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Prevalence and outcomes of *trans*-radial access for percutaneous coronary intervention in contemporary practise

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ABSTRACT

Background: *Trans*-radial access for percutaneous coronary intervention (PCI) has been associated with lower vascular complication rates and improved outcomes. We assessed the current uptake of *trans*-radial PCI in Victoria, Australia, and evaluated if patients were selected according to baseline bleeding risk in contemporary clinical practise, and compared selected clinical outcomes.

Methods: PCI data of all patients between 1st January 2013 and 31st December 2014 were analysed using The Victorian Cardiac Outcomes Registry (VCOR). Propensity-matched analysis was performed to compare the clinical outcomes.

Results: 11,711 procedures were analysed. The femoral route was the predominant access site (66%). Patients undergoing *trans*-radial access PCI were younger (63.9 ± 11.6 vs. 67.2 ± 11.8; $p < 0.001$), had a higher BMI (28.9 ± 5.5 vs. 28.5 ± 5.2; $p < 0.001$), more likely to be male (80.0 vs. 74.9%;$p < 0.001$), less likely to have presented with cardiogenic shock (0.9 vs. 2.8%; $p < 0.001$) or have the following comorbidities: diabetes (19.8 vs. 23.1%; $p < 0.001$), peripheral vascular disease (2.9 vs. 4.3%; $p = 0.005$) or renal impairment (13.6 vs. 22.1%; $p < 0.001$). The radial group had less bleeding events (3.2 vs. 4.6%; $p < 0.001$) and shorter hospital length of stay (3.1 ± 4.7 vs. 3.3 ± 3.9; $p = 0.006$). There was no significant difference in mortality (1.0 vs. 1.4%; $p = 0.095$).

Conclusions: *Trans*-femoral approach remains the dominant access site for PCI in Victoria. The choice of route does not appear to be selected by consideration of bleeding risk. The radial route is associated with improved clinical outcomes of reduced bleeding and length of stay consistent with previous findings, and this supports the efficacy and safety of *trans*-radial PCI in real-world clinical practise.

1. Introduction

Trans-radial access for percutaneous coronary intervention (PCI) has been associated with lower vascular complication rates, increased cost-effectiveness and shorter hospital length of stay as compared to the femoral approach [1–4]. Furthermore, in patients with ST-elevation acute coronary syndromes (STEACS), it has been associated with reduced morbidity and cardiac mortality [3–5]. In a large registry analysis from the United States [6], the greatest benefit of *trans*-radial PCI in terms of absolute reduction of bleeding and vascular complications was seen in high-risk patients aged ≥75 years, women, and patients with acute coronary syndrome (ACS). Paradoxically, the use and growth of the radial approach were reported to be the lowest in these higher bleeding risk subgroups, despite the potential benefits. Other large registries have similarly shown benefits with *trans*-radial PCI in reducing mortality, vascular complications and bleeding [7–9]. In support of this, several prospective randomized trials of ACS patients with relatively smaller sample sizes have also demonstrated associations with

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reduced bleeding [10,11], vascular complications [5,11] and mortality with the radial approach [3,4,10]. Contemporary guidelines recommend the *trans*-radial approach over femoral in patients with higher bleeding risk [12].

The primary aim of our study was to assess the current uptake of *trans*-radial PCI in Victoria, Australia and to assess if patients with risk factors for bleeding are preferentially selected for *trans*-radial PCI in contemporary clinical practise, given its associated benefits of reduced bleeding. Our secondary aims were to compare selected clinical outcomes between patients undergoing *trans*-radial versus *trans*-femoral PCI, which include clinically significant bleeding, mortality, and hospital length of stay.

2. Methods

Data of all patients in the Victorian Cardiac Outcomes Registry (VCOR) who had PCI performed over a 2-year period between 1st January 2013 and 31st December 2014 was analysed. VCOR is a state-wide population-based clinical quality registry that is coordinated by the Victorian Cardiac Clinical Network. It catalogues data related to PCI procedures gathered from 21 public and private centres across Victoria. All participants require informed consent and an opt-out option given. A Steering Committee with representation from contributing centres oversees the registry activities and a peer-review committee has been established to audit and monitor data collection and outcomes from each site. The study was approved by the institutional ethics committee.

Patients receiving PCI via the brachial artery were excluded. Baseline demographic data, clinical characteristics and treatment profiles were compared between the radial and femoral approaches. Factors associated with bleeding and mortality were compared between *trans*-radial vs. femoral access for PCI to demonstrate differences in patient risk profiles. These included: age, body mass index (BMI), patient gender, ACS, cardiogenic shock or out-of-hospital cardiac arrest, diabetes mellitus requiring medication, peripheral vascular disease (PVD), cerebrovascular disease, prior revascularization with PCI or coronary artery bypass grafting (CABG), renal impairment (defined as an estimated glomerular filtration rate (eGFR) of ≤60 mL/min/1.73 m [2] or requiring renal replacement therapy), and the use of glycoprotein IIb/IIIa inhibitors. Clinical outcomes were compared between the two routes, including 30-day cumulative events of mortality, clinically significant bleeding and hospital length of stay. Bleeding was categorized according to the Bleeding Academic Research Consortium (BARC) classification [13], as type 1 (minor bleeding, not actionable), type 2 (overt, actionable sign of haemorrhage or more than expected bleeding for a clinical circumstance that requires non-surgical, medical intervention, hospitalization, increased level of care or prompting evaluation), type 3 (overt bleeding with a haemoglobin drop of >3 g/dL, intracranial haemorrhage, cardiac tamponade, or requirement of transfusion or surgical intervention), type 4 (CABG-related bleeding) and type 5 (probable or definite fatal bleeding). Clinically significant bleeding was defined as the occurrence of BARC 2, 3 or 5 bleeding events. A *trans*-radial subgroup analysis to compare *trans*-radial high and low volume centres was also performed. High-volume *trans*-radial centre was defined as ≥50% *trans*-radial cases in a centre performing >250 cases per year [4]. Based on this criterion, 8 centres were classified as high *trans*-radial volume, 12 as low *trans*-radial volume, and one centre was excluded as the contributed data was limited to 2 months only.

