

Transradial Approach versus Anatomical Snuff Box Distal Radial Access for Coronary Procedures

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Abstract

Background: Radial artery catheterization is a fundamental approach that is used as a procedural access in the different catheterization laboratories so our study is a comparison between distal radial artery approach and conventional traditional transradial approach to explore the feasibility and safety of coronary angiography and percutaneous coronary. **Aim of the Work:** The purpose of our study is a comparison between the conventional transradial approach versus distal transradial approach for diagnostic and interventional coronary procedures. **Materials and Methods:** This is a prospective study that included 60 patients who presented to the Cardiology departments in Ahmed Maher Teaching Hospital from December 2018 until October 2019 to perform planned Transradial Coronary Angiography and/or coronary intervention. The study is divided into two groups, group (A) included 30 patients who undergone the procedure through the distal radial approach (The Anatomical Snuffbox) and group (B) included 30 patients who undergone the procedure through the traditional Transradial approach. **Results:** Thrombosis and hospital stay are higher significant in radial group than distal radial group and patient satisfaction is higher significant in distal radial group than traditional Transradial while there is no significant difference between both groups as regard Success and failure rate of cannulation, bleeding, infection and duration of the procedure. **Conclusion:** coronary procedures by distal radial approach have minor access complication versus the conventional Transradial approach.

Keywords

Radial Artery, SnuffBox, Catheterization

1. Introduction

Coronary angiography with or without PCI requires arterial access. The standard access sites are femoral and radial arteries. During the last decade, the refinement and miniaturization of stents permitted the use of guiding catheters with smaller diameters that were better suited for use through the (relatively small) radial artery, in parallel to the recent improvements in the procedural success of PCI with modern devices [1] [2].

The focus of attention is shifting from the technical success of the coronary intervention to the prevention of access site complications. As a result, there is a growing interest in an alternative to TFA [3]. Randomized controlled trials and a meta-analytic study have suggested that radial access for CAG and/or PCI is a safe and effective alternative to the femoral approach, while the radial technique is associated with a reduction in hemorrhagic entry site complications and permits earlier patient ambulation [3] [4].

Radial artery catheterization is a fundamental approach that is used as a procedural access in the different catheterization laboratories due to low prevalence of access-related complications [5] [6]. Feasibility and safety of this technique initially provoked some euphoria among some interventional specialists, but later there was a realization of disadvantages of Radial artery catheterization including radial artery spasm, vessel thrombosis and different types of wall lesions of the access artery. Traditionally, the optimal radial artery puncture site was considered to be at the distal third of forearm because of the superficial position of the artery close to the radial bone that facilitates puncture and following hemostasis. The preferred puncture site is about 2 cm proximal to the radial styloid. Although the pulse is often palpated more easily below this point, the artery is tortuous and below the flexor retinaculum. A more distal puncture will often do not permit the wire to pass [3] as shown in **Figure 1**.

Another site for the puncture is anatomical snuffbox where the artery lies closely to the skin along the surface of radio carpal joint that serves as “basement” [8].

The anatomical snuffbox is a hollow space on the radial side of the wrist when the thumb is extended; it is bounded by the tendon of the extensor pollicis longus posteriorly and of the tendons of the extensor pollicis brevis and abductor pollicis longus anteriorly. The RA crosses the floor that is formed by the scaphoid and the trapezium bones [9] as shown in **Figure 2**.

The distinctive feature of this area is its location distally to the superficial palmar branch of radial artery that communicates with superficial palmar arterial arch of ulnar artery and other feature of this area is surrounded by soft tissues of hand, which is essential for the adequate hemostasis [11].

Arterial wall damages in access site are multi-faceted: perforation and/or pulsatile hematoma (false aneurysm), injury of proximal major blood vessels, arteriovenous fistula. Post-catheterization radial artery occlusion (PCRAO) is the most common complication of radial access, it's reported by different authors to

