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Comparison between radial versus femoral percutaneous coronary intervention access in Indonesian hospitals, 2017–2018: A prospective observational study of a national registry

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ABSTRACT

Background: Coronary heart disease is a leading cause of death in Indonesia and percutaneous coronary intervention (PCI) is a routinely performed procedure. The aim of this study is to provide real-world insight on the demographics of coronary artery disease and comparison between radial compared to femoral PCI in Indonesia, which performed radial access whenever possible.
Methods: This is a prospective cohort study involving 5420 patients with coronary artery disease who underwent PCI at 9 participating centers in the period of January 2017–December 2018.
Results: Radial access rate was performed in 4038 (74.5%) patients. Patients receiving femoral access has a higher rate of comorbidities and complex lesions compared to radial access. The incidence of in-hospital mortality, cardiogenic shock, major arrhythmia, and tamponade were higher in femoral group. The incidence of in-hospital mortality was 114 (2.1%). New-onset angina (OR 3.412), chronic renal failure (OR 3.47), RBBB (OR 4.26), LBBB (OR 6.26), left main stenosis PCI (OR 3.58), cardiogenic shock (OR 4.9), and arrhythmia (OR 15.59) were found to be independent predictors of in-hospital mortality. Radial access did not independently affect in-hospital mortality. In propensity-matched cohort, radial access was not associated with lower in-hospital mortality in both bivariable and multivariable model. However, radial access was associated with reduced in-hospital mortality in STEMI subgroup (OR 0.31).
Conclusion: Higher rate of adverse events was noted on the femoral access group. However, it might stem from the fact that patients with more comorbidities and complex lesions are more likely to be assigned to femoral access-group. Neither radial or femoral access is superior in terms of in-hospital mortality upon propensity-score matching/multivariable analysis.

Abbreviations: ACE, Angiotensin Converting Enzyme; AF, Atrial Fibrillation; ARB, Angiotensin Receptor Blocker; AVB, Atrioventricular Block; CAD, Coronary Artery Disease; CKD, Chronic Kidney Disease; CTO, Chronic Total Occlusion; CVD, Cerebrovascular Disease; HF, Heart Failure; LAD, Left Anterior Descending; LBBB, Left-bundle Branch Block; LCX, Left Circumflex Artery; LM, Left Main; PCI, Percutaneous Coronary Intervention; PVD, Peripheral Vascular Disease; MI, Myocardial Infarction; NOAC, Non-vitamin K Antagonist Oral Anticoagulant; NSTEACS, Non-ST segment Elevation Acute Coronary Syndrome; RBBB, Right-bundle Branch Block; RCA, Right Coronary Artery; TIA, Transient Ischemic Attack.

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1. Introduction

Approximately one-third of mortality in Indonesia can be attributed to cardiovascular diseases [1]. The prevalence of coronary heart disease (based on diagnosis) in Indonesia was 1.5% (1.017.290 patients) in the year 2018 [2]. Percutaneous coronary intervention (PCI) is a procedure that is routinely done in Indonesia. However, there was no national registry data to uniformly record these procedures. The Indonesia PCI registry is the first multicentre interventional cardiology project involving 9 centers across Indonesia. This registry is developed, coordinated, and funded by the Indonesian Society of Interventional Cardiology (ISIC). This project was launched on January 1st of 2017.

The radial access rate in Indonesian PCI registry 2017–2018, was 74.5% due to radial-first policy, in which radial access is preferred to femoral access whenever possible and appropriate. This enables an observation for PCI with a high rate of radial access in a real world setting. The aim of this study is to provide insight on the demography of coronary artery disease and provide comparison between radial compared to femoral PCI in Indonesia. To the best of our knowledge, this is also the first report on nationwide PCI registry in Indonesia.

2. Methods

2.1. Study design

This is a prospective cohort study involving 5420 patients designed to evaluate the clinical profile and outcome of patients. Patients consist of individuals aged 18 years old or older with coronary artery disease who underwent PCI at 9 participating centers in the period of January 2017- December 2018.

