Original Article

Safety of Radial vs. Femoral Artery Access in Coronary Angiography

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Abstract:

Background: To evaluate the safety of radial versus femoral artery approach in routine coronary angiography (CAG) practice.

Methods: We retrospectively evaluated consecutive patients in Ibrahim Cardiac Hospital & Research Institute, a tertiary care centre, who underwent diagnostic CAG over a period of 12 months. Procedure duration was calculated as time from initiation of local anesthesia to completion of the procedure. Contrast volume and fluoroscopy time were recorded.

Results: 3346 patients who underwent a diagnostic CAG were included in this study. The radial approach was used in 3030 patients (90.5%) and the femoral approach in 316 patients (9.5%). As the radial group was disproportionately large compared to femoral group the size of the radial group was reduced to 1010 using a systematic sampling procedure, where every 3rd patient of radial group was chosen.Fluoroscopy and procedural times were not significantly different (3.41±1.14 vs. 3.85±1.43 min, p=0.314 & 11.87±4.61 vs. 13.74±6.33 min, p=0.180, respectively) comparing the radial and femoral approaches. While contrast utilization during the procedure was significantly lower in the radial than the femoral approach (57.60±22.42 vs. 69.52±24.30 mL respectively, p=0.030).

Conclusion: Transradial coronary angiography can be safely performed as the transfemoral approach.

Keywords: Coronary angiography, Radial, Femoral.

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Introduction:

Although transbrachial approach via brachial cut down, that has been introduced by Sones in 1959, was the prefer method for coronary angiography (CAG) in the 1950s and 1960s, because of the complexity of the procedure, it lost its popularity during last decades. Meanwhile transfemoral (TF) approach became popular and dominant method for catheterization and angiography, because of the simplicity of the technique and operator friendly. Whereas transradial (TR) approach in aortography for the first time was reported by Rander S, in 1948[1], due to small vessel size, this technique has been abandoned until 1989, that Campeau did relive this technique and introduced it as an ideal approach for CAG.[1] Although TF approach still is dominant approach worldwide, during the last decade TR approach has emerged as a new method for CAG and angioplasty, mostly in European countries & Japan. Percutaneous arm approach via the radial artery is becoming more popular now throughout the world as an alternative to the femoral artery technique.[2-12] Advantages of this approach include a lower incidence of access site complications, earlier patient ambulation, improved patient satisfaction, and lower cost.[2-4,7,11-13] TR procedures may be

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performed by cannulation of either the right or the left radial artery. At present, the choice for the right radial or the left radial approach largely depends on the operator's preference. Most of the studies of the TR approach have been performed through right radial artery probably because of the familiarity in performing the study from the patient's right side as commonly used in the femoral approach.[2] One of the major criticisms of the radial approach is that it takes longer overall procedure and fluoroscopy time, which means not only more staff (interventionists, radiographers, nurses, and anesthetists if needed clinically) will be exposed during the procedures, but they will also stand close to the patient where rates of radiation scattered by the patient are higher.[14] So, the aim of this study was to evaluate the safety of the radial versus femoral artery approach in our institution's routine CAG practice.

Methods:

All cases of diagnostic CAGover a 12 month period (starting from January 2014 till the end of December 2014) at a tertiary care hospital (Cardiology department, Ibrahim Cardiac Hospital & Research Institute, Dhaka, Bangladesh) were retrospectively reviewed for this analysis. All the data were collected after the end of each procedure, detailing arterial access route, crossover from one access to other approach, contrast amount, overall procedure time and fluoroscopy time.

The choice between femoral or radial artery access was left to the discretion of the operator. The right radial approach is the default strategy at the catheterization laboratory. The femoral approach was favored for patients with negative findings on the Allen test,[15,16] and for patients with coronary artery bypass grafts (CABG). Radial arterial access was achieved in a standard fashion using commercial micropuncture kits. After sheath insertion, 2500 U of unfractionated heparin was injected directly into the radial artery through the sheath; also intra-arterial verapamil (2.5 mg) was used as the primary antispasmodic. CAG was performed using 5 Fr diagnostic catheters. At procedure completion, the sheath was removed immediately and a manual compression followed by placement of a compressive bandage was installed for 3 h. Femoral procedures were done using vascular sheaths, which placed using Seldinger's technique. CAG was performed using 6 Fr diagnostic catheters. After the end of the procedure, the sheath was removed in the catheter laboratory and manual compression was performed for a minimum of 15 min or until satisfactory hemostasis had been achieved. This was followed by placement of a compressive bandage for 6 h.

