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Original Research Article

Comparison of incidence of acute kidney injury following percutaneous coronary intervention between transradial and transfemoral approaches

Mithun Saha[1]*, Mir Jamal Uddin[1], Abdul Momen[1], Antara Dey[2], Gokul Chandra Datta[1], Badal Chandra Barman[1], Deb Dulal Debnath[3]

[1]Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh
[2]Directorate General of Health Services (DGHS), Dhaka, Bangladesh
[3]Department of Cardiology, National Institute of Ophthalmology and Hospital, Dhaka, Bangladesh

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***Correspondence:**
Dr. Mithun Saha,
E-mail: drmithunsaha.nicvd@gmail.com

ABSTRACT

Background: Acute kidney injury (AKI) is a significant complication in percutaneous coronary intervention (PCI) patients. Periprocedural bleeding and vascular access site complications are emerging risk factors for post-PCI AKI. Recent studies suggest that transradial PCI has a lower incidence of AKI compared to transfemoral PCI, attributed to reduced vascular and bleeding complications. This study aimed to compare the incidence of acute kidney injury following PCI between transradial and transfemoral approaches.
Methods: This cross-sectional study included 200 ischemic heart disease patients who underwent percutaneous coronary intervention (PCI) via transradial access (TRA, n=98) or transfemoral access (TFA, n=102) from June 2018 to May 2019 at the National Institute of Cardiovascular Diseases (NICVD) Hospital, Dhaka, Bangladesh. Samples were selected purposively, and AKI incidence was assessed post-procedure through serum creatinine levels and urine output. Data analysis was performed using SPSS version 23.0.
Results: Demographic and risk factor variables were similar in both groups. Compared to transfemoral approaches (TFA), transradial approaches (TRA) resulted in significantly fewer major bleeding events (0% vs. 4%, p=0.04) and vascular access site complications (p=0.04). TRA was also associated with a lower incidence of AKI post-PCI (2% vs. 8.8%, p=0.03). Multivariate logistic regression identified transfemoral access as the strongest predictor of AKI after PCI (p=0.001).
Conclusions: The transradial approach is associated with a lower incidence of acute kidney injury (AKI) following percutaneous coronary intervention (PCI) compared to the femoral approach.

Keywords: Acute kidney injury, Percutaneous coronary intervention, TFA, Transfemoral approaches, Transradial route

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading global cause of death and a significant barrier to sustainable development.[1] The 2013 Global Burden of Disease (GBD) study reported 17.3 million CVD-related deaths worldwide, accounting for 31.5% of all deaths and 45% of non-communicable disease deaths, surpassing cancer and all communicable, maternal, neonatal, and nutritional disorders combined.[2] Notably, 80% of these deaths occur in low- and middle-income countries. Ischemic heart disease (IHD) alone causes approximately 1.8 million deaths annually and accounts for 20% of all deaths in Europe, with significant variations across countries.[3]

