

Safety and Feasibility of Transradial Approach for Coronary Artery Bypass Graft Intervention

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ABSTRACT

Background & Objective: To compare the safety and feasibility of using radial versus femoral access during coronary artery intervention of patients who had previously undergone coronary artery bypass graft (CABG) surgery.

Methods: The study was conducted in Ibrahim Cardiac Hospital & Research Institute (ICHRI), Dhaka from January 2013 to December 2015. During the period a total of 380 patients with past CABG surgery underwent diagnostic coronary angiogram (CAG) and percutaneous coronary intervention (PCI) at our institution. We retrospectively evaluated 98 consecutive patients who underwent graft intervention via the transradial (TRA, n=54) or transfemoral approach (TFA, n=44) route. Baseline clinical characteristics, angiographic characteristics and complications between the two study groups were observed.

Result: The baseline clinical characteristics between the two study groups were similar. No significant difference was observed in terms of angiographic characteristics between the two groups. Contrast volume in between the groups was pretty similar ($p = 0.267$). Procedure time (40 ± 20 min vs. 41 ± 7 min, $p=0.36$) and fluoroscopy time (11.1 ± 6.5 min vs. 12.5 ± 8.7 min, $p=0.19$) were almost similar in both access for graft intervention. All PCI attempts were successful in both groups. Stent deployment was significantly more common in the TR access group. No significant difference was observed between the groups in terms of target vessel intervention. There was no major adverse cardiac event during hospitalization. However, the vascular access site complications were significantly lower ($p=0.003$) in the TRA group.

Conclusion: The TRA for coronary artery bypass graft intervention is safe and feasible.

Key words: Transfemoral, Transradial, Coronary Artery Bypass Graft intervention etc.

INTRODUCTION:

Among patients undergoing coronary procedures, patients with coronary artery bypass grafts (CABG) represent an important, high risk subgroup. Coronary angiography (CAG) via transradial approach (TRA) has gained growing acceptance and

operator preference in recent years, based on a reduction in vascular complications and mortality when compared with transfemoral approach (TFA).^{1,2} However, it has been suggested that these advantages come at the cost of increased procedure time and fluoroscopy dose.³⁻⁵

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Considering the significant morbidity and mortality benefits, increased patient preference and cost effectiveness, the European Society of Cardiology now advocates TRA as the default access route for CAG.⁶⁻⁸ Studies comparing access route preference mainly involve native coronary vessel angiograms, mostly excluding patients post CABG surgery.⁹ Although there is insufficient evidence to advocate TRA for patients with coronary grafts, both native arteries and grafts, including the left internal mammary artery, can be commonly studied from the left radial artery. We sought to compare safety and feasibility using radial versus femoral access during coronary intervention of patients who had previously undergone CABG surgery.

METHODS:

A retrospective analysis was undertaken of demographic, clinical and procedural variables of all patients with past CABG surgery who underwent diagnostic CAG and percutaneous coronary intervention (PCI) at Ibrahim Cardiac Hospital & Research Institute (ICHRI) between January 2013 and December 2015. The study protocol was approved by the Ethics Committee of ICHRI. Choice of TRA or TFA was at the consultant/operator's discretion. During the period a total of 380 patients with past CABG surgery underwent diagnostic coronary angiogram (CAG) and percutaneous coronary intervention (PCI) at our institution. TRA was accessed in 54 cases, while TFA was accessed in 44 cases. For TRA catheterization, a satisfactory Allen's test result was confirmed. Cardiology fellows were equally involved in both TRA and TFA cases during the study and were supervised throughout, with prompt consultant intervention if access attempts failed twice or difficulties arose during the procedure. After subcutaneous local anesthesia, the radial artery was cannulated with a 6 Fr Radifocus introducer sheath (Terumo Corporation). Then, 5000 U of intraarterial unfractionated heparin and 2.5 mg of intraarterial verapamil were administered. Radial hemostasis was subsequently obtained using digital pressure. Femoral arteries were cannulated similarly with 7 Fr sheaths and hemostasis was later obtained by digital pressure. Contrast volume was the primary

endpoint whereas the procedural and fluoroscopy time, procedural success (less than 50% residual stenosis with antegrade TIMI flow grade 3 at the end of the procedure), access site major bleeding, pre discharge major adverse cardiovascular events (MACE) were the secondary endpoint both for CAG and PCI.

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS), version 20. Continuous variables were presented as mean with SD and categorical variables as counts and percentages. While continuous data were compared between groups using Unpaired t-Test, categorical data were compared between groups using Chi-square (χ^2) or Fisher's Exact Test. Level of significance was set at 5% and differences between groups were considered statistically significant when p-value was observed to be <0.05.