Study population was stratified according to arterial access used to perform the procedure into two groups; radial group and femoral group. Access crossover was recorded and stratified based on the first route of access attempted. Crossover to femoral was defined as the need to shift to the TF approach and was left to the operator's discretion. Crossover to the femoral approach was classified into the following three groups: puncture failure (lack of radial cannulation), radial and brachial failure (severe spasm, tortuosity, loops, remnant, or other anomalies), and epiaortic failure (severe subclavian or aortic tortuosity).[17]

Procedure duration was calculated as time from initiation of local anesthesia to completion of the procedure. Contrast volume and fluoroscopy time were recorded.

The data were computed on a statistical package for social sciences SPSS version 17.0 for statistical analysis. Continuous data were analyzed using student's *t* test and presented as mean ± SD. Categorical data are presented as a percentage, and were analyzed using a chi squared analysis. Times measured were analyzed and reported in minutes. Significance was defined as $p < 0.05$.

Results:

A retrospectively collected catheterization laboratory data of consecutive patients (n = 3346) who underwent a diagnostic CAG at Ibrahim Cardiac Hospital & Research Institute, Dhaka, Bangladesh over a 12 month period (between January to December 2014) were reviewed for this analysis. The radial approach was used in 3030 patients (90.5%) & the femoral approach in 316 patients (9.5%).Asthe radial group was disproportionately large compared to femoral group the size of the radial group was reduced to 1010 using a systematic sampling procedure, where every 3rd patient of radial group was chosen.

The baseline characteristics of the patients are summarized in Table I, which were similar in both groups. The incidence of post CABG patients was higher in the femoral group (29.45%), while only 2.89% CABG patients were done through the left radial artery (p =000).

Crossover from right radial artery access to the femoral approach occurred in 4.1% cases, while there was no crossover in the femoral group (p =0.003). Crossover due to puncture failure occurred in 1.9% patients, 1.4% cases due to radial failure, and in 0.8% patients because of epiaortic failure.

Comparing the radial and femoral approaches, fluoroscopy and procedural times were not significantly different (3.41±1.14 vs. 3.85±1.43 min, p=0.314 & 11.87±4.61 vs. 13.74±6.33 min, p=0.180, respectively). While contrast utilization during the procedure was significantly lower in the radial than the femoral approach (57.60±22.42 vs. 69.52±24.30 mL respectively, p=0.030) (Table II).

Table-I

Patient demographics

	Radial CAG (n=1010)	Femoral CAG (n=316)	p value
Age (y.)			
Range	30-88	31-90	0.316
Mean ± SD	59.47 ± 10.22	61.36 ± 18.20	
Sex, %			
Male	64.49	68.60	0.273
Female	35.51	31.40	
BMI (kg/m^2)			
Range	15.35–35.89	16.62–34.25	0.530
Mean ± SD	27.29 ± 12.68	26.53 ± 11.13	
Diabetes, %	66.94	71.39	0.127
Hypertension,%	70.90	73.82	0.321
Dyslipidaemia,%	58.52	61.31	0.340
Previous CABG, %	2.89	29.45	0.000
Renal impairment,%	24.13	28.21	0.081

CAG = coronary angiography, BMI = body mass index, CABG = coronary artery bypass grafting, Renal impairment = serum creatinine > 1.4 mg/dL.

Table-II

Procedure data

	Radial CAG (n=1010)	Femoral CAG (n=316)	p value
Fluoroscopy time (min.)			
Range	1.4 – 6.9	1.3 – 7.4	0.314
Mean ± SD	3.41 ± 1.14	3.85 ± 1.43	
Procedure duration (min.)			
Range	6-19	4-23	0.180
Mean ± SD	11.87 ± 4.61	13.74 ± 6.33	
Contrast dose (mL)			
Range	43-83	39-105	0.030
Mean ± SD	57.60 ± 22.42	69.52 ± 24.30	

CAG = coronary angiography, min. = minutes.

Discussion:

The TR approach for cardiac catheterization is a common alternative to TF access both for diagnostic CAGand percutaneous coronary interventions.[18] The radial approach is an appealing technical strategy to reduce bleeding complications in patients with coronary artery disease undergoing percutaneous invasive management.[19,20] A major effort in increasing the rate of invasive procedures performed through the TR approach is expected worldwide in the next years.[21]

Radial artery access has been associated with a greater access crossover rate, which reported to be 4% to 7% in previous studies.[22,23,24] The crossover from the radial to femoral approach occurred in 4.1% patients in our study for the radial group, while there was no crossover in the femoral group (p = 0.003). Louvard et al.[25] reported the crossover from the radial to the femoral approach was 8.9% and from femoral to radial occurred in 8.1% of their patients' study (p = NS). Roberts et al.[26] reported the incidence of the crossover from radial to femoral access to be 1% in their study, which is a low crossover rate. They attributed this level of success to the accurate selection of suitable radial cases and the use of specific techniques, careful guide catheter choice, methods for dealing with tortuous subclavian anatomy, and specific guide catheter manipulation techniques have also developed alongside increasing use of radial access, and reflect the practice of high volume experienced radial operators.