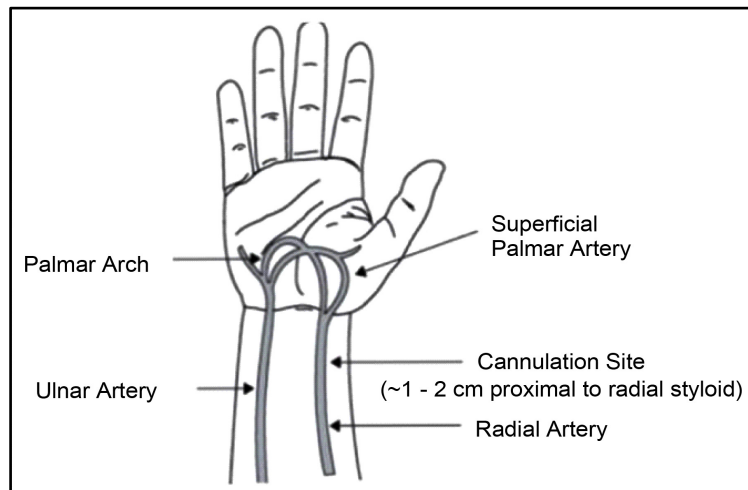


Figure 1. Puncture site of conventional radial approach [7].

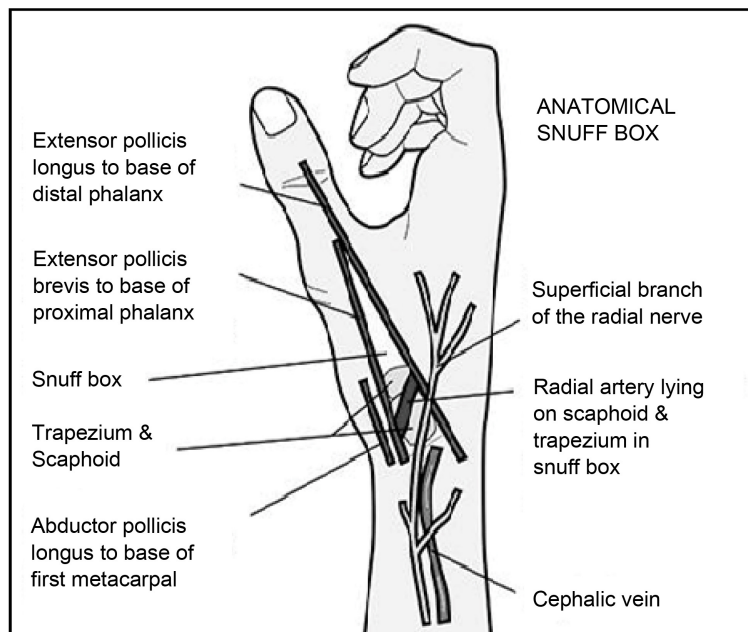


Figure 2. Anatomical snuff box Anatomy [10].

occur in 0% - 10% of case, there are three fundamental causes of the access artery occlusion, arterial puncture, arterial catheterization and incorrect puncture hemostasis [12].

On the basis of observations, the suggestion that in case of total radial artery occlusion within the anatomical snuffbox (RAAS), the ante grade blood flow would be preserved through the superficial palmar arch, therefore the risk of thrombosis and extensive forearm radial artery occlusion would be minimized. Radial artery portion of the hand is surrounded by soft tissues that are elastic by nature; this leads to “non complete” artery compression with a hemostatic Bandage applied to this area. Combining this consideration with the aforementioned possibility of preserved ante grade blood flow in the superficial palmar arch

makes to suggest lower risk of post-catheterization radial artery occlusion in this area [5].

The post-catheterization impairment of the radial artery does not manifest only with occlusion but also with stenosis. The pulsation over a length of the radial artery is preserved but its use as an access artery seems problematic [13].

2. Methods

This is a prospective randomized study that included 60 patients who presented to the Cardiac cath. Lab in Ahmed Maher Hospital from December 2018 until October 2019 to perform Transradial Coronary angiography and intervention.

The study divided in to two groups, Group (A) included 30 patients who undergone the procedure through the distal radial approach (The Anatomical Snuffbox), and Group (B) included 30 patients who undergone the procedure through the traditional Transradial approach.

Patients with past history of hand orthopedic surgery, past history of vascular hand surgery, past history of GABG using radial artery graft and patients with past history of complicated radial artery approach were excluded from the study.

Each patient was subjected to history as Age, gender, habits of medical importance, Full analysis of chest pain especially as regards type, duration, what increase and what decrease, risk factors as Previous ischemic events, Diabetes mellitus, hypertension, dyslipidemia, chronic kidney disease, peripheral vascular disease, cerebrovascular disease and obesity.

