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Transradial Artery Approach for Diagnostic Coronary Angiography: Immediate Clinical and Procedural Outcome

Abbass Baker Alqarashi [1]

Ali Jabbar Alibrahemi [2]

Muthanna Hameed.Alquraishi [3]

[1]Al-Najaf Cardiac Center, Najaf, Iraq.

[2,3] Ibn Albitar Cardiac Center, Baghdad, Iraq.

*** Ibn Albitar Cardiac Center, Baghdad, Iraq.

الخلاصة:

خلفية البحث: ان تصوير الشرايين التاجية عن طريق الشريان الكعبري ظهر كبديل جذاب بالنسبة للشريان الفخذي وان هذا النهج اذا كان في ايدي ذات خبرة فانه سوف يمنح المرضى الراحة ويقلل من مضاعفات موضع الدخول للشريان.

الهدف: لتقييم النتيجة السريرية والاجرائية لتصوير شرايين القلب التاجية عن طريق الشريان الكعبري.

المنهجية: هذه دراسة مقطعية وصفية تم اجرائها في مركز احالة ثلاثي للتداخل القسطاري وجراحة القلب لمرضى لديهم نبض جيد للشريان الكعبري وفحص طبيعي لاختبار الين وقد شملت الدراسة 70 مريضا, تم اجراء تصوير الشرايين التاجية لهم من الفترة اكتوبر / تشرين الاول / 2012 الى ابريل / نيسان 2013.

النتائج: تمت محاولة اجراء تصوير الشرايين التاجية لسبعين مريضا وكان الشريان الكعبري الايمن هو المفضل في كل الحالات. وكانت نتيجة نجاح الاجراء 91.4 % وكان السبب الرئيس لفشل العملية هو عدم امكانية ثقب او اقتاء الشريان الكعبري وكذلك التواء الشريان تحت الترقوة او بسبب التشنج الشرياني. لم تحصل مضاعفات وعائيه بسيطة او رئيسية بسبب الاجراء ماعدا مريضا واحدا (1.4%) والذي حصل عنده ورم دموي سطحي وصغير في الساعد. وكان معدل وقت القسطرة الناجحة 3.9 ±4.8 دقيقة (مدى3.3-8.1 دقيقة) وكان معدل الوقت الكلي لأجراء القسطرة 11.2 ± 33.12 دقيقة (مدى 20 -60 دقيقة).

الاستنتاجات: تعتبر قسطرة الشرايين التاجية عن طريق الشريان الكعبري اجراء أمين وبديل فعال لأجرائها عن طريق الشريان الفخذي.

CORRESPONDING AUTHOR:
Ali Jabbar Alibrahemi; Ibn Albitar Cardiac Center, Baghdad, Iraq,
E-mail: alialibrahemi@yahoo.com

ABSTRACT

Background: The transradial approach has emerged as an attractive alternative to the femoral approach for coronary angiography. In the hands of experienced operators, transradial coronary angiography offers improved patient comfort and decreased access-site complications.

Objectives: To evaluate the immediate clinical & procedural outcome of transradial approach for coronary angiography.

Methodology: This is a descriptive cross sectional study carried out in a tertiary cardiac center .The transradial approach was attempted in patients with a good radial pulse and normal Allen test. This study enrolled 70 patients who underwent coronary angiography during the period from October 2012 to April 2013.

Result: The transradial approach was attempted in 70 Patients. The preferred side for transradial

approach was the right side in all cases. The procedure success was 91.4%. Failure of puncture or canulation of the radial artery was the main cause of failure rate, followed by subclavian tortuosity and radial artery spasm. No minor or major vascular complications due to the procedure apart from one patient (1.4%) who got small superficial hematoma in the forearm. The average time for successful canulation was 4.8± 3.9 min (range 3.3 to 8.1 minutes), and that of the catheterization procedure was 33.12 ± 11.2 minutes (range 20-60 min.).

Conclusion: The transradial approach for coronary angiography is a safe and effective alternative to femoral approach.

Keyword: Transradial , coronary, angiography.

INTRODUCTION

Transradial approach (TRA) for performing coronary angiography and coronary intervention has become increasingly popular since its first introduction by Campeau in 1989 for diagnostic coronary angiography [(1)]. It is associated with decreased incidence of hemorrhagic and vascular complications, increased patient comfort, earlier ambulation, earlier hospital discharge and cost reduction [(2)]. The inherent advantages of the TRA are that, the hand has a dual arterial supply connected through the palmar arches and that there are no nerves or veins at the site of puncture. In addition, bed rest is unnecessary after the procedure, allowing more efficient outpatient angiography [(3)].

AIMS OF THE STUDY

To evaluate the immediate clinical & procedural outcome of transradial approach for coronary angiography.