Fluoroscopy time in our study for both radial and femoral approaches was not significantly different (3.41±1.14 vs. 3.85±1.43 min respectively, p=0.314). Louvard et al.[27]reported fluoroscopy time was significantly shorter in the femoral group (3.1±1.7 min) than in both radial groups (right: 3.8±2.2 min; left: 4.2±1.7 min), *p* <0.01. Kawashima et al.[28] reported the fluoroscopy time in CAGwas shorter in the left radial than in the right radial approach group (3.7 ± 2.5 vs. 5.0 ± 3.3 min;*p* <0.001). Again Louvard et al.[25] conducted another study to compare TR and TF approaches for CAGand angioplasty in octogenarians and they reported that fluoroscopy time was shorter in the femoral group versus the radial group (4.5±3.7 vs. 6.0±4.4 min; *p* <0.05) for the CAG. They commented that the radial approach is more demanding and takes longer in elderly patients because of the frequent presence of specific vascular abnormalities, such as calcification or arterial loops. Khan and Kabir[29] reported lower fluoroscopy time in diagnostic CAG in the left radial than in the right radial approach group (*p* <0.005) in diabetic patients.

Louvard et al.[27] reported the procedural duration (from first puncture attempt to removal of last catheter) was significantly longer with the left radial (14.2±3.3 min) approach than the femoral approach (11.2±3.3 min); *p* <0.001 while procedureduration was 12.4±5.8 min in right radial access without any significant differences between the femoral and right radial approach. Again Louvard et al.[25] reported in another study for octogenarians population that procedure duration was 15.9±9.5 min in the femoral group vs 18.5±10.5 min in the radial group (right and left radial in a common pool); *p* <0.05. Kawashima et al.[28] reported the procedural duration in CAG(time from the initiation of local anesthesia to completion of the procedure) was shorter in the left radial than in the right radial approach group (11.4±4.8 vs. 13.7±6.4 min; *p* <0.001). Sciahbasi et al.[17] reported procedural time (the time from local anesthesia to the end of the procedure) was not significantly different between the 2 arms (left radial approach 13 min vs right radial approach 13 min; *p* =0.56).The overall procedure time between the time from initiation of local anesthesia to completion of the procedure in our study – was not significantly different (11.87±4.61 vs. 13.74±6.33 min respectively, p=0.180) for both radial and femoral approaches.

Contrast utilization during the CAG procedure was significantly lower in the radial than the femoral approach in our study (57.60±22.42 vs. 69.52±24.30 mL respectively, p=0.030). Louvard et al.[25] reported the volume of contrast was similar in radial and femoral approaches for CAG. Kawashima et al.[28] reported the amount of contrast material in CAGdid not differ between the left radial and right radial approach group (79±27 vs. 83±25 mL; *p*>0.05).Khan and Kabir[29] reported a trend toward a lower dose of contrast media used during diagnostic coronary procedures in the left radial approach compared with the right radial approach (37±16 and 47±11.9 mL respectively, *p* =0.006) in 512 diabetic patients.

Khan, Kabir and Banerjee found that 5 F guide catheter is a safer alternative to 6 F guide catheter in left radial approach for coronary intervention among 400 diabetic patients in terms of lower amount of contrast volume (p=0.006).[30] Again Kabir and Khan conducted another study in CKD patients and they reported that PCI using 5 F guide catheter causes lower renal impairment (mean contrast volume and mean rise of serum creatinine was significantly lower in 5 F group than in 6 F group, p=0.006 and p=0.001 respectively) in case of radial approach.[31] The higher significant contrast dose in the femoral group in our study may partly account for the use of 6 F catheters. Also for the higher percentage of post CABG patients in the femoral group and the subsequent significant higher utilization of contrast dose during procedure to visualize the graft bypass vessels in addition to native coronary vessels. Also this explanation can be applied to fluoroscopy and procedure times, which were longer in the femoral than the radial group; however it did not reach a significant difference.

Conclusions:

From all of the above data, we can conclude that TR coronary angiography can be performed with the same safety as for the TF approach. The operator's experience plays a major role in the success rate and procedure duration. Our results are obtained in an experienced center in the TR approach, and conclusions might look different in catheter laboratory with lower experience in this approach.

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