ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

THE RISK OF CONTRAST-NDUCED NEPHROPATHY IN TRANSRADIAL VERSUS TRANSFEMORAL ACCESS APPROACHES AFTER PERCUTANEOUS CORONARY INTERVENTION

Mahmoud Shawky Abdelmoneum[1], Hesham Mohamed Aboul-Enein[1], Khaled Sabry Hawas[2]*, Wael Ahmed Elsayed Makled[3], and Mohammed Mahros Ali[1]

[1]Cardiology Department, Benha University Hospital, Benha, Egypt. [2]Cardiology Department, Agoza Hospital, Giza, Egypt. [3]Cardiology Department, Benha teaching hospital, Benha, Egypt

***Corresponding author;Dr. Khaled Sabry Hawas**

Email: Khaledhawasmed@yahoo.com

Phone: 01112961543

Abstract

Background: Contrast-induced nephropathy, often known as CIN, is a frequent complication that may occur after procedures that include contrast media administration. Several riskshave been recognized as being independent predictors of CIN; nevertheless, to this day, there are no conclusive data available on the association between the angiographic technique and its development.

Aim and objectives:to investigate the incidence of CIN and the variables that may have contributed to its development in patients who had percutaneous coronary intervention (PCI) using either the transfemoral (TF) or the transradial (TR) access technique.

Subjects and methods: The Cardiology Departments of Agoza, Benha university, and Benha teachinghospitals participated in this prospective research. Patients who had PCIwere included in the study. Patients with congenital or structural heart disease and people with end-stage renal disease were not included in the study. Patients were categorized into two study groups TFA and TRA. For CIN, it was defined as an absolute (≥0.5 mg/dL) or relative (>25%) increase in the baseline serum creatinine level within 48 hours following PCI.

Result: The TFA group showed a significantly higher rate of post-procedural CIN than the TRA group (22 percent vs 6 percent; P =0.041).Also, Contrast volume was significantly higher in the TFA than in the TRA group (P-value <0.001). In addition, the TFA group had a Mehran score that was considerably higher than the TRA group (P-value = 0.04)

Conclusion: In comparison to TFA, the risk of CIN is much lower with TRA after coronary intervention.

Keywords; Contrast-Induced Nephropathy; Percutaneous Coronary Intervention; Transfemoral Access; Transradial Access.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

Introduction

Contrast-induced nephropathy, for example, is a frequent and dangerous complication of the use of contrast media. This condition has been linked to a higher risk of disease and death. Despite advancements in the chemical structure of contrast medium, contrast-induced nephropathy (CIN) remains the third most common cause of hospital-acquired acute kidney injury. This condition increases the risk of hemodialysis, heart attack, congestive heart failure, stroke, and mortality in the immediate and long term.**(1)**

Theincidence rangewas reported for CIN after coronary angiography or PCI from 2% to 25% of the time. **(2)** CIN is thought to be caused in part by renal hypoperfusion and toxic effects on tubular epithelial cells, according to research.**(3)**

Diabetes and renal insufficiency are the two patient-related conditions that provide the greatest threat of developing postprocedural CIN. To evaluate the overall risk posed by the aforementioned risk variables, the Mehran scoring system was developed for predicting CIN after PCI.**(4)**A lower incidence of CIN may be attributed to transradial access (TRA) than transfemoral access (TFA), according to the findings of certain recent studies that compared the two standard approaches used in angiography.**(5,6)**In contrast, several other researchers have not been successful in demonstrating the advantage of the TRA in terms of the decrease of post-procedural CIN, even in high-volume radial centers.**(7)**In addition, there is evidence suggesting that distinct populations may be susceptible to the development of nephropathy due to a unique combination of risk factors.**(8)**

The purpose of this study was to investigate the incidence of Contrast-induced nephropathy (CIN) and the factors that may have contributed to its development in patients whounderwent percutaneous coronary intervention (PCI) using either the transfemoral (TF) or the transradial (TR) access approach.

