Original Research Article

Open Brachial Access for Endovascular Treatment: Our Five Years Institutional Experience

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Abstract

Endovascular treatment has currently replaced open surgical procedures as the first-line treatment for many vascular diseases. Hence, besides mastery in endovascular techniques and instruments, Vascular surgeons must be well versed with various endovascular access sites too. Presently, Common Femoral Artery (CFA) is the most common access site being used for percutaneous as well as open vascular access for endovascular management of upper /lower limbs, Aorto-iliac, carotid and arch vessels diseases. However, though Brachial use is being selectively used as vascular access, especially when CFA can't be used (groin sepsis, Aorto-iliac occlusion, abnormal femoral anatomy, severe calcification etc) or failure/adjunct to CFA access (e.g – complex thoracic/ abdominal aneurysm), its use haith the advancement and complexity of endovascular management. This study was an observational retrospective study conducted between June 2015 - September 2020 at a tertiary care hospital and was aimed at critical analysis various aspect of brachial access including the target arteries and complications. A total of 72 patients were included in this study, most of the patients were male (80%) and mean age of presentation was 60.79 with SD of 14.9 years. Patients were predominantly Male (58/72). The left brachial was accessed in 87.5%, right in 6.9% and both brachial arteries were accessed in 5.6% of patients.Iliac artery was the most common target artery (32 %), which were approached via trans-brachial access, followed by SCA (26%) and Abdominal Aorta (18%). Overall complication rate was 5.55 %. Hematoma was observed in two patients, one patient had brachial artery thrombosis and one patient developed brachial artery pseudoaneurysm. Our limited study suggests that brachial approach is safe and suitable in difficult aorto-iliac lesions and also as an adjunct or alternative to femoral access in specific cases.

Keywords: Brachial Access, Endovascular, Target arteries, Haematoma, Pseudoaneurysm.

Introduction

Endovascular treatment has currently replaced open surgical procedures as the first-line treatment for many vascular diseases. Hence, mastery of endovascular technique is of paramount importance in modern practice of vascular surgery. Besides, endovascular techniques and instruments, Vascular surgeons must be well versed with the various sites of endovascular access too. Various arterial access e.g tibial, popliteal, Common Femoral Artery (CFA), iliac, radial, ulnar, brachial, axillary and carotid arteries can be used to accomplish diagnostic and therapeutic endovascular procedures. The key factors that must be considered in choosing a site for access include (1) appropriateness for the procedure being completed, (2) ability to obtain hemostasis once the procedure is completed, (3) ability to safely convert to an open procedure if there is a complication, and (4) ensuring that cannulation of that site will have minimal adverse effects on the tissue being supplied by the access vessel [1].

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Considering above facts, CFA is the most common artery used for endovascular interventions. Access through other vessels, including the brachial, radial, and ulnar has been used when femoral access is unavailable. Considerable experience has been achieved with these approaches for endovascular interventions of the coronary arteries, with excellent technical results and a low incidence of complications [2,3]. Brachial access, which was initially developed for coronary intervention, is now progressively being used primarily in patients with subclavian artery and brachiocephalic trunk, contraindicated femoral access, complex aortic aneurysm, aorto-Iliac occlusive diseases [4,5]. Initially, there was a hesitancy in using brachial artery access for non-coronary interventions due to high complication rates pertaining to primitive access sheath, wires and catheters. But now this approach has become more safer with the development of thin-walled, small diameter balloon catheters with sufficient shaft length [6,7].Brachial artery access offers a full range of interventions including Upper and lower limb, Thoracic and abdominal aorta, Arch and neck vessels etc. The development of longer catheters and wires has led to the ability to treat more distal lesions through brachial artery access [8]. Despite its utility as an adjunctive and sometimes obligatory technique, some endovascular surgeons are reluctant to enlarge its indications for fear of an increased rate of local complications which includes pseudoaneurysm, brachial artery thrombosis, access hematoma, median nerve injury, and a higher risk of central neurological complication. Several series have documented complication rates as high as 11% [9]. Brachial access can be secondarily used after the ipsilateral and contralateral CFA approach failure. It has the advantage to allow the treatment of bilateral lesions and it enables an antegrade catheterization through the descending thoracic aorta [10].

Brachial access for endovascular intervention not only provides early ambulation but also ensures lesser length of in-hospital stay when compared to femoral access. Earlier mobilization improves patient comfort, making endovascular interventions more tolerable for patients with comorbidities such as chronic back pain, congestive heart failure, or obesity[5,11]. The brachial artery access can be obtained percutaneously using seldinger's technique or open surgical technique can be used for arterial access. The choice of surgical approach rather than percutaneous puncture of brachial artery is justified by the need to use large profile of sheath or device, difficulty in brachial artery puncture, and also by the need to have a reliable hemostasis. Besides these, brachial access allows an ambulatory care, even when the approach is surgical and reduces the risk as well cost associated with prolonged immobilization especially for elderly patients [6,10,12].

