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Immediate Outcomes of Trans Radial Approach versus Anatomical Snuff Box 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 interventions in more than 90% of procedures due to low prevalence of access-related complications.

Aim of the work: The aim of the study was to develop and to implement a new radial artery access (located at hand) for performing endovascular interventions. Also, our object to reduce the rate of access-related complications by comparison between the traditional radial access and new trans distal radial approach by history and Doppler investigation and follow up. **Materials and methods:** This was a clinical trial study that included 100 patients who presented to the Cardiology Departments in El Sayed Galal Hospital to perform planned trans radial coronary angiography and coronary intervention for diagnosis and treatment of ischemic heart events. The study was carried out on 100 patients that were divided into two groups, one group had 50% of patients underwent the procedure through the traditional Trans radial approach and the other half of the patients underwent the procedure through the new approach (The Anatomical Snuffbox).

Results: the results revealed that Complication higher in radial but not significant (12% in Snuff- box group and 24% in Radial group).

Conclusion: To be proficient with both approaches, the operator needs to understand the differences between these two routes in terms of patient preparation, procedural technique, catheter selection and laboratory setup.

Keywords: Radial Artery, Snuff Box, Catheterization Clinical Trial.

INTRODUCTION

Radial arterial access for performing interventional procedures was first introduced in 1993 [(1)]. 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 closely to the radial bone that facilitates puncture and following hemostasis. 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 [(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 and other feature of this area is that it is surrounded by soft tissues of hand, which is essential for the adequate hemostasis. Technique of radial artery intervention through anatomical snuffbox access starts by placing the right arm comfortably on a cushion on the right 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 xylocine [(2)].

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. Then, under angle of 21 degrees, radial artery is punctured with a 45 G needle. The needle was directed to the point of strongest pulse proximal in the anatomical snuffbox. After successful puncture in the anterior wall of the radial artery, soft tip coronary wire 0.014 mm is used to pass a tortuosity that exist in the radial artery traditional site of puncture. A small skin incision is done, followed by introduction of 5 Fr radial sheath subsequently underwent an administration of 200 mcg of nitroglycerine and a weight- adjusted dose of heparin. The operator takes up a position at the level of the patient's knee to manipulate the wire and the coronary catheters (Right and Left Judkins catheters) to do the coronary procedures [(1)]. In this area, the radial artery is surrounded by soft tissues of hand, which is essential for the adequate hemostasis. Performing the endovascular interventions via forearm, radial artery (FRA) is considered preferable due to the lower risk of access site bleeding. This is because of the above-mentioned anatomical proximity of the radial artery to the "bone basement [(3)]. Arterial wall damages in access site are multi-faceted: perforation and/or pulsatile haematoma (false aneurysm), injury of proximal major blood vessels and arteriovenous fistula. Post-catheterization radial artery occlusion is the most common complication of radial access. It is reported by different authors to occur in 0-10% of case. There are three fundamental causes of the access artery occlusion; arterial puncture, arterial catheterization [(4)] and incorrect puncture hemostasis [(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 [(4)].

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PATIENTS AND METHODS

This was a clinical trial study that included 100 patients who presented to the Cardiology Department, Al-Azhar University to perform planned trans-radial coronary angiography and coronary intervention for diagnosis and treatment of ischemic heart events.

Ethical approval and written informed consent:

An approval of the study was obtained from Al-Azhar University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation.

Exclusion criteria:

1- Patients that are undergoing coronary intervention from radial access.
2- Patient who had past history of vascular hand surgery.
3- Patient who had past history of GABG been taking radial artery graft.

All cases will be analyzed thoroughly as regards:

I. History:

• **Personal history**: Age, gender, habits of medical importance

• **Present history**: Full analysis of chest pain especially as regards type, duration, what increase and what decrease.

• **Past history**:

Medical: Diabetes mellitus, hypertension, dyslipidemia, chronic kidney disease, ischemic heart disease, peripheral vascular disease, cerebrovascular disease and obesity.

Family history: family history of premature coronary artery disease.