Data collections were performed during cath lab visit and follow up visits. The cath lab visits records 9 types of data consisting of (1) demographics (2) status before event (3) clinical examination and baseline investigation (4) previous interventions (5) cardiac status at PCI procedure (6) cath lab visit (7) PCI procedure details & advanced PCI procedure details (8) procedural complication (9) in-hospital outcome. Follow up visits collects data regarding the procedural outcome, smoking status, readmission, and medications. Major bleeding was defined as per Bleeding Academic Research Consortium (BARC) criteria; Type 2 (Any clinically overt sign of hemorrhage that "is actionable" and requires diagnostic studies, hospitalization, or treatment by a health care professional) and Type 3 [Type 3a. Overt bleeding plus hemoglobin drop of 3 to <5 g/dL (provided hemoglobin drop is related to bleed); transfusion with overt bleeding; Type3b. Overt bleeding plus hemoglobin drop <5 g/dL (provided hemoglobin drop is related to bleed); cardiac tamponade; bleeding requiring surgical intervention for control; bleeding requiring IV vasoactive agents 3c. Intracranial hemorrhage confirmed by autopsy, imaging, or lumbar puncture; intraocular bleed compromising vision].

Information was recorded on a form which contains details of patient and procedural characteristics. Both online and printed forms are provided to hospitals to be used at discretion. After verification, the PCI report form was submitted online into Indonesia PCI registry website. Data checking and data cleaning were performed periodically to identify missing or inconsistent data.

2.2. Data management

Data were pooled from 9 Hospitals located across Indonesia that includes (1) National Cardiovascular Center Harapan Kita, Jakarta (2) RSUD Dr. M Yunus, Bengkulu (3) RSUP Sanglah, Denpasar (4) Gatot Soebroto Central Army Hospital, Jakarta (5) RS Jantung, Jakarta (6) RSUP Dr. Sardjito, Yogyakarta (7) RSUP Dr. Wahidin Sudirohusodo, Makassar (8) Siloam Hospitals Lippo Village, Tangerang (9) RSUP Dr. Moewardi, Surakarta. Site coordinators were appointed for each hospital.

2.3. Statistical analysis

Continuous data were summarized as median, mean ± standard deviation (SD), minimum and maximum; discrete data were presented as a percentage. SPSS version 25 was used to manage these datasets. We performed descriptive analysis on Baseline patient characteristics, procedural characteristics and procedural adverse effects. Continuous variables were analyzed with Student's *t*-test or Mann-Whitney *U* test and χ^2 test or Fisher's exact test were used to compare categorical variables as appropriate. All statistical tests were two-tailed and a p-value <0.05 was considered significant. Multivariable logistic regression was performed to determine independent predictor of in-hospital mortality. Propensity-score matching was performed using logistic regression algorithm with nearest neighbour matching using a 0.1 calliper for patients with radial and femoral group. Subgroup analysis was performed for Acute Coronary Syndrome (ACS) and ST-segment Elevation Myocardial Infaction (STEMI) group. Statistical analyses were performed with SPSS for Windows V.25.0 (SPSS, Chicago, Illinois, USA).

3. Results

From a total of 5420 patients, 74.5% of patients received radial access while 25.4% of patients received femoral access.

3.1. Baseline characteristics

We found that the baseline characteristics differed between the radial and femoral group. Radial group was younger (57.10 + 9.91 vs 58.36 + 9.69 years old p < 0.001), had a higher proportion of males (84.1% vs 81.4% p = 0.023), and new-onset angina (21.4% vs 14.9% p < 0.001) compared to those who underwent femoral approach. On the other hand, patients with heart failure (25.3% vs 20.3% p < 0.001), chronic kidney disease (11.9% vs 9.3% p = 0.007), 2nd & 3rd degree AV block (2.5% vs 0.8% p < 0.001), documented significant Coronary Artery Disease (CAD) (61.2% vs 46.6% p < 0.001), previous history of PCI (25.8% vs 37.5% p < 0.001), and Coronary Artery Bypass Grafting (CABG) (4.6% vs 1.1% p < 0.001) were more likely to be assigned to femoral than radial group (Table 1).

3.2. Procedural/angiographic characteristics

We found that upon analysis of procedural/angiographic characteristics, there were several statistically significant differences (Table 2). We found that there were a higher proportion of STEMI (26.7% vs 17.9% p < 0.001), NSTEACS (Non ST-segment Elevation Acute Coronary Syndrome) (6.7% vs 5.9% p < 0.001), and PCI for CTO (Chronic Total Occlusion) (57.1% vs 42.9% p < 0.001) in the radial group. On the other hand, there were a higher proportion of left main stem (8.5% vs 3.8% p < 0.001), LCX (Left Circumflex Artery) (48.8% vs 44.5% p = 0.006), and graft lesion (1.7% vs 0.4% p < 0.001) that were treated using femoral approach. In contrast to STEMI and NSTEACS, a larger proportion of stable angina/elective patients were more frequently treated using femoral approach (76.2% vs 66.6% p < 0.001).

