Original Article

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Comparison between Ultrasound-Guided and Traditional Palpatory Approaches of Proximal Transradial Access for Coronary Angiography and Intervention

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Author`s Contribution

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ABSTRACT

Objectives: To compare the efficacy and safety of ultrasound-guided versus traditional palpatory approaches of proximal transradial access (TRA) for coronary angiography and intervention.

Methodology: This cross-sectional analytical study was carried out from September 2023 to February 2024 at the Cardiology Department of Fauji Foundation Hospital, Rawalpindi after ethical approval. After obtaining informed consent, 75 patients who presented with ischemic heart disease and underwent coronary angiography and /or percutaneous primary coronary intervention with proximal TRA were included by convenient sampling. In 37 patients of Group I, the traditional palpatory technique was used whereas, in 38 patients of Group II, the ultrasound-guided technique was used. The Statistical Package for the Social Sciences (SPSS) version 25 was used for data analysis.

Results: The first pass success rate was 92.1% in Group II versus 75.7% in Group I with statistical significance. The mean cannulation time was greater in Group I than in Group II (p-value = 0.001). The switchover to another procedure was 35.1% in Group I and 0% in Group II. Hematoma formation occurred in 24.3% of patients in Group I and 10.5% of patients in Group II but was not significant. Loss of radial pulse at 2 months was reported in 5.4% and 2.6% of the patients in Group I and Group II, respectively (p-value=0.53).

Conclusion: Ultrasound-guided transradial access is associated with improved patient outcomes as compared to traditional approach. It has a higher first-pass success rate, reduced mean cannulation time, and lower frequency of switchover procedure. However, the difference in hematoma formation and loss of radial pulse between the two groups is not significant.

Keywords: Ultrasound-guided transradial access, Traditional transradial access, Coronary Angiography.

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Introduction

Arterial cannulation is frequently performed in the Emergency, critical units and operation theaters. Currently, transradial access (TRA) is the technique of choice for arterial cannulation owing to the superficial location of the radial artery, double vascular supply of hand and increased success rate.[1,2] It is linked with a better prognosis with reduced incidence of vascular complications, hemorrhage and deaths than femoral access.[3] However, arterial cannulation can be challenging in some cases due to the small diameter of the artery, anatomical variations, vasospasm or calcification. The failure rate and risk of complications e.g. hemorrhage, hematoma, infection and occlusion rise significantly with multiple attempts of cannulation.[4]

The prevalence of ischemic heart disease (IHD) is 126 million people across the world, contributing to consequential morbidity, mortality and disability.[5] Cardiac catheterization is one of the most frequently performed procedures in IHD for diagnostic purposes and treatment.[6] One of the major innovations in the management of IHD in recent years is the arterial access technique for coronary procedures. The transfemoral access has been replaced by the transradial technique. The transradial access has the advantages of reduced major adverse cardiovascular events (MACE), deaths, fewer bleeding & complications at the puncture site and cost-effectiveness. The use of TRA is recommended for primary percutaneous angioplasty (P-PCI) irrespective of the clinical presentation.[7]

Conventionally, the palpatory method was used for radial access. But recently the trend has shifted towards the ultrasound-guided technique which is associated with reduced episodes of major bleeding, improved access outcomes and fewer complications. This can be explained by the fact that a blind arterial puncture by palpatory method results in more puncture attempts and higher chances of hematoma & tendon damage. The multiple attempts also raise the risk of blockage of the radial artery which precludes TRA for subsequent procedures.[8] The ultrasound-guided procedure identifies anatomical landmarks and can prevent injury to the cephalic vein and radial nerve. It also makes the vessel access easier & accurate on the first attempt and determines the vessel size before puncture to estimate its caliber according to the sheath size used for the procedure.[9]

This study compared the efficacy and safety of ultrasound-guided and traditional palpatory proximal TRA for coronary procedures. The outcomes assessed were first-pass success rate, average cannulation time, need to switchover procedure, hematoma formation and loss of radial pulse (at 2-month follow-up). Studies have been conducted in Pakistan comparing proximal and distal TRA. But there is lack of studies comparing traditional palpatory and ultrasound-guided approaches of proximal TRA in Pakistan. As the ultrasound-guided approach is now increasingly being used for transradial access, this study would help us in using the better approach for TRA for coronary angiography and P-PCI based on outcomes in our setup.

Methodology

This cross-sectional analytical study was carried out from September 2023 to February 2024 at the Cardiology Department of Fauji Foundation Hospital, Rawalpindi after ethical approval. A sample size of 50 was calculated using the 96.6% first-pass success rate with an ultrasound-guided transradial approach.[10] After obtaining informed written consent, 75 patients who presented in the Emergency department with signs and symptoms of IHD were included by convenient sampling These patients underwent coronary angiography and /or P-PCI with proximal transradial access. Patients who had recent TRA, evidence of infection at the access site, hemodynamically unstable, coagulopathies and peripheral vascular disease were not included. Two groups of patients were made with Group I having 37 patients and Group II having 38 patients. In Group I, the traditional palpatory technique was used whereas, in Group II, the ultrasound-guided technique was used. The patient demographics, co-morbidities and outcomes were recorded on Proforma. The primary outcome was the first-pass success rate. The secondary outcomes were mean cannulation time, need to switchover procedure, hematoma formation and loss of radial pulse (at 2-month follow-up).