II. Clinical examination:

•General examination:

ABP, heart rate, weight and height with special attention to signs suggestive of CAD e.g. Xanthelasma

•Local examination:

Presence of S4, Mitral regurgitation.

III. Investigation:

- Twelve lead surface ECG.
- Echo Doppler Study
- Arterial Doppler pre-and post-procedures.

Procedure: **A-Distal Trans-radial approach technique:** After receiving institutional review board approval, patient demographics, procedural and radiographic metrics, and clinical data were recorded.

• Distal trans-radial approach technique procedural consent, pre-procedure testing, room setup, and post-procedure assessment were performed.

• Patients with a history of right arm trauma, surgery, known anatomical variants, arterial occlusion, or stenosis were excluded.

• In contrast to the traditional Trans-radial technique, the puncture site is distal to the palmer arch, and thus, pre procedural assessment of collateral palmar circulation.

• The right arm is placed comfortably on a cushion on the right 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 radial fossa.

• 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 successful puncture in the anterior wall of the RA, a soft tip coronary wire 0.014" (guide-wire BMW, Abbott Vascular, Illinois, USA) was used to pass a tortuosity that exist in the RA traditional site of puncture.

• A small skin incision was made, followed by introduction of 5 Fr radial sheath

• Subsequently, patient 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 (Judkins left 3.5 catheter and Judkins right 3.0catheter; Medtronic Inc.) to make the CA. After Removal of the band, the vessel patency was confirmed by manual palpation and by Doppler study

B- Trans-radial 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 are generally used to minimize trauma to the radial artery. An anticoagulant (usually unfractionated heparin or bivalirudin) is given to prevent radial artery thrombosis.

•A guide wire is then advanced from the radial artery to the ascending aorta.

• Catheters are advanced over the guide wire and used for coronary angiography and/or coronary intervention. Specialized catheters shaped to aid in engaging the coronary arteries from the trans-radial 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. Several devices have been developed to assist in maintaining pressure on the wrist most are bands that allow easy modification of hemostasis.

- **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. Outcomes of the procedures in the two groups had been reviewed including:
- Success and failure rate of cannulation

- Post-catheterization radial artery occlusion, which is the most common complication of such procedure (0-10%).
- Hematoma (0.2%)
- Pulsatile haematoma (0.1%)
- Infection (0.1%)
- Arteritis (0.1%)
- Dissection (0.2%)
- Rupture of access artery (0.2%).
- A-V fistula (0.1%).

Statistical methods

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures are coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. Qualitative data were represent as number and percentage. Quantitative were represented by mean ± SD.

The following tests were used to test differences for significance: difference and association of qualitative variable by Chi square test and differences between quantitative independent groups by t test. P value was set at < 0.05 for significant results & < 0.001 for highly significant result.

RESULTS

Demographic data among studied groups

Table (1): Age and sex distribution between studied groups

			Snuff box group	Radial group	t/X^2	P
Age (years)			**53.42 ± 4.13ys**	**54.07 ± 4.22ys**	**-0.791**	**0.431**
Gender	**F**	**N**	**15**	**14**	**0.049**	**0.82**
		%	**30.0%**	**28.0%**		
	M	**N**	**35**	**36**		
		%	**70.0%**	**72.0%**		
Total		**N**	**50**	**50**		
		%	**100.0%**	**100.0%**		

Age was distributed as 53.42 ± 4.13 years and 54.07 ± 4.22 years with no significant difference between groups. Out of the 100 patients, 35 (70%) were males and 15 (30%) were females in snuff box group, whereas 36 (72%) members of the radial group were males and 14 (28%) were females. There was no significant difference between groups regarding sex. So patient and control group were age and sex matched (table 1).