RESULTS:

There was no significant difference between TRA and TFA in terms of age, gender, BMI, prior MI, prior PCI and diabetes and all other clinical variables of interest. The mean LVEF was also similar between the groups (Table I). Compared with femoral access, diagnostic CAG in TRA required relatively low contrast volume though the difference was not statistically significant (70 ± 34 vs. 72 ± 40 ml, $p=0.267$). Procedure time (25.2 ± 10.7 vs. 26.9 ± 6.8 min, $p=0.735$) and fluoroscopy time (10.7 ± 5.5 vs. 9.5 ± 4.7 min, $p=0.424$) were almost similar in both access groups for CAG (Table II). No significant difference was found between TRA and TFA with regard to mean number of grafts used and number of lesions treated ($p > 0.05$ in each case) (Table III & IV). Stent was deployed in more than 90% cases in both groups ($p < 0.05$). The mean diameter of the stents was larger in the TFA group, but no significant difference was found with regard to mean number of stents used (Table IV).

All PCI attempts were successful in both groups. There was no major adverse cardiac event during hospitalization. However, TRA was associated with significantly lower rate of vascular complications

($p = 0.003$) and less access site-related bleeding ($p = 0.404$). Major complications were limited to 2 cases of acute renal failure and 1 case of cerebrovascular event in the TFA group, and 1 case of acute renal failure in the TRA group. Three failed cases of TRA necessitated crossover to TFA-one due to the spasm of the radial artery and two others due to the tortuosities of the upper arms (Table V).

Table I. Distribution of patients by their baseline characteristics

Baseline characteristics	Group		p-value
	Radial access (n=155)	Femoral access (n=225)	
Demography			
Age # (years)	60.7±8.9	60.3±8.2	0.555
Men*	129 (83.2)	181 (80.4)	0.089
BMI# (kg/m ²)	26.1±4.4	25.7±3.4	0.479
Clinical presentation			
SA*	75 (48.4)	88 (39.1)	0.103
UA*	23 (14.8)	39 (17.3)	0.736
NSTEMI*	36 (23.2)	60 (26.7)	0.633
HTN*	122 (78.7)	164 (72.9)	0.368
DL*	59 (38.1)	86 (38.2)	0.735
DM*	109 (70.3)	167 (72.9)	0.583
HF*	24 (15.5)	25 (11.1)	0.424
Previous MI*	29 (18.7)	43 (19.2)	0.883
Previous PCI*	14 (9.0)	11 (4.9)	0.267
Previous stroke*	4 (2.6)	1 (0.4)	0.197
CKD*	18 (11.6)	18 (8.0)	0.471
PAD*	1 (0.6)	5 (2.2)	0.475
LVEF#	50.7±9.2	51.4±9.8	0.469

Figures in the parentheses denote corresponding percentage.

*Data were analyzed using **Chi-square (χ^2) Test**.

#Data were analyzed using **Unpaired t-Test** and were presented as **mean ± SD**.

Table II. Distribution of patients by their procedural characteristics

Procedural characteristics	Group		p-value
	Radial access (n=155)	Femoral access (n=225)	
Contrast volume # (ml)	70±34	72±40	0.267
Procedure time # (min)	25.2±10.7	26.9±6.8	0.735
Fluoroscopy time # (min)	10.7±5.5	9.5±4.7	0.424

#Data were analyzed using **Unpaired t-Test** and were presented as **mean ± SD**.

Table III. Procedural outcomes in patients undergoing diagnostic CAG

Procedural outcomes	Group		p-value
	Radial access (n=155)	Femoral access (n=225)	
No of patent grafts*			
No patent graft	9(5.8)	16(7.1)	0.567
1 graft	58(37.4)	78(34.7)	
2 graft	59(38.1)	84(37.3)	
3 graft	28 (18.1)	41 (18.2)	
4 graft	1 (0.6)	5 (2.2)	
5 graft	-	1 (0.4)	
No of diagnostic catheters used#			
	1.9±0.7	2.5±1.3	0.529

Figures in the parentheses denote corresponding percentage.

*Data were analyzed using **Chi-square (χ^2) Test**.

#Data were analyzed using **Unpaired t-Test** and were presented as **mean ± SD**.

Table IV. Procedural outcomes in patients undergoing PCI

Procedural outcomes in patients undergoing PCI	Group		p-value
	Radial access (n=155)	Femoral access (n=225)	
No of lesions treated #			
1 lesion	43(79.7)	36(81.4)	0.583
2 lesion	11(20.4)	7(15.9)	
3 lesion	-	1 (2.3)	
No of stents used #			
1 stent	36(66.7)	27(31.4)	0.194
2 stent	14(25.9)	10(22.7)	
3 stent	3(5.6)	3(6.8)	
4 stent	-	1 (2.3)	
Average stent length # (mm)	29.8±15.4	31.2±16.5	0.689
No of balloons used #	1.2±0.9	1.3±1.5	0.404
Stent deployment*	53(96.3)	41(93.2)	0.002
POBA*	4(7.4)	6(13.6)	0.985
Target vessel intervention*			
SVG	13 (24.1)	13 (29.5)	0.590
LCx	22 (38.9)	16 (36.4)	0.073
RCA	19 (35.2)	18 (40.9)	0.367
LAD	10 (18.5)	3 (6.8)	0.026
LIMA	3 (5.6)	3 (6.8)	0.891

Figures in the parentheses denote corresponding percentage.

