Prevalence of Acute Kidney Injury Following Percutaneous Coronary Intervention by Transradial and Transfemoral Route

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ABSTRACT

Background: *Acute kidney injury (AKI) is a common complication following percutaneous coronary intervention (PCI) and is associated with increased morbidity and mortality. The risk of AKI may vary between PCI approaches, such as the transradial and transfemoral routes, due to differences in procedural duration, contrast volume, and patient characteristics. This study aimed to determine the prevalence of AKI in patients undergoing PCI via transradial and transfemoral routes.* ***Methods:*** *This cross-sectional study was conducted amongst 200 cases of ischemic heart disease (IHD) patients who had undergone percutaneous coronary intervention (PCI) through transradial access (TRA) (group I=98) and transfemoral access (TFA) (group II=102) between June 2018 to May 2019 in National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh. Samples were selected purposively. The incidence of acute kidney injury (AKI) was recorded during follow-up by serum creatinine value and urine volume after the procedure. Data were analyzed by MS Office tools.* ***Results:*** *Post-PCI outcomes showed no major bleeding events in Group I, while four cases (3.9%) occurred in Group II, a statistically significant difference (p=0.04). Vascular complications were also notably lower in Group I, with an incidence one-fourth that of Group II (2 cases vs. 8 cases, p=0.04). The prevalence of acute kidney injury (AKI) following PCI was 2.0% in Group I, 8.8% in Group II, and 5.5% among all participants. The incidence of AKI was significantly higher in Group II compared to Group I (p=0.03).* ***Conclusion:*** *In percutaneous coronary intervention (PCI), the prevalence of acute kidney injury (AKI) is significantly lower with the transradial route compared to the transfemoral route, making the transradial approach a safer option for PCI.*

Keywords: *Acute kidney injury, PCI, Percutaneous coronary intervention, Prevalence, Transfemoral route, Transradial*

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INTRODUCTION

Acute kidney injury (AKI) is a common and serious complication following percutaneous coronary intervention (PCI), contributing significantly to increased morbidity, mortality, and healthcare costs. Despite advancements in interventional cardiology, AKI remains a critical concern, especially in patients with predisposing risk factors such as advanced age, diabetes, and chronic kidney disease (CKD) [1]. The pathogenesis of AKI in PCI is multifactorial, involving contrast-induced nephropathy (CIN), and renal hypoperfusion during the procedure [2]. Understanding the prevalence of AKI and identifying strategies to mitigate its occurrence are essential for improving outcomes in patients undergoing PCI. The choice of vascular access for PCI has evolved over the years, with the transradial route (TRA) gaining widespread popularity due to its association with reduced bleeding and vascular complications compared to the transfemoral route (TFA) [3]. However, the impact of vascular access on AKI prevalence remains a subject of debate. Some studies have suggested that the TRA may be associated with a lower risk of AKI due to improved hemodynamic stability and reduced procedural time, while others report no significant difference between the two approaches [4,5]. Contrast volume is another critical factor influencing AKI development in PCI patients. Studies have demonstrated that higher contrast volumes are an independent predictor of AKI, regardless of the access route used [6]. Operators performing PCI through the TRA may face challenges such as smaller guiding catheter sizes and difficulty in complex interventions, potentially leading to increased procedural contrast use [7]. On the other hand, the TFA may involve more extensive manipulation of larger catheters, which could also contribute to renal insult [8]. While several studies have examined AKI following PCI, data from low- and middle-income countries, including Bangladesh, remain limited. Variations in patient demographics, procedural techniques, and healthcare resources necessitate a region-specific understanding of AKI prevalence and its determinants [9]. Furthermore, the increasing adoption of the TRA in resource-constrained settings underscores the need to evaluate its impact on renal outcomes comprehensively [10]. This study aimed to determine the prevalence of AKI in patients undergoing PCI by the TRA and TFA in a tertiary care hospital in Bangladesh. By examining patient characteristics, procedural factors, and access-specific outcomes, this research seeks to provide valuable insights into optimizing PCI practices to reduce the risk of AKI and improve patient care.

