

THE TRANS-RADIAL APPROACH FOR ENDOVASCULAR SALVAGE OF FAILING ARTERIO-VEINOUS FISTULA PROVES TO BE THE BEST

BY

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Abstract

One of the keys for successful salvage of failing arterio-venous fistulae by angioplasty is to obtain a convenient endovascular access. This has been performed via the trans-venous or trans-brachial approach with some disadvantages. The aim of this study is to evaluate the feasibility, safety, efficacy and the limitations of the trans-radial approach in endovascular salvage of failing arterio-venous fistula. Fifty seven patients with failing fistulae were enrolled into the study (36 males "63.1%" and 21 females "36.9%") with a mean age of 53.8+14years. The study points included: the technical success, the limitations of the approach, the way adopted to overcome each of the limitations, the ability to tackle different lesions sites, the incidence of puncture site hematoma, the patency of the radial artery, the incidence of hand ischaemia and the radiological and clinical success of the salvage technique. In view of the ability to tackle different lesions in the arterial, anastomotic, and venous sites of AVF at ease, the trans-radial approach proves to be the best. Moreover, this approach has the least morbidity among others, and the post procedural compression does not jeopardize proper fistula function by any mean.

Keywords: transradial, endovascular, failing fistula, fistula salvage.

Introduction:

To maximize the number of fistulas being used in dialysis patients, it is important to have a program designed to salvage early failures or those that become dysfunctional during the course of usage. Endovascular techniques are very effective in the management of these problems, and carry a high expectation of successful salvage of what would have otherwise been an abandoned access¹. Salvage of recently occluded autogenous fistulae is really a more challenging procedure than that for stenotic fistulae. One of the keys for success in general is to obtain a convenient endovascular access². Until few years ago, catheter interventions for native fistula failure have been performed via the trans-venous or trans-brachial approach with some disadvantages for each³. The trans-radial artery approach has rarely been reported as a method for treating dysfunctional Brescia-Cimino fistulas by

angioplasty⁴. The aim of this study is to evaluate the feasibility, safety, efficacy and also the limitations of the trans-radial approach in endovascular salvage of failing arterio-venous fistulae.

Patients and methods:

This study was conducted over four years in Kasr El Aini teaching hospitals. Fifty seven consecutive end stage renal disease (ESRD) patients with early non-maturing or later dysfunctional AVF were selected according to the presence of one or more of the following criteria:

- decreased or absent thrill and increased pulsatility,
- development of persistent marked limb swelling,
- difficulty in cannulation,
- decreased haemodialysis flow rate,
- high venous pressure during dialysis.
- prolonged needle sites bleeding after dialysis,

Exclusion criteria:

- Infected fistula
- Severe contrast allergy
- Non palpable radial artery
- Abnormal Allen's test

Demographic and clinical data including age, gender, cause of renal failure, and the presence of cardiovascular co-morbidities were obtained. Prior and current access history was recorded. The blood pressure of both upper limbs was measured and compared for difference indicating proximal arterial disease. The upper limb was inspected for scars of previous access operations, aneurysmal dilatation, peri-venous hematoma, abnormality in the overlying skin, and for edema and dilated veins on the shoulder and the chest wall indicating central venous occlusion or stenosis. Palpation of pulses at all levels and the propagation of thrill over the fistula were done. Allen's test was performed to assess the relative contribution of the radial and ulnar arteries to the hand.

Duplex scan protocol was implemented for each patient including:

- Visualization of the arterial tree from the level of the axillary artery down to the radial and ulnar arteries,
- Evaluation of the diameter of the radial artery and the point where it originates from the brachial artery.
- The anastomotic site.
- The draining vein up to the level of subclavian vein including the peri-vascular space for compressing or communicating hematoma.
- The peak systolic velocity ratio across the stenotic lesions.

The patients were scheduled for salvage of their native fistulae and the study was approved from the ethical committee, and informed written consent was obtained from every patient before doing the endovascular salvage trial. Treatment was on outpatient basis and the patients were only admitted when necessary for other reasons. The trans-radial approach was the one used in the 57 patients included in this study, after the authors' prior experience with trans-venous or trans-brachial approach in a previous five cases.

Trans-radial approach technique

Trans-radial approach was performed under local infiltration of 2% lidocaine hydrochloride with a small pillow behind the wrist to hyper extend it. In 49 cases the access was obtained percutaneously (Fig.1), and in 8 cases by cut down technique after a percutaneous trial or from the start (fig. 2). In the open cut-down technique, after exposing the radial artery it is hanged from below on mosquito forceps then we go with the needle, wire and sheath as in classic Seldinger technique.



Fig. 1: A 5 Fr 6 cm radial sheath introduced by percutaneous technique to deal with failing brachio-cephalic AVF.