Table 1
Baseline Characteristics of patients between radial and femoral access groups.

	Radial N = 4046 (74.6%)	Femoral N = 1374 (25.4%)	P Value
Age	57.10 (±9.96)	58.36 (±9.69)	<0.001
BMI	25.64 (±3.73)	25.5 (±3.73)	0.319
Male	84.1%	81.4%	0.023
Dyslipidemia	36.5%	35.2%	0.417
Hypertension	69.6%	71.3%	0.261
Diabetes	37.9%	38.7%	0.650
MI History	33.2%	35.1%	0.211
HF History	20.3%	25.3%	<0.001
CVD History	2.5%	2.8%	0.561
PVD History	0.4%	0.6%	0.492
CKD History	9.3%	11.9%	0.007
On Dialysis	0.6%	0.9%	0.231
2nd & 3rd deg AVB	0.8%	2.5%	<0.001
RBBB	1.4%	1.6%	0.651
AF	1.3%	1.2%	0.731
LBBB	0.7%	0.5%	0.532
Family History of Premature CAD	12%	10.7%	0.246
Documented Significant CAD	46.6%	61.2%	<0.001
Previous PCI	25.8%	37.5%	<0.001
Previous CABG	1.1%	4.6%	<0.001
New-onset Angina	21.4%	14.9%	<0.001
Medications at Discharge			
Aspirin	95.7%	94.0%	0.01
Clopidogrel	84.6%	86.8%	0.056
Ticlopidine	0.1%	0%	0.578
Warfarin	1.1%	1.4%	0.459
Prasugrel	0.3%	0%	0.076
Ticagrelor	11.6%	8.4%	0.001
NOAC	0%	0.1%	0.251
Statin	93.4%	91.4%	0.019
Beta Blocker	81.6%	81.6%	1.000
ACE Inhibitor	52.9%	46.2%	<0.001
ARB	26%	32.5%	<0.001

Description: ACE = Angiotensin Converting Enzyme; AF = Atrial Fibrillation; ARB = Angiotensin Receptor Blocker; AVB = Atrioventricular Block; CAD = Coronary Artery Disease; CKD = Chronic Kidney Disease; CVD = Cerebrovascular Disease; HF = Heart Failure; LBBB = Left-bundle Branch Block; PCI = Percutaneous Coronary Intervention; PVD = Peripheral Vascular Disease; NOAC = Non-vitamin K Antagonist Oral Anticoagulant; RBBB = Right-bundle Branch Block.

Table 2
Procedural characteristics between patients of radial and femoral access groups.

	Radial N = 4046 (74.56%)	Femoral N = 1374 (25.4%)	
Left Main Stem Treated	3.8%	8.5%	<0.001
CTO treated	57.1%	42.9%	<0.001
LAD Treated	76.5%	73.7%	0.042
RCA Treated	50.1%	49.6%	0.755
LCX Treated	44.5%	48.8%	0.006
Graft Treated	0.4%	1.7%	<0.001
Drug Eluting Stent	98.1%	97.6%	0.515
Bare Metal Stent	1.9%	2.4%	0.515
STEMI	26.7%	17.9%	<0.001
NSTEACS	6.7%	5.9%	<0.001
Stable Angina (Elective)	66.6%	76.2%	<0.001
Catheter Size			
4 French	0.0%	0.2%	0.419
5 French	2.6%	2.3%	0.419
6 French	92.1%	92.3%	0.419
7 French	5.2%	5.3%	0.419

Description: CTO = Chronic Total Occlusion; LAD = Left Anterior Descending; LCX = Left Circumflex Artery; RCA = Right Coronary Artery; NSTEACS = Non-ST segment Elevation Acute Coronary Syndrome.