METHODOLOGY

This cross-sectional study was conducted on 200 ischemic heart disease (IHD) patients who underwent percutaneous coronary intervention (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), 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 study adhered to the principles of human research as outlined in the Helsinki Declaration [14] and was conducted in full compliance with applicable regulations, including the General Data Protection Regulation (GDPR) [15]. The inclusion criteria comprised patients with ischemic heart disease (IHD) who underwent percutaneous coronary intervention (PCI) through either the transradial or transfemoral route. The exclusion criteria included 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 in the study were excluded. The incidence of acute kidney injury (AKI) was monitored during follow-up by assessing serum creatinine levels and urine output post-procedure. Data analysis was performed using MS Office tools.

RESULT

The mean age of the total study patients was 55.1±4.7 years, ranging from 40 to 65 years. There was no statistically significant difference in the mean age of the two groups. Most patients in both groups were aged between 51 to 60 years. There was no significant association between Group I and Group II in terms of gender distribution (p=0.89). Dyslipidemia was the most common and family history of CAD was the least common risk factor of IHD in both groups. No risk factors were significantly different between the two groups. The biochemical characteristics were found almost similar in both groups with no significant difference (p>0.05). The clinical diagnoses were almost similar in both groups of patients with no statistical association (p>0.05). LAD (Left anterior descending) artery was the most common and LM (Left main) coronary artery was the least common vessel stented in both groups. The difference was not statistically significant between the two groups. As per the CAG, it was observed that in almost three-fourths of group I (74.5%) and in group II (75.5%) single vessel involvement was present. In analyzing the lesion severity in CAG and PCI characteristics we observed that type B lesions were common in both groups with statistically no significant difference. Multivessel PCI was done more in group I than in group II (19.4% vs. 11.8%, p=0.13) with no significant difference (p>0.05). The mean contrast amount was 150.31±17.12 (ml) in group I and 148.53±16.17 (ml) in group II. The difference was not statistically significant between the two groups (p=0.45). Post-PCI outcomes revealed no major bleeding events in Group I, whereas four cases (3.9%) were recorded in Group II, a statistically significant difference (p=0.04). Additionally, vascular complications were significantly lower in Group I compared to Group II, with the incidence being one-fourth that of Group II (2 cases vs. 8 cases, p=0.04). The prevalence of acute kidney injury (AKI) following PCI was found 2.0% in group I, 8.8% in group II, and 5.5% among total participants. So, in group II, the incidence of AKI was found significantly higher than that in group I (p=0.03).

Table 1: Distribution of patients according to clinical diagnosis (N=200)

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

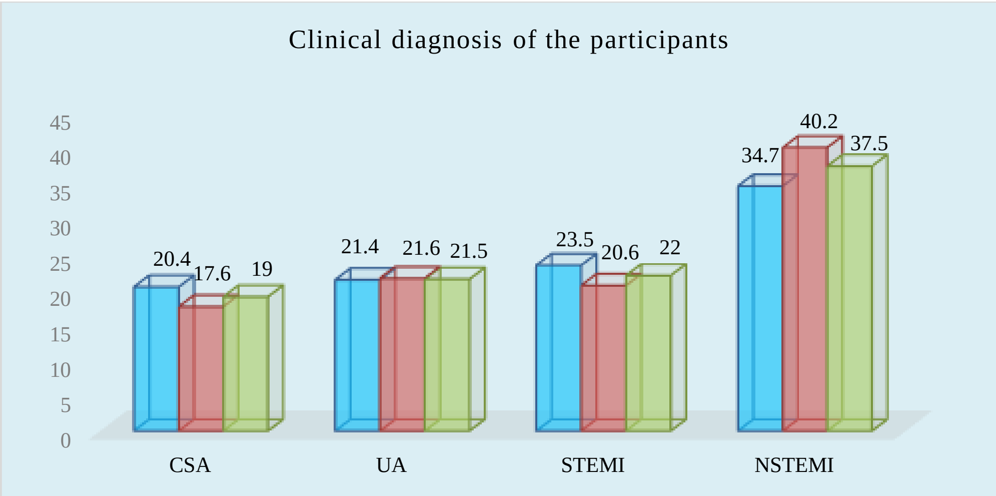

Figure I: Column chart showed clinical diagnosis wise patients (N=200)

Table 2: 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
	Number	%	Number	%	Number	%	
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	0.54ns
LM	3	3.1	3	2.9	6	3	0.96ns