Study design and population:

This prospective study was conducted over 1 year period from January 2021 to January 2022 and was performed in Cardiology Departments at Agoza, Benha University, andBenha teachinghospitals on 100 patients who were admitted to these hospitals and underwent percutaneous coronary intervention. Patients were randomized into 2 groups each composed of 50 patients: group Atransfemoral and group Btransradial approach.

All Patients were indicated for percutaneous coronary intervention either elective or emergency and PCI via transradial approach by an expert radial operator. Unstable patients (acute pulmonary edema, cardiogenic shock) were excluded from the study as well as Patients with Congenital or Structural heart disease, and end-stage renal disease on dialysis or serum creatinine > 1.5 mg/dL.

All included patients were subjected to full history taking, clinical examination, and laboratory investigations such as Renal function tests (blood urea, serum creatinine, urine analysis, and eGFR), complete blood picture (CBC), Lipid profile (Total lipids,

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

Serum total cholesterol, serum HDL cholesterol, total cholesterol/HDL cholesterol ratio, Serum triglycerides, LDL, VLDL, HDL), and cardiac enzymes (Troponin, CKMB, CK).Standard 12-lead resting ECGs were recorded using a common ECG device (Hewlett Packard, Page-writer, USA) with a paper running speed of 25 mm/s.
RestingTransthorathic Echocardiography was done with special stress on RWMA and LVEF. Assessment of radial & femoral artery patency before and after the procedure (Clinical, pulse oximeter).Coronary angiography through radial or femoral approach; The evaluation of the presence of CIN and accesses, the clinical and procedural characteristics of the patients were compared between the two groups undergoing Coronary angiography through radial or femoral approach. These variables include risk factors, hypotension, anemia, hematocrit, the contrast volume, troponin, CK, CKMB, blood urea, serum creatinine, and creatinine clearance were followed up for 48 hours, Nonionic low-osmolar iodinated contrast agent was used for all procedures. At 48 hours post-procedurally, the changes in blood urea levels, serum creatinine, and creatinine clearance were evaluated. None of the patients receive any preventive medication for CIN, except 500 mL of normal saline (0.9% sodium chloride), pre-and post-procedurally for up to 12 hours. CIN is defined as an absolute (≥ 0.5 mg/dL) or relative (>25 %) rise in the baseline serum creatinine level within 48 hours post-cardiac catheterization.We use the Mehran risk scorefor the assessment of individual patient risk stratification for the development of postprocedural CIN.
Official permission was obtained from the Faculty of Medicine, Benha University. Official permission was obtained from Agoza, Benha University, and Benha teaching hospitals. Approval from the ethical committee in the faculty of medicine (Institutional Research Board IRB).

Statistical Analysis

SPSS version 25 was used to handle the data and perform the statistical analysis (IBM, Armonk, New York, United States). The Kolmogorov–Smirnov test and techniques for direct data visualization were used to determine if the quantitative data were normal. Means and standard deviations or medians and ranges were used to describe numerical data in accordance with normality tests. As a result, categorical data were summarized in the form of numbers and percentages. An independent t-test or a Mann-Whitney U test was used to compare numerical variables that were either normally or non-normally distributed. The chi-square or Fisher's exact test was used to compare categorical data. Two-sided statistical tests were used in all cases. P-values less than 0.05 were regarded as statistically significant.

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Results

- **General characteristics in both groups**

No significant differences were reported between both groups regarding age (P-value = 0.06), gender (P-value = 0.64), BMI (P-value = 0.107), smoking (P-value = 0.422), hypertension (P-value = 0.171), chronic kidney disease (P-value = 1.0), heart failure (P-value = 0.715), and ischemic heart disease (P-value = 0.41).

