

Incidence of Contrast-induced Nephropathy in Patients Undergoing Coronary Angiography: An Annual Review in A University Hospital



*Katherine Ann N. Tan, M.D.¹,
John Patrick F. Ona, M.D.²,
Marcellus Francis L. Ramirez, M.D.³,
Wilson L. Tan de Guzman, M.D.⁴*

ABSTRACT

Introduction The rapidly growing number of percutaneous coronary interventions has led to a considerable improvement in the outcome of patients with acute coronary syndromes, yet concurrently exposing patients to enormous volumes of contrast media with the inherent risk of renal function impairment.

Objective To determine the incidence of contrast induced nephropathy of patients admitted at University of Santo Tomas Hospital (USTH) who underwent coronary angiography with or without Percutaneous Transluminal Coronary Angioplasty (PTCA).

Methodology This is a retrospective, descriptive study including patients aged 18 years and above, of any gender, admitted at the USTH from January 1, 2016 to December 31, 2016, who underwent coronary angiography with or without PTCA with baseline and follow up creatinine levels 48-72 hours after the procedure. Data were retrieved by review of medical records of these patients.

Results Three out of 78 patients (3.8%) had elevated creatinine but all three patients also underwent major surgery within 48 hours after coronary angiography which could explain the renal impairment.

Conclusion Although contrast induced nephropathy was described as the third most common cause of new Acute Kidney Injury in hospitalized patients, it was accordingly nil among those who underwent coronary angiography at USTH from January to December 2016. Benefits and risks of undergoing coronary angiography should always be weighed

✉ Dr. Katherine Ann N. Tan
kathz_17@yahoo.com

¹ Resident-in-Training, Department of Medicine, University of Santo Tomas Hospital, Manila, Philippines, Contact Number: (0922) 805 5135

² Fellow-in-Training, Section of Cardiology, Department of Medicine, University of Santo Tomas Hospital, Manila, Philippines, Contact Number: (0916) 241 5869

³ Consultant, Section of Cardiology, Department of Medicine, University of Santo Tomas Hospital, Manila, Philippines, Contact Number: (0917) 883 1000

⁴ Consultant, Section of Cardiology, Department of Medicine, University of Santo Tomas Hospital, Manila, Philippines, Contact Number: (0917) 892 9998

individually. Risk stratification scores should only serve as a guide in managing patients and proper preventive measures should be applied.

Keywords Contrast Induced Nephropathy; Coronary Angiography; Epidermal Growth Factor Receptor; Transluminal Coronary Angioplasty

INTRODUCTION

The rapidly growing number of percutaneous coronary interventions has led to a considerable improvement in the outcome of patients with acute coronary syndromes, yet concurrently exposing patients to enormous volumes of contrast media with the inherent risk of renal function impairment (1).

Contrast induced nephropathy (CIN) is an iatrogenic disorder, defined as absolute (≥ 0.5 mg/dl) or relative increase ($\geq 25\%$) in serum creatinine at 48–72 hours after exposure to a contrast agent compared to baseline serum creatinine values, when alternative explanations for renal impairment have been excluded. Although rare in the general population, CIN occurs frequently in patients with underlying renal dysfunction, diabetes, anemia, and the elderly. These risk factors are synergistic in their ability to predispose to the development of CIN (2).

Contrast induced acute kidney injury was described as the third most common cause of new acute kidney injury in hospitalized patients (after decreased renal perfusion and nephrotoxic medications) and was responsible for 11% of cases (3). An overall incidence of CIN in the general population is reported to be 0.6–2.3%. However, in several patient subsets the prevalence of CIN is significantly higher. This is especially true in patients with cardiovascular pathology. In the interventional cardiology registry from Mayo Clinic including 7586 patients, the incidence of CIN was 3.3%. In a smaller study from William Beaumont Hospital, among 1826 patients treated, CIN occurred in 14.5% of the cases. Dialysis as a result of CIN in these two series was required in 0.7 and 0.3%, respectively. The risk of CIN is especially high (19%) in the setting of primary percutaneous coronary intervention for acute myocardial infarction (2).

CIN is known to increase morbidity and mortality rates and healthcare costs as well as to prolong the duration of hospitalization (4). It is important to identify patients at high risk for CIN as this would allow

appropriate prophylactic interventions and improve prognosis (3). The Mehran risk score has been validated as a good score for predicting CIN in patients with acute coronary syndrome who underwent coronary angiography (5). A careful risk–benefit analysis must always be performed prior to the administration of contrast media to patients at risk for CIN (2).