METHODOLOGY

From October 2012 to April 2013, seventy patients who underwent diagnostic coronary angiography in whom TRA was used were included in this study. The study was done in Ibn Albitar specialized center for cardiac surgery in Baghdad, Iraq.

The choice of approach was left to the cardiologist. In order to determine eligibility for attempted radial access, we determined if contraindications for the procedure were slight or absent, the existence of an abnormal Allen test, the existence of a known arterial circulatory disease in one of the upper limbs, a history of coronary revascularization surgery with the left internal mammary artery, the need for the simultaneous performance of right catheterization, acute pulmonary edema, and shock, chronic renal insufficiency (creatinine >2.0mg/dl) with the potential necessity of using the radial artery as a native fistula in the future, hemodialysis patients with an arteriovenous fistula, absence of an experienced operator, and patient refusal were considered as

exclusion criteria. All patients gave written informed consent before cardiac catheterization procedures.

The study was approved by the ethics committee of the hospital. An Allen test was performed on both hands prior to TRA. The radial pulse should be monitored regularly for several hours after the procedure.

All patients were evaluated 24 hours after the procedure for the presence of palpable hematomas at the puncture point, hemorrhage, and the presence of a distal radial pulse. Similarly, we performed an inverse Allen test which was considered abnormal if normal color did not return to the hand within 10 seconds after removing pressure to the radial artery (4).

Statistical analysis:

Data were expressed as mean ± standard deviation. Chi square test had been applied for categorical association and independent t test for mean difference of numerical variables at level of significance $\alpha = 0.05$ ($P \leq 0.05$).

RESULTS

Table (1): The base line clinical characteristics of the patients

Characteristic	Total no. (70)
Age (years)	56.6 ± 10.4 (range 31-76)
Sex	Male : 45 (64.3%)
	Female : 25 (35.7%)
Height (meter)	1.65 ± 0.06 (range 1.48-1.78)
Weight (Kg)	75.2 ± 9.6 (range 60-116)
Body Mass Index, BMI (Kg/m^2)	27.6 ± 4.01(range 21.31-44.2)
Clinical indications for catheterization.	
- Stable Angina	12 (17.1%)
- Unstable Angina	42 (60%)
- Myocardial infarction	12 (17.1%)
- Valvular heart disease and other indications	5 (7.1%)

CAD=coronary artery disease

Seventy patients were included in this study, 45 (64.3%) were males and 25 (35.7 %) were females, with a mean age of 56.6 ± 10.4 years (range 31-76 years). The base line clinical characteristics are summarized in (table 1).

Access site selection and technical aspect

The preferred side for TRA was right radial artery in all cases. Allen test was done in all patients to assess dual hand circulation before TRA. The procedure was performed via the femoral artery in 5 patients (7.14%) and via the ipsilateral brachial artery in one patient (1.4 %) because of failure of the TRA. In all patients included in this study, the needle used to puncture the radial artery was a 21-gauge bare needle. The introducing wire used was a

straight 0.021- inch wire, and the sheath was 6 F-7.5 cm hydrophilic. Nitroglycerine plus heparin was used as premedication (given into the sheath) to prevent artery spasm in 60 patients (93.75 %), while combination of nitroglycerine and verapamil plus heparin was used in only 4 patients (6.25 %), depending on the availability of the drugs. In all patients a 0.035 J-shaped standard advancing wire for catheters was used. In twenty patients out of 64 (31.2%) ,use of more than one catheter were required to engage the right coronary artery (RCA), while in 15 patients (23.4%),more than one catheter were required for engagement of the left coronary artery (LCA).

Table (2): Types of catheters used to engage left & right coronary arteries

LCA		RCA	
Catheter type	**Total no. (64)**	**Catheter type**	**Total no. (64)**
JL 6/3.5	54(84.4%)	**JR 6/3.5**	35(54.7%)
JL6/4	7(11%)	**JR 6/4**	20(31.3%)
JL6/3 (GUIDING)	2(3.1%)	**JL 6/3.5**	6(9.4%)
AL 1	1(1.5%)	**AR1**	3(4.6%)

JL= Judkins left, AL= Amplatz left, JR= Judkins right, AR= Amplatz right

Left coronary artery (LCA) was engaged by JL 6/ 3.5 in 84.4% of cases; and right coronary artery was mainly engaged by JR 6/ 3.5 and JR 6/ 4 in 54.7% and 31.3% respectively (table 2).