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

The number of patients with DM and dyslipidemia was significantly higher in the TFA group than in TRA (P-value = 0.019, <0.001 respectively). ***(Table1)***

Table 1: General characteristics of the studied groups

		TFA(n = 50)	**TRA(n = 50)**	**P-value**
Age (years)	Mean ±SD	58.24 ±9.28	61.64 ±8.74	0.06
Gender	Male (%)	39 (78%)	37 (74%)	0.640
	Female (%)	11 (22%)	13 (26%)	
Body mass index	Mean ±SD	26 ±2	26 ±3	0.107
Smoking	n (%)	25 (50%)	29 (58%)	0.422
Hypertension	n (%)	40 (80%)	34 (68%)	0.171
Dyslipidemia	n (%)	34 (68%)	13 (26%)	**<0.001**
Diabetes mellitus	n (%)	39 (78%)	27 (54%)	**0.019**
Chronic kidney disease	n (%)	1 (2%)	0 (0)	1.0
Heart failure	n (%)	3 (6%)	5 (10%)	0.715
Ischemic heart disease	n (%)	17 (34%)	21 (42%)	0.41

An independent t-test was used for age and BMI. Chi-square or Fisher's exact test was used for categorical data.

- **Echo & angio characteristics in both groups**

Both groups showed no significant differences in LVEF (P-value = 0.68) and RWMA (P-value = 0.211).***(Table 2)***

Table 2: Echo & angio characteristics in both groups

		TFA (n = 50)	**TRA (n = 50)**	**P-value**
LVEF (%)	Mean ±SD	58 ±7	57 ±7	0.68
RWMA	n (%)	29 (58%)	35 (70%)	0.211

An independent t-test was used for LVEF. A Chi-square test was used for RWMA
LVEF = Left Ventricular Ejection Fraction
RWMA = Regional wall motion abnormality

- **Mehran score in both groups**

Mehran score was significantly higher in the TFA group than in the TRA group (P-value = 0.04). ***(Table 3)***

Table 3: Mehran score in both groups

		TFA(n = 50)	**TRA(n = 50)**	**Total (n=100)**	***p*-Value**
Mehran score n (%)		19 (38%)	24(48%)	43 (43%)	**0.04**
Low (<6)					
Intermediate (6-10)		22 (44%)	10 (40%)	42(42%)	
High (11-16)		7 (14%)	6 (12%)	13 (13%)	
Very high (>16)		2 (4%)	0 (0%)	2 (2%)	

Mann Whitney U test was used.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

❖ **Laboratory findings in both groups**

Serum creatinine before the procedure was significantly higher in the TFA group (0.8 mg/dl) than TRA group (0.7 mg/dl); P-value was 0.027. Also, after treatment, it was significantly higher in TFA group (1.3 mg/dl) than TRA group (0.8 mg/dl); P-value was 0.006. e-GFR was significantly higher in the TRA group (88.9) than the TFA group (79.8); The P-value was 0.047. No significant differences were reported between both groups regarding CK (P-value = 0.247), CK-MB (P-value = 0.583), troponin (P-value = 0.545), creatinine clearance (P-value 0.519), hemoglobin (P-value = 0.396), and hematocrit (P-value = 0.418). ***(Table 4)***

Table 4: Laboratory findings in both groups

		TFA (n = 50)	**TRA (n = 50)**	**P-value**
CK	Median (range)	144 (87 - 1398)	138 (84 - 960)	0.247
CK-MB	Median (range)	21 (8 - 237)	21 (11 - 97)	0.583
Troponin	Median (range)	0.2 (0.09 - 6.5)	0.21 (0.1 - 3.8)	0.545
Serum creatinine before (mg/dl)	Median (range)	0.8 (0.5 - 1.4)	0.7 (0.5 - 1.2)	**0.027**
Serum creatinine after (mg/dl)	Median (range)	1.3 (0.7 - 4.1)	0.8 (0.6 - 3)	**0.006**
Creatinine clearance	Mean ±SD	101 ±39.1	105 ±27.9	0.519
e-GFR	Mean ±SD	79.8 ±28.69	88.9 ±20.9	**0.047**
Hemoglobin (g/dl)	Mean ±SD	11.9 ±1.2	12.1 ±1.3	0.396
Hematocrit (mg/dl)	Mean ±SD	41 ±3	41 ±2	0.418

An independent t-test or Mann Whitney U test was used.