Clinical examination included general examination as ABP and heart rate, weight, height, body mass index and local examination.

Investigation as Twelve lead surface ECG, Echo_Doppler Study and Arterial Doppler Pre and post procedures

1) Procedure:

- **Distal transradial approach technique**

After receiving institutional review board approval, Patient demographics, procedural and radiographic metrics, and clinical data were recorded. Distal transradial approach technique Procedural consent, pre procedure testing, room setup, and post procedure assessment were performed. The right arm or the left arm is placed comfortably on a cushion on the right or left side of the patient, after disinfection, the patient is covered with a sterile drape. The operator took up a position near the patient's forearm for subcutaneous injection of 3 cc xylocaine filling the Snuff Box area. To bring the artery to the surface of the fossa, the patient was asked to grip slightly his thumb under the other four fingers, with the hand slightly abducted. The RA was punctured with a 21G needle, under an angle of 45 degrees. The needle was directed to the point of strongest pulse, proximal in the anatomical snuffbox. After the successful puncture in the anterior wall of the RA, a small skin incision was made, followed by introduction of 6F radial sheath. Subsequently underwent an administration of 200 mcg of nitroglycerine and a weight-adjusted dose of heparin. The operator took up a

position at the level of the patient's knees to manipulate the 0.35 wire and the coronary catheters to make the Coronary angiography and/or coronary intervention. After the procedure, the sheath is removed and pressure is held over the arteriotomy site to achieve hemostasis. Used TR—Band either Traditional band.

- **Conventional Transradial Catheterization**

Under sterile conditions, the radial artery is accessed with a 20- to 21-gauge needle, and a 5F-6F sheath is advanced into the artery over a wire using the Seldinger technique. Vasodilators (usually verapamil and nitroglycerin) are administered to reduce radial artery spasm, Hydrophilic sheaths were generally used to minimize trauma to the radial artery. An anticoagulant (usually unfractionated heparin) is given to prevent radial artery thrombosis; a guidewire is then advanced from the radial artery to the ascending aorta. Catheters are advanced over the guidewire and used for coronary angiography and/or coronary intervention. Specialized catheters shaped to aid in engaging the coronary arteries from the transradial approach have been developed, although traditional coronary catheters can also be used. After the procedure, the sheath is removed and pressure is held over the arteriotomy site to achieve hemostasis. Used TR-Band either Traditional band.

2) Follow up:

Arterial Doppler had been done pre procedural and post procedural for all the patients in the two groups to assess the flow through the Radial artery and to evaluate the post procedural complications.

3) Outcomes of the procedures in the two groups had been reviewed including:

Success and failure rate of cannulation. Post Catheterization Radial Artery Occlusion, Hematoma, Pulsatile hematoma, Infection, Arteritis, Dissection, and Rupture of access artery (perforation), Total duration of the procedure, Discharge time and satisfaction between groups.

Statistical Methods

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean \pm SD, the following tests were used to test differences for significance; Difference and association of qualitative variable by Chi square test (X²). Differences between quantitative independent groups by t test. P value was set at <0.05 for significant results & <0.001 for high significant result.

3. Results

All patients were subjected to history taking and full clinical examination, Radial

artery Doppler pre procedural and post procedure was done, Coronary angiography was recorded and intervention was done, the data was collected and analyzed as follows:

Age distributed as 53.47 ± 4.32 ys and 53.07 ± 4.412 ys with no significant difference between groups as shown in **Table 1**.

Group (A) included 30 patients out of them: 25 patients were males and 5 were females, whereas in group (B): 21 patients were males and 9 were females. There was no significant difference between groups regarding gender as shown in **Table 2** and **Figure 3**.

There was no significant difference between groups regard risk factors. Group (A): were diabetic, 18 were dyslipidemia and 7 were hypertensive while in Group

Table 1. Comparison between two groups as regard age.

Groups	Age					T-test	
	Range	Mean	\pm	SD	t	P-value	
Snuff box (Group A)	45 - 60	53.47	\pm	4.32	0.266	0.791	
Radial (Group B)	46 - 60	53.77	\pm	4.41			

Table 2. Comparison between two groups as regard gender.