The prevalence of CAD in Bangladesh varies between 0.33% and 19.6% across different studies, with a recent review estimating it at 4-6%.[4,5] Although nationwide PCI data is unavailable, NICVD performed 16,747 PCI procedures from 2001 to 2016.[5] PCI is commonly performed via femoral or radial approaches. Femoral access can lead to vascular and bleeding complications, contributing to morbidity, extended hospitalization, and increased costs, especially under aggressive anticoagulation and antiplatelet therapy.[6] The first transradial coronary angiography was reported by Campeau in 1989, and transradial intervention by Kiemeneij et al in 1992. Since its introduction, the transradial approach has become a widely accepted alternative for coronary angiography and angioplasty.[7] While it is minimally invasive, the procedure carries potential risks, including AKI. AKI is a common complication among ischemic heart disease patients undergoing PCI, significantly increasing short-term and long-term mortality risks and adverse outcomes.[8] AKI is defined as an increase in serum creatinine by ≥0.3 mg/dl (≥26.5 μmol/l) within 48 hours, or to ≥1.5 times the baseline within seven days, or urine output <0.5 ml/kg/hour for six hours.[9] Few studies on renal impairment at NICVD highlight key findings. One study identified AKI as an independent predictor of in-hospital mortality and morbidity, stressing the need to identify risk factors and prevent AKI during STEMI management.[10] Another study showed that preprocedural low hemoglobin significantly increases the risk of contrast-induced nephropathy after PCI.[11] Recent evidence indicates that reduced renal perfusion, vascular, and bleeding complications also contribute to worsening renal function post-PCI, beyond contrast nephropathy.[12] Recent studies indicate that transradial PCI (TR-PCI) has a lower incidence of AKI compared to transfemoral PCI (TF-PCI).[13] Periprocedural bleeding, which is significantly reduced in the radial approach, is a notable risk factor for AKI development.[14] The AKI-MATRIX study, the first randomized controlled trial on renal outcomes of TR-PCI versus TF-PCI, supports these findings.[15] Mechanisms reducing AKI risk in TR-PCI include minimized hemodynamic instability, reduced major bleeding, and lower cholesterol embolization risk due to avoiding mechanical trauma to the descending aorta.[16,17] A recent cohort study confirmed the association of TR-PCI with reduced AKI risk.[18]

METHODS

This cross-sectional study was conducted on 200 IHD patients who underwent PCI via transradial access (TRA, Group I: 98 patients) or transfemoral access (TFA, Group II: 102 patients) between June 2018 and May 2019 at the National Institute of Cardiovascular Diseases (NICVD) Hospital, Dhaka, Bangladesh. Participants were selected using a purposive sampling method. Ethical approval was obtained from the hospital's ethical committee, and informed consent was secured from all participants prior to data collection. The inclusion criteria comprised patients with IHD who underwent percutaneous coronary intervention (PCI) through either the transradial or transfemoral route. The exclusion criteria comprised patients with preprocedural serum creatinine levels >1.4 mg/dl, known chronic kidney disease (CKD), those on dialysis, patients presenting with cardiogenic shock or cardiac arrest, and those on nephrotoxic drugs within 48 hours before the procedure. Additionally, patients with unavailable initial or maximal serum creatinine data, Type C coronary artery lesions, three or more vessel stents, cardiomyopathies, severe comorbidities (e.g., anemia, malignancy, or bleeding disorders), or those unwilling to participate were excluded. The incidence of AKI was monitored by assessing serum creatinine levels and urine output post-procedure. Data were analyzed using SPSS version 23.0. The p value of <0.05 was considered as the statistical significance.

RESULTS

The mean age of the study patients was 55.1±4.7 years, with a range of 40 to 65 years. There was no statistically significant difference in mean age between the two groups. Most patients in both groups were aged between 51 to 60 years, and male patients were predominant, with a male-to-female ratio of 2.6:1. Gender distribution showed no significant difference between the groups (p=0.89). Dyslipidemia was the most common risk factor, while a family history of CAD was the least common. No significant differences in risk factors were found between the two groups. Most patients in both groups had mildly abnormal LVEF, with only 7 (7.1%) in group I and 5 (4.9%) in group II showing moderately abnormal LV systolic dysfunction. The mean LVEF was nearly identical between the two groups. Clinical diagnoses were similar in both groups, with no statistical association (p>0.05). LAD was the most commonly stented vessel, while LM was the least common in both groups. There was no statistically significant difference between the groups. Single vessel involvement was observed in 74.5% of group I patients and 75.5% of group II patients, with no significant difference between the groups. Type B lesions were common in both groups, with no significant difference. Multivessel PCI was more frequent in group I than in group II (p=0.13), though this difference was not statistically significant (p>0.05). Regarding post-PCI outcomes, no major bleeding occurred in group I, while four (3.9%) cases were reported in group II, with a statistically significant difference (p=0.04). Vascular complications were also significantly fewer in group I than in group II, being one-fourth of the incidence in group II (p=0.04). The incidence of AKI following PCI was significantly lower in group I, with two (2.0%) cases compared to nine (8.8%) in group II (p=0.03). Multivariate analysis identified three independently significant predictors for developing AKI following PCI: major bleeding, vascular complications, and the transfemoral route. The odds ratios (ORs) for these predictors were 3.17, 3.24, and 6.12, respectively.