3.3. Periprocedural adverse events

There were statistically significant differences regarding the incidence of periprocedural adverse events between the radial and femoral groups. The incidence of in-hospital mortality (3.3% vs 1.7% p = 0.001), Cardiogenic shock (1.8% vs 0.8% p = 0.005), major arrhythmia (2.8% vs 1.6% p = 0.001), and tamponade (0.3% vs 0% p = 0.016) were more frequently found in the femoral compared to radial group. (Table 3) The average stent implementation rate in this study was 1.38 (1.36–1.40, P < 0.001) per procedure. In this registry, the majority of catheters used in both radial and femoral approach were size 6 Fr (92.1 vs 92.3% p = 0.419) respectively. Followed by Size 7Fr (5.2% vs 5.3% p = 0.419) and size 5 Fr (2.6% vs 2.3% p = 0.419) respectively.

3.4. Predictors of In-hospital mortality

The incidence of in-hospital mortality was 114 (2.1%). New-onset angina (OR 2.383 [1.14–4.0], p < 0.001], chronic renal failure (OR 3.42 [1.97–5.92], p < 0.001), Right Bundle Branch Block (RBBB) (OR 3.69 [1.53–8.80], p = 0.004), Left Bundle Branch Block (LBBB) (OR 5.56 [1.60–19.33], p = 0.007), left main stenosis (LMS) treated/PCI (OR 0.79 [1.92–7.48], p < 0.001), cardiogenic shock (OR 4.65 [2.02–10.69], p < 0.001), arrhythmia (OR 13.29 [7.15–24.70], p < 0.001) and STEMI (OR 2.709 [1.51–4.83] , p = 0.001) were found to be independent predictors of in-hospital mortality after multivariable logistic regression analysis [Table 4]. Radial access was significant on bivariable analysis but not after adjustment. Documented significant CAD was shown to be protective OR 0.395 [0.22–0.70], p = 0.001 even after adjustment.

Subgroup analysis on ACS patients showed that the mortality (OR 0.34 [0.22–0.52], p < 0.001) was lower in the radial compared to femoral group. Subgroup analysis on STEMI patients showed that radial access was associated with lower mortality compared to femoral access (OR 0.31 [0.19–0.50], p < 0.001).

3.5. Propensity-score matched outcome

There were 784 matched pairs after propensity-score matching for radial and femoral group. There was no significant difference in mortality between the radial and femoral group (OR 0.66 [0.34–1.25], p = 0.2). Subgroup analysis on ACS patients showed that there was no significant difference in mortality between the radial and femoral group (OR 0.63 [0.31–1.28], p = 0.196). Subgroup analysis on STEMI patients showed that radial access was associated with lower mortality compared to femoral access (OR 0.42 [0.18–0.96], p = 0.036).

Table 3
Adverse events between patients of radial and femoral access groups.

	Radial N = 4046 (74.56%)	Femoral N = 1374 (25.4%)	P Value
In-hospital Mortality	1.7%	3.3%	0.001
Periprocedural MI	0.6%	0.8%	0.836
Emergency Reintervention	0.3%	0.4%	0.567
Stent Thrombosis	0.1%	0%	0.578
Coronary Dissection	0.1%	0.2%	0.605
Coronary Perforation	0%	0.1%	0.438
New Ischemia	0%	0.2%	0.157
Cardiogenic Shock	0.8%	1.8%	0.005
Arrythmia	1.6%	2.8%	0.009
TIA/STROKE	0.1%	0.3%	0.377
Tamponade	0.0%	0.3%	0.016
Contrast Reaction	0%	0%	1.000
HF Worsening	0.7%	0.6%	0.835
Worsening Renal Impairment	0.3%	0.6%	0.286
Bleeding	0.4%	0.4%	1.000

Description: HF = Heart Failure; MI = Myocardial Infarction; TIA = Transient Ischemic Attack.

Table 4
Bivariate and Logistic Regression analysis for predictors of in-hospital mortality.