Fig. 2: Surgical exposure of the radial artery to obtain an access

Percutaneous access of the radial artery & the interventional procedure

The radial artery was punctured with a 30-mm 20-G sheathed needle in 40 cases (unsheathed needle was used in 9 cases). After successful access and free flow of blood, the needle was removed from the sheath and a 150 cm 0.035" angled or straight hydrophilic guide-wire (Terumo) was inserted through the soft sheath. The wire was advanced until secured, and then the 20-G soft sheath was replaced by 5-Fr

6cm radial sheath. Then the wire and the sheath dilator were removed simultaneously leaving the sheath in place. Heparin (5000IU) was given in all cases in order to prevent intra-procedural thrombus formation.

A diagnostic angiography was performed as a first step by injecting non-ionic contrast media directly in the radial sheath with its tip near the anastomotic site in cases of radio-cephalic AVF. While in cases of brachio-cephalic or brachio-basilic AVF the contrast is injected via Bernstein catheter with its tip in the brachial artery near to the anastomosis (figure 3). A 0.035" hydrophilic guide wire (Terumo) on Bernstein catheter was used to go to the site of the lesion then to cross it aided by both catheter-wire manipulation and external maneuvers as arterial or venous digital compression. Once the lesion is crossed, a 4.0- to 6.0-mm balloon was used (figure 4) and inflated up to 6 to 14 atm several times, usually for 30-60 seconds at a time. The balloon size was usually based on the adjacent vein size. Final angiography was obtained at the end (figure 5).



Fig. 3: the contrast is injected in the brachial artery near the anastomosis via Bernstein catheter, showing complete occlusion of the cephalic vein 5 cm from the anastomosis.



Fig. 4: 5mm x 10 cm balloon is inflated to dilate total occlusion in the cephalic vein.

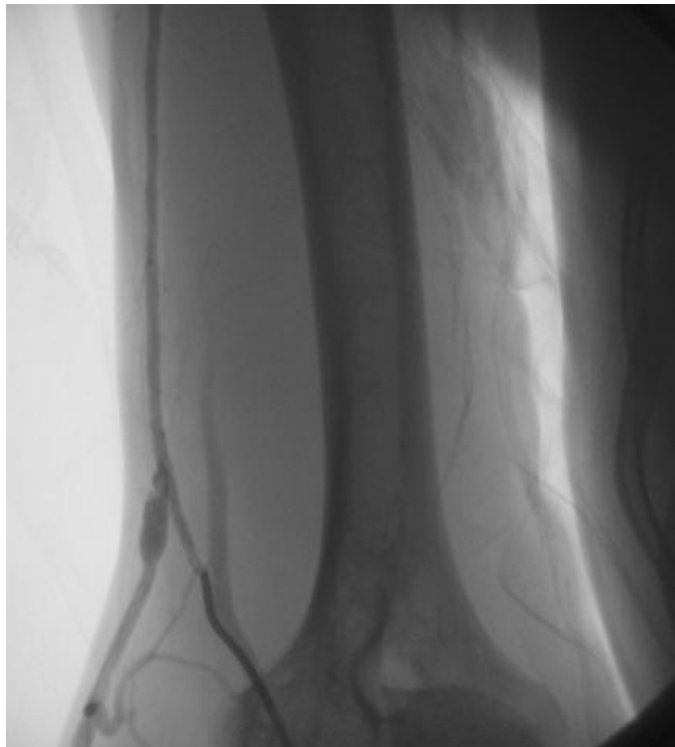


Fig. 5: final angiogram with good visualization of the cephalic vein.

After the intervention, the sheath was removed and the puncture site compressed. Great care was taken to avoid compression of nearby anastomotic site. In case of open technique, the radial artery puncture is closed transversely by interrupted 6/0 prolene sutures. The study points included: the technical success of achieving a radial access, the limitations of the trans-radial approach, the way adopted to overcome each of the limitations, the ability to tackle various lesions sites, the incidence of puncture site hematoma, the patency of the radial artery, the incidence of hand ischaemia and the radiological and clinical success of the salvage technique.

Results:

The 57 patients enrolled into the study were 36 males (63.1%) and 21 females (36.9%) with a mean age of 53.8±14years (ranging from 27 to 73 years). The etiological factors of ESRD among the studied patients were diabetes mellitus in 15 (26.3%) , obstructive uropathy in 11 cases (19.2%), chronic glomerulo-nephritis in 13 cases (22.9%), polycystic-kidney disease in 5 cases (8.7%) and systemic lupus nephritis in 3 cases (5.2%). In 10 patients (17.5%) no definite etiological factor was identified.