This study was done to determine the incidence of contrast induced nephropathy among patients who underwent coronary angiography with or without PTCA from January 1, 2016 to December 31, 2016 at the USTH. It also aimed to determine the risk factors in developing contrast induced nephropathy and to correlate the actual rate of contrast induced nephropathy to their respective Mehran risk score for contrast induced nephropathy.

METHODOLOGY

This is a retrospective, descriptive study, which included patients aged 18 years and above, of any gender, admitted at the USTH private and clinical division, with baseline and follow up creatinine levels 48–72 hours after the procedure, while patients with end stage renal disease on dialysis and those with incomplete data were excluded. Data was retrieved by review of medical records of these patients. Pertinent risk factor including age, gender, hemodynamic status, Intra-Aortic Balloon Pump (IABP), congestive heart failure, anemia, diabetes mellitus, contrast volume, urgency of procedure, creatinine levels, Mehran risk scores and preventive measures were then be correlated with the incidence of developing contrast induced nephropathy.

Mean, range, and standard deviation summarized the data in quantitative form, such as age, duration of hospital stay, Epidermal Growth Factor Receptor (eGFR), baseline and follow-up creatinine. While counts and percentage summarized the data in categorical form.

RESULTS

A total of 272 patients underwent coronary angiography with or without PTCA at the University of Santo Tomas Hospital from January to December 2016. 23 patients were excluded since the procedure was done as outpatient. Out of the 249 in patients, 171 were excluded for the following reasons: 61 patient charts were not available at the records section, 95

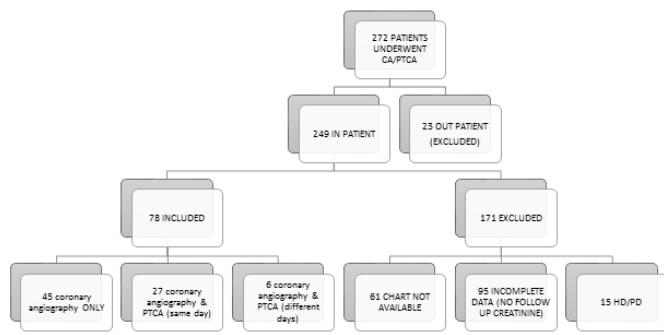


Figure 1. Patients who Underwent Coronary Angiography at USTH from January to December 2016.

patient charts reviewed had incomplete data (i.e. no follow up creatinine) and 15 patients were on renal replacement therapy. Only 78 patients were included in this study, with 45 patients that underwent coronary angiography only and 33 patients that underwent coronary angiography and PTCA.

Patients included in this study had a mean age of 61.8 years old (range 35-89), majority of them were males (78.2%), with mean duration of hospital stay of 10 days. Comorbidities include the following: hypertension (79.5%), diabetes mellitus (41%), congestive heart failure (30.8%), and previous stroke (6.4%). 32% of these patients had computed eGFR of less than 60 mL/ min/1.73 m² and 24.4% had

Table 1. Clinical Profile of Patients who Underwent Coronary Angiography at University of Santo Tomas Hospital.

Number of Patients	78
Age	61.8 (11.3)
≥75 years	10 (12.8%)
<75 years	68 (87.2%)
Gender	
Male	61 (78.2%)
Female	17 (21.8%)
Height (cm)	165.0 (7.6)
Weight (kg)	68.9 (13.9)
BMI (kg/m ²)	25.2 (4.2)
Length of Hospital Stay (days)	10.0 (12.5)
Indication for Coronary Angiography	
STEMI	19 (24.4%)
NSTEMI	25 (32.1%)
UA	7 (9%)
Stress test positive	7 (9%)
Symptomatic CAD	14 (17.9%)
Prior to aneurysm repair	3 (3.8%)
Prior to cardiac surgery	2 (2.6%)
Post arrest	1 (1.3%)
Hypertension	62 (79.5%)
Diabetes Mellitus	32 (41%)
Congestive Heart Failure	24 (30.8%)
Previous Stroke	5 (6.4%)
Acute Kidney Injury	19 (24.4%)
eGFR <60 mL/ min/1.73 m ²	25 (32.0%)
Coronary Angiogram Result	
Normal Coronaries	3 (3.8%)
Non Obstructive CAD	6 (7.7%)
One Vessel CAD	15 (19.2%)
Two Vessel CAD	11 (14.1%)
Three Vessel CAD	43 (55.1%)

Table 2. Profile of Patients who Underwent Coronary Angiography with Significant Creatinine Elevation