Table 3: 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	0.733ns
Double	22	22.4	20	19.6	
Triple	3	3.1	5	4.9	

Table 4: 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
	Number	%	Number	%	Number	%	
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]

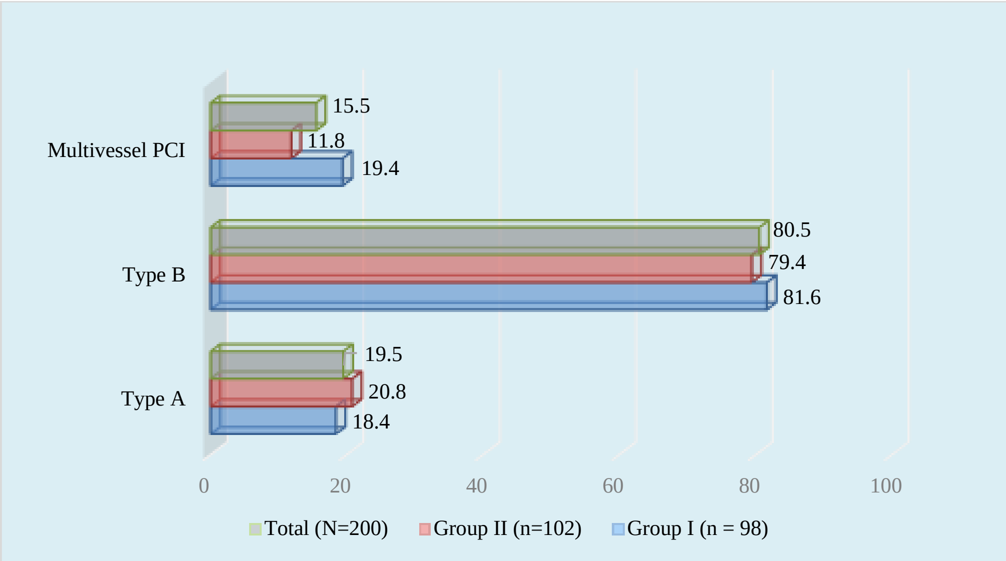

Figure II: Bar chart showed lesion severity in CAG and PCI characteristics of the patients (N=200)

Table 5: Comparison of contrast amount between two groups (N=200)

Variable	(Group I) n=98	(Group II) n=102	(Total) N=200	p value
	Mean □ SD	Mean □ SD	Mean □ SD	
Contrast Amount (ml)	150.3±17.1	148.5±16.2	149.4±16.6	0.45[ns]

Table 6: Post PCI outcomes among two groups (N=200)

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

Table 7: Prevalence of acute kidney injury (AKI) following PCI in two groups (N=200)