These dysfunctional fistulae were 19 radio-cephalic, 27 brachio-cephalic and 11 brachio-basilic. Forty three fistulae were LT sided and 14 were RT sided. The age of the AVF from the time of creation to the time of presentation ranged from 2 to 64 months. A single stenosis was demonstrated in 44 fistulae (77.2%) and multiple stenoses (ranged from 2 to 3) were found in 13 fistulae (22.8%). The majority of the stenoses were located in the outflow vein especially juxta-anastomotic.

The trans-radial punctures were successfully obtained percutaneously without ultrasound guidance in 49cases with a radial artery diameter more than 2 mm. In 8 cases open technique was resorted to. The trans-radial access was obtained in a time ranging from 2 to 13 minutes and the whole procedure average time was 42 ± 22 min. The radiological success was achieved in 54 cases (95%). Radiological success was accompanied by clinical success in 51 cases.

Although the trans-radial approach enabled the authors to reach all lesions sites, yet certain limitations were encountered and successfully dealt with:

- Radial artery with less than 2 mm diameter (8 cases) was extremely difficult for percutaneous access and mandated open cut down technique from the start.
- When going with the needle in the lumen of the artery it was not necessary to get an arterial jet like in the case of brachial or femoral artery punctures. This is because the bevel of the needle may be facing the wall of such small sized artery rather than the lumen. So, it may be enough to have a bright bead of blood at the hub of the needle.
- Sometimes a curved tip wire find difficulty to pass into the artery, so straight tip wire can do the job.
- The proximity of the fistula to the endovascular access site: For radio-cephalic AVF higher than the wrist level, the trans-radial approach can be adequately used with introducing only small part of the sheath, whereas for fistulae at the wrist level (5 cases), the trans-radial approach was also adopted using the radial artery while in the anatomical snuff box by percutaneous or open route (figure 6).
- The radial artery had a spiral turn (a loop) in one case (figure 7) and by meticulous catheter wire manipulation the turn was unfolded with progression to the brachial artery (figure 3).
- Sometimes the radial artery has a high origin from the brachial artery in the mid arm well above the level of brachio-cephalic or brachio-basilic anastomosis. In these circumstances, the trans-radial approach should not be chosen.



Fig.6: The trans-radial approach by open route using the artery in the anatomical snuff-pox.



Fig. 7: Spiral turn (loop) in the radial artery

The puncture site in the trans-radial approach was compressed without hindering the fistula flow. This was not the case in our past experience with trans-venous or trans-brachial approach. Small puncture site hematomas around the radial artery were observed in 3 cases (5.26%), and radial artery thrombosis in 2 cases (3.5%) but with no incidence of hand ischaemia.

Discussion:

The history of the use of the radial artery for intervention appears to date back to 1989 when Campeau et al performed 100 catheterizations via this approach⁵. Although this trans-radial approach has now been widely used for coronary intervention in many areas around the world, yet its use for salvage of failing arterio-venous fistulae is still limited⁶.

The retrograde venous approach has traditionally been the preferred method for occluded fistulae, but it has some disadvantages. First, it may be difficult to go into the vein especially in the needling segment as the wire may be hindered by intravenous synechiae. Second, underlying stenosis is difficult to visualize, which may also cause difficulties for the introduction of the sheath. Third, it may be also difficult to cross the anastomosis to the artery due to the sharp angulation. Because of

these limitations, an antegrade brachial artery approach has been reported by some interventionists⁷. The antegrade brachial artery approach offers some advantages: the puncture is easy and all lesions can be treated via one puncture. However, some drawbacks were encountered including difficult venous lesions manipulation, more incidence of puncture site hematoma and sometimes compromised fistula function due to brachial artery spasm or thrombosis⁸.

Most of the above drawbacks were avoided by the radial artery approach². This was elicited and further upgraded in this current study. First, the radial artery was easy to puncture either percutaneous if more than 2mm in diameter or by cut down technique from the start for smaller caliber. Second, one sheath was enough to treat all the downstream and upstream lesions at the same time with no sharp angle to hamper wiring or device advancing. Third, the sheath was kept distal to the fistula site and hence did not interrupt the blood flow of the treated fistula. Fourth, for close site fistulae, the anatomical snuff-pox could be satisfactorily used. Fifth, it is relatively easy to stop bleeding from the radial artery despite the concurrent use of heparin during the procedures. Sixth, the potential risk of distal embolization to the hand was minimized and hand ischaemia was not encountered as the procedure was limited to patients with a normal Allen test. Seventh, post-procedure puncture site compression did not jeopardize the fistula function and had the least complications. Trans-radial approach is not possible for the end-to-end radial-cephalic anastomosis or high origin of the radial artery above the level of the brachio-cephalic or brachio-basilic anastomosis.

Conclusion:

In view of the ability to tackle different lesions in the arterial, anastomotic, and venous sites of AVF at ease, the trans-radial approach proves to be the best. Moreover, this approach has the least morbidity among others, and the post procedural compression does not jeopardize proper fistula function by any mean.

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