Among these, the transfemoral route was the strongest predictor for AKI, with an OR of 6.12 (95% CI: 1.98-34.11) and a p value of 0.001.

Table 1: Comparison of the study patients according to age (n=200).

Age in years	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
41-50	15	15.3	10	9.8	25	12.5	0.30[ns]
51-60	65	66.3	81	79.4	146	73	
>60	18	18.4	11	10.8	29	14.5	
Mean±SD	54.7±5.6		55.5±3.6		55.1±4.7		

ns-Non-significant

Table 2: Distribution of patients according to risk factors (n=200).

Risk factors	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
Smoking	42	42.9	46	45.1	88	44	0.75[ns]
Hypertension	37	37.8	43	42.2	80	40	0.52[ns]
Diabetes mellitus	34	34.7	40	39.2	74	37	0.51[ns]
Dyslipidemia	42	42.9	47	46.1	89	44.5	0.65[ns]
Family history of CAD	15	15.3	19	18.6	34	17	0.53[ns]

ns-Non-significant

Table 3: Comparison of left ventricular ejection fraction (LVEF) between two groups (n=200).

LVEF	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
Normal (≥50%)	32	32.7	33	32.4	65	32.2	0.72[ns]
Mildly abnormal (40-49%)	59	60.2	64	62.7	123	61.5	
Moderately abnormal (30-39%)	7	7.1	5	4.9	12	6	
Mean±SD	49.7±5.7		49.9±5.4		49.8±5.5		

ns-Non-significant

Table 4: Distribution of patients according to clinical diagnosis (n=200).

Diagnosis	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
CSA	20	20.4	18	17.6	38	19	0.61[ns]
UA	21	21.4	22	21.6	43	21.5	0.92[ns]
STEMI	23	23.5	21	20.6	44	22	0.89[ns]
NSTEMI	34	34.7	41	40.2	75	37.5	0.42[ns]

ns-Non-significant

Table 5: Distribution of study patients by the vessel involved in CAG (n=200).

Vessels	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
LAD	54	55.1	51	50	105	52.5	
LCX	30	30.6	33	32.4	63	31.5	
RCA	39	39.8	45	44.1	84	42	0.54[ns]
LM	3	3.1	3	2.9	6	3	0.96[ns]

ns-Non-significant

Table 6: Vessel involvement among participants as per CAG (n=200).

Vessels	Group I (n=98)		Group II (n=102)		p value
	N	%	N	%	
Single	73	74.5	77	75.5	0.733[ns]
Double	22	22.4	20	19.6	
Triple	3	3.1	5	4.9	

ns-Non-significant

Table 7: Distribution of study patients by lesion severity in CAG and PCI characteristics (n=200).

Lesion severity	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
Type A	18	18.4	21	20.8	39	19.5	0.69[ns]
Type B	80	81.6	81	79.4	161	80.5	0.69[ns]
Multivessel PCI	19	19.4	12	11.8	31	15.5	0.13[s]

s-significant; ns-Non-significant

Table 8: Post PCI outcomes among two groups (n=200).

Outcomes variables	Group I (n=98)		Group II (n=102)		Total (n=200)	
	N	%	N	%	N	%
Major bleeding	0	0	4	3.9	4	2
Vascular complications	2	2	8	7.8	10	5

Table 9: Comparison of incidence of AKI following PCI between two groups (n=200).