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

DISCUSSION

The mean age of this study was 55.1±4.7 years which was close to other relevant studies [13,14]. In this settings, no risk factors were significantly different between two groups and their prevalence in study population was consistent with relevant previous studies [15,16]. Regarding pattern of vessel involvement, single vessel disease was the most common finding in both groups in our study which is similar to other studies done by Valgimigli, et al. (2015) [17] and Andò, et al. (2015) [16]. But Akanda, et al. (2011) [18] found triple vessel disease and double vessel disease to be more common respectively. In this study, Type C coronary lesion were excluded. Type B coronary lesion was common in both groups in this study. It was 80.5% of total sample. Cader, et al. (2018) [19] also found type B lesion mostly common in their study, but it was 50.6% in young female group and 65.3% in young male group. The difference in the finding might be due to the fact that they have considered younger patients (< 55 years). LAD was the most common target vessel stented in this study which is consistent with other studies [15,16]. In this study mean contrast volume was 150.3±17.1 ml in transradial PCI and 148.5±16.2 ml in transfemoral PCI. The difference was not statistically significant between two groups (p=0.45). Steinvil, et al. (2017) [15] found mean contrast volume 155 ml in TR-PCI and 157 ml in TF-PCI which was also statistically not significant. Experienced operators do not use extra volume of contrast for PCI in radial intervention [20]. In the present study total major bleeding event was 4% in comparison to 3.7 % in the study done by Steinvil, et al. (2017) [15]. We found lower incidence of major bleeding in transradial group in comparison to transfemoral (0% versus 4%, p = 0.04) which was statistically significant. Steinvil, et al. (2017) [15] found significantly lower incidence of major bleeding in transradial group in comparison to transfemoral (1.3% versus 2.4%, P = 0.02). In contrast to our finding, Huq, (2018) [21] found non-significant reduction of incidence of major bleeding in transradial group (0% versus 3%, P=0.12) in NSTEMI patients which may be due to inclusion of only NSTEMI patients. We also found lower incidence of vascular complications including minor bleeding in transradial group in comparison to transfemoral (2% versus 8 %, P = 0.04) which was statistically significant. Steinvil, et al. (2017) [15] also found significantly lower incidence of vascular complications in transradial group (0.2 % versus 1.9%, P< .001) in IHD patients. Mehta, et al. (2012) [22] also found significantly lower incidence of vascular complications in transradial group (1.4% versus 3.8%, P = 0.001) in NSTEMI patients. In this study the incidence of acute kidney injury following PCI was less in transradial group in comparison to transfemoral group (2% versus 8.8%, p= 0.03) which was statistically significant. Steinvil, et al. (2017) [15] also found that incidence of AKI was significantly lower in transradial group than in transfemoral group (4.3% versus 10.4%, p< 0.001). Andò, et al. (2015) [16] in their AKI-MATRIX study also found that incidence of AKI was lower in transradial group (15.4% versus 17.4%, p=0.0181) which was statistically significant. In a recently published meta-analysis, the rates of AKI following trnasradial PCI ranged from 1.4% -8.4% with a mean of 4.6% compared with a range of 1.9%-16.8% with a mean of 10.3% for transfemoral PCI [16]. So, the incidence of AKI following PCI is more or less similar among studies. Recently, Ohno, et al. (2013) [23] confirmed that patients who experienced peri-procedural bleeding had a higher incidence of AKI. The mechanisms by which transradial access reduced the incidence of AKI might be due to a reduction of postprocedural bleeding events and vascular complications [24].

LIMITATION OF THE STUDY

This study had several limitations, including a heterogeneous population with variations in gender, clinical presentations, and vessel involvement. The small sample size, limited by time constraints, didn't reach the target. Purposive sampling may have introduced selection bias, and multiple operators performing PCI procedures could have led to inter-operator variability affecting the outcomes.

CONCLUSION & RECOMMENDATION

In percutaneous coronary intervention (PCI), acute kidney injury (AKI) prevalence is notably higher with the transradial route compared to the transfemoral route. However, overall, the transradial route is considered safer than the transfemoral route due to its lower risk of vascular complications and enhanced patient outcomes. This highlights the need for careful patient evaluation and risk assessment when selecting the optimal approach for PCI.

REFERENCES

[1] Ogbadu, Jeremiah, Gaaminepreet Singh, and Devesh Aggarwal. "Factors affecting the transition of acute kidney injury to chronic kidney disease: Potential mechanisms and future perspectives." European Journal of Pharmacology 865 (2019): 172711.

[2] McCullough, Peter A., et al. "Contrast-induced acute kidney injury." Journal of the American College of Cardiology 68.13 (2016): 1465-1473.

[3] Kiemeneij, Ferdinand, and G. Jan Laarman. "Percutaneous transradial artery approach for coronary stent implantation." Catheterization and cardiovascular diagnosis 30.2 (1993): 173-178.

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[4] Romagnoli, Enrico, et al. "Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study." Journal of the American College of Cardiology 60.24 (2012): 2481-2489.

[5] Del Rio-Pertuz, Gaspar, et al. "Transradial versus Transfemoral Access and the Risk of Acute Kidney Injury following Primary Percutaneous Coronary Intervention in Patients with ST-Elevation Myocardial Infarction: A Systematic Review and Meta-Analysis of Randomized Controlled Trials and Propensity-Score-Matched Studies." Journal of Interventional Cardiology 2022.1 (2022): 6774439.

[6] Andò, Giuseppe, et al. "Renal function–adjusted contrast volume redefines the baseline estimation of contrast-induced acute kidney injury risk in patients undergoing primary percutaneous coronary intervention." Circulation: Cardiovascular Interventions 7.4 (2014): 465-472.