Gender	Groups					
	Snuff box (Group A)		Radial (Group B)		Total	
	N	%	N	%	N	%
Female	5	16.7	9	30.0	14	23.3
Male	25	83.3	21	70.0	46	76.7
Total	30	100.0	30	100.0	60	100.0
Chi-square	X ²		1.491			
	P-value		0.222			

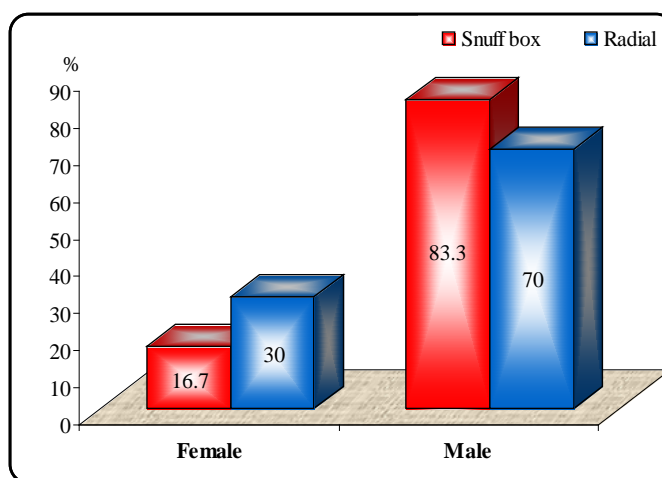


Figure 3. Comparison between two groups as regard gender.

B: 6 were diabetic, 17 dyslipidemia and 7 hypertensive were as shown in **Table 3**.

There was no significant difference between two groups as regard 1st cannulation attempts, in group, (A) 5 patients failed to be cannulated while in group (B) 3 patients failed to be cannulated also. There was no significant difference between the two groups as regard failure of cannulation. In group (A) 27 were successfully Cannulated with (3) failure of cannulation and this failure rate because of this new approach needs more experience, whereas 30 successfully cannulated members of the Group (B) due to higher experience of traditional radial artery cannulation as shown in **Table 4**.

Thrombosis higher significantly at group (B) with more thrombosis 8 cases in group (B) with monophasic wave in Doppler post procedure at the time of discharge, even 2 cases in group (A) with Monophasic wave in Doppler study after procedure at the time of discharge, Bleeding is more in group (B) 2 cases have bleeding in group (A) and need more long time of compression, in comparison with group (A) which 1 case have bleeding as shown in **Table 5** and **Figure 4**.

Patient satisfaction is higher significant with group (A) (90%) than group (B) (66.7%) as shown in **Table 6** and **Figure 5**.

Total duration of the procedure (totally 30 cases) in group (A) is 22.67 ± 11.28 minutes in comparison with group (B) (totally 30 cases) is 23.83 ± 11.57 minutes with non-significant difference between two groups as shown in **Table 7**.

In group (A) the time of discharge assessed after the procedure was 3.43 ± 0.50 H, in comparison with the group (B) the time of discharge was 4.76 ± 0.61 H, significantly shorter as time distributed in group (A) as the time needed for compression is shorter than group (B) and this result with P value $< 0.001^*$ as shown in **Table 8**.

Table 3. Comparison between two groups as regard risk factor.

Risk Factor	Groups				Chi-square	
	Snuff box (Group A)		Radial (Group B)		X ²	P-value
	N	%	N	%		
DM	5	16.7	6	20.0	0.111	0.739
Dyslipidimc	18	60.0	17	56.7	0.069	0.793
HTN	7	23.3	7	23.3	0.000	1.000

Table 4. Failure of arterialcannulation distribution between groups.

Failure	Groups				Chi-square	
	Snuffbox (Group A)		Radial (Group B)		X ²	P-value
	N	%	N	%		
Failure of 1 st cannulation	5	16.67	3	10	0.144	0.704
Failure of cannulation	3	10	0	0	1.404	0.236

Table 5. Comparison between two groups as regard complication.

Complication	Groups				Chi-square	
	Snuff box (Group A)		Radial (Group B)		X ²	P-value
	N	%	N	%		
Non complicated	26	86.7	20	66.7	3.54	0.067
Thrombosis	2	6.7	8	26.7	4.320	0.03
Bleeding	1	3.3	2	6.7	0.351	0.554
Infection	1	3.3	0	0.0	1.017	0.313

Table 6. Comparison between two groups as regard patient satisfaction.