The first pass success rate is the number of successful arterial cannulations in the first attempt as indicated by the arterial waveform on the monitor. The duration between a skin puncture and the display of the arterial waveform on the monitor is referred to as the mean cannulation time. The switchover procedure is the shift to the other technique or access site of arterial cannulation after 2 unsuccessful attempts. Loss of radial pulse at 2 months was confirmed on Doppler ultrasound.[11]

The Statistical Package for the Social Sciences (SPSS) version 25 was used for data analysis. Quantitative variables were expressed using mean and standard deviation. Qualitative variables were expressed using frequency and percentage. Chi-Square test for qualitative variables and Student t-test for quantitative variables were used to determine the relation between qualitative and quantitative variables, respectively. A p-value of ≤ 0.05 was significant.

Results

The mean age of the patients was 62.21 ± 8.57 years in Group I and 64.21 ± 9.01 years in Group II. Most of the patients in both groups were in the age group 61-70 years, females and had body mass index (BMI) of 25 to 29.9 kg/m^2. The majority of the patients were hypertensive, diabetic, nonsmokers and had dyslipidemia. There was no difference in demographic characteristics and co-morbidities among the two groups (p-value > 0.05) (Table I).

Table I: Patient Demographics & Co-morbidities in Group I and Group II.

Variable	Group I (n = 37)	Group II (n = 38)	Chi-Square/ t-Statistic	p-value
Age (Years)	62.21±8.57	64.21±9.01	9.81	0.33
Age Groups (Years)				
41-50	5(13.5%)	3(7.9%)	2.47	0.65
51-60	8(21.6%)	9(23.7%)		
61-70	19(51.4%)	16(42.1%)		
71-80	4(10.8%)	8(21.1%)		
81-90	1(2.7%)	2(5.2%)		
Gender				
Male	5(13.5%)	8(21.1%)	0.744	0.389
Female	32(86.5%)	30(78.9%)		
BMI (kg/m^2)	25.67± 2.72	25.15± 2.86	0.801	0.425
BMI Groups (kg/m^2)				
18.5 to 24.9	14(37.8%)	18(47.4%)	0.741	0.690
25 to 29.9	19(51.4%)	17(44.7%)		
≥30	4(10.8%)	3(7.9%)		
Hypertension (HTN)				
Hypertensive	36(97.3%)	35(92.1%)	1.001	0.317
Nonhypertensive	1(2.7%)	3(7.9%)		
Diabetes mellitus (DM)				
Diabetic	22(59.5%)	24(63.2%)	0.108	0.742
Nondiabetic	15(40.5%)	14(36.8%)		
Smoking				
Smoker	3(8.1%)	5(13.2%)	0.502	0.479
Nonsmoker	34(91.9%)	33(86.8%)		
Dyslipidemia				
Normal lipid profile	14(37.8%)	18(47.4%)	0.696	0.404
Dyslipidemia	23(62.2%)	20(52.6%)		
Chronic Kidney Disease (CKD)				
CKD	4(10.8%)	2(5.2%)	0.376	0.324
No CKD	33(89.2%)	36(94.8%)		

Table II: Patient Outcomes in Group I and Group II.

Outcome	Group I	Group II	Chi-Square/t-Statistic	p-value
First pass success rate	28(75.7%)	35(92.1%)	3.76	0.05*
Mean cannulation time (sec)	94.89±3.02	71.44±3.79	29.52	0.001*
Need to Switchover Procedure	13(35.1%)	0(0%)	15.312	0.001*
Hematoma formation	9(24.3%)	4(10.5%)	2.168	0.141
Loss of Radial Pulse at 2-month follow-up	2(5.4%)	1(2.6%)	0.375	0.53

**Statistically Significant*

The first pass success rate was 92.1% in Group II versus 75.7% in Group I with statistical significance. The mean cannulation time was 94.89±3.02 seconds in Group I and 71.44±3.79 seconds in Group II (p-value = 0.001). In Group I, 13(35.1%) patients had switchover to ultrasound-guided procedure whereas, in Group II, none of the patients needed to switchover to another technique/access site. Hematoma formation was seen in 9(24.3%) patients in Group I and 4(10.5%) patients in Group II but has no statistical significance. Loss of radial pulse at 2 months was reported in 5.4% of the patients in Group I and 2.6% of the patients in Group II (p-value=0.53). The outcomes of the patients are shown in Table II.