[7] Hess, Connie N., et al. "The learning curve for transradial percutaneous coronary intervention among operators in the United States: a study from the National Cardiovascular Data Registry." Circulation 129.22 (2014): 2277-2286.

[8] Andò, Giuseppe, et al. "Therapeutic Considerations with Revascularization in Chronic Kidney Disease: Radial Versus Femoral Arterial Access." Kidney Disease in the Cardiac Catheterization Laboratory: A Practical Approach (2020): 85-101.

[9] Windecker, Stephan, et al. "Revascularisation versus medical treatment in patients with stable coronary artery disease: network meta-analysis." Bmj 348 (2014).

[10] Kapumba, Blessings Msango. Understanding Ancillary Care in the Global South: Examining Practice, current Ethical Guidance, and Stakeholder Perspectives in Malawi. Diss. London School of Hygiene & Tropical Medicine, 2023.

[11] World Medical Association. (2001). World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bulletin of the World Health Organization, 79 (4), 373 - 374. World Health Organization. https://apps.who.int/iris/handle/10665/268312.

[12] Voigt, Paul, and Axel von dem Bussche. "Enforcement and fines under the GDPR." The EU General Data Protection Regulation (GDPR). Springer, Cham, 2017. 201-217.

[13] Akhtaruzzaman, M., et al. "Impact of low hemoglobin on contrast-induced nephropathy after percutaneous coronary intervention." Cardiovascular Journal 5.1 (2012): 30-36.

[14] Islam, AKM Monwarul, and A. A. S. Majumder. "Coronary artery disease in Bangladesh: A review." Indian heart journal 65.4 (2013): 424-435.

[15] Steinvil, Arie, et al. "Comparison of propensity score–matched analysis of acute kidney injury after percutaneous coronary intervention with transradial versus transfemoral approaches." The American Journal of Cardiology 119.10 (2017): 1507-1511.

[16] Andò, Giuseppe, et al. "Acute kidney injury after percutaneous coronary intervention: Rationale of the AKI-MATRIX (acute kidney injury-minimizing adverse hemorrhagic events by TRansradial access site and systemic implementation of angio X) sub-study." Catheterization and Cardiovascular Interventions 86.5 (2015): 950-957.

[17] Valgimigli, Marco, et al. "Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomised multicentre trial." The Lancet 385.9986 (2015): 2465-2476.

[18] Akanda, M. A.K., Ali, S. Y., Islam, A. E.M.M., Rahman, M. M., Parveen, A., Kabir, M. K., Begum, L. and Barman, R. C., 2011. Demographic Profile, Clinical Presentation & Angiographic Findings in 637 Patients with Coronary Heart Disease. Faridpur Medical College Journal, 6(2), pp. 82–85.

[19] Cader, Fathima Aaysha, et al. "Comparison of short-term outcomes of percutaneous coronary intervention between young male and female patients with acute coronary syndrome." Bangladesh Heart Journal 33.1 (2018): 1-9.

[20] Pristipino, Christian, et al. "Major improvement of percutaneous cardiovascular procedure outcomes with radial artery catheterisation: results from the PREVAIL study." Heart 95.6 (2009): 476-482.

[21] Haque, Md Mosharul, et al. "In-Hospital Outcomes of Acute ST Elevation Myocardial Infarction in Patients with Acute Kidney Injury." Cardiovascular Journal 11.1 (2018).

[22] Mehta, Shamir R., et al. "Effects of radial versus femoral artery access in patients with acute coronary syndromes with or without ST-segment elevation." Journal of the American College of Cardiology 60.24 (2012): 2490-2499.

[23] Ohno, Yohei, et al. "Impact of periprocedural bleeding on incidence of contrast-induced acute kidney injury in patients treated with percutaneous coronary intervention." Journal of the American College of Cardiology 62.14 (2013): 1260-1266.

[24] Kooiman, J., Seth, M., Dixon, S., Wohns, D., LaLonde, T., Rao, S. V. and Gurm, H. S., 2014. Risk of acute kidney injury after percutaneous coronary interventions using radial versus femoral vascular access. Insights from the Blue Cross Blue Shield of Michigan Cardiovascular Consortium. Circulation. Cardiovascular Interventions, 7(2), pp. 190– 198.