Table (3): Procedural characteristics and complications

Characteristic	Total no. 67	Total no. (70)		Sex		P-value	Age (years)		P-value
				Male No.(45)	Female No.(25)		<65 No.(49)	≥ 65 No.(21)	
Success rate		64 (91.4%)		40 (88.8%)	24 (96%)	0.31	46 (93.8%)	18 (85.7%)	0.26
Procedure failure		6 (8.6%)		5(11.1%)	1(4.1%)	0.28	3(6%)	3(14.2%)	0.28
Puncture or canulation failure		3 (4.3%)		1(2.2%)	2(8%)	0.5	1(2%)	2 (9.5%)	0.5
Failure to reach coronary arteries	3(4.4%)	Radial artery spasm	1(1.5%)	1(2.2%)	0(0%)	0.76	1(2.04%)	0(0%)	0.19
		Subclavian artery tortuosity	2(3.0%)	1(2.2%)	1(4.0%)	0.75	1(2.04%)	1(4.7%)	0.87
Vascular complications: (Hematoma of forearm)		1 (1.4%)		0	1 (4%)	0.5	0	1(4.7%)	0.5

Time for successful canulation of RA		4.7± 3.9 min. (range 3.3 to 8.1)	4.6± 3.8	5.7±4.5	0.23	4.4±3.6	4.8±3.9	0.23
Total time of the procedure		33.12 ± 11.2 minutes (range 20-60 min.)	34.15± 11.82	31.29± 10.59	0.24	32.28± 10.32	35.27± 13.44	0.13
Fluoroscopy time		6.4 ± 4.1 minutes (range 2-22min.)	6.34± 3.98	6.40± 4.50	0.81	6.30±4.45	6.54±3.34	0.24
Contrast volume	148.2 ± 39.01 ml (range =100-250 ml							

The procedure was performed successfully in 64 cases (91.4%), and in 6 patients (8.6 %), it was not possible to perform the procedure trans radially. Reasons for procedural failure were: inability to puncture or cannulate the radial artery which occurred in three patients (3.4%) and inability to reach coronary arteries because of radial artery spasm in one patient (1.5%) or subclavian artery tortuosity in two patients (3.0%). Good-quality opacification of both coronary arteries was obtained in all 64 patients in whom selective catheterization was carried out.

Age and gender had no statistical significance on all the above procedural characteristics. Clinical follow up for 24 hours revealed no minor or major vascular complications due to the procedure apart from one patient (1.4%) who got small superficial hematoma in the forearm.(table 3).

Table (4): Relation of the height and BMI of patients to the success of the procedure

Outcome	**Length group**		**P-value**	**BMI group**			**P-value**
	≤1.55 m	> 1.55 m	0.078	Ideal BMI (18.5-24.9)	Overweight (25-29.9)	Obese ≥ 30	0.68
	No.(8)	No.(62)		NO.(20)	NO.(35)	NO.(15)	
Successful	6 (75%)	58 (93.5%)		19 (95%)	32(91.4%)	13 (86.7%)	
Failure	2 (25%)	4 (6.5%)		1 (5%)	3 (8.6%)	2 (13.3%)	

Fifty eight out of 62 patients (93.5%) whose height was above 1.55 m had successful procedure and 19 out of 20 (95%) patients with ideal body mass index (BMI) had successful procedure, however the effect of height and BMI on the procedure outcome was no significant. (Table 4)

Access site management after coronary angiography by radial approach

Hemostasis was obtained using Terumo TR Band hemostasis device in 45 patients (64.3%) or gauze and bandage in 25 patients (35.7%), immediately applied to the puncture site without a period of manual compression. Radial artery obstruction assessment was done for all patients before discharge in the next day, the method of diagnosing radial artery obstruction was done by pulse checking and reverse Allen's test which revealed no evidence of radial artery obstruction in all patients.

DISCUSSION

In this study, the preferred side for transradial approach was right radial artery in all cases, however almost 90 % of interventional cardiologists select the right radial artery as a first access route when performing transradial procedures in international survey data [5].

Results of the studies showed, that in the hands of expert operators, there were no differences in overall success rate, procedure total duration time, number of catheters used and amount of contrast used in coronary procedures using left or right radial approach [5, 6].

Allen test was done in all patients in this study to assess dual hand circulation before TRA. Patients with poor vascular communications between the radial artery and ulnar artery, as indicated by an abnormal Allen test, are excluded from transradial coronary angiography to avoid ischemic hand complications.

Greenwood MJ et al concluded in his study that Transradial cardiac catheterization should not be performed in patients with an abnormal Allen test [7].

Ruzsa z, et al found that in the presence of an abnormal Allen test and concomitant peripheral artery disease, the use of radial artery for peripheral or coronary catheterization and angioplasty is not recommended [8].

Five of six patients in this study in whom TRA for coronary angiography was failed, the procedure was performed via the femoral artery. Olivier, et al. in the First International Transradial Practice Survey found that 31.3% cross over to the contralateral radial artery after initial radial access failure, whereas most (54.5%) revert to the standard femoral artery [5].