AKI	Group I (n=98)		Group II (n=102)		Total (n=200)		p value
	N	%	N	%	N	%	
Present	2	2	9	8.8	11	5.5	0.03[s]
Absent	96	98	93	91.2	189	94.5	

s-significant

Table 10: Multivariate logistic regression analysis for determinants of AKI (n=200).

Variables of interest	Regression coefficient (β)	OR	95% CI	p value
Age >50 years	0.684	1.95	0.113-7.394	0.648[ns]
Hypertension	0.629	1.98	0.102-16.248	0.10[ns]
Diabetes mellitus	0.411	1.47	0.117-14.248	0.13[ns]
STEMI	1.165	3.2	0.929-11.054	0.65[ns]
LVEF <50%	0.219	1.65	0.853-13.532	0.09[ns]
Multivessel PCI	0.269	1.58	0.249-11.829	0.08[ns]
Major bleeding	1.178	3.17	1.249-29.378	0.03[s]
Vascular complications	1.478	3.24	1.498-33.018	0.02[s]
Contrast amount	0.011	1.02	0.109-6.172	0.33[ns]
Transfemoral route	2.478	6.12	1.978-34.111	0.001[s]

s-significant; ns-Non-significant

DISCUSSION

The mean age of the study population was 55.1±4.7 years, consistent with findings from other relevant studies.[11,19] However, Steinvil et al, reported a higher mean age of 64.8±3.2 years.[18] This difference may reflect the earlier onset and rapidly progressive course of IHD in Bangladesh, where the first myocardial infarction typically occurs 5-10 years earlier than in other populations. The male-to-female ratio in this study was 2.7:1, with no significant difference between the groups. This aligns with other Bangladeshi studies, which have consistently reported a predominance of male patients.[19,20] Regarding risk factors, no significant differences were observed between the groups, and their prevalence was consistent with findings from previous studies.[14,21] Single-vessel disease was the most common finding in both groups, aligning with the results of Valgimigli et al.[14] However, another previous study reported a higher prevalence of triple-vessel and double-vessel diseases.[20] Type B coronary lesions were the predominant type in this study, accounting for 80.5% of the total sample. Similarly, Cader et al, found Type B lesions to be the most common, though their study reported a lower prevalence 50.6% in young females and 65.3% in young males likely due to focusing on younger patients (<55 years).[22] LAD was the most frequently stented target vessel in this study, consistent with findings from other studies.[14,18] In this study, the overall major bleeding rate was 4%, comparable to the 3.7% reported by Steinvil et al.[18] A significantly lower incidence of major bleeding was observed in the transradial group compared to the transfemoral group (p=0.04). Similarly, Steinvil et al, reported a significantly lower incidence of major bleeding in the transradial group (p=0.02).[18] However, Huq et al, found a non-significant reduction in major bleeding in transradial PCI (p=0.12) in NSTEMI patients, potentially due to their exclusive focus on this subgroup.[23] The reduced bleeding risk in the transradial approach is attributed to the radial artery's superficial course and its location against the radial head, allowing effective hemostasis through local compression. The femoral artery's deeper location poses challenges in identifying the optimal puncture site. A high puncture increases the risk of inadequate compression, hematoma formation, or retroperitoneal bleeding after catheter removal, while a low puncture heightens the likelihood of false aneurysm formation.[24] This study observed a significantly lower incidence of vascular complications, including minor bleeding, in the transradial group compared to the transfemoral group. Similarly, Steinvil et al and Mehta et al reported a significantly lower incidence of vascular complications in the transradial group among IHD and NSTEMI patients, respectively.[18,25] In this study, the findings regarding major bleeding and vascular complications were consistent with the results of previously mentioned studies. The incidence of AKI following PCI was significantly lower in the transradial group compared to the transfemoral group (p=0.03). Similarly, Steinvil et al, reported a significantly reduced incidence of AKI in the transradial group (p<0.001).[18] The AKI-MATRIX study by Andò et al, also found a lower incidence of AKI in the transradial group (p=0.0181).[15] A recent meta-analysis indicated that AKI rates following transradial PCI ranged from 1.4% to 8.4% (mean 4.6%), compared to 1.9% to 16.8% (mean 10.3%) for transfemoral PCI.[13] The incidence of AKI following PCI appears consistent across various studies. Ohno et al (2013) confirmed that peri-procedural bleeding significantly increases the risk of AKI.[16] The reduced AKI incidence with transradial access can be attributed to the mitigation of postprocedural bleeding and vascular complications.[17] In our study, multivariate regression analysis identified major bleeding, vascular complications, and the transfemoral route as independent predictors of AKI, with the transfemoral route being the strongest predictor (p=0.001). Similarly, Andò et al (2015) reported the transradial route's superiority in reducing AKI incidence following PCI.[15] This study reinforces the finding that the transradial route is associated with a significantly lower risk of AKI compared to the transfemoral route.