One-way ANOVA and Chi-Square tests were used to compare the baseline characteristics and clinical outcomes between *trans*-radial and femoral access groups. To adjust for the non-randomized selection of access site for PCI, we generated propensity scores to obtain matched pairs of patients based on the route of choice for PCI using the following predictors: age >75, BMI, patient gender, ACS, cardiogenic shock, cardiac arrest prior to PCI, history of comorbid diseases: diabetes mellitus requiring medication, PVD, cerebrovascular disease, previous CABG or PCI, use of glycoprotein IIb/IIIa inhibitors and renal impairment. Sampling without replacement was used with a match tolerance of 0.004. Standardized differences were calculated to compare variables between matched pairs. The Chi-Square and Independent t-tests were used to compare categorical and continuous variables between propensity-matched groups respectively. Continuous variables are presented as means ± standard deviations (SD). Categorical variables are expressed as the number of patients with proportions according to choice of arterial access. The IBM SPSS Statistics software (version 22) was used for all calculations and two tailed values of $P < 0.05$ were considered statistically significant.

3. Results

We analysed a total of 11,711 PCI procedures with the specified criteria. Baseline characteristics are shown in Table 1. The femoral approach was the predominant access route (66%). Variations (ranges) between sites for radial and femoral access were: radial: 1% to 71%; femoral: 28% to 99%. Compared to patients who underwent PCI through the femoral route, patients undergoing *trans*-radial access PCI were significantly younger (63.9 ± 11.6 vs. 67.2 ± 11.8 years; $p < 0.001$), had a statistically higher BMI (28.9 ± 5.5 vs. 28.5 ± 5.2 kg/m^2; $p < 0.001$) and were more likely to be male (80.0 vs. 74.9%; $p < 0.001$). Patients in the radial access group were also less likely to present with cardiogenic shock (0.9 vs. 2.8%; $p < 0.001$) or cardiac arrest (2.3 vs. 4.9%; $p < 0.001$), or to have the following comorbidities: diabetes mellitus (19.8 vs. 23.1%; $p < 0.001$), PVD (2.9 vs. 4.3%; $p = 0.005$), renal

Table 1
Unadjusted baseline variables and clinical outcomes of radial vs. femoral procedures.

	Overall ($n = 11.711$)	Radial ($n = 4040$)	Femoral ($n = 7671$)	*P* value
Age (years)	66.1 ± 11.9	63.9 ± 11.6	67.2 ± 11.8	<0.001
BMI (kg/m^2)	28.7 ± 5.3	28.9 ± 5.5	28.5 ± 5.2	<0.001
Male Gender	76.7	80.0	74.9	<0.001
Female Gender	23.3	20.0	25.1	<0.001
Clinical Characteristics at presentation				
Cardiogenic shock	2.1	0.9	2.8	<0.001
Cardiac arrest				
Out-of-hospital	2.2	1.5	2.6	<0.001
Pre-procedural	1.6	1.1	1.8	<0.01
Medical comorbidities				
Diabetes mellitus	22.0	19.8	23.1	<0.001
PVD	3.8	2.9	4.3	<0.005
Prior CVD	3.8	3.6	3.9	0.360
Prior PCI	33.5	28.4	36.2	<0.001
Prior CABG	8.6	2.4	11.9	<0.001
eGFR ≤60	19.2	13.6	22.1	<0.001
Procedure indication				
Elective/stable	47.9	43.9	50.0	<0.001
ACS				
NSTEACS	32.1	34.8	30.8	<0.001
STEACS	19.9	21.3	19.2	<0.01
Use of Glycoprotein IIb/IIIa inhibitor	12.4	10.1	13.7	<0.001
Clinical outcomes				
Clinically significant bleeding	4.4	3.2	5.0	<0.001
Length of stay (days)	3.4 ± 5.1	3.1 ± 4.7	3.6 ± 5.2	<0.001
Mortality at 30 days	2.2	1.3	2.6	<0.001

Data are means ± SD or n (%). BMI: body mass index; PVD: peripheral vascular disease; CVD: cerebrovascular disease; PCI: percutaneous coronary intervention; CABG: coronary artery bypass grafting; eGFR: estimated glomerular filtration rate; ACS: acute coronary syndrome; NSTEACS: Non ST-elevation acute coronary syndrome; STEACS: ST-elevation acute coronary syndrome.