



Percutaneous brachial artery access for coronary artery procedures: Feasible and safe in the current era



Yasir Parviz^{a,*}, Rebecca Rowe^{a,b}, Sethumadhavan Vijayan^b, Javaid Iqbal^{a,b}, Allison C. Morton^a, Ever D. Grech^a, Ian Hall^a, Julian Gunn^{a,b}

^a Department of Cardiology, Northern General Hospital, Sheffield, UK

^b Department of Cardiovascular Science, University of Sheffield, Sheffield, UK

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ABSTRACT

Background: Percutaneous vascular access for coronary intervention is currently achieved predominately via the radial route, the femoral route acting as a backup. Percutaneous trans-brachial access is no longer commonly used due to concerns about vascular complications. This study aimed to investigate the safety and feasibility of percutaneous brachial access when femoral and radial access was not possible.

Methods: This is a retrospective data analysis of patients who attended a single tertiary cardiology centre in the UK between 2005 and 2014 and had a coronary intervention (coronary angiogram or PCI) via the brachial route. The primary endpoints were procedural success and the occurrence of vascular complications.

Results: During the study period 26602 patients had a procedure (15655 underwent PCI and 10947 diagnostic angiography). Of these, 117 (0.44% of total) had their procedure performed via the brachial route. The procedure was successful in 96% (112/117) of cases. 13 (11%) patients experienced post procedural complications, of which 2 (1.7%) were serious. There were no deaths.

Conclusion: Percutaneous trans-brachial arterial access is feasible with a high success rate and without evidence of high complication rate in a rare group of patients in whom femoral or sometimes radial attempts have failed.

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1. Introduction

Coronary angiography and percutaneous coronary intervention (PCI) are routinely performed via the femoral or radial route. Occasionally these two routes cannot be used safely e.g. when the radial arteries are impalpable or there is severe peripheral vascular disease, making femoral approach unfavourable and alternative access route is required. A percutaneous brachial approach is often used in these cases.

Trans-brachial access has the same advantages of large calibre as trans-femoral access, with the reduced risk of life threatening haemorrhage however, there is concern over compartment syndrome and the use of an end artery. This risk may be reduced with percutaneous access as compared to brachial cut down [1,2]. There are historic data concerning the rate of complications from brachial cut down, in an era of predominantly diagnostic procedures [3], with relatively few data concerning percutaneous brachial access in the modern era [4,5]. In BRAFE (Brachial, Radial, or Femoral approach for Elective Palmaz-Schatz stent) Benit et al demonstrated that in a population of 150 patients, femoral puncture (n = 56), radial (puncture) (n = 56), or brachial (cut down) (n = 38) local complications and length of hospital

stay were similar with the three possible approaches, and brachial approach was associated with a shorter procedural time [6].

This goal of this study was to evaluate the safety and feasibility of using a percutaneous brachial approach for diagnostic and therapeutic coronary interventions, when radial and femoral routes were not possible, in a 'real world', single-centre setting. We have attempted to address a relatively dormant but important issue in the vascular access: the modern utilisation of the brachial route.

2. Methods

2.1. Study population

This was a retrospective analysis of patients undergoing coronary angiography or PCI via the percutaneous brachial route at the South Yorkshire Cardiothoracic centre from January 2005 to August 2014. The reason for choice of brachial route was determined from hospital records. Complications were categorised as major and minor, defined as follows:

3.1. Major complications

Major complications are as follows: bleeding complications that were categorised according to BARC (Bleeding Academic Research

* Corresponding author at: Northern General Hospital, Herries Road, Sheffield, S Yorkshire, S5 7AU. Tel.: +44 1246 512425; fax: +44 1246 512061.

E-mail address: dr1yasir@hotmail.com (Y. Parviz).

Consortium) definition of bleeding; vascular complications that required surgery; and permanent neurological deficit in the arm or lower limb.

3.2. Minor complications

Minor complications are all vascular complications not requiring blood transfusion or surgery; and transient neurological deficit in the arm or lower limb. These assessments were made during the inpatient stay, up to the time of discharge. A successful procedure was defined as completion of diagnostic or therapeutic procedure without complications.

2.4. Data collection

Patients who had undergone coronary angiography or PCI using the brachial route were identified from the Sheffield database. Demographic, clinical and procedural data were collected from hospital records. Outcome data were collected using the UK national mortality database.

2.5. Data analysis

Data are presented as mean $\pm$ SD or as percentages (proportions) unless otherwise stated. Analysis was carried out using a Student's t-test or one-way ANOVA for continuous variables and chi squared for categorical variables. Analysis was carried out using SPSS version 21. (IBM, SPSS Inc. NY, USA)

3. Results

3.1. Patient characteristics

During the study period 117 patients underwent diagnostic or interventional procedures via the brachial route. This represented 0.44% of all patients undergoing such procedures during the time period studied. The mean age was 67.7 years, 56% were male, 59% underwent angiography only and 41% underwent PCI. Of the PCI procedures, 50% were performed for stable symptoms, 38% for non ST elevation ACS (NSTEMI) and 6% for ST elevation myocardial infarction (STEMI). 94.2% of patients had significant peripheral vascular disease. 8 patients (6.8%) had previously undergone coronary artery bypass grafting. 70 (59.8%) had initial failed attempts at radial access (right radial and left radial) and in 47 (40.2%) cases operator opted for brachial route as first choice due to unfavourable femoral access (attempted both right and left femoral arteries) and operator was not comfortable with radial access during the study period.

Patient characteristics and various complications are summarised in Tables 1 and 2. None of the patient or procedural characteristics were associated with an increased rate of complications.

