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Original Article

Advantages of transradial cardiac catheterization regarding complications (bleeding and hematomas), care, and hospital stay over the femoral techniques

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Abstract

Background
In the hands of experienced operators and high-volume transradial catheterization centers, transradial coronary angiography and intervention offers improved patient comfort, decreased access-site complications, and decreased costs without compromising procedural success or long-term outcomes. Patients presenting with ST-elevation myocardial infarction, in particular, benefit from a transradial approach to coronary intervention. Transradial access has become the default mode of catheterization for a growing number of cardiologists and will undoubtedly continue to be increasingly performed.

Objective
This was a retrograde study in 100 patients who were involved in coronary angiography whether as emergency acute coronary syndrome or elective cases. The patients were divided into two equal groups that used radial or femoral techniques to assess the advantage of radial over femoral approach regarding complications, care, and hospital stay. All patients were subjected to the usual investigations before the procedure, and strict precautions were taken. The complications of both groups were compared together, and statistical data were done beside the hospital stay and the need for medical care.

Patients and methods
A nonrandomized study was done on 100 cases comprising 34 females and 66 males with mean age of 50 ± 14 years, with youngest being 39 years old and eldest being 77 years old, referred with suspected Ischemic heart disease (IHD) and coronary angiography. All patients were analyzed for clinical problems, namely, chest pain or dyspnea, and patients with atrial fibrillation were excluded from the study. Transthoracic echocardiography was used to assess wall motion abnormality by apical 4 chamber, apical 2 chamber, parasternal, and subcostal views, and blood flow by Doppler across the mitral and aortic valves was analyzed. A 12-lead ECG was used to prove the presence of ischemic changes. Myocardial perfusion images and computed tomography scanning were done for some patients.

Results
The incidence of vascular complications, namely, bleeding and hematomas, was much less compared with those using the femoral technique. The incidence of vascular complications was less in the elective cases than patients with acute coronary syndrome. All patients with transradial technique had mean hospital stay of 2 ± 1.22 h compared with femoral technique of 6 ± 3.34 h. The need of medical care in the first group regarding compression after catheterization, dressing, bandage, ICU transfer, and lower limb care is markedly different than the femoral technique.

Conclusion
Transradial catheterization also has the potential to reduce procedural costs. Fewer complications equate to shorter hospital stays. Additionally, less staffing is needed to care for patients following transradial catheterization. Furthermore, same-day discharge is feasible after coronary intervention, which shortens stays and significantly reduces costs. One study showed percutaneous coronary intervention with transradial access was associated with cost savings per patient relative to transfemoral access.

Keywords: Bleeding and haematomas, emergency acute coronary syndrome, transradial catheterization

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Introduction

Percutaneous coronary intervention (PCI) today is not what it was 2 decades ago. The field of interventional cardiology has seen a dramatic increase in procedural success and declines in ischemic and bleeding complications, largely because of advances in antithrombotic therapies, evidence-based pharmacological strategies, and device technology [1]. With these successes, recent attention has turned to reducing complications associated with vascular access [2]. The search for a procedural approach to bleeding reduction, coupled with the goal of improving patient comfort, has led to a renewed interest in radial artery access, as opposed to the traditional femoral artery access, for coronary catheterization and intervention.

Approaching the heart from the upper extremity is not a new concept. Indeed, the first human cardiac catheterization was performed via the brachial vein by Forssmann-Falck in 1929 [3], and the first transradial aortic cannulation was described in 1948 [4]. Initial angioplasties in the 1970s involved large guide catheters; however, it required larger arterial access, so femoral cannulation became the primary mode of arterial access for coronary catheterization and intervention.

Patients and methods

A nonrandomized study was done on 100 cases comprising 34 females and 66 males with mean age of 50 ± 14 years, with youngest being 39 years old and eldest being 77 years old, referred with suspected IHD and coronary angiography. All patients were analyzed for clinical problems, namely, chest pain or dyspnea, and patients with atrial fibrillation were excluded from the study. Transthoracic echocardiography was used to assess wall motion abnormality by apical 4 chamber, apical 2 chamber, parasternal, and subcostal views, and blood flow by Doppler across the mitral and aortic valves was analyzed. A 12-lead ECG was used to prove the presence of ischemic changes. Myocardial perfusion images and computed tomography scanning were done for some patients. ethics committee approval was Taken

Although the first transradial angiography was reported by Campeau [5], followed shortly thereafter by the first transradial coronary stenting by Kiemeneij and Laarman [6], transradial coronary catheterization was relegated to 'backup' access for patients without alternate arterial access.

The transfemoral approach has remained the primary route of arterial access for cardiac catheterization in the USA. As recently as 2008, only 1.3% of coronary interventions in the USA were performed via the transradial approach [7]. Transradial catheterization is currently much more frequently performed in Europe and Asia [8,9]. However, transradial cardiac catheterization in the USA has seen growing use and enthusiasm over recent years, driven by improved patient comfort, decreased length of stay and hospital costs, and accumulating data showing clinical benefit, primarily in terms of decreased access-site complications. In the USA, the proportion of transradial PCI procedures increased from 1.2% in the first quarter of 2007 to 16.1% in the third quarter of 2012 and accounted for 6.3% of total procedures from 2007 to 2012 (n = 178 643) [10].

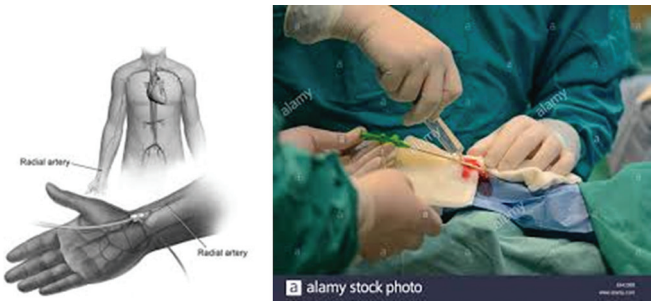

Figure 1: Radial technique.

Advantages of transradial cardiac catheterization and intervention

The primary advantage of transradial cardiac catheterization and intervention is reduced access-site complications [7,11,12]. Because the radial artery is small and superficial, it is easily compressible, and bleeding complications associated with radial arterial access are extremely rare (Fig. 1).

Femoral arterial cannulation, contrarily, carries a significant risk of access-site bleeding complications. Hematomas and pseudoaneurysms at the site of arterial access are frequent and often painful complications of cardiac catheterization, which are much less common with transradial access [13]. Retroperitoneal hemorrhage is a potentially life-threatening complication of femoral arterial catheterization. Certain patient populations, such as elderly and obese patients, are at an increased risk of bleeding complications from femoral arterial catheterization.

Up to 80% of all major bleeding events associated with PCI may be access-site related, and both major and minor bleeding events with PCI are significant predictors of mortality and morbidity [14–16].

Patient groups who derive an increased benefit from transradial cardiac catheterization include elderly persons [17], those with acute coronary syndrome [18], and those receiving IIb/IIIa inhibitors.

Improved patient comfort is also a significant advantage to transradial cardiac catheterization. Even with vascular closure devices, transfemoral cardiac catheterization requires that the patient maintain a supine position for an extended period after procedure to achieve hemostasis. This can be especially uncomfortable in patients with chronic back problems. Transradial catheterization obviates the need for postprocedural flat time, and most patients are able to ambulate immediately following the procedure. Patient preference is clearly in favor of transradial catheterization.

In the The Radial Vs femoral access for coronary intervention (RIVAL) trial, 90% of patients randomized to undergo the transradial approach reported preference for the same approach

if a repeat procedure was needed, as opposed to 49% in the transfemoral arm [19]. Other studies have reported improved quality-of-life measures with transradial versus transfemoral cardiac catheterization [20].

Transradial catheterization also has the potential to reduce procedural costs [21,22]. Fewer complications equate to shorter hospital stays [20]. Additionally, less staffing is needed to care for patients following transradial catheterization. Furthermore, same-day discharge is feasible after coronary intervention, which shortens stays and significantly reduces costs [23,24]. One study showed PCI with transradial access was associated with a cost savings exceeding $800 per patient relative to transfemoral access [25].

Disadvantages of transradial cardiac catheterization and intervention

Transradial cardiac catheterization and intervention has a steep learning curve [26,27]. Negotiating the radial artery and aortic arch with guide wires and catheters from the transradial approach is more technically challenging than from the femoral approach. The radial and subclavian arteries are frequently tortuous and require operator proficiency at navigating such vessels (Fig. 2).

Catheter manipulation and engagement of coronary arteries from the transradial approach is also technically different than that from the femoral artery and requires a different skillset. Studies have shown a significant decrease in procedural failure, access-site crossover, procedural time, and fluoroscopic time with increasing operator volume and experience [19,28]. Jolly *et al*. [11] found that, among experienced transradial operators, the procedural success rate of the transradial approach compared with transfemoral approach did not differ, but among inexperienced operators, the procedural failure rate was high. A substudy of the RIVAL trial further evaluated the role of center and operator volume on clinical outcomes. The authors found a strong interaction between overall and transradial center volumes, and clinical outcomes, but not transfemoral center volumes [29].

One study found that independent predictors of transradial failure among low-to-intermediate volume transradial operators included patient age older than 75 years, prior coronary artery bypass grafting (CABG), and short stature [30].

Increased procedural time and increased radiation exposure are both a concern with transradial cardiac catheterization. Several studies have shown longer procedural time and fluoroscopy time for transradial coronary angiography compared with transfemoral catheterization [31,32]. The gap, however, significantly decreases with operator volume and experience. For experienced operators, there is little difference in fluoroscopy time; indeed, procedural times are actually shorter with transradial catheterization [22]. Cumulative radiation exposure to the operator with either left or right radial artery approach is well under the annual dose-equivalent limit [33] (Fig. 3).

Radial artery occlusion is a potential complication with transradial catheterization, though rarely a clinically significant

Figure 2: Radial technique complications (marked hematoma).

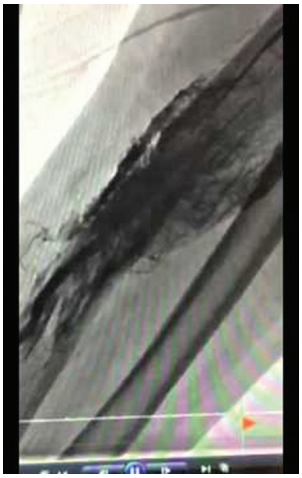

Figure 3: Radial artery rupture.

Figure 4: The palmar arch.

event if adequate ulnar supply to the palmar arch is confirmed preprocedurally. Radial artery occlusion can potentially limit future radial access and limit the use of the radial artery for dialysis fistulas or as grafts for coronary artery bypass, so attempts should be made to avoid occlusion. Procedural techniques have been shown to significantly reduce radial artery occlusion [34–36] (Fig. 4).

Hand ischemia following transradial angiography is extremely rare. Of the estimated 650 000 transradial procedures performed annually around the world [9], only one incident of hand ischemia has been reported, which was successfully revascularized percutaneously [37].

Coronary interventions in specific patient/coronary lesion subsets

Most complex coronary interventions can be safely performed using a transradial approach. Bifurcation procedures, thrombus aspiration, chronic total occlusion procedures, ostial lesions, rotational atherectomy (with up to 1.5-mm diameter burr size), and embolic protection can all be successfully and routinely performed through 6 F sheaths, meaning that most patients are suitable to undergo these procedures via the transradial approach.

In a single-center study, transradial percutaneous coronary revascularization for unprotected left main coronary disease was associated with similar procedural success, abbreviated hospitalization, reduced bleeding, and comparable late-term clinical safety and efficacy compared with transfemoral catheterization [38]. Revascularization of coronary chronic total occlusions via a transradial approach has also been shown to be safe and effective [39].

Results

The incidence of vascular complications, namely, bleeding and hematomas, were much less compared with those who used the femoral technique. The incidence of vascular complications was less in the elective cases than patients with acute coronary syndrome. All patients with transradial technique had mean hospital stay of 2 ± 1.22 h compared with femoral technique of 6 ± 3.34 h (Fig 5).

The need of medical care in the first group regarding compression after catheterization, dressing, bandage, ICU transfer, and lower limb care is markedly different in radial rather than the femoral technique.

Conclusion

The largest randomized trial to date comparing transradial and transfemoral approaches for coronary angiography and intervention was published in April 2011 [19]. The RIVAL trial randomized more than 7000 patients with acute coronary syndrome from 158 hospitals in 32 countries to transradial versus transfemoral cardiac catheterization and/or coronary intervention.

In the RIVAL trial, there was little difference between the catheterization groups in terms of primary outcome of death, myocardial infarction, stroke, or non-CABG-related major bleeding at 30 days (3.7% of patients in the radial access group and 4% in the femoral access group; $P = 0.50$). Procedural success rates were high in both groups: 95.4% in the transradial arm and 95.2% in the transfemoral arm ($P = 0.83$).

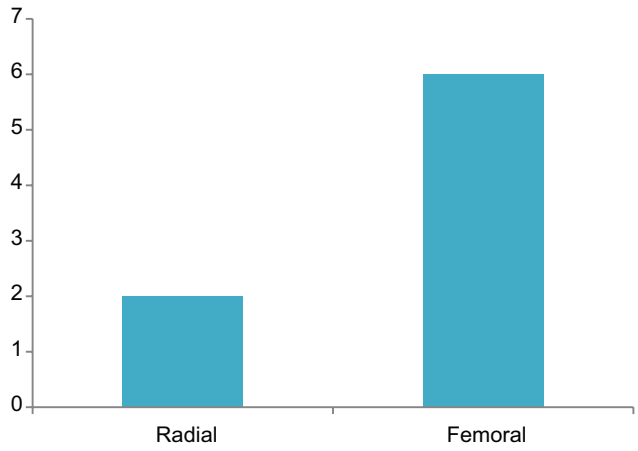

Figure 5: Comparison of mean hospital stay between Radial and femoral Technique

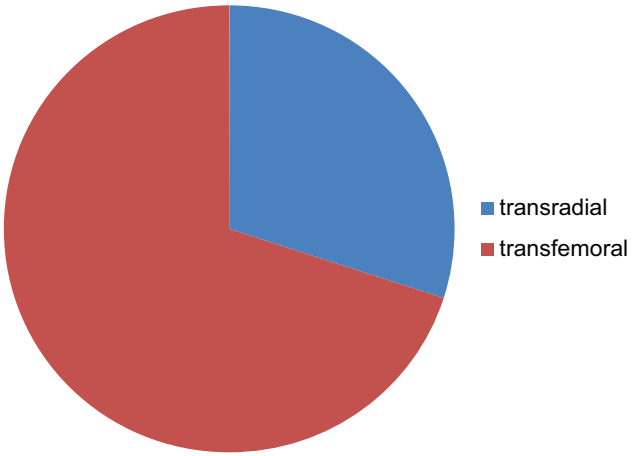

Figure 6: Ratio of major complications in transradial versus transfemoral technique

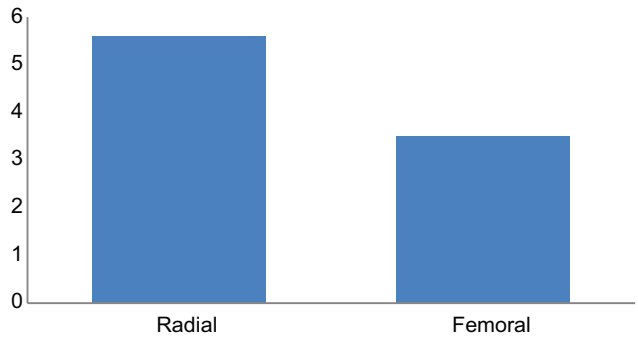

Figure 7: Ratio of median fluoroscopy time in transradial versus transfemoral technique

Our results regarding primary end points (death, myocardial infarction, stroke, or non-CABG-related major bleeding at 30 days) are comparable to RIVAL results; however, congenital abnormality and radial artery spasm occurred each in one patient only (statistically nonsignificant).

There was no significant difference in major bleeding events between the groups. Major vascular complication rates were higher in the transfemoral arm (2.8 vs 1.2%; $P < 0.0001$) (Fig 6).

The median fluoroscopy time was higher in the radial group than in the femoral group (5.6 vs 3.5 min; $P < 0.0001$) (Fig 7).

Recommendations:
The study has the following recommendations:
(1) Results of the study can serve as good screening test for a large population.
(2) It is invasive with very good follow-up.
(3) No hospital stay.
(4) No hazards of bleeding or hematomas.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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