	Bivariate Analysis		Multivariate Analysis	
	OR [95% CI]	P-value	OR [95% CI]	P-value
Radial Access	0.541 [0.37–0.78]	0.001	0.66 [0.41–1.06]	0.79
Documented Significant CAD	0.23 [0.14–0.37]	<0.001	0.576 [0.31–1.1]	0.082
New Onset Angina	6.57 [4.48–9.64]	<0.001	2.383 [1.14–4.0]	<0.001
CVD History	2.77[1.33–5.79]	0.005	2.404 [0.96–6.01]	0.61
Chronic Renal Failure	3.157 [2.07–4.82]	<0.001	3.42 [1.97–5.92]	<0.001
2nd & 3rd Degree AV Block	7.023 [3.41–14.48]	<0.001	1.48 [0.57–3.84]	0.427
RBBB	9.727 [5.21–18.15]	<0.001	3.69 [1.53–8.80]	0.004
LBBB	6.427 [2.22–18.58]	0.006	5.56 [1.60–19.33]	0.007
LMS Treated (PCI to LM)	2.876 [1.65–5.01]	0.001	3.79 [1.92–7.48]	<0.001
Periprocedural MI	8.709 [3.55–21.35]	<0.001	1.87 [0.55–6.40]	0.320
Cardiogenic Shock	31.16 [17.2–56.42]	<0.001	4.65 [2.02–10.69]	<0.001
Arrhythmia	38.356 [24.02–61.23]	<0.001	13.29 [7.15–24.70]	<0.001
STEMI	8.396 [5.62–12.55]	<0.001	2.709 [1.51–4.83]	0.001

Description: CAD = Coronary Artery Disease; CVD = Cerebrovascular Disease; LM = Left Main; MI = Myocardial Infarction; PCI = Percutaneous Coronary Intervention, RBBB = Right-bundle Branch Block.

In the propensity-score matched cohort, chronic renal failure (OR 3.91 [1.79–8.55], p = 0.001), cardiogenic shock (OR 21.40 [6.69–68.44], p < 0.001), and STEMI (OR 2.709 [1.51–4.83], p < 0.001) are independent predictors of mortality. Radial access was not associated with lower in-hospital mortality in bivariable or multivariable model.

4. Discussion

Higher rate of adverse events was noted on the femoral access group. However, it might stem from the fact that patients with more comorbidities and complex lesions are more likely to be assigned to femoral access group. Neither radial nor femoral access was superior in terms of in-hospital mortality in our registry upon multivariable analysis. This is further confirmed after the propensity-score matching. However, subgroup analysis in STEMI patients demonstrate a significant in-hospital mortality reduction with the use of radial access. Chronic renal failure, cardiogenic shock, and STEMI were independent predictors of mortality in the propensity-matched cohort.

The feasibility of radial access arises from the fact that the superficial position and absence of adjacent anatomical structures of the distal radial artery contributes to the ease of puncture or even compression in the events of bleeding. Furthermore, the double blood supply of the palmar arch that exists by the ulnar artery decreases the odds of ischemic complications of the distal upper limb should radial artery thrombosis occur [3].

Currently, the European Society of Cardiology (ESC), in regards to access site selection between radial and femoral artery, advocates a default radial approach in routine practice with adequate training and proficiency in performing radial artery based percutaneous coronary intervention in both stable and unstable patients including STEMI patients. With the considerations that the operators maintain a femoral based approach proficiency should the need for a bailout strategy or implementation of larger guiding catheters arises [3,4].

This is in accordance with the Society for Cardiovascular Angiography and Interventions (SCAI) recommendation regarding the role of radial access as the first choice for PCI procedures. Recommendation by SCAI also acknowledges the caveat that larger catheters might not be feasible to be used on radial based approach [5].

To this date, there has been no consensus by the American Heart Association (AHA) that advocates the use of radial access as first-line access in PCI. A scientific statement from the AHA in 2018 has discussed this issue [6].

The result from a substudy from the ACCOAST study showed that trans-radial approach was correlated with an elevated risk of Cerebrovascular Accidents (CVA) (0.7% vs 0.2% radial and femoral, respectively; HR 0.31, 0.11–0.88). However, despite the statistical insignificance, our study showed a higher proportion of patients developing CVA on the femoral access group (0.3% vs 0.1%). This result of ACCOAST substudy was further disputed by results of several meta-analysis involving 24,000 patients by Sirker et al which showed the result of OR 0.32 (0.11–0.89) of developing stroke while on radial access [7,8].

Specific contraindications to radial access exist in cases of the documented previous Raynaud's phenomenon, requirements for larger catheters and presence of AV fistula for hemodialysis. Considerations also exist in regards to possible damage to the radial artery in using larger catheter size (7 Fr and 8 Fr). Currently on ESC consensus, in most cases, 6 Fr sized guiding catheters is the largest catheter that is advisable to be used on radial access. With the assumption that guiding catheter of this size allow most PCI to be performed including complex cases, plaque ablation, bifurcation PCI, thrombus aspiration and distal protection. However, a study by Aminian et al which was conducted in a prospective multicentre trial and studied the relation between catheter size and complex coronary lesion using radial approach found that the use of 7 Fr catheters remains a feasible option in dealing with complex coronary lesions even using radial approach, this approach was also not associated with higher vascular complications, procedural success was also high using 7 Fr catheter in radial approach [9].