Patient Satisfaction	Groups				Total	
	Snuff box (Group A)		Radial (Group B)		N	%
	N	%	N	%		
Not	3	10.0	10	33.3	13	21.7
Satisfied	27	90.0	20	66.7	47	78.3
Total	30	100.0	30	100.0	60	100.0
Chi-square	X ²			4.812		
	P-value			0.028*		

Table 7. Comparison between two groups as regard duration.

Groups	Duration (Minute)					T-test	
	Range	Mean	±	SD	t	P-value	
Snuff box (Group A)	10 - 44	22.67	±	11.28	0.395	0.694	
Radial (Group B)	10 - 45	23.83	±	11.57			

Table 8. Comparison between two groups as regard discharge time.

Groups	Discharge time (Hours)					T-test	
	Range	Mean	±	SD	t	P-value	
Snuff box (Group A)	3 - 4	3.43	±	0.50	8.566	<0.001**	
Radial (Group B)	4 - 6	4.67	±	0.61			

4. Discussion

Radial access for coronary and peripheral interventional angiography has dramatically increased worldwide since its introduction in 1989 by Campeau. Interventional cardiology studies comparing a transradial approach (TRA) with a transfemoral approach (TFA) have shown an unequivocal benefit of the former,

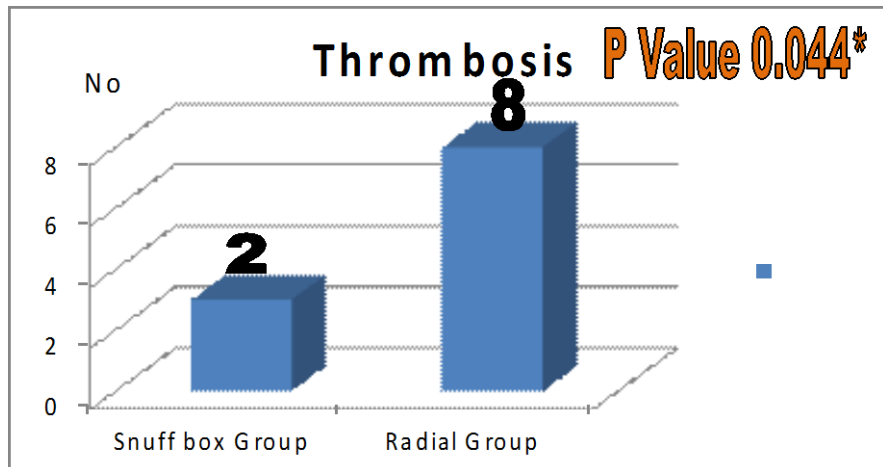


Figure 4. Thrombosis COMPLICATION (RAO) distribution between groups.

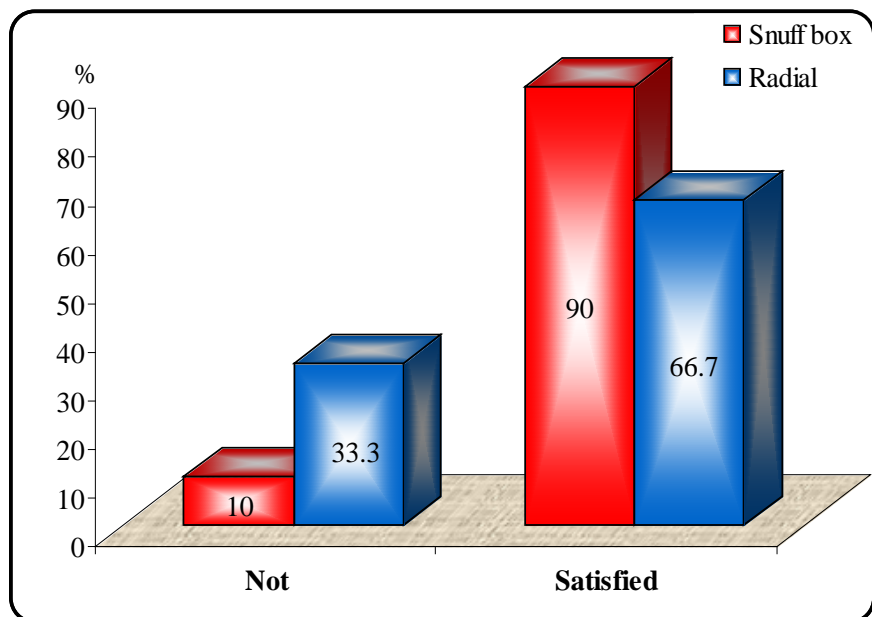


Figure 5. Comparison between two groups as regard patient satisfaction.

with reduced morbidity and mortality, greater patient preference, and cost reductions [14].