Discussion

Ultrasound has gained utmost importance in interventions performed in Cardiology. Ultrasound-guided TRA procedures are related to improved outcomes such as higher success rates, shorter cannulation time, and lesser risk of complications such as hematoma. Another benefit of the ultrasound-guided procedure is that it also monitors vascular access-related problems.[12]

The average age was 62.21±8.57 years in the palpatory group and 64.21±9.01 years in the ultrasound-guided group in our study. In another study, patients had an average age of 70.4±10.5 years in the ultrasound-guided puncture group and 74.1±9.6 years in the conventional puncture group.[13] The mean age was 46 years in both groups in a study.[14] Females were predominant in our study with 78.9% and 86.5% in ultrasound-guided and traditional groups, respectively. In a study, 35.3% of the patients were females in the ultrasound-guided group and 46.5% in the traditional group.[14] In contrast, in another study, 60% and 70% were males in ultrasound-guided and conventional groups, respectively.[13] Our study showed no significant difference in age, gender, BMI, HTN, DM, smoking, dyslipidemia and CKD between the two groups. Rajasekar et al. reported the same results in their study[11]

In another study, age was statistically significant between the two groups but all other variables were similar.[13] In a study, patients in two groups differed in their weight but no difference was seen in their age, gender and blood pressure.[10] Gutte et al. reported that age, gender and BMI were the same between the two groups but the difference in CKD and HTN was significant.[14]

Our results revealed the first pass success rate of 92.1% in the ultrasound-guided versus 75.7% in the traditional group with statistical significance. The mean cannulation time was 94.89±3.02 seconds in the palpatory group and 71.44±3.79 seconds in the ultrasound-guided group (p-value = 0.001). In the palpatory group, 35.1% of patients had switchover to ultrasound-guided procedure whereas, in the ultrasound-guided group, none of the patients had switchover to another technique/access site. Hematoma formation was seen in 24.3% of patients in the palpatory and 10.5% of patients in the ultrasound-guided group but

has no statistical significance. Similarly, loss of radial pulse was not significant between the two groups. In another study, the ultrasound-guided procedure showed a significantly higher first-pass success rate as compared to the traditional puncture technique. The average cannulation time was less in ultrasound-guided procedures with statistical significance. In addition, it was associated with lesser switchover compared to the traditional approach. The number of complications was same in both groups.[11] According to Mori et al., the success rate of the ultrasound-guided procedure was significantly greater (97%) than the traditional method (87%) in distal TRA.

The switchover was reported in 5.1% of the cases in the traditional group. But in contrast to our study, puncture time was the same in both groups. Complications were the same in patients of both groups.[13] A meta-analysis revealed a better success rate of ultrasound-guided procedure at first attempt but the duration of cannulation and number of attempts were the same.[15] Yu et al. reported a first-attempt success rate of 96.6% in the ultrasound-guided group and 73.3% in the traditional method group with statistical significance. The two groups did not differ in total procedure duration, cannulation duration and rate of complications. In the traditional group, 2 patients developed hematoma whereas, none of the patient's developed hematoma in the ultrasound-guided group.[10] A study was conducted to compare ultrasound-guided and traditional palpatory techniques in the cannulation of various arteries. The first-pass success rate was significantly higher in the ultrasound-guided group (83.3%) than the traditional group (55.6%). The cannulation time and number of attempts were also less in ultrasound-guided group with a p-value if < 0.001. The complication rate was the same in both groups; 1.9% in the ultrasound-guided and 1.01% in the traditional technique.[14] A study compared the MACE in patients undergoing radial and femoral cannulation via ultrasound-guided and traditional techniques. There was no statistical difference in MACE between the two techniques.

However, the ultrasound-guided approach was linked with higher first-pass success (73%) as compared to the traditional technique (59.7%), reduced cannulation time of 93 seconds than 111 seconds in the traditional technique and less number of attempts (1.47%) versus 1.9% in the traditional method.[16] The results of a systematic review and meta-analysis revealed a higher success rate at the first attempt with the ultrasound-guided technique with a lower rate of access failure. Switchover was reported in 73.2% of the patients after failed cannulation with the traditional approach. The rate of complications was low in both groups with no significant difference.[17] The results of a study showed that the number of attempts was much less in the ultrasound-guided group. The success rate at first attempt was slightly higher in ultrasound-guided group but it was not significant. The cannulation time was 72.4 ± 23.0 sec in the ultrasound-guided and 94.6 ± 13.7 sec in the palpatory group. Hematoma was only reported in 2 patients in the palpatory group.[18] Yeap et al. revealed improved outcomes with an ultrasound-guided approach with less cannulation time, fewer attempts of cannulation and a higher success rate.[19] Another study also reported a higher first-pass success rate with ultrasound guided procedures but unlike our study, the frequency of complications was also much less in patients who underwent ultrasound-guided procedures than palpatory procedures.[20]

Conclusion

Ultrasound-guided transradial access is associated with improved patient outcomes than the traditional palpatory approach. It has a higher first-pass success rate, reduced mean cannulation time, and lower frequency of switchover procedure. However, the difference in hematoma formation and loss of radial pulse between the two groups was not significant.

LIMITATIONS AND RECOMMENDATIONS OF THE STUDY:
It was a single-institution study. Large, multicenter, randomized controlled trials should be conducted in the future. The study compared the outcomes of traditional and ultrasound-guided techniques of proximal TRA. Further research should be carried out to evaluate the outcomes of distal TRA as well.

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