Although higher in the femoral group in this study (0.4% vs 1.7%), graft PCI can be successfully done on radial access. This also applies to the restenotic lesion which can also be successfully treated with radial approach. Our study showed that despite current data [3], CTO can be effectively treated using radial access, with 57.1% on radial vs 42.9% on femoral CTO treated in this study. A larger portion of patients with heart failure is assigned to femoral access, however, this is not done to anticipate placement of Intra-Aortic Balloon Pump (IABP) or short term mechanical circulatory access devices (Impella™), as IABP placement rate is very low and non-IABP mechanical circulatory access devices (Impella™) are not currently available in our country.

In our study, patients with 2nd and 3rd degree heart block were more likely to be assigned to the femoral group, this is to anticipate the need for temporary venous pacemaker placement on these patients, should the need arise, access on the femoral vein next to the femoral artery access can be obtained, this approach was tailored to minimize access point in patients to minimize bleeding risk. As with patients with documented significant CAD who also more likely to be assigned to a femoral group, femoral access was chosen for these points to anticipate larger guiding catheter needed should a multivessel PCI is mandated.

More patients with prior CABG were assigned to femoral access in this study (1.1% vs 4.6% $p < 0.001$ for radial and femoral respectively). A study by Koifman et al also showed a higher proportion of patients with prior CABG assigned to the femoral group (21% vs 12% $p < 0.001$). Similar results were also shown by the ACCOAST substudy on radial vs femoral access and study by Baklanov et al on US CATHPCI NCRD data (1.93% vs 5.87% $p < 0.01$) [7,10,11].

More patients with male gender are assigned to radial access (84.1% vs 81.4% $p = 0.023$) while more patients with prior PCI are assigned to femoral access in this study (25.8% vs 37.5% $p < 0.01$) respectively. This result is similar to US NCRD data showed on study by Baklanov et al on male (75.27% vs 72.38% $p < 0.01$) and prior PCI patients (17.92% vs 21.19% $p < 0.01$) respectively. However, more patients with history of heart failure are assigned to femoral access group in this study (20.3% vs 25.3% $p < 0.01$), in contrast, US CATHPCI NCRD data showed that a larger proportion of this subset of patients is assigned to radial access group (6.59% vs 5.97% $p = 0.049$) [11].

In this study, we did not observe a statistically significant difference in bleeding complications between radial and femoral access. BARC bleeding classifications were used to define bleeding in this study [12]. In other registries, less bleeding is seen in radial approach compared to femoral approach 0.9% vs 2.2% respectively in a study by Dobies et al and 3.5% vs 11.4% in a study by Louvard et al [13,14]. This result is in accordance with data of another Asia Pacific cardiovascular registry, the Malaysian National Cardiovascular Disease Database (NCVD) in which bleeding rates were observed to be 0.2% compared to 0.4% in our registry. The lack of difference in bleeding rates in our registry between radial and femoral approach were due to lower bleeding rates in Southeast Asian patients, this resulted in the need of larger sample size to show a statistically significant difference in bleeding rates between the two groups. In-hospital mortality was lower in the radial access group, 1.7% vs 3.3% respectively. Similar results are also seen in in the results of subgroup analysis from the EUROMAX trial and British Cardiovascular Intervention Society and National Institute for Cardiovascular Outcomes Research in regards to the influence of arterial access selection on the outcomes in primary percutaneous coronary intervention [15,16,17].

Our study also included data rarely found in other studies including cardiogenic shock and post PCI in-hospital life-threatening arrhythmia. Lower incidence of these two adverse events was seen on the radial approach. (0.8% vs 1.8% $p = 0.005$ and 1.6% vs 2.8% $p = 0.009$, respectively).