Performing the endovascular interventions via forearm radial artery (FRA) is considered preferable due to the lower risk of access site bleeding his is caused by anatomical proximity of the radial artery to the “bone basement” [15].

Interventional cardiologists have recently begun to adopt a modification of TRA, the distal transradial approach (dTRA), for coronary interventions. A rare minor complication of TRA is radial artery occlusion (RAO), a clinically silent complication that occurs in approximately 4% of patients [16].

Repeated transradial procedures may increase the occurrence of arterial occlusion and limit the viability of the vessel as an access site for further procedures or grafting. The dTRA confers theoretical improvements in preservation

of the radial artery, as well as ease of left-sided catheterization, and improved patient-operator ergonomics. More importantly, this segment of the radial artery is distal to the origin of the superficial palmar branch, which supplies numerous palmar collaterals to the deep palmar arch. Puncture at this site preserves palmar collaterals, decreasing the risk of ischemic hand events even in cases of post procedural arterial occlusion at the access site. Preliminary cardiology results have shown technical and procedural success and no access-site complications [17].

The anatomical snuffbox is a depressed space located in the radial part of the wrist and surrounded laterally by the tendons of the abductor pollicis longus and extensor pollicis brevis muscles and medially by the tendon of the extensor pollicis longus muscle. Although the rate of RAO in standard TRA is low (1% - 6%) and nearly always asymptomatic, rare cases of hand ischemia have been described in the setting of inadequate ulnar collateral circulation, as well as symptoms of pain or paresthesias at the site of the arterial occlusion [18].

Additionally chronic RAO or intimal damage to the radial artery can limit future transradial access as well as use of the radial artery as a conduit for bypass grafting or arteriovenous fistula formation. Puncture distal to the origin of the superficial palmar branch of the radial artery diminishes the risk of ischemic events in the setting of RAO, because post procedural RAO typically occurs at the site of puncture. Owing to bifurcation of the radial artery, in dTRA the superficial palmar branch is preserved and allows for adequate perfusion of the hand even in the event of distal radial RAO. Furthermore, RAO in the distal radial artery does not limit future interventions via a traditional TRA or surgical grafting [19].

Feasibility and safety of this technique initially provoked some euphoria among some interventional specialists, but later there was a realization of disadvantages of Radial artery catheterization including radial artery spasm, vessel thrombosis and different types of wall lesions of the access artery, The common place for radial artery catheterization is forearm at its distal third, but another site to puncture the radial artery is located within the anatomical snuffbox, and distally, at the dorsal hand, in the vertex of the angle between the long extensor of the thumb and the second metacarpal bone. Radial artery catheterization within the anatomical snuffbox followed by hemostasis allows preserving distal blood flow in the superficial palmar arch thus reducing the risk of occlusion of the access artery. Moreover, this approach also reduces the risk of redundant compression with following occlusion of the access artery [19].

That is why the study was selected to be conducted to reduce the rate of access-related complications by compare between the Traditional radial access and new distal radial approach by history and Doppler investigation and follow up.

The main results of the study were as following:

Our study show that Out of the 60 patients, 25 (83%) were male and 5 (17%)

were female in Snuff box Group whereas 21 (70%) members of the Radial Group were male and 9 (30%) were female. There was no significant difference between groups regarding sex. The mean \pm SD ages was distributed as 53.47 ± 4.32 years and 53.77 ± 4.42 years with no significant difference between groups also there was no significant difference between groups.

This agreement with study conducted by [20] who study Coronary angiography using the left distal radial approach-an alternative site to conventional radial coronary angiography and reported that mean age of patients was 59.3 years and 80% were male.

This copied that study conducted by [21] who reported that the mean \pm SD ages of studied group was distributed as 53.42 ± 4.13 . Also this agreement with study is conducted by who reported that Male participants comprised 41.2% of the recruited participants.