CK = Creatine phosphokinase

CK-MB = Creatine phosphokinase-myoglobin binding

e-GFR = Estimated Glomerular Filtration Rate

❖ **Contrast-induced nephropathy & Contrast volume in both groups**

The TFA group had a significantly higher incidence rate of postprocedural CIN than the TRA group (P-value was 0.041). Also, Contrast volume was significantly higher in the TFA than in the TRA group (P-value <0.001). ***(Table 5)***

Table 5: Contrast-induced nephropathy & Contrast volume in both groups

		TFA (n = 50)	**TRA (n = 50)**	**P-value**
CIN	**n (%)**	**11 (22.0)**	**3(6.0)**	**0.041**
Contrast volume	**ml**	**208 ±45**	**175 ±38**	**<0.001**

The Chi-square test was used for CIN

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

An independent t-test was used for Contrast volume
CIN = Contrast-induced nephropathy.

Discussion

Contrast-induced nephropathy is a frequent complication of the use of contrast media. This condition has been linked to a higher risk of disease and death. CIN remains the third most common cause of hospital-acquired acute kidney injury. This condition increases the risk of hemodialysis, heart attack, congestive heart failure, stroke, and mortality in the immediate and long term. **(9).**

The reported incidence of CIN may vary from 2 percent to 25 percent. Diabetes and renal insufficiency are the two patient-related conditions that provide the greatest threat of developing postprocedural CIN. In order to evaluate the overall risk posed by the aforementioned risk variables, the Mehran scoring system was developed for predicting CIN after PCI.**(10)**.

This study's primary objective was to investigate the incidence of CIN and the variables that may have contributed to its development in patients who had percutaneous coronary intervention (PCI) using either the transfemoral (TF) or the transradial (TR) access technique.

As regards general characteristics in both groups, no significant differences were reported between both groups regarding age (P-value = 0.06), gender (P-value = 0.64), BMI (P-value = 0.107), smoking (P-value = 0.422), hypertension (P-value = 0.171), chronic kidney disease (P-value = 1.0), heart failure (P-value = 0.715), and ischemic heart disease (P-value = 0.41). Our results agreed with the study of **Firouzi et al., (11)**which reported that 410 patients comprised of 289 men and 121 women at a mean age of 61.3±10.8 years underwent diagnostic or interventional coronary management. Of the 410 patients, 258 were treated via the TFA and 152 via the TRA. No significant differences were reported between both groups regarding age, sex, BMI, smoking, and hypertension. Similarly, **Andò et al., (3)** revealed that their study included 96 FA and 82 RA patients. Baseline demographics and procedural characteristics were similar for the two groups.

Our results showed that the number of patients with DM was significantly higher in the TFA group than in the TRA group (P-value = 0.019). Also, the number of patients with dyslipidemia was significantly higher in the TFA group (P-value <0.001). On contrary, in the study of **Firouzi et al., (11)** no significant differences were reported between both groups regarding DM and dyslipidemia.

With reference to Echo & angio characteristics, no significant differences were reported between both groups regarding LVEF (P-value = 0.68) and RWMA (P-value = 0.211). Similar results were reported by **Firouzi** and co-workers **(11)** regarding LVEF. Also, **Kolte et al., (2)** revealed that no significant differences were reported between both groups regarding LVEF. Whereas, in the study of **Barbieri et al., (5)** patients treated with the TR approach had a higher ejection fraction.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

On the other hand, the Mehran score was significantly higher in the TFA group than in the TRA group (P-value = 0.04). Our results were in agreement with the study of **Firouzi et al., (11)** which reported that patients treated with the TFA approach had significantly higher Mehran scores at baseline than did the TRA group.

