Transradial coronary angiography and intervention

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ABSTRACT

Objective: Transradial cardiac catheterization promises fewer access site complications and improved patient comfort due to immediate ambulation. However, the use of miniaturized systems and the presence of a steep learning curve have discouraged the acceptance of transradial catheterization. The purpose of this study was to assess the applicability and learning curve of transradial catheterization in the Saudi population for operators without prior experience in this approach.

Methods: The study was performed at the King Fahd Armed Forces Hospital, Jeddah, Kingdom of Saudi Arabia between June 2001 and January 2003. Right radial artery cannulation was performed and standard 5 French (F) femoral curve catheters for angiography and standard 6F guiding catheters were used for intervention. The first 101 patients comprised group 1 and the subsequent 101 patients comprised group 2.

Results: Two hundred and two patients underwent transradial catheterization (diagnostic alone in 49%, intervention alone in 10%, and diagnostic plus intervention in 41%). The procedure was successful in 191 patients (95%). The success rate was higher (99% versus 90%, p=0.013), and the mean diagnostic catheterization time was lower (28 versus 20 minutes, p=0.013) in group 2 patients compared with group one patients. There were no vascular or ischemic complications.

Conclusion: Transradial catheterization is safe and feasible for diagnostic and interventional procedures. With experience, the success rates and the procedural times have both improved.

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Percutaneous transradial access for coronary angiography and intervention was developed to achieve rapid patient mobility and reduced access site complications.[1,2] This is possible due to the relative superficial course of the radial artery near the wrist, lack of important vascular and neural structures near it and it is easy to compress. Wider applicability of transradial approach has been hindered by the presence of a steep learning curve and by the need for smaller systems by operators who are used to larger catheters.[3,4] Studies from the American and European populations, performed by operators dedicated to this approach, have established the safety and efficacy of transradial catheterization.[5,6] These patients tend to have larger body sizes than the smaller Arab or Asian patients.[7] The purpose of this study was to assess the feasibility and safety of transradial approach for routine catheterization in our population with operators experienced in the femoral but not the radial approach.

Methods. Patients undergoing catheterization at the King Fahd Armed Forces Hospital, Jeddah, Kingdom of Saudi Arabia between June 2001 and January 2003 were selected on the basis of having strongly palpable right radial arteries, absence of peripheral arterial disease and available femoral access, should radial access fail. Exclusion criteria were: a negative Allen's test, presence of renal dialysis fistula, small radial arteries, and post coronary artery bypass patients who had a left internal mammary artery graft.

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Preparation. Before the start of the procedure, all patients received intravenous mediazolam and fentanyl for sedation. The right arm was abducted to 30 degrees and placed next to the right groin. The wrist was hyper-extended. The right arm and both groins were prepared using standard angiographic drapes. Lidocaine 1% was infiltrated over the radial artery, which was then punctured using a 20-gauge needle. A 0.021 inch straight tip wire was then introduced. Once the wire position was confirmed by fluoroscopy, a 5 French (F) or 6F radial introducer sheath [Cordis, Miami, FL, United States of America (USA)] was placed in the radial artery. If the 0.021 straight tip guide wire did not navigate the radial artery it was changed to a 0.021 J tip guide wire. Early in the experience 23 cm long radial introducer, sheaths were used and later 11 cm sheaths were used. A cocktail consisting of 2 mg verapamil, 200 micro grams nitroglycerin and 2000 units of heparin was injected via the sidearm of the sheath into the radial artery.

Coronary cannulation. A 0.035 inch J tipped guide wire was used to enter the ascending aorta. Standard femoral shaped 5F Judkins left (JL) 4 or Judkins right (JR) 4 coronary diagnostic catheters (Boston Scientific, Natick, MA, USA) were used to cannulate the coronary arteries. In cases where the JL4 catheter did not engage the left coronary artery ostium, a JL3.5 was used and if that catheter failed then an Amplatz (AL1) shaped catheter was used. If the 0.035 inch J tipped guide wire could not navigate the radial artery or the subclavian artery then it was substituted successively with a 0.025 inch J tipped guide wire, a 0.035 Terumo Glide wire or a 0.018 inch angled Terumo Glide wire (Terumo, Japan). For coronary interventions a 6F radial sheath (Cordis) was used and an appropriately curved 6F guiding catheter (Cordis) was selected. All catheter exchanges took place over a wire.

Introducer sheath removal. At the end of the procedure, the sheaths were immediately removed and local pressure dressing applied over the radial artery. In case of radial artery spasm, patients received additional analgesia, additional intra-arterial verapamil (2-4 mg), and local warm packs over the radial artery. The pressure dressing was removed on the following day and the patency of the radial artery was assessed using a hand held Doppler probe. The patients were allowed to sit upright and ambulate immediately following the procedure.

Definition. Procedure time was calculated from the time of the local lidocaine infiltration to the time the sheath was removed.

Statistical analysis. Demographic, patient and procedure variables were prospectively entered into a computer database. Patients were divided into 2 groups. group one comprising the first 101 patients and group 2 the subsequent 101 patients. Continuous variables are presented as mean ± standard deviation and were compared by student's t-test. Proportions were compared using the chi-square test. Probability value ≤0.05 was considered significant.

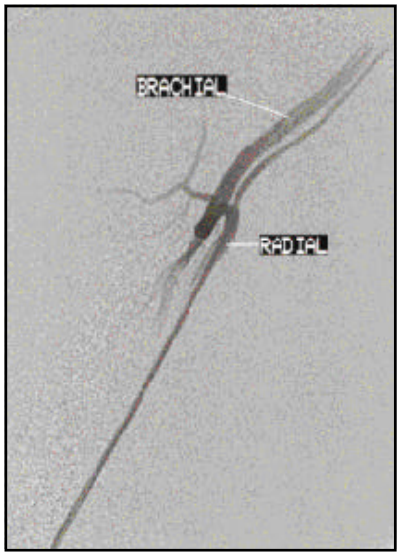

Figure 1 - Angiogram of the right radial artery with a 180 degree loop prior to the brachial artery. This loop precluded passage of the catheters.

Results. Two hundred and two consecutive patients underwent an attempt at transradial catheterization. Except for one patient, all patients were males (99%). The mean age was 54 ± 12 years (range, 23-89 years). The procedure was successful in 191 patients (95%). Ninety-four (49%) of the 191 successful procedures were coronary diagnostic studies alone, 78 patients (41%) underwent diagnostic catheterization plus coronary artery intervention at the same sitting and 19 patients (10%) underwent elective coronary intervention alone. Radial artery access failed in 7 patients (3.5%) due to inability to cannulate the radial artery. Coronary artery cannulation failed in 4 patients (2%) after successful sheath placement in the right radial artery. In 2 of these 4 patients the subclavian artery was very tortuous and prevented guiding catheter manipulation and coronary cannulation; the third patient had an abnormal take-off of the left main and none of the available diagnostic catheters (JL4, JL3.5, AL1) could engage the left main from the right radial approach; the fourth patient had a tortuous radial artery loop, which allowed a 5F JR4 catheter to pass through, but not the 5F JL4 catheter (**Figure 1**). All of these patients had a successful catheterization via the femoral artery. In 63 patients (37%) left coronary artery cannulation was not possible using the JL4 catheter. Fifty-one patients (30%) required the JL3.5 shaped catheter, and 12 patients (7%) required the AL1 shaped catheter to engage the left coronary ostium. The mean procedural time for diagnostic angiography was 24 ± 14 minutes (range, 7-93 minutes) and the mean fluoroscopy time

was 8 ± 7 minutes. For combined diagnostic studies and interventions the procedure time was 56 ± 24 minutes (range, 13-135 minutes) and the fluoroscopy time was 16 ± 8 minutes.

Effect of learning curve. In group one failure to access the radial artery or the coronary artery occurred in 10 patients (10%) compared with one patient (1%) in group 2 (p=0.013). The mean diagnostic procedure time was 28 minutes in group one patients compared with 20 minutes in group 2 patients (p=0.013). The mean fluoroscopy time was 10 minutes for group one patients compared with 6 minutes for group 2 patients (p=0.02). No vascular or ischemic complications occurred in any of our patients. One patient developed painful swelling without bleeding on the second day of the transradial angioplasty. This resolved without any sequelae with bed rest and analgesia. All patients had palpable radial artery pulsations and doppler flow in the radial arteries the next day of the procedure.

Discussion. Transradial access is technically more demanding than the conventional femoral access, with a steep learning curve and it requires a full assortment of catheters and wires to be available. The success rate and the procedure times improve significantly with increasing experience. Operators without prior experience can successfully perform transradial coronary angiography and intervention in selected patients with strong palpable radial arteries. Our success rate of 95% and the presence of the learning curve is comparable to the early experience of others. Louvard et al[3] reported a failure rate of 10.3% in their first 300 patients which was reduced to 1.7% later in the experience and Goldberg et al[4] reported a success rate of 84% in their first 27 patients.[3,4] Despite the smaller body size of the Asian patients compared with the European patients, initial reports of transradial access in Asian patients have been encouraging. Transradial access was reported from Malaysia (success rate 91%), China (success rate 98%) and Japan (success rate 98%).[7-9] The 2 major advantages of transradial access are reduced bleeding complications and early mobilization. The risk of femoral vascular complications remains significant especially with the use of glycoprotein IIb-IIIa receptor inhibitors despite early sheath removal and smaller guiding catheters.[10] The morbidity of post femoral catheterization bed rest, back pain and urinary voiding difficulties are eliminated with the transradial approach. A randomized trial compared the femoral, brachial and the radial approaches showed similar clinical outcomes. However, access failure was more common with the transradial approach while access site complications were more common with the femoral and brachial interventions.[11] The greatest potential of the transradial approach lies in the likelihood of performing possibility of outpatient coronary interventions, which can reduce the load on the hospital beds and subsequently reduce the long waiting lists for coronary interventions. Preliminary studies have demonstrated the feasibility and safety of outpatient coronary stenting.[12] Three patients in our study underwent coronary intervention as outpatients. The limitations to the transradial approach are well known and it will never replace the femoral approach completely. Patients who are unsuitable for the transradial approach are those with an abnormal Allen's test, weak radial artery pulsations, or those with dialysis fistulas. The radial artery is prone to spasm and anatomical variations such as loops lead to access failure. Women tend to have smaller radial arteries that are more prone to spasm thus we did not include women in our early experience. Left coronary cannulation is more difficult via the right radial approach, and to tackle the anatomical challenges more equipment resources need to be in hand. Furthermore, some cardiologists are not comfortable using the 6F guiding catheters for coronary intervention.

In conclusion, transradial coronary angiography and intervention can be safely performed in selected Saudi patients with a high rate of success. Success rate improves with increasing experience. Future studies are needed to assess the potential of outpatient interventions using this technique, which may reduce hospital waiting lists for coronary interventions.

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