Table (2): Risk Factors distribution between groups

				Groups		Total	X^2	P
				Snuff box group	Radial group			
Risk Factor	DM		N	9	8	17	0.48	0.78
			%	18.0%	16.0%	17.0%		
	Dyslipidemia		N	30	28	58		
			%	60.0%	56.0%	58.0%		
	HTN		N	11	14	25		
			%	22.0%	28.0%	25.0%		
Total			N	50	50	100		
			%	100.%	100.0%	100.0%		
Smoking	No		N	28	30	58	**0.16**	**0.68**
			%	56.0%	60.0%	58.0%		
	Smoking		N	22	20	42		
			%	44.0%	40.0%	42.0%		
Total	N		50	50	100	Total		

There was no significant difference between groups regarding risk factors. Out of the 100 patients, 9 (18%) were DM in snuff box group whereas 8 (16%) members of the radial group. 30 (60%) were dyslipidemia in snuff box group whereas 28 (56%) members of the radial group and 11 (22%) were HTN in snuff box group whereas 14 (28%) members of the radial group. Out of the 100 patients, 22 (44%) were smoking in snuff box group whereas 20(40%) members of the radial group were smoking (table 2).

Table (3): Failure distribution between groups

			Groups		Total	X^2	P
			Snuff box group	Radial group			
Failure	No	N	46	50	96	2.34	**0.12**
		%	92.0%	100.0%	96.0%		
	Failed	N	4	0	4		
		%	8.0%	0.0%	4.0%		
Total		N	50	50	100		
		%	100.0%	100.0%	100.0%		

There was no significant difference. Out of the 100 patients, 46 (92%) showed no failure in snuff box group whereas 50 (100%) members of the radial group. 4 (8%) failed in snuff box group whereas 0% members of the radial group as shown in table (3).

Table (4): Status distribution between groups

			Groups		Total	X^2	P
			Snuff box group	Radial group			
Status	Coronary Angio	N	32	33	65	**0.044**	**0.83**
		%	64.0%	66.0%	65.0%		
	PCI	N	18	17	35		
		%	36.0%	34.0%	35.0%		
Total		N	50	50	100		
		%	100.0%	100.0%	100.0%		

Status distribution coronary angio was distributed as 64 & 66% with no significant difference between groups and PCI was distributed as 36% & 34% (table 4).

Table (5): Duration distribution between studied groups

	Snuff box group	Radial group	t	P
Duration	**22.4 ± 7.03**	**23.0 ± 7.2**	**-0.286**	**0.775**
Time to sheath(hours)	**10.6 ± 2.24**	**9.55 ± 2.11**	**-0.327**	**0.643**

This table showed that duration was distributed as 22.4 ± 7.03 minutes and 23.0 ± 7.2 minutes with no significant difference between groups. 10.6 ± 2.24 minutes in sheath insertion in snuff box group and 9.55 ± 2.11 minutes in radial group with no significant difference between groups (table 5).

Table (6): Complication distribution between groups

			Groups		Total	X^2	P
			Snuff box group	Radial group			
Complication	NAD	N	**44**	**38**	**82**	**0.87**	**0.34**
		%	**88.0%**	**76.0%**	**82.0%**		
	Bleeding	N	**2**	**3**	**5**	**0.4**	**0.52**
		%	**4.0%**	**6.0%**	**5.0%**		
	Infection	N	**1**	**1**	**2**	-----	-----
		%	**2.0%**	**2.0%**	**2.0%**		
	Thrombosis	N	**3**	**8**	**11**	**4.51**	**0.033***
		%	**6.0%**	**16.0%**	**11.0%**		
Total		N	**50**	**50**	**100**		
		%	**100.0%**	**100.0%**	**100.0%**		

Thrombosis was significantly associated with radial group (16%) as shown in table (6).

Table (7): Overall complication distribution between groups

			Groups		Total	X^2	P
			Snuff box group	Radial group			
Complication	**Not**	N	**44**	**38**	**82**	**2.43**	**0.11**
		%	**88.0%**	**76.0%**	**82.0%**		
	Complicate	N	**6**	**12**	**18**		
		%	**12.0%**	**24.0%**	**18.0%**		
Total		N	**50**	**50**	**100**		
		%	**100.0%**	**100.0%**	**100.0%**		

Complication higher in radial but not significantly (12%) in snuff box group and (24%) in radial group (table 7).