Some surgeons prefer radial access to brachial access to avoid local complications (hematoma, nerve compression, brachial artery thrombosis). However, the radial approach has the same disadvantages of the brachial approach (push weakness, increased length of the distance from puncture to lesion) [5,13, 14] and small diameter of the radial artery, which can permit catheters up to 6 Fr size only. Furthermore, the small diameter of the radial artery and its spastic characters present technical difficulties to pass the appropriate devices [15,16]. The axillary artery provides an alternate access site in the upper extremity. The closer proximity of the axillary artery to the lower extremity vasculature is advantageous, and its larger calibre permits insertion of larger diameter sheaths than the radial artery. While axillary artery access can be considered in special situations, this vessel is not commonly used because of concerns relating to potential vascular complications and injury of the adjacent brachial plexus [17]

As endovascular interventions for arterial reconstruction continue to expand, brachial access has become an increasingly useful alternative access site. The brachial approach can provide antegrade access to a lower extremity when the contralateral iliac artery is occluded or after bilateral iliac artery stents, for internal iliac artery coiling, subclavian stenting, or endovascular aneurysm repair. It may also facilitate revascularization of visceral arteries by providing a more favourable anatomic approach. Brachial artery access offers an attractive option because of its typically superficial nature as well as its acceptable calibre for interventional sheaths and guiding catheters [18]

In case of left brachial artery access the material does not pass through the aortic arch, thus reducing thromboembolic complications. Central neurological injury rate during aortic catheterization using brachial access is estimated between 1.8% and 2.9% [7].

Despite significant advancement and wider acceptability of endovascular approach, limited studies are available on brachial access for vascular interventions. This study aims at critical analysis of open brachial arterial approach; its merit/demerit, target artery approached and complications occurred during endovascular interventions at our institution in last five years. Hence, this study will further enrich our existing knowledge of various aspects of trans-brachial approach for endovascular interventions.

Patients and Methods

This was a single- centre, retrospective (June 2015 - September 2020), observational study conducted at the department of Vascular surgery in a tertiary care hospital.

Inclusion criteria

All patients of age more than 18 years who underwent trans- brachial approach for endovascular interventions.

Exclusion Criteria

1. Patients, who were not amenable for endovascular procedures e.g patients with known contrast allergy /Chronic Kidney Disease.
2. Patients with Complex TASC 'C' and TASC 'D' Aorto-Iliac disease
3. Patients with Acute Limb Ischemia (ALI)
4. Patient requiring primary amputation at first admission were also excluded.
5. Patients who were not willing for this study.

Methodology

All the procedures were performed by vascular surgeons in the operating room with mobile or fixed C arm facility. Local anaesthesia with conscious sedation was performed in most of the cases, General /Regional anaesthesia was needed in limited patients, who were restless or non-cooperative. Brachial artery exposure was performed in all cases. Incision was made in cubital fossa; Proximal and distal control of brachial artery was obtained and then the artery was accessed with 18G needle. Initially 5Fr or 6Fr sheath with 11cm length was introduced over guide wire. After sheath placement, an intravenous bolus of 50 U/kg of heparin was given. Slip cobra with terumo wire was taken for crossing the aortic arch in all the cases which enable the easier access because of angle of subclavian artery and its entry into thoracic aorta is highly angulated most of cases. Terumo wire exchanged with PTFE wire and then long sheath of varying length (65cm, 80cm or 90cm) were used for visceral artery, Aorto- Iliac and distal interventions. Post procedure artery was checked for forward flow and back bleed and then arteriotomy was closed with either prolene or ePTFE suture of size 6-0 or 7-0. Post closure distal pulse was confirmed and then the wound closure done in single layer using interrupted suture. Patients were followed up, in vascular OPD, clinically and sonologically (in selected cases) for access site complications. All data was tabulated and analysed.

Statistical Analysis

Statistical analysis was done by using descriptive and inferential statistics using **Pearson chi square test** for categorical data, **Unpaired t-test** to compare mean values between the two groups and **Paired t-test** was used to test the relative change with respect to time. P-value less than 0.05 is considered as significant at 95% confidence level. The **statistical software SPSS 16.0** used for the analysis.