The average stent use in per case in this study is 1.38 (1.36–1.40, $p < 0.001$) for both femoral and radial access groups, similar number was also shown by a study of similar PCI registry of the Korean PCI registry by Han et al which shows an overall average of 1.39 ± 0.64 ($p < 0.001$) [18]. These results were comparably lower compared to average stent use in STEMI registries such as RIFLE STEACS Study, which shows an overall average of 1.42 stent per patient ($p = 0.745$). The lower number of stent implementation rate per patient at our study might result from the fact that not all of the patients in this registry receive stenting [19].

In the present study, radial access was not an independent predictor of mortality, suggesting that the higher mortality in femoral access patient was due to several unfavourable factors (such as LM PCI and 2nd & 3rd degree AV block) rather than the access itself. This is further confirmed after propensity-score matching of the radial access and femoral access groups, showing that radial access was not associated with reduction of mortality in both bivariable and multivariable model. It is interesting that new-onset angina was associated with higher in-hospital mortality and documented significant CAD was protective. Longer history of angina has been shown to increase the number of collaterals [20] and the presence of collaterals has been associated with reduced in-hospital and 5-year mortality [21]. Furthermore, transient nonlethal period of ischemia allows myocardium to adapt and becoming more resistant to infarction or other subsequent ischemic insult, a phenomena known as preconditioning [22]. Preinfarction angina has also been shown to reduce infarct size in STEMI patients [23]. These factors may explain that documented significant CAD is protective against in-hospital mortality in contrast to new-onset angina.

Subgroup analysis showed that radial access reduce mortality in the STEMI patients, similar results have been previously demonstrated [6,24]. One of the possible mechanism of observed benefit is lower rate of bleeding [6], however, the rate of bleeding was similar in our cohort. Besides bleeding, radial access enables early ambulation, and a shorter length of stay which may reduce thromboembolism and nosocomial infections [6].

Indonesian Universal Healthcare Coverage (IUHC) influence PCI considerations. Tertiary centers such as National Cardiovascular Center Harapan Kita has a higher reimbursement limit compared to non-tertiary centers, leading to a higher number of stents deployed in tertiary (number of stent deployed = 3) than non-tertiary centers (number of stent deployed = 1). Results of this study may be affected by this policy, for example, multivessel PCI is not done in the non-tertiary hospital (may affect the outcome in STEMI); the need of repeat procedure for two-vessel disease requiring two or more stents. The use of vascular closure devices is very low, and hence, not included in this analysis. This is because the Indonesian national health insurance reimbursement cap did not allow the liberal use of vascular closure devices.

4.1. Limitation

Although this project involved PCI centers across the nation, most of the reports came from Jakarta, the capital city of Indonesia and not every Province in Indonesia reported their respective PCI data. Also, there are underdeveloped provinces that did not have a PCI facility. Data from a high volume, national cardiovascular center comprise of 68.57% of the reports; possibly leading to a higher success rate, lower adverse events, and a higher number of complex PCI than expected. Hence, the result of this study may not represent Indonesia as a whole. Our study also did not have follow-up data as of now, and we cannot measure the long-term outcomes of our procedure. We are unable to perform direct comparison in mortality risk between STEMI and NSTEMI patients due to the presence of multi colinearity between the variables, we are however, able to include STEMI patients in our multivariable analysis on mortality risk.

4.2. Conclusion

In this study, higher rate of adverse events was observed on the femoral access group. However, this result might stem from the fact that patients with worse clinical state, comorbidities, and complex lesions tend to get assigned to the femoral access group due to the need of larger catheter size. Furthermore, neither radial nor femoral access is superior in terms of in-hospital mortality in our registry.

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CRediT authorship contribution statement

Amir Aziz Alkatiri: Conceptualization, Methodology, Supervision, Project administration. **Doni Firman:** Writing - review & editing. **Nur Haryono:** Writing - review & editing. **Emir Yonas:** Writing - original draft, Writing - review & editing, Formal analysis. **Raymond Pranata:** Writing - original draft, Writing - review & editing, Formal analysis. **Ismir Fahri:** Writing - review & editing. **I Made Junior Rina Artha:** Writing - review & editing. **Vireza Pratama:** Writing - review & editing. **Wishnu Aditya Widodo:** Writing - review & editing. **Nahar Taufiq:** Writing - review & editing. **Abdul Hakim Alkatiri:** Writing - review & editing. **Sunanto Ng:** Writing - review & editing. **Heru Sulastomo:** Writing - review & editing. **Sunarya Soerianata:** Writing - review & editing.

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Declaration of Competing Interest

The authors declare no conflict of interest

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