Our results showed also that serum creatinine before the procedure was significantly higher in the TFA group (P-value = 0.027). After treatment, the level of serum creatinine was significantly higher in the TFA group (1.3 mg/dl) than in the TRA group (0.8 mg/dl) with a P-value = 0.006. Moreover, e-GFR was significantly higher in the TRA group (88.9) than in the TFA group (79.8) P-value was 0.047. No significant differences were reported between both groups regarding CK (P-value = 0.247), CK-MB (P-value = 0.583), troponin (P-value = 0.545), creatinine clearance (P-value = 0.519), hemoglobin (P-value = 0.396), and hematocrit (P-value = 0.418). Our results were against the study of **Khalil et al., (6)** which reported that the serum creatinine before PCI was higher in the radial group (1.18 ± 0.38 mg/dL) than in the femoral group (0.97 ± 0.17 mg/dL). Furthermore, **Andò et al., (3)** revealed that there were no significant differences between both groups regarding creatinine clearance and hemoglobin.

Our results showed that the patients treated with the TFA approach had a significantly higher incidence rate of postprocedural CIN than the TRA approach (22% vs 6%; P-value was 0.041) and Contrast volume was significantly higher in those who underwent TFA (208 ml) than TRA (175 ML) P-value was <0.001. In accordance with the study of**Firouzi et al., (11)** which reported an overall incidence rate of 12% for CIN in their patients and the incidence of CIN was lower in the TRA approach than in the TFA approach (6.6% vs 15.1%; P = 0.01). The volume of the contrast medium used intraprocedural was higher in the TFA approach than in the TRA approach; nevertheless, the multivariable regression analysis showed that the volume of the contrast medium was not an independent variable for the development of postprocedural CIN (P = 0.341). The multivariate analysis showed that the TFA was the independent predictor of the development of CIN (OR: 2.37, 95% CI: 1.11 to 5.10, and P = 0.027). Also, the study of **Cortese et al., (10)** showed that the incidence of AKI in the 2 matched groups was lower in patients treated with TR primary PCI (8.4% vs 16.9%, p = 0.007). Our results were in agreement with **Kolte et al., (2)** who revealed that contrast volume was significantly higher in those who underwent TFA than in TRA.

The meta-analysis of **Andò et al., (3)** agreed with our study, in which the authors found that the TRA approach lowered the incidence of CIN after PCI. The MATRIX-Access trial showed that CIN was 3 times less prevalent and trended lower with the TRA approach (OR: 0.85, 95% CI: 0.70 to 1.03, and P = 0.090) than with the TFA approach in patients with the acute coronary syndrome who underwent invasive management. Along with this, the study by**Amin et al., (12)** reported that the incidences of bleeding, AKI, and death were higher with TFI versus TRI.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

Our results were in disagreement with the metanalysis of **Del Rio-Pertuz et al., (7).** which reported 5 studies from 2014 to 2021 with a total of 20,154 patients with STEMI were included. TRA was not significantly associated with reduced risk for CI-AKI compared with TFA (odds ratio: 0.87; 95% CI: 0.67-1.13; P = 0.31; I2 = 64%). Also, the metanalysis of **Soud et al., (13)** revealed that the incidence of major adverse cardiovascular and cerebrovascular events (MACCE) and the contrast-induced nephropathy were similar in both groups. Moreover, **Barbieri et al., (14),** stated that no significant difference was observed between the two groups regarding the development of CIN (TR 13.2% vs TF 11.7%, p = 0.16).

Conclusion

In comparison to TFA, the risk of CIN is much lower with TRA after coronary intervention.

Limitations

Small sample size- Limited duration of the study

Financial support and sponsorship

Nil

Conflicts of interest

There are no conflicts of interest.