Results

In our study,72 patients with different target lesions were included. Majority of patients (70%) were in the age group of 50-80 years and Mean age of presentation was 60.79 with SD of 14.9 years. Patients were predominantly Male (58/72) and Male: Female ratio was 4:1. In our study, 94.4% (68/72) of patients were smokers and Hypertension (47.22 %) was most common associated comorbidity followed by Diabetes Mellitus (27.77 %) and COPD (13.89 %) among them (Table1).

Table 1:Comorbidities

Comorbidity	Frequency (n)	Percentage (%)
Hypertension (HTN)	34	47.22
Diabetes Mellitus (DM)	20	27.77
Chronic Obstructive Pulmonary Diseases (COPD)	10	13.89
Hyperlipidaemia	08	11.10

Coronary Artery Disease (CAD)	06	8.30
Cerebro-Vascular Accidents (CVA)	02	2.78

Brachial access- The left brachial artery was accessed in 63 patients (87.5%), right brachial in 5 patients (6.9%) and both brachial arteries were accessed in 4 cases (5.6%).

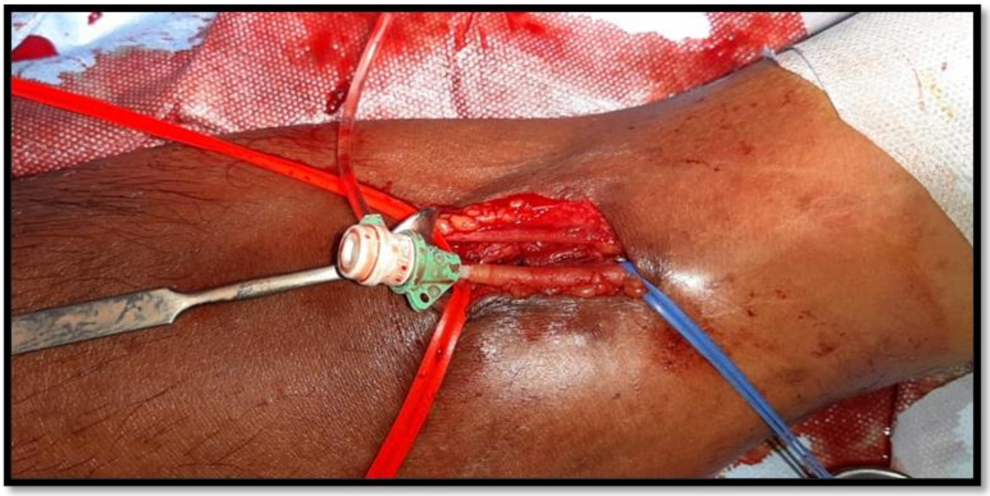

Fig 1: Brachial artery Open Access

Anaesthesia:the procedures were performed under local anaesthesia with or without conscious sedation in 65 cases (90.27%) and the rest 7 cases (9.73%) were done under general anaesthesia.
Sheath Size:Minimum sheath size was 6Fr and maximum was 9Fr with an average sheath size of 7fr used in most of cases (86.11%)
Sheath length:Minimum of 11cm and maximum of 90 cm. The average sheath length was 65cm used in 41 cases (56.9%).
Target vessel: Iliac artery was the most common artery (32 %) followed by SCA (26%) and Abdominal Aorta (18%) which were approached via trans-brachial access(Table 2).

Table 2: Target Vessels approached with their frequency

Target vessel	Frequency (n)	Percentage (%)
Iliac Angioplasty +/- Stenting	23	31.94
SCA (Angioplasty +/- stenting, plug)	19	26.38
Abdominal Aorta (EVAR +/- Chimney +/- IMA coiling)	13	18.05
Thoracic Aorta (TEVAR)	04	5.55
Visceral arteries (Celiac, SMA, IMA)	04	5.55
Superficial Femoral Artery	04	5.55
Renal Artery angioplasty +/- stenting	03	4.16
IIA coiling	02	2.77
Total	72	

Complications: Overall complication rate was 5.55 % (4/72). Hematoma was observed in two patients, one patient had brachial artery thrombosis and one patient developed brachial artery pseudoaneurysm (Table 3). None of our patient had local or central neurological complication following open brachial access

Table 3: Complications

Complication	Frequency (n)	Percentage (%)
Haematoma	02	2.77
Pseudoaneurysm	01	1.39
Brachial Artery Thrombosis	01	1.39
Nerve injury	00	0.00
Total	04	5.55

Fig 2: Pseudoaneurysm at Brachial Access Site

Discussion

Brachial artery access is a critical component of complex endovascular procedures and routinely being performed by cardiologist for cardiac interventions. Though, presently femoral access is widely being used for endovascular management, brachial access is gaining popularity as an alternative.