*Data were analyzed using **Chi-square (χ^2) Test**.

#Data were analyzed using **Unpaired t-Test** and were presented as **mean ± SD**.

Table V. Procedural success & MACE in patients undergoing PCI

Procedural success & MACE in patients undergoing PCI	Group		p-value
	Radial access (n=155)	Femoral access (n=225)	
Procedure success* (%)	96.2	96.0	0.445
Cross over	3(5.6)	-	0.194
Vascular complications*	1(2.3)	6 (13.6)	0.003
Access site bleeding	-	2 (4.6)	0.404
Access site haematoma*	1(2.3)	2 (4.6)	0.531
Stroke	0	1 (2.3)	0.376
Acute Kidney Injury*	1(2.3)	2 (4.6)	0.590

Figures in the parentheses denote corresponding percentage.

*Data were analyzed using Fisher's Exact Test.

DISCUSSION:

Patients with a history of CABG usually have severe coronary lesions & are at high risk of cardiovascular events. Although the graft works well right after the bypass surgery, the long-term patency of the graft raises concerns. Saphenous vein graft (SVG) and the internal mammary artery (IMA) are estimated to block up again within 10 years.¹⁰ A second CABG surgery was not suggested because of the serious chest tissue adhesion and the increased risk of death after the surgery. However, PCI is still effective in treating occluded grafts. This retrospective analysis shows that angiography and intervention of post-CABG patients can be safely performed via left TRA without significantly altering procedure time and fluoroscopy dose when compared with TFA. TRA is associated with a lower rate of access site-related bleeding.

While there are numerous studies to support the feasibility and safety of TRA of native coronaries, evidence is limited for performing graft angiography. Transradial approach PCI has been increasingly used since its first successful application in 1993 not only because of the easier puncturing and haemostasis, but also for the better survival rate in certain patients.¹¹ Han and associates¹² found similar rates of short-term major adverse cardiac and cerebrovascular events between TRA and TFA (1.5 vs. 5.4, $P = 0.479$) in post-CABG patients undergoing angiography or PCI. Several investigators reported similar short-term death and MACE in post-CABG

patients undergoing SVG PCI.¹³ Consistent with these results, the present study showed similar procedural success and short-term clinical outcomes between TRA and TFA.

Access site-related bleeding accounts for approximately 50-80% of all major bleeding events in patients undergoing PCI.^{13,14} A recently published meta-analysis showed that the introduction of TRA decreased the risk of access site related bleeding by 73%. This reduction could lead to better patient outcomes.¹⁵ More type 2 bleeding was detected in the TFA group than in the TRA group, indicating the benefit of TRA in reducing nuisance bleeding, even under the frequent use of GP IIb/IIIa inhibitors. The rates of access site complications were almost similar between TRA & TFA (5.1 vs. 7.0, $P = 0.22$).¹⁶

Reduced procedure times are important, not just for patient comfort, but also for improving catheter laboratory efficiency and therefore the cost effectiveness of angiography. Previous studies have already shown that TRA is more cost-effective than TFA due to earlier ambulation and time to discharge.¹⁷ Our study revealed that the important procedural variable of procedure time, in addition to radiation dose, was unaffected by transradial access route choice for CABG patients, which may result in improved cost-efficiency and patient satisfaction, without affecting patient safety. Fluoroscopy dose remains one of the main safety concerns in coronary angiography, due to the link between radiation exposure and malignancy in operators and patients.¹⁸ Importantly, we have been able to show that there was no significant difference in radiation dosage between TFA and TRA groups.

Michael and associates demonstrated that TRA resulted in longer procedure times, but no statistically significant increase in patient radiation exposure. Interestingly, in the subgroup of patients who underwent PCI, there was no significant difference between TRA and TFA in terms of procedural time and radiation exposure.¹⁹ There was no significant crossover rate from radial to femoral route (3%). This crossover rate may have been

partly attributed to trainee involvement as first operators and their underlying inexperience in TRA. This inexperience might be a major contributor to the prolonged procedural times in the TRA group. Our results are comparable with two similar retrospective studies, where there was no difference in procedural time and radiation exposure in patients with coronary grafts undergoing PCI and diagnostic angiography.¹⁹ Both of these studies involved over 300 patients and had similar crossover rates from radial to femoral route of around 4%. However, the following limitations of study should be considered before generalizing the findings to reference population.

LIMITATIONS:

The retrospective design was the inherent weakness of our study. The selection of the route was not randomized but was at the doctor's discretion, which might have resulted in selection bias. However, most of the patients' baseline characteristics were similar between the TRA and TFA groups. All the PCIs were conducted only in one hospital, which may restrict the extrapolation of the result to reference population in general.

CONCLUSION:

The TRA for coronary artery bypass graft intervention is safe and feasible in terms of contrast volume, procedure and fluoroscopy time and other clinical endpoints comparing to femoral access in patients previously under went CABG.

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