References

1. Tsai TT, Patel UD, Chang TI, Kennedy KF, Masoudi FA, Matheny ME, et al. Contemporary incidence, predictors, and outcomes of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the NCDR Cath-PCI registry. JACC Cardiovasc Interv. 2014;7(1):1–9.
2. Kolte D, Spence N, Puthawala M, Hyder O, Tuohy CP, Davidson CB, et al. Association of radial versus femoral access with contrast-induced acute kidney injury in patients undergoing primary percutaneous coronary intervention for ST-elevation myocardial infarction. Cardiovasc Revascularization Med. 2016;17(8):546–51.
3. Andò G, Cortese B, Russo F, Rothenbühler M, Frigoli E, Gargiulo G, et al. Acute kidney injury after radial or femoral access for invasive acute coronary syndrome management: AKI-MATRIX. J Am Coll Cardiol. 2017;69(21):2592–603.
4. Hossain MA, Costanzo E, Cosentino J, Patel C, Qaisar H, Singh V, et al. Contrast-induced nephropathy: Pathophysiology, risk factors, and prevention. Saudi J Kidney Dis Transplant. 2018;29(1):1.
5. Barbieri L, Verdoia M, Nardin M, Marino P, Suryapranata H, De Luca G. Gender difference in the risk of contrast-induced nephropathy in patients undergoing coronary angiography or percutaneous coronary intervention. Angiology. 2017;68(6):542–6.
6. Khalil WA, Abdelhameed MG, Elmenshawy MD, Elhelaly A. Serum cystatin c

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

and renal dysfunction in transradial versus transfemoral approaches in primary percutaneous coronary intervention. J Indian Coll Cardiol. 2019;9(2):88.

7. Del Rio-Pertuz G, Mekraksakit P, Triana A, Parmar K, Elharabi Z, Abohelwa M, et al. TCT-383 Transradial Versus Transfemoral Access and the Risk for Contrast-Induced Acute Kidney Injury Following Primary Percutaneous Coronary Intervention in Patients With ST-Segment Elevation Myocardial Infarction: A Meta-Analysis of Randomized Controlled Trials and Propensity Score–Matched Studies. J Am Coll Cardiol. 2021;78(19_Supplement_S):B157–8.
8. Damluji A, Cohen MG, Smairat R, Steckbeck R, Moscucci M, Gilchrist IC. The incidence of acute kidney injury after cardiac catheterization or PCI: a comparison of radial vs. femoral approach. Int J Cardiol. 2014;173(3):595–7.
9. Narula, A., Mehran, R., Weisz, G., Dangas, G. D., Yu, J., Généreux, P., ... & Stone, G. W. (2014). Contrast-induced acute kidney injury after primary percutaneous coronary intervention: results from the HORIZONS-AMI substudy. Eur Heart J;35(23):1533–40.
10. Cortese, B., Sciahbasi, A., Sebik, R., Rigattieri, S., Alonzo, A., Silva-Orrego, P., ... & Berni, A. (2014). Comparison of risk of acute kidney injury after primary percutaneous coronary interventions with the transradial approach versus the transfemoral approach (from the PRIPITENA urban registry) Am J Cardiol;114(6):820–5
11. Firouzi A, Alemzadeh-Ansari MJ, Mohammadhadi N, Peighambari MM, Zahedmehr A, Mohebbi B, et al. Association between the risks of contrast-induced nephropathy after diagnostic or interventional coronary management and the transradial and transfemoral access approaches. J Cardiovasc Thorac Res. 2020;12(1):51.
12. Amin AP, Rao S V, Seto AH, Thangam M, Bach RG, Pancholy S, et al. Transradial access for high-risk percutaneous coronary intervention: implications of the risk-treatment paradox. Circ Cardiovasc Interv. 2021;14(7):e009328.
13. Soud, M., SayedAhmad, Z., Kajy, M., Alahdab, F., Darmoch, F., Al-Khadra, Y., ... & Alraies, M. C. (2020). The efficacy and safety of transradial and transfemoral approach in treatment of coronary chronic total occlusion: a systematic review and meta-analysis. Expert Review of Cardiovascular Therapy;18(11):809-17.
14. Barbieri, L., Verdoia, M., Suryapranata, H., De Luca, G., & Novara Atherosclerosis Study Group. (2019). Novara Atherosclerosis Study Group. Impact of vascular access on the development of contrast-induced nephropathy in patients undergoing coronary angiography and/or percutaneous coronary intervention. International journal of cardiology;275:48-52.