This study was a single-center investigation conducted on a small sample size, which may limit the generalizability of the findings. Additionally, the cross-sectional study design was another limitation, restricting the ability to assess causality or long-term outcomes.

CONCLUSION

The transradial route is associated with a lower incidence of acute kidney injury (AKI) following percutaneous coronary intervention (PCI) compared to the transfemoral route. Additionally, ischemic heart disease (IHD) patients undergoing transradial PCI experience significantly fewer major bleeding events and vascular access site complications than those undergoing transfemoral PCI. These findings suggest that transradial PCI may enhance patient prognosis compared to the transfemoral approach.

Recommendations

Further large-scale, multicenter studies with longitudinal follow-up are recommended to validate the findings and assess long-term outcomes of transradial PCI. Efforts should also focus on increasing operator proficiency and promoting the transradial approach to improve patient safety, minimize complications, and optimize clinical outcomes in PCI procedures.

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REFERENCES

1. Clark H. NCDs: a challenge to sustainable human development. Lancet. 2013;381(9866):510-1.
2. Townsend N, Wilson L, Bhatnagar P, Wickramasinghe K, Rayner M, Nichols M. et al. Cardiovascular disease in Europe: Epidemiological Update 2016. Eur Heart J. 2016;37(42):3232-45.
3. Ibánez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Rev Esp Cardiol (Engl Ed). 2017;70(12):1082.
4. Sayeed MA, Banu A, Hussain MZ, Khan AR, Ahamed SA, Ali SMK. et al. Prevalence and risk factors of coronary heart disease in a rural population of Bangladesh. Ibrahim Med Coll J. 2010;4(2):37-43.
5. Islam AKMM, Mohibullah AKM, Paul T. Cardiovascular disease in Bangladesh: a review. Bangladesh Heart J. 2016;31(2):80-99.
6. Kwok CS, Wong CW, Gilchrist G, Narain A, O'Flaherty M, Mamas MA. et al. Access and non–access site bleeding after percutaneous coronary