In all the patients included in this study, the technical aspects which include the needle which used to puncture the radial artery, the introducing wire, the sheath size and the advancing wire for catheters are comparable to the result of the First International Transradial Practice Survey which found that sheath length is most frequently short (52.3% use 10 cm) or very short (34.7% use 7.5 cm) and standard J-shaped 0.035-inch (0.889-mm) wire remains the most frequently used wire (80.0%) [5].

Premedications with nitroglycerin and verapamil have been documented to be effective in preventing radial spasms. Verapamil is relatively contraindicated for some patients with left ventricular dysfunction, hypotension and bradycardia [9,10]. In this study, the premedication given into the sheath to prevent radial artery spasm was nitroglycerin and heparin which was given to 64 patients (93.75%). Chen CW, et al study who found that intra-arterial premedication with 100 microgram nitroglycerin and 3,000 units of heparin is effective in preventing radial spasms during transradial cardiac catheterization [9].

In this group of patients included in the study, LCA was engaged by JL6/3.5 catheter in 84.4% of cases and RCA was engaged by JR6/3.5 and JR6/4 catheters in 55% of patients. The ESC guideline

suggests Judkins right or Amplatz right for right coronary artery (RCA), Judkins left for left coronary artery (LCA) and special multipurpose catheters like Tiger II as further options [11]. The diagnostic catheter is same for both transradial and trans femoral angiography, only downsizing of the catheter is required for transradial intervention [12].

Use of a single diagnostic catheter may minimize frequent exchange of hardware and thus reduce the incidence of spasm and catheter-induced cholesterol debris embolism [13].

In this study, the procedure success of TRA was 91,4% .Failure of puncture or cannulation of the radial artery was the main cause of failure rate, followed by subclavian tortuosity and radial artery spasm.

The SPASM study found that young and female were the independent predictors of radial artery spasm (RAS) [14].

In JIA De-an, et al study, it was found that female, small radial artery diameter, diabetes and unsuccessful access at first attempt were the independent predictors of radial artery spasm. For young and female patients, the sympathetic tonicity was high and the concentration of catecholamine was easy to increase, leading to increased vascular tone. For diabetic patients, serious endothelial dysfunction and the imbalance between vasodilator and vasoconstrictor substances constituted the main reasons for spasm [15].

Kiemeneij F pointed out, a straightforward, accurate, single puncture will lower the risk of spasm [16].

Carillo X , et al obtained a success rate of 94.6% among 8463 patients who underwent transradial approach coronary angiography. The main causes of transradial failure were puncture failure in 48.3% and tortuous brachiocephalic arteries in 22.8% of cases [17].

Procedural failure lessens with experience, and ultimately occurs with a frequency of less than 5% [18].

At the time of discharge the following day there were no minor or major vascular complications due to the procedure apart from one patient (1.4%) who got small superficial hematoma in the forearm.

Fernandes et al in his study found at 24 h of follow-up small hematomas in 9.4%, bleeding in 4.9%, and radial artery obstruction in 2.8%, with no cases of arteriovenous fistula, pseudo aneurysm, or need for vascular surgery [19].

The complication profile of TRA is different from those related to the femoral route, with no life-threating complications and no need of vascular surgery or blood transfusions. Most radial complications are preventable [13].

Female gender and advancing age are factors that predict TRA failure, but in this study, no significant correlation between these factors and success or failure rate was found, probably because of small sample of patients included in this study [13].

Time for successful radial artery cannulation, fluoroscopy time, total procedure time and quality of pacification of both coronary arteries in this study are similar to many other studies; In Chin et al., study [20], the time of radial puncturing was 2.19 ±1.62(min.), duration under X-ray fluoroscopy was 3.21 ±1.49 (min.) and the total duration of the procedure was 12.98 ±2.85(min.). In Fernandez JS, et al study [19], in the group B patients, the length of time for the procedure was 19 minutes (15 to 24 minutes) and the length of time for fluoroscopy was 5.0 minutes (3 to 7.7 minutes).

In this study, we found that the effect of height and BMI of the patients on the procedural outcome was no significant, however, Jack P, et al reported that, low BMI is a factor that predicts TRA failure [13]. In Dehghani P, et al study it was found that short stature was independent predictor of TR-PCI failure [21].

In this study the method of diagnosing radial artery obstruction was by pulse checking and reverse

Allen test which revealed no evidence of radial artery obstruction in all patients.

Radial artery occlusion (RAO) occurs in 3–5% of cases and is asymptomatic as a rule; 50% of radial spontaneously recanalized over time. Predictive factors for radial occlusion include long duration of catheterization, high sheath: artery ratio, heparin dosage, longer sheath, and prolonged compression times [4,13].

CONCLUSION

The transradial approach for coronary angiography is a safe and effective alternative to femoral approach because of lower complication rates and shorter hospital stay.

RECOMMENDATIONS

Radial access can be used as the first choice in most patients.

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