In our study, 72 patients, who underwent endovascular management through brachial access were studied in details. The mean age of presentation was 63.79 with SD of 14.9 years, which was found similar to the study by Kret MR et al [18] and DeCarlo et al [21], in which mean age was 65 years. The Male: Female ratio was 4:1 (58 male and 14 female). Ninety four percent of patients (68/72) were smoker in our study which was similar to the findings of Franz et al (86%) [19] and study by. Kret MR et al (91%) [18]

In our study trans-brachial access was used as primary access in 73.58 %, adjunctive to femoral access site in 26.42% cases and all the cases were elective. In study by Alvarez-Tostado et al [6], brachial artery access was used as a matter of preference in 41%, was considered obligatory in another 40%, and was used as an adjunctive access to facilitate cases in 19% and the procedures were elective in 77% of patients.

In our study all the procedures were therapeutic whereas in study by Franz et al [19], the therapeutic procedures were done in 85.1% cases. In our study Iliac interventions were done in 31.94% of patients followed by SCA (26.38%) and aortic interventions (23.60 %) (Table 2). In study by Franz et al [19], the most cases were performed for Peripheral Vascular Disease (87.9%), and Subclavian steal, stenosis of carotid-subclavian bypass graft, or upper extremity disease was the indication in 9.4% cases whereas Alvarez-Tostado et al [6], reported percutaneous angioplasty in 42%, Aortic intervention in 23% and thrombolysis in 4%.

In our study the left brachial was used in 63 cases (87.5%), right brachial in 5 cases (6.9%) and in 4 cases (5.6%) both brachial arteries were accessed and the findings were in concordance with the results of Alvarez-Tostado et al [6] in which the left arm was used in 85% of the cases, the right arm in 13.8%, and both arms in 1.2% of patients. Similarly, Franz et al [19] reported the left brachial artery access in 92.5% and the right brachial artery access in 7.5% of their cases.

In our study the procedures were performed under local anaesthesia with or without conscious sedation in 65 cases (90.27%) and the rest 7 cases (9.73%) were done under general anaesthesia. In study by Nasr B et al [10], Local anaesthesia was used in 65% of cases and locoregional anaesthesia in 9%, general anaesthesia was used in 26% of their cases. Whereas, Millon A et al [20] reported use of local anaesthesia in 77%, locoregional anaesthesia in 12% and general anaesthesia in 11% of their cases. Brachial artery open access can be amicably done under local anesthesia and offers the choice of arteriotomy repair under vision.

The minimum sheath size used was 6Fr and maximum was 9Fr with an average sheath size of 7fr used in 86.11% in our study. In one case we used 9Fr sheath for placement of covered stent in subclavian artery. In the study by Alvarez-Tostado et al [6], sheath sizes were in diameter ranging from 4F to 9F. A surgical closure was used in 29 procedures in which the artery was accessed with a surgical cutdown. In 17 of these, sheaths >5Fr were used and in seven instances a surgical cutdown was used to close an artery that had been accessed percutaneously. In study by Franz et al [19], Sheath size ranged from 4F to 7F, with at least a 5F sheath used for most interventions. This shows that open approach is better for upgradation of sheath size with minimal complication.

The complications in our study were seen in Four cases (5.55%); Hematoma was observed in 2 patients (2.77%) which was less than 3 cm in size and without any significant drop in haemoglobin (>1gm%). In study by Alvarez-Tostado et al [6], hematoma was seen in 14% of patients who were accessed percutaneously and they did not observe any complications in those patients who underwent a primary cutdown for artery exposure and cannulation and subsequent surgical closure. This shows the complications rate were more in case of percutaneous approach compared to open approach. In study by Kret MR et al [18], complications of access site were seen in 4.1% of cases of open brachial approach and found more or less similar to our study.

Despite stringent protocol our study had certain limitations. It was a single centre, retrospective study with relatively a smaller number of cohorts. Besides these, study population includes armed forces personal and their families which may not represent the general Indian population. Hence, multi-centre study/meta-analysis with larger study population is recommended to overcome the limitations of various studies.

Conclusion

Appropriate choice of vascular access site for a particular lesion type is extremely important, Our limited study suggests that brachial artery approach, as a vascular access site, is more suitable in difficult aorto-iliac lesions and also as an adjunctive to femoral access site in cases of EVAR and TEVAR. This access site gives benefit of upscaling the sheath size, offering much more versatility in managing the sheath size, and reducing the complication rate. Although this access site entails open access of brachial artery, but the same can be amicably done under local anesthesia and offers the choice of arteriotomy repair under vision. The complications rate is also low.

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