intervention and risk of subsequent mortality and major adverse cardiovascular events: systematic review and meta-analysis. Circ Cardiovasc Interv. 2015;8(4):e001645.
7. Patwary MS, Uddin MJ, Rahman MM, Haque SA, Ahmed MK, Haider S, et al. Advantage of trans radial coronary angiography. a study of 40 patients. Univ Heart J. 2010;5(2):52-5.
8. Alreja G, Koyner JL. Acute kidney injury: a modifiable risk factor for cardiovascular morbidity and mortality. Am J Nephrol. 2015;42(4):282-4.
9. Kellum JA, Lameire N, Aspelin P, Barsoum RS, Burdmann EA, Goldstein SL, et al. Diagnosis, evaluation, and management of acute kidney injury: a KDIGO summary (Part 1). Crit Care. 2013;17:1-15.
10. Huq AM, Sultana R, Chowdhury JMA, Akhter N, Rahman MR, Khatun A, et al. Adverse In-Hospital Outcome of Transradial PCI in Comparison to Transfemoral PCI in NSTEMI Patients during Index Hospitalization: A Single Center Study in Bangladesh. Mymensingh Med J. 2022;31(2):400-5.
11. Akhtaruzzaman M, Habib SH, Karim MA, Rahman MS, Islam MS, Kamal MA, et al. Impact of low hemoglobin on contrast-induced nephropathy after percutaneous coronary intervention. Cardiovasc J. 2012;5(1):30-6.
12. Shacham Y, Steinvil A, Arbel Y. Acute kidney injury among ST-elevation myocardial infarction patients treated by primary percutaneous coronary intervention: a multifactorial entity. J Nephrol. 2016;29:169-74.
13. Andò G, Tranchita E, Ravera A, Cortese B, Tosto A, Capodanno D, et al. Impact of vascular access on acute kidney injury after percutaneous coronary intervention. Cardiovasc Revasc Med. 2016;17(5):333-8.
14. Valgimigli M, Gagnor A, Calabró P, Frigoli E, Leonardi S, Zaro T, et al. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomized multicentre trial. Lancet. 2015;385(9986):2465-76.
15. Andò G, Cortese B, Russo F, Picci A, La Manna A, Capodanno D, et al. Acute kidney injury after percutaneous coronary intervention: Rationale of the AKI-MATRIX sub-study. Catheter Cardiovasc Interv. 2015;86(5):950-7.
16. Ohno Y, Maekawa Y, Ueno K, Tanaka S, Koyama Y, Nakaoka Y, et al. Impact of periprocedural bleeding on incidence of contrast-induced acute kidney injury in patients treated with percutaneous coronary intervention. J Am Coll Cardiol. 2013;62(14):1260-6.
17. Kooiman J, Seth M, Dixon S, Wohns D, LaLonde T, Rao SV, et al. Risk of acute kidney injury after percutaneous coronary interventions using radial versus femoral vascular access. Circ Cardiovasc Interv. 2014;7(2):190-8.
18. Steinvil A, Garcia-Garcia HM, Rogers T, Koifman E, Buchanan K, Alraies MC, et al. Comparison of Propensity Score-Matched Analysis of Acute Kidney Injury After Percutaneous Coronary Intervention with Transradial Versus Transfemoral Approaches. Am J Cardiol. 2017;119(10):1507-11.
19. Islam AKMM, Majumder AAS. Coronary artery disease in Bangladesh: A review. Indian Heart J. 2013;65(4):424-35.
20. Akanda MAK, Ali SY, Islam AEMM, Rahman MM, Parveen A, Kabir MK, et al. Demographic Profile, Clinical Presentation & Angiographic Findings in 637 Patients with Coronary Heart Disease. Faridpur Med Coll J. 2011;6(2):82-5.
21. Rahman A, Mahmud S, Jahan N, Akter S, Hossain MI, Haque MR, et al. Relation of radial artery occlusion after trans-radial percutaneous coronary intervention with the duration of hemostatic compression. Int J Res Med Sci. 2024;12(5):1457.
22. Cader FA, Rahman A, Rahman MA, Zaman S, Arefin MM, Reza AT, et al. Comparison of Short-term Outcomes of Percutaneous Coronary Intervention between Young Male and Female Patients with Acute Coronary Syndrome. Bangladesh Heart J. 2018;33(1):1-9.
23. Haque MM, Hossain MZ, Hasan MR, Rahman A, Sultana A, Islam M, et al. In-hospital outcomes of acute st elevation myocardial infarction in patients with acute kidney injury. Cardiovasc J. 2018;11(1).
24. Kiemeneij F, Laarman GJ, de Melker E. Transradial artery coronary angioplasty. Am Heart J. 1995;129(1):1-7.
25. Mehta SR, Jolly SS, Cairns J, Niemelä K, Rao SV, Cheema AN, et al. Effects of radial versus femoral artery access in patients with acute coronary syndromes with or without ST-segment elevation. J Am Coll Cardiol. 2012;60(24):2490-9.

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