line insertion time in 1st attempt was also significantly less in ultrasound guided group 77.68±7.98 seconds versus 95.46±15.53 seconds in blind palpation group (p-value <0.001) (Table 2).

DISCUSSION

We found significantly higher rate of arterial line access in first attempt in ultrasound guided arterial line insertion. Time of insertion was also significantly less ultrasound guided group.

Many studies have concluded that ultrasound guided arterial line insertion into the radial artery successfully increases the rate of insertion and decreases the incidence of complications as compared to the traditional blind palpation method^{1,7,8}. Ultrasound guided insertion is also superior in obese patients, elderly patients and in patients suffering from edema, hypotension, vascular anomalies e.g. patients with tortuous vessels⁹. Sites et al demonstrated that the most common problem of ultrasound guided arterial line insertion procedure is to

Table 1: Comparison of baseline characteristics

Variable	Ultrasound Group (n=50)	Blind Palpation Group (n=50)	P-value
Age of Patients (Y)	44.60±7.54	45.54±5.15	0.45
Male Gender (%)	45 (90.0)	46 (92.0)	0.72
Mean Systolic Blood Pressure	105.96±12.99	108.98±14.00	0.27
Mean Diastolic Blood Pressure	71.60±9.28	74.84±8.90	0.08
Pulse (rate per min)	76.52±7.22	77.80±6.40	0.35
Reasons for Arterial Line Insertion			
No. of patients cannulated (%)	46 (92.0)	42 (84.0)	0.22
Continuous Arterial Blood Gas Analysis (%)	43 (86.0)	41 (82.0%)	0.58
Continuous Blood Pressure Monitoring (%)	30 (60.0)	32 (64.0)	0.68

Table 2: Comparison of study endpoints

Variable	Ultrasound Group (n=50)	Blind Palpation Group (n=50)	P-value
No. of insertions in 1st attempt (%)	44 (88.0)	35 (70.0)	0.027
No. of attempts	1.16±0.37	1.44±0.67	0.025
Time of insertion in 1st attempt (sec)	77.68±7.98	95.46±15.53	<0.001

accurately image the catheter during insertion¹⁰. Hansen et al¹¹ found that problem of imaging the needle can be sort out by using dynamic needle tip positioning via continuous visualization of the cannula tip and tracking the tip into the vessel lumen. Previous studies have found rate of successful insertion in first attempt in 62.0 to 95.0%^{1,8,11-13}. In our study, the rate of successful radial line insertion in first attempt in ultrasound guided group was 88.0% and 70.0% in blind palpation technique group.

Another beneficial use of ultrasound guided radial line insertion is to identify the patients with high risk of complications i.e. it can identify the blockage in radial or ulnar artery and arteriosclerosis. Arteriosclerosis can be identified easily through ultrasonography¹⁴, so catheterization can be done in more proximal part of the radial artery. Other anatomical variations and anomalies e.g. anomalous branching of radial artery, tortuosity, radio-ulnar loop and radial artery hypoplasia can also be identified using ultrasonography. These complications are encountered in more than 17.0% patients¹⁵. Radial artery cannulation using ultrasonography also have higher success rate of insertion (up to 67%) in first attempt in pediatric patients as compared to only 20% using blind palpation technique.

CONCLUSION

Ultrasound guided radial artery cannulation is associated with higher rate of successful insertion and less

time is required for arterial line insertion as compared to blind palpation method.

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CONTRIBUTORS

AA conceived the idea, planned the study, and drafted the manuscript. LA designed the study, drafted the manuscript and did statistical analysis. AF helped acquisition of data and drafted the manuscript. All authors contributed significantly to the submitted manuscript.