	Patient A	Patient B	Patient C
Age/Sex	69/M	63/M	69/F
Duration of Hospital Stay	12 days	6 days	38 days
Chief Complaint	For colon surgery and repair of aneurysm	For repair of thoracoabdominal aortic aneurysm	Chest pain and dyspnea
Diagnosis	Rectal adenocarcinoma, Abdominal aortic aneurysm	Thoracoabdominal aneurysm with thrombus formation	Cardiogenic shock, ASHD, 3V CAD, NSTEMI, CHF, Class IIIC, ARF sec to pulmonary congestion, AKI sec to cardiogenic shock on top of CKD sec to APKD/HTN neph
Comorbids	Hypertension, CKD stage III sec to CTIN (gout)	Hypertension	Hypertension, s/p MI (1 yr ago), post thyroidectomy, CKD sec to APKD
Risk Factors	Contrast Volume, CKD	Anemia, Contrast Volume	Hypotension, Poss IABP, CHF, Anemia, Contrast Volume, AKI, CKD
Risk Assessment	7.5% AKI, 0.04% RRT	7.5% AKI, 0.04% RRT	57% AKI, 12.6% RRT
Prevention	NAC, PNSS 1.28ml/kg/hr – 12 hours prior	D5NSS 1.48ml/kg/hr	NAC, 0.45% NaCl (1ml/kg/hr) – 12 hours prior, hold furosemide
Contrast Used	Ultravist 370 – 50cc	Ultravist 370 – 50cc	Ultravist 370 – 50cc
Baseline creatinine	1.18 mg/dL	1.05 mg/dL	0.98 mg/dL
Creatinine after 48-72 hours	2.36-2.58 mg/dL	1.38-3.06 mg/dL	0.86-1.51 mg/dL
Absolute increase in creatinine	1.4 mg/dL	2.01 mg/dL	0.53 mg/dL
% increase in creatinine	118%	191%	54%
Comments	3 rd HD: coronary angiography 4 th HD: Hartman's procedure and repair of infrarenal AAA (EBL: 6L)	3 rd HD: coronary angiography 4 th HD: thoracoabdominal aneurysm repair (EBL 3L)	9 th HD: coronary angiography 11 th HD: CABG (transfused 5u pRBC, 6u FFP, 1u plt pheresis)

Table 3. Creatinine Level of Patients who Underwent Coronary Angiography with No Significant Creatinine Elevation

Number of Patients	75
Baseline creatinine	1.17 (0.49)
Follow up creatinine (48-72 hours after)	1.08 (0.38)
Change in creatinine	-0.09 (0.21)
% change in creatinine	-4.95 (14.19)

acute kidney injury. 65% underwent coronary angiography due to acute coronary syndrome.

On review of patient records, three patients were identified to have significant creatinine elevation defined as absolute (≥ 0.5 mg/dl) or relative increase ($\geq 25\%$) in serum creatinine at 48–72 hours after exposure to a contrast agent compared to baseline serum creatinine values. However, on further investigation, all three patients underwent major surgery within 48 hours after coronary angiography which could explain the renal impairment, and therefore,

not labeled as contrast induced nephropathy. Clinical profiles of these patients were summarized in table 2. Hence, the incidence of contrast induced nephropathy among patients who underwent coronary angiography at the University of Santo Tomas Hospital from January to December 2016 is 0%.

Of the 75 remaining patients who did not have significant creatinine elevation, there was a mean 0.09mg/dL (4.95%) decrease in follow up creatinine 48-72 hours after the procedure in comparison to baseline creatinine.

42.3% of patients were risk stratified as low risk, 33.3% were moderate risk, 19.2% were high risk and 5.1% were very high risk of contrast induced nephropathy and renal replacement therapy, but none of these patients had CIN.

Of the 78 patients, 39.7% were referred to a nephrologist prior to the procedure. 70.5% of patients were adequately hydrated (1.0–1.5 ml/kg/h of IV fluid administered for 3–12 hours before and

Table 4. Risk Stratification of Patients who Underwent Coronary Angiography according to Mehran Risk Scores