3.2. Outcomes

Of 117 procedures, 112 (95.73%) were completed successfully. 13 (11%) experienced complications. Of these, two were serious and required intervention. The first patient developed a large haematoma with a drop in haemoglobin of 3 g/dl (Bleeding Academic Research Consortium type 3a bleeding) and required blood transfusion. The second patient developed a compartment syndrome and required surgical fasciotomy with full independent recovery and no long term sequelae.

The overall risk of major and minor complications was therefore 0.11 (95% CI 0.060–0.18); comprising major complications of 0.02 (95% CI 0.002–0.06) and minor complications of 0.09 (95% CI 0.05–0.16). The complications are summarised in Table 2.

4. Discussion

The radial access route has seen a rapid rise in popularity in the last decade, with equivalent efficacy to the femoral route, improved safety,

Table 1

Characteristics of patients stratified by presence of complications.

	Brachial without complications	Brachial with complications	P value
No. of patients	104	13	
Age	68.1 $\pm$ 12.4	64.7 $\pm$ 10/6	0.34
Male	60 (58%)	5 (38.5%)	0.29
Current smoker	52 (50%)	7 (53.8%)	0.79
Diabetes	52 (50%)	6 (46.2%)	0.45
Dyslipidaemia	92 (88.5%)	12 (92.3%)	0.417
Hypertension	92 (88.5%)	11 (84.6%)	0.16
Previous MI	42 (40.4%)	7 (53.8%)	0.80
PVD	98 (94.2%)	11 (84.6%)	0.13
Previous CABG	7 (6.7%)	1 (7.7%)	0.91
Degree of CAD			0.83
No vessels	22 (21.1%)	3 (23.1%)	
1 vessel	40 (38.5%)	5 (38.5%)	
2 vessels	17 (16.3%)	1 (7.7%)	
3 vessels	25 (24%)	4 (30.8%)	
Procedure			0.24
LHC only	63 (60.6%)	6 (46.2%)	
PCI	41 (39.4%)	7 (53.8%)	
Indication			0.545
STEMI	6 (5.8%)	1 (7.7%)	
NSTEMI	38 (36.5%)	7 (53.8%)	
Stable angina	54 (62.5%)	5 (38.5%)	
Other (pre-op)	6 (5.8%)	0 (0%)	
Catheter size			0.14
4F	2 (19.2%)	0 (0%)	
5F	55 (52.9%)	5 (38.5%)	
6F	45 (43.3%)	8 (61.5%)	
7F	2 (19.2%)	0 (0%)	

more rapid mobilisation and reduced hospital stay [7–9]. It has therefore become the access route of choice in recent years. Whilst rarely there are cases in which access is not always feasible via radial or femoral routes, mandating an alternative approach.

In this 'real world' retrospective analysis we found that between 2005 and 2014, 117 patients (0.44% of the entire patient population) underwent coronary intervention via the brachial artery. 11.1% experienced complications, of which 1.7% were major. There were no access related deaths.

Access via the brachial route has a long history, being the original access point for Sones and Shirey [10]. There is, therefore, an extensive early literature surrounding this route of access, although those data are now historic, because they involved cut down, suture closure, large catheters or sheaths, low uptake of PCI and various anticoagulation regimens. The brachial cut down route has lost its popularity due to success of femoral and radial routes, and hence now considered as a last resort when other routes are not favourable.

A study by Kiemeneij et al looked at a population of 900 patients undergoing PCI who were randomised to radial, brachial or femoral artery access. In this study, coronary cannulation was achieved in 93.0%, 95.7% and 99.7% respectively with successful PCI in 91.7%, 90.7% and 90.7%. There were major vascular site complications in 0, 7, and 6 patients, respectively [11]. Our results are comparable to this study with a procedure success rate of 95.73% and a major complication rate of 1.7%.

It is also worth noting that the risks associated with a femoral artery approach, even in cases in which it is feasible, are not trivial, and are increased in patients with peripheral vascular disease (PVD) [12–15].

Concerns about using the brachial approach have focussed on two issues. The first is bleeding after sheath removal. Unlike the radial route, there are no devices suitable for external arterial compression. Manual compression has to be used, which can be problematic in patients with obesity or oedema, and it is difficult to obtain compress against the humerus. The consequences of bleeding at this site can include compartment syndrome, with ischemic injury to the median nerve and ischaemia to the hand from decreased blood flow. Secondly, injury to the brachial artery, which is an 'end-artery', can cause distal ischemia,

Table 2

Summary of complications occurring in patients undergoing brachial access.

	Complications managed conservatively	Complications requiring intervention	Total
Haematoma	8	1	9
Arterial Dissection	3	0	3
Compartment syndrome	0	1	1
Total	11	2	13

which may constitute a vascular emergency. Operators are also less familiar with brachial approach, contributing to the risk of complications [15].

5. Conclusion

This study shows that a percutaneous brachial approach to the coronary circulation provides an acceptable alternative when other access routes are not possible, with a high success rate and without evidence of extremely high complications rate in a rare group of patients in whom femoral or sometimes radial attempts have failed.

5.1. Study limitations

This was a retrospective observational study, with the data derived from a prospectively completed database. Ultrasound assessment of distal vasculature patency was not routinely performed. Patient comfort, hospital stay or radiation exposure, contrast use, and fluoroscopy were not assessed. The procedures were performed by five cardiologists with varying levels of experience and there is significant operator variability in both selection criteria and in the brachial experience, and a variety of antiplatelet and anticoagulant regimens were in use, according to the era and the clinical presentation of the patients.

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