In the present study regarding Risk Factor. Out of the 60 patients, 5 (17%) were DM in Snuff box Group whereas 6 (20%) members of the Radial Group, 18 (60%) were Dyslipidemia indistal radial Group whereas 17 (57%) members of the Radial Group and 7 (23%) were HTN in distal radial Group whereas 7 (23%) members of the Radial Group.

This agreement with study conducted by [20] who reported that Hypertension and diabetes mellitus were the most frequent risk factors for cardiovascular disease, with rates of 61.1% and 33.3% respectively.

Data on distal radial access remain limited in both the cardiology and neuro interventional literature. Failure rates requiring cross over to either TRA or TFA is reported to be between 0.3% and 11% [22].

In the present study regarding Failure rate distribution between groups. Out of the 60 patients, 27 (90%) were no Failure in distal radial Group whereas at radial group 30 (100%) members without failure of cannulation.

[23] Reported that access was suitable in 195 patients with a success rate of 89.4%. In 9 patients arterial puncture failed, while in 14 others despite successful arterial puncture the wire could not be advanced towards the forearm part of the radial artery.

[24] reported that The overall failure attempt incidence was 10.2% and the mean puncture time 3.9 ± 4.1 min. Angiography only was performed in 81.8% and angiography followed by percutaneous coronary intervention in 18.2% of the patients.

[25] Reported that the successive use of the same radial artery is associated with a cannulation failure rate of 3.5% and 7.9% in men and women, at the second attempt, rising to 30% and 50% at the 5th attempt, respectively.

The present study showed that duration was distributed as 22.4 ± 7.03 and 23.0 ± 7.2 with no significant difference between groups.

The present study showed that Thrombosis was higher significant with radial group (2.7%) than distal radial group (6.7%).

Although occurrence of RAO depends on various factors, including heparin dose, sheath size, vasodilator use, and hemostatic events, recent studies have

suggested that damage to the arterial wall and subsequent changes including medial dissection, intimal tear, and thrombus formation are predominantly observed at the puncture site [26] [27]. This may contribute to the subsequent retrograde thrombus formation and total occlusion of the radial artery [25].

One randomized study of 200 patients demonstrated no significant difference in rates of RAO after dTRA versus TRA for coronary intervention (5% dTRA vs 9% TRA, $p = 0.407$). However, in a study of 1320 patients who underwent right dTRA for coronary intervention, late RAO was observed in only 0.61% of cases [19].

[20] reported that Owing to the clear safety benefits of transradial access, our center uses a default traditional transradial approach for diagnostic angiography. However, recent reports in the interventional cardiology literature have suggested additional advantages of decreased rates of RAO and ischemic hand events, as well as improved ergonomics with distal transradial artery access in the “snuffbox”.

The present study showed that Bleeding was none significantly between radial group 6.7% and distal radial group 3.3%.

[24] Reported that Manual hemostasis was applied in 63.6% of the patients, which had a significantly shorter duration than device hemostasis (11 ± 7 versus 198 ± 42 min, $p < 0.001$). No distal or forearm radial artery occlusion was observed on triplex ultrasonography 24 h after successful hemostasis. No major complications were recorded.

The present study showed that discharge time Shorter in distal radial Group significantly 3.43 ± 0.50 hours versus radial group 4.67 ± 0.61 hours.

This agree and Further benefits cited for snuff box access include shorter discharge times due to statistically significant decreases in the time needed for radial artery compression (69 min less than traditional radial puncture for punctures in the snuff box in patients undergoing cardiac interventions). As of 2018, only 200 snuff box radial access cases had been described and predominately in the cardiac literature [13].

The present study showed that patients Satisfaction more in distal radial Group (90%) and (66.7%) in radial group.

[25] Found that slightly higher rates of patient satisfaction in the dTRA group than in the TRA group, although this difference was not significant.

Conclusion and Recommendation

Coronary procedures by distal radial approach have minor access complication versus the conventional transradial approach.

So the present study recommends that the cardiac intervention from distal radial artery access more benefits, less incidence of complication. Also we found we can do Coronary angiography and intervention from anatomical snuff box access.

Further long-term studies will be needed for a more accurate assessment of

procedure-related complications.

Limitation

The study was performed at a single center with a relatively small study population. Different operators with variable skills, Financial issues also limit the increasing the population of the study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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