Number of Patients	78
Hypotension	7 (9.0%)
With IABP	2 (2.6%)
Congestive Heart Failure	24 (30.8%)
Age >75 years old	10 (12.8%)
Anemia	31 (39.7%)
Diabetes Mellitus	32 (41.0%)
Contrast Volume	
0-100 mL	49 (62.8%)
101-200 mL	23 (29.5%)
201-300 mL	5 (6.4%)
301-400 mL	1 (1.3%)
Creatinine Clearance	
>60 mL/ min/1.73 m ²	48 (61.5%)
40-60 mL/ min/1.73 m ²	9 (11.5%)
20-40 mL/ min/1.73 m ²	2 (2.6%)
<20 mL/ min/1.73 m ²	19 (24.4%)
Risk Stratification	
7.5% risk of CIN, 0.04% risk of RRT	33 (42.3%)
15% risk of CIN, 0.12% risk of RRT	26 (33.3%)
26.1% risk of CIN, 1.09% risk of RRT	15 (19.2%)
57.3% risk of CIN, 12.6% risk of RRT	4 (5.1%)

Table 5. Preventive Measures Done on Patients who Underwent Coronary Angiography

Number of Patients	78
With Nephrologist	31 (39.7%)
Hydration	
No	2 (2.6%)
Yes, inadequate	21 (26.9%)
Isotonic (Plain or D5 NSS)	18
Hypotonic (Plain or D5 0.45% NaCl)	2
Hypotonic (D5W)	1
Yes, adequate	55 (70.5%)
Isotonic (Plain or D5 NSS)	48
Hypotonic (Plain or D5 0.45% NaCl)	2
NaHCO ₃ (150meqs)	5
N-Acetylcysteine	53 (67.9%)

6–12 hours after contrast-media exposure) with either isotonic, hypotonic solution or intravenous sodium bicarbonate. 67.9% of these patients received N-acetylcysteine prior to the procedure.

DISCUSSION

Three out of 78 patients (3.8%) were identified to have significant creatinine elevation in this study.

However, the said patients underwent major surgery within 48 hours after coronary angiography which could explain the renal impairment, and therefore, may not necessarily be labeled as contrast induced nephropathy. Therefore, in comparison to an overall incidence of contrast induced nephropathy in the general population of 0.6-2.3%⁴, the incidence of contrast induced nephropathy among patients who underwent coronary angiography at the University

of Santo Tomas Hospital from January to December 2016 is nil.

Hypertension (79.5%) is the most common comorbid that was present in the patient population, while diabetes mellitus (41%) is the most common risk factor present in the Mehran Risk Scores, followed by anemia (39.7%) and congestive heart failure (30.8%). 62.8% of these patients used <100mL of contrast and 61.5% of these patients had baseline creatinine of >60 mL/ min/1.73 m².

More than half of the patient population received adequate hydration and N-acetylcysteine prior to coronary angiography with or without PTCA, however the significance of these preventive measures cannot be determined from this study since there was no positive contrast induced nephropathy group for comparison.

Of the 78 patients, 42.3% of patients were risk stratified as low risk, 33.3% were moderate risk,

19.2% were high risk and 5.1% were very high risk of contrast induced nephropathy and renal replacement therapy, but none of these patients had CIN.

CONCLUSION

Although contrast induced nephropathy was described as the third most common cause of new AKI in hospitalized patients, it was accordingly nil among those who underwent coronary angiography at USTH from January to December 2016. Benefits and risks of undergoing coronary angiography should always be weighed individually. Risk stratification scores should only serve as a guide in managing patients and proper preventive measures should be applied.

ACKNOWLEDGEMENT

The authors are grateful to all the participants of this study and to the University of Santo Tomas Hospital especially the Department of Medicine, Institutional Review Board (IRB) and Department of Medical Education and Research (DMER) who reviewed and approved this study.

DISCLOSURE AND CONFLICT OF INTEREST

The authors report no conflict of interest in this work

REFERENCES

1. Wybraniec M, Mizia-Stec K, Więcek A. Contrast-induced acute kidney injury: the dark side of cardiac catheterization. *Polish Archives of Internal Medicine*. 2015;125(12):938-949.
2. Mehran R, Nikolsky E. Contrast-induced nephropathy: Definition, epidemiology, and patients at risk. *Kidney International*. 2006;69:S11-S15.
3. KDIGO Clinical Practice Guideline for Acute Kidney Injury Section 4: Contrast-induced AKI. *Kidney International Supplements*. 2012;2(1):69-88.
4. Lian D, Liu Y, Liu Y, et al. Pre-Procedural Risk Score of Contrast-Induced Nephropathy in Elderly Patients Undergoing Elective Coronary Angiography. *International Heart Journal*. 2017;58(2):197-204.
5. Abellás-Sequeiros R, Raposeiras-Roubín S, Abu-Assi E, González-Salvado V, Iglesias-Álvarez D, Redondo-Diéguez A et al. Mehran contrast nephropathy risk score: Is it still useful 10 years later?. *Journal of Cardiology*. 2016;67(3):262-267.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.