Table (8): Satisfaction distribution between groups

			Group		Total	X^2	P
			Snuff box Group	Radial Group			
Satisfaction	Not	N	**5**	**14**	**19**	**5.26**	**0.022****
		%	**10.0%**	**28.0%**	**19.0%**		
	Satisfied	N	**45**	**36**	**81**		
		%	**90.0%**	**72.0%**	**81.0%**		
Total		N	**50**	**50**	**100**		
		%	**100.0%**	**100.0%**	**100.0%**		

Satisfaction significantly associated with snuff box group (90%) more than in radial group (72%) as shown in table (8).

Table (9): Satisfaction distribution between right and left snuffbox

			Group		Total	X^2	P
			Right	Left			
Satisfaction	Not	N	**4**	**1**	**5**	**2.92**	**0.081**
		%	**18.8%**	**3.5%**	**10.0%**		
	Satisfied	N	**18**	**27**	**45**		
		%	**81.2%**	**96.5%**	**90.0%**		
Total		N	**22**	**28**	**50**		
		%	**100.0%**	**100.0%**	**100.0%**		

Satisfaction was more in left snuff box group but not significantly (96.5% and 81.2%) in left and right successively.

DISCUSSION

From womb to tomb" it matters, argues the 2001 Institute of Medicine report**;** biological sex should be a fundamental consideration in human health and disease. Indeed, a number of human diseases manifest profound sex-based differences in prevalence, incidence, severity, and response to treatment. Yet, sex as a biological variable has long been ignored experimentally in the biomedical sciences and clinically in the application of evidence-based medicine such a sex bias that is well entrenched in our understanding. It is slightly more common in men, who are generally at greater risk of coronary artery disease, family history and race [(6)]. Our study showed that out of the 100 patients, 35 (70%) were male and 15 (30%) were female in snuff box group whereas 36 (72%) members of the radial group were male and 14 (28%) were female. There was no significant difference between groups regarding sex and age (53.42 ± 4.13 and 54.07 ± 4.2 years for snuffbox and radial groups successively). This is in agreement with the study conducted by **Soydan and Akın** [(6)] who studied 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. Besides, **Roghani-Dehkordi *et al.*** [(7)] reported that in 159 patients, men were 76% with age 58.1 ± 10.5 years and women were 24% with age 61.2 ± 9.6 years). This coped with the study conducted by **Brunet *et al.*** [(8)] who reported that the mean ages of studied group was 53.42 ± 4.13 years and Male participants comprised 41.2% of the recruited participants.

In the present study, regarding risk factors, 9 (18%) were DM in snuff box group whereas 8 (16%) members of the radial group, 30 (60%) were dyslipidemia in snuff box group whereas 28 (56%)

members of the radial group and 11 (22%) were HTN in snuff box group whereas 14 (28 %) members of the radial group. Also, ECG finding distribution between groups showed that out of the 50 patients, 11 (22%) were MI in snuff box group whereas 14 (28%) members of the radial group, 39 (78%) were normal in snuff box group whereas 36 (72%) members of the radial group with no significant difference. This is in agreement with the study conducted by **Soydan and Akın** [6] who reported that hypertension (HTN) and diabetes mellitus (DM) were the most frequent risk factors for cardiovascular disease, with rates of 61.1% and 33.3% respectively. Also, they reported that seventeen patients were admitted to clinic with acute coronary syndrome, four of them had anterior ST elevation myocardial infarction (STEMI). Inferior STEMI was diagnosed in six patients. The other six patients presented with non-STEMI and the last one referred with unstable angina pectoris. Also coped with the study conducted by **Arboix** [9] who reported that the main risk factors in patients with cerebral infarction are hypertension (54.1%), atrial fibrillation (29.3%) and diabetes (22.6%), whereas in patients with hemorrhagic stroke, the frequency of hypertension was higher (61.3) but the occurrence of atrial fibrillation (15.3%) and diabetes (14.7%) was lower.

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 are reported to be between 0.3% and 11% [10]**.**

In our study, out of the 100 patients, 46 (92%) were no failure in snuff box group whereas 50 (100%) members of the radial group. 4 (8%) failed in snuff box group whereas 0% members of the radial group. There was no significant difference between groups. Regarding status distribution, coronary angio was distributed as 64 & 66% with no significant difference between groups and percutaneous coronary intervention (PCI) was distributed as 36% & 34%. **Kiemeneij** [1] reported that in a study of 70 cardiac patients, he noted a snuff box arteriotomy failure rate of eight patients**. Wretowski *et al.*** [11] reported that the Very distal trans-radial approach (VITRO) 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. **Ziakas *et al.*** [12] 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. **Brunet *et al.*** [8] reported that failure rate was 8% and the majority of failed TRA cases were converted to TFA for convenience, as the arm would have to be repositioned with more supination and subsequently re-prepped and draped to perform rescue TRA. **Mizuguchi *et al.*** [13] 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.

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. The present study showed that thrombosis was significantly associated with radial group (16%). Although, occurrence of radial artery occlusion (RAO) depends on various factors, including heparin dose, sheath size, vasodilator use and hemostatic events. Recent studies 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 [20 & 21]. This may contribute to the subsequent retrograde thrombus formation and total occlusion of the radial artery [13]**. Sinha *et al.*** [14] found that 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. However, in a study of 1320 patients who underwent right distal trans-radial access (dTRA) for coronary intervention, late RAO was observed in only 0.61% of cases [15]**. Ziakas *et al.*** [12] reported that no distal or forearm radial artery occlusion was observed on triplex ultrasonography 24 h after successful hemostasis. No major complications were recorded**. Soydan and Akın** [6] reported that owing to the clear safety benefits of trans-radial access, our center uses a default traditional trans-radial approach for diagnostic angiography.

The present study showed that bleeding was non-significant between radial group (6 %) and snuff box group (4 %), **Ziakas *et al.*** [12] Reported that, No major bleeding, requiring prolonged hospital stay, surgery or transfusion occurred. One patient on oral anticoagulation with DAP T????? had conservatively managed minor forearm bleeding.

Left-sided approaches are commonly used for cardiac catheterization, but can be cumbersome for the operator who stands on the right side of the patient. The natural hand position of dTRA allows for simple left-sided dTRA with the hand draped across the body, thus making access easier for the interventionalist standing on the patient's right side. Preferable left-sided trajectory to the coronary vessels has led to the rapid adoption of this technique in interventional cardiology [8]. The left

radial snuff box access allows for comfortable positioning of the patient's hand by the right groin, which permits the operator to stand at a further distance from the radiation source, allowing for patient comfort and an ergonomically friendly workflow similar to femoral access [16].

The present study showed that satisfaction was more in left snuff box group but not significantly (**96.5%**) as compared to right snuff box group (**81.2%**). **Koutouzis *et al.*** [17] found that slightly higher rates of patient satisfaction in the dTRA group than in the TRA group, although this difference was not significant.

CONCLUSION

In conclusion, the dTRA was associated with no bleeding complications extending to the forearm, a lower incidence of RAO at both the puncture site and forearm radial artery, and post-procedural dilatation of the radial artery lumen. Future large-scale studies are needed to further elucidate our findings. Also, snuff box, or distal trans-radial access, is a useful technique in a surgeon's armamentarium. While this technique's use is in its infancy within the neuroendovascular setting, at this time, it appears to be safe, well tolerated, and preferred by patients over transfemoral access.

RECOMMENDATIONS

With appropriate patient assessment and preparation, the right and left routes to transradial catheterization are equally safe and effective. To be proficient with both approaches, the operator needs to understand the differences between these two routes in terms of patient preparation, procedural technique, catheter selection, and laboratory setup. It is recommended that each cardiac catheterization laboratory develop specific protocols for right and left radial access to enhance the efficiency and likelihood of successful outcomes from trans-radial procedures.

LIMITATIONS

- The study was performed at a single center with a relatively small study population**.**
- The results were obtained from only one centers (Cardiology Department. Al-Azhar University).
- Different operators with variable skills.
- Financial issues also limit the increasing the population of the study.

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