Kidney and Blood Pressure Research

Kidney Blood Press Res , DOI: 10.1159/000533141
Received: January 26, 2023
Accepted: July 13, 2023
Published online: July 28, 2023

Left Main Coronary Artery Revascularization in Patients with Impaired Renal Function; Percutaneous Coronary Intervention vs. Coronary Artery Bypass Grafting

Daoulah A, Taha Baqais R, Aljohar A, Alhassoun A, Hersi AS, Almahmeed W, Yousif N, Alasmari A, Alshehri M, Eltaieb F, Alzahrani B, Elmahrouk A, Arafat AA, Jamjoom A, Alshali KZ, Abuelatta R, Ahