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DIAGNOSTIC AND INTERVENTIONAL CORONARY PROCEDURES USING DISTAL RADIAL ARTERY IN ANATOMICAL SNUFF BOX: INITIAL EXPERIENCE AT OUR CENTRE

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ABSTRACT

Objective: To evaluate the safety and effectiveness of the dTRA from both the right and left arm.
Study Design: Prospective longitudinal study.
Place and Duration of Study: The study was conducted in Army Cardiac Centre, Lahore Pakistan, from Nov 2018 to Dec 2018.
Methodology: Forty-five consecutive patients who were undergoing coronary angiography/angioplasty were included regardless of indication. Right dTRA was used in 22 patients and left dTRA was used in 20 patients. Procedural success was defined as ability to complete the procedure without conversion to different access site due to failure of coronary artery cannulation. Radial artery patency was checked with doppler ultrasonography both at forearm and snuff box 24 h after successful hemostasis by manual method. We monitored for bleeding and ischemic complications and failure of hemostasis while hospitalization.
Results: Procedure was successful in 42 cases (93.3%), 22 (52.3%) diagnostic and 20 (47.6%) coronary intervenetional procedures, 22 (52.3%) cases from right dTRA and 20 (47.6%) cases from left dTRA. 3 (6.6%) cases were unsuccessful because of weak pulse/hypoplastic distal radial artery or vessel spasm. Manual hemostasis was applied in all cases. There were no ischemic or bleeding complications. No distal or forearm radial artery occlusion (RAO) was observed on doppler ultrasonography 24 h after successful hemostasis.
Conclusion: dTRA is a safe and feasible radial arterial access which is comfortable for both operator and patient and especially left dTRA provides improved operator ergonomics. Also despite longer time to access distal radial artery and a steeper learning curve, dTRA is a reproducible procedure for coronary interventions in a radial experienced catheterization lab.

Keywords: Angiography, Angioplasty, Distal radial, Hemostasis, Radial occlusion, Snuff box, Transradial.

INTRODUCTION

Cardiac catheterization has continually evolved since the first procedure in 1929[1]. There is a marked improvement in understanding of vascular anatomy and technology for coronary angiography. Inspite of the ease of femoral artery access, much research has been done on best access site for coronary procedures as vessel related complications have given rise to increased mortality, morbidity and hospital stay. The radial artery access for diagnostic coronary procedures was first described in literature in 1989 by Lucien Campeau[2]. Later kiemeneij published article with first three patients who underwent angioplasty with stent implantation using this route[3]. In 1997, ACCESS study published comparing intervention from radial, brachial and femoral accesses showing significant reduction in local hemorrhagic complications associated with radial access (0% versus 2.3% versus 2.0, respectively, p=0.035) giving a global boost to this access[4]. Certain advantages have contributed to its acceptance from the interventionists' community which includes lower incidence of bleeding and access site complications, shorter length of hospital stay, lower cost, and better convenience for the patient, than those with the trans-femoral access[5,6]. However, certain limitations of conventional transradial access are to be addressed such as radial artery occlusion, ergonomic and comfort reasons (pati-

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ents must lie with their arm in asupine position), orthopedic reasons (injuries, frozen shoulders, and elbows causing inability to flex the wrist), and operator inconvenience (the operator needs to stand in a bent position for long periods and closer to the radiation source for left TRA)[7]. As operators work on the right side of the patient, so they prefer taking right radial access. However, right radial artery occlusion, under developed right radial artery, extreme tortuosity, sclerosis, calcifications, arteria lusoria, past or futureuse of right radial artery as free arterial graft make the operators choose the left radial artery[8]. This makes the operators to bend over patients to introduce sheaths and catheters to left radial artery, development of unpleasant position, making the catheterization procedure inconvenient pushing operators to crossover to another arterial access (femoral artery). In 2017, Kiemeneij sharpens the scientific curiosity of our community with the publication of a series of 70 patients in which coronary diagnostic and interventional procedures were performed by using the left distal radial artery in the anatomical snuffbox with procedural success in almost 90% cases setting foundation of a new season of questioning and hypothesis formulation and opening a new site of access to an already well-studied artery in interventional cardiology[9].

The present study analyzed the reproducibility of the distal transradial artery access in the anatomical snuff box, regardless of the indication for catheterization, in different hospitals and with different operators, in diagnostic procedures or therapeutic interventions in the coronary territory.

METHODOLOGY

It is a prospective longitudinal study conducted in Army Cardiac Centre, Lahore Pakistan of consecutive series of patients undergoing coronary angiography or coronary angioplasty through distal transradial artery (dTRA), from 1st November 2018 to 31st December 2018. Of the 45 patients, puncture failed in 3 (6.6%) patients requiring conventional transradial access (cTRA). The procedure was carried out in the single centre by the hands of two distinct operators. The data of each patient and procedure were collected at the end of the examination. The time of the procedure was timed by a professional nurse from the administration of the local anesthetic to the withdrawl of the catheter. Puncture time was determined from administration of local anesthetic to the saline flush through sheath. Alternatively, one patient under went right distal radial access and then the other patient underwent left distal radial access. All patients had a normal arterial pulse in their forearm (conventional site) and anatomical snuff box area. In the catheterization laboratory, after disinfection with povidone iodine the patient's right hand was kept in the right side of the body on the hand support system in thesemi-prone position close to the body curling the thumb with other four fingers, thus making the fossa radial is more prominent. The operator was positioned in the right side of the patients preparing for right distal radial artery puncture. For left hand site, patient's hand was kept in the left side of the body on the hand support system in the semi-prone position close to the body curling the thumb with other four fingers, thus making the fossa radial is more prominent. The operator was positioned on the left side of the patient preparing for left distal radial artery puncture using his left or right hand for puncturing the artery. After injecting 3 mL of 2% lignocaine over a single area of right/left anatomical snuff box, a 21-gauge open needle was introduced with a 30 to 45 degree angle. Successful puncture was followed by an insertion of 0.021-inch straight guide wire with a soft, flexible proximal part and a rigid distal part. Then a 6 French radial hydrophilics heath for dTRA was introduced into the radial artery (figure). The protocols for giving heparin and a cocktail of vasodilators to prevent vessel spasm followed the conventional standard of the institution for routine radial technique. In case of interventions being performed, heparin dose was adequately adjusted. After flushing of the radial sheath, the operator on the right side of the patient would begin the

transradial coronary angiography or intervention for both left and right dTRA. Most frequently used catheters were Judkins, Tiger, AL and XB according to need of the patients. Advancement of the catheters was achieved by 0.035-inch J-tipped wire. At the termination of the procedure the radial sheath was pulled out and early hemostasis was obtained by compression with the thumb of the assistant for approximately 5 min, then a slightly compressive bandage with gauze was applied for 2 h over the access site for complete hemostasis (figure). The radial arterial pulse at the forearm and at anatomical snuff box was checked bypalpation after the procedure and at discharge day. The arterial pulse was also assessed by doppler ultrasonography after 24 h of hemostasis at both forearm and anatomical snuff box.

RESULTS

Between November 1, 2018 and December 31, 2018, 45 patients were selected to undergo-coronary angiography/angioplasty from right and left dTRA alternatively. The selection was made at the discretion of the operator, when ever there was a palpable pulse in the region of the anatomical snuff box. Among these 45 patients, there were 15 patients who underwent angiography previously using conventional radial approach and still have a palpable radial artery in forearm and anatomical snuff box. Of the 45 patients, puncture failed in 3 (6.6%) patients requiring conventional radial access. Two (9.0%) puncture failed out of 22 cases from left dTRA and 1 (4.3%) puncture failed out of 23 cases from right dTRA. Therefore, 42 patients were effectively included for analysis, of which 22 (52.3%) underwent diagnostic coronary an-giography and 20 (47.6%) underwent coronary angioplasty procedure. Among 22 diagnostic angiography patients, 12 (54.5%) underwent procedure through right dTRA and 10 (45.4%) through left dTRA. Among 20 coronary angioplasty patients, 13 (65%) underwent procedure through right dTRA and 7 (35%) through left dTRA. The essential demographic, clinical and Procedural characteristics of patients are listed in table-I. Hemostasis parameters are depicted in table-II.

Manual hemostasis was applied in all the cases. In only 1 patients, a discrete hematoma was found around the puncture site immediately after a diagnostic procedure requiring no additional care. There was no loss of radial pulse immediately and 24 hour after the procedure. Doppler ultrasound was also done 24 hour after

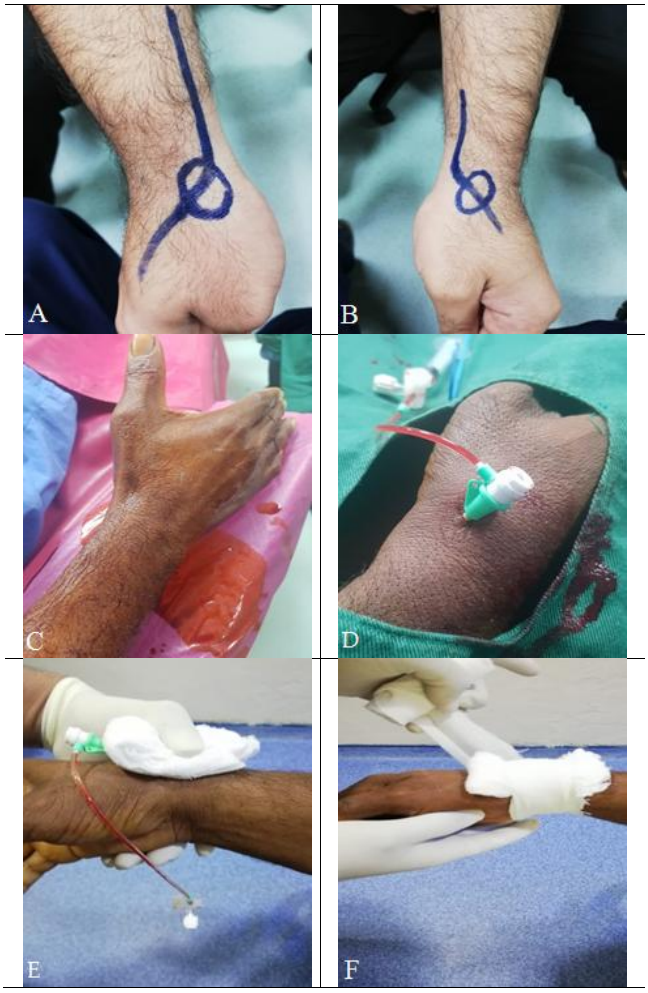

Figure: A and B are Highlighting course of radial artery in forearm and through snuff box in right (A) and left (B) hands. C. Snuff box visible on hyper-extension of right thumb with hand in semiprone position (also see the radial support under the right arm). D. Right distal transradial access successfully taken (also note the position of wrist-semiprone and hand-thumb semiflexed medially). E.Applying pres-sure manually over access site using a small gauze. While pressure being applied, pulled out the radial sheath completely followed by maintenance pressure for about 5 minutes. F. After application of some pre-ssure, gentle rollover dressing applied at the access site.

the procedure revealing not even a single radial occlusion at snuff box site or conventional forearm site. No major complications occurred. The only complaint was pain at the site of puncture. No decrease in perfusion of the hand noted nor there were any neurological complications.

Table-I: Essential demographic, clinical and Technical data / procedural characteristics.

Demographic, clinical and Procedural characteristics	**(n = total 45 patients, n= 42 patients with successful sheath placement in snuff box)**
Age (years)	58.9 ± 3.81 (42-78)
Gender	Male 30 (66.6%) Female 15 (33.3%)
Hypertension	26 (57.7%)
Diabetes mellitus	24 (53.3)
Smoking	21 (46.6)
Family history of CAD	4 (8%)
Snuff box hand	Right = 23/45 (51.1%) Left = 22/45 (48.8%)
Puncture attempts	2.44 ± 0.46 (1-5)
Puncture time (min)	5.91 ± 2.19 (1-15)
Puncture failure	Overall 3/45 (6.6%) Right dTRA 1/23 (4.3%) Left dTRA 2/22 (9.0%)
Sheath placement failure	Overall 3/45 (6.6%) Right dTRA 1/23 (4.3%) Left dTRA 2/22 (9.0%)
Sheath size (Fr)	6Fr 42/42 (100%)
Vasodilators	Nitroglycerin: 14/42 (33.3%) Verapamil: 5/42 (11.9%)
Radial artery spasm	10/42 (23.8%)
Angiography only	Overall 22/42 (52.3%) Right dTRA 12/22 (54.5%) Left dTRA 10/22 (45.4%)
PCI	Overall 20/42 (47.6%) Right dTRA 13/20 (65%) Left dTRA 7/20 (35%)
Successful procedure after sheath placement	42/42 (100%)

Continuous variables are expressed as mean ± SD (minimum-maximum). Nominal variables are expressed as n (%). PCI: Percutaneous Coronary Intervention. dTRA: distal trans radial access. CAD: Coronary Artery Disease.

DISCUSSION

The dTRA was initially described with the objective of recanalizing occluded radial artery retrogradely[10]. Later it was proposed to use this access route for preserving the entire radial artery and by this radial artery could also be used in future surgical procedures[11]. The technique awakens curosity in the world of interventional cardiology.

After the publication of the work of Dr. Keimeneij, we aimed to reproduce the technique in different services and through different hemodynamics, which would allow evaluating if there is feasibility in its routine application in the real world. Our first and new experience with an approach through the right and left distal radial artery for coronary angiography and intervention demonstrates its feasibility as a safe accessite because of less complications and more comfortability to the patient as well as operator.

Table-II: Hemostasis parameters.

Hemostasis characteristics	n=42 patients with successful sheath placement in snuff box
Hemostasis method	Manual 42/42 (100%)
Early Hemostasis time (min)	Angiography 5.81 ± 1.14 (5-10)
Hematoma (EASY)	None 41/42(97.6%) Type I 1 /42 (2.3%) Type II 0 /42 (0%) Type III 0 /42 (0%) Type IV 0 /42 (0%)
Forearm RAO after 24 h by Doppler ultrasound	None 0 /42 (0%)
Snuff box RAO after 24 h by Doppler ultrasound	None 0 /42 (0%)
Symptoms	None 40/42(95.2%) Pain 3 /42(7.1%) Numbness 0/42(0%) Paresis 0/42(0%) Acute hand/arm ischemia 0/42 (0%)

Continuous variables are expressed as mean ± SD (minimum-maximum). Nominal variables are expressed as n (%). EASY: Early Discharge After Trans radial Stenting of Coronary Arteries Study, RAO: Radial Artery Occlusion

When puncture was performed on the left side, the main reason was the fact that the patient was previously revascularized with Left Mammary Artery Graft. In this way, access was obtai-

ned from the left side in the usual way or from the right side of the patient with the left hand positioned towards the right groin. This somewhat more ergonomic mode proved to be very comfortable for the operator. However, performing the puncture on the left side of the patient did not impose any additional difficulties. An observation to be taken in these cases is that, when the patient presents some degree of respiratory discomfort and uses the abdominal breathing more intensely, there is much oscillation of the hand at this moment, which may hinder, not the correct palpation of the pulse, but its puncture. Regarding the feasibility and incidence of complications, it has already been shown that there are no differences between the two sides, despite discrete differences in favour of the left radial in terms of a shorter fluoroscopy time and a lower volume of contrast used[12,13]. We speculate if this small disproportion is not due to the fact that we find more tortuosity when navigating the Brachiocephalic Trunk, which does not occur on the left side. Also, advancement of the catheters and anchoring at the coronary ostium is easier through the left sided approach[12] and bending of the operators over the patient toward his or her left arm which makes the procedure inconvenient and disturbing, especially in obese and female patients can be much avoided using left dTRA.

The right side dapproach for conventional radial and distal radial artery access in AS provides advantages for both the patients and the operators. At the start of vascular access of cTRA right hand was kept along the side of the body insupine position with fingers and wrist kept in dorsiflexedstate with a support but during DTRA patient's hand was kept in semiprone position without any support thusavoiding the possible discomfort that may arise from prolonged procedure.

Regarding the technique, open needles were used to puncture distal radial artery inclining at an angle of 30 to 45 degrees, tip directed to the medial plane targeting the portion of the wrist where conventional access is made. Transfixation should be avoided as inadvertent touch in the periosteum of underlying trapezius and scaphoid bones is painful. After successful puncture, a 6 Fr hydrophilic radial sheath was introduced in all patients. We did not experience any resistance in advancing guide wires and catheters through the sheath reflecting that the angle of the sheath is coaxial with the radial artery.

In certain patients of large stature with long upper limbs, it is already well known that conventional TRA access eventually causes the catheter used to reach the ostia of the coronary arteries at the limit of their length. However, while doing procedure from anatomical snuff box, this distance between the entry point in the skin to the coronary artery ostium increases by a few centimetres, which could even render procedure sunviable in large individuals. This may represent a possible draw back of the method, but this can be supplanted by making of dedicated catheters slightly longer in length.

An advantage of the dTRA pathway is to preserve the radial artery in forearmsince the need for multiple procedures in the same patient is becoming increasingly frequent due to the increase in life expectancy as well as increased comorbidities which contribute to the development of a therosclerotic disease. There is no tissue trauma or vascular trauma at the usual sitenor does it suffer the effects of prolonged hemostatic compression.

However it was observed that some individuals with a palpable radial artery at forearm, have either too thin or imperceptible pulse in the anatomical snuff box. This disadvantage certainly decreases the eligibility for the technique in a small number of individuals having vessels with smaller calibre.

Safety profile of dTRA closely resembles cTRA, since a minimal incidence of hemorrhagic complications was detected and there was no loss of pulse. In fact, in a study of 472 patients who underwent coronary angioplasty with cTRA using the same operator, the incidence of asymptomatic pulse loss inthe in-hospital period was 4%[14]. Due to the similarity of the advantages of

the two techniques, dTRA access can become another access routein which there will be possibility of early discharge, even on the sameday. Data from the Brazilian reality[15,16] already begin to confirm the safety of this strategy, provided that a period of observation of about 6 hours is observed in selected patients.

Kaledin *et al*. showed that dTRA access is a safer option compared to cTRA regarding the possibility of hand ischemiawhich is actually due to preservation of palmar arch as the puncture site in anatomical snuff box is that segment of the radial artery which is distal to the origin of superficial palmar arch[17]. In addition, multiple collateral vessels communicating between the superficial and deep palmararches act as salvage vessels if any occlusion occurred in the hand's arterial circulation. From this anatomic and physiological evaluation of the palmararches, dTRA can be expected to avoid any peri- or post-procedural vascular occlusions. This is also a very useful way to preserve the radial artery for future graft in CABGor establishment of AV fistula.

Memory trial showed that hemostasis time with manual method was significantly shorter than the mechanical one[18]. Only Soydan *et al*. used exclusively manual compression for hemostasis, whereas Kiemeneij and Al-Azizi *et al*. combined mechanical hemostasis with air-inflated devices and compression bandages[8,19,20]. Valsecchi *et al*. and Kim *et al*. used only compression bandages but with no exact assessment of hemostasis duration[21-22]. As the distal radial artery courses over the bony prominence, compression with thumb over it may lead to radial occlusion. So we applied the pressure for 5 minutes only. Early hemostasis was achieved by manual method applying compression bandage with gauze over the puncture site regardless of the administered anticoagulation. Moreover, complete hemostasis was achieved in almost 2h. No major complications and no neurologic complications were recorded. Only one type Ihematoma, classified according to the Early Discharge After Transradial Stenting of Coronary Arteries Study (EASY) occurred which was well managed with local compression. The ease, safety and comfortability of this new radial approach should be kept in mind toprevent radial artery occlusion, radial artery spasm and extended procedure times.

CONCLUSION

The dTRA technique appears to be safe and feasible when performed by experienced operators in cTRA. Despite longer time to access and a steeper learning curve, it is a reproducible technique with potential benefit of early and better hemostasis, improved operator ergonomics and patient comfort through right as well as left dTRA and preservation of radial artery in forearm. The technique deserves a careful look by the scientific community since it may represent an alternative but refined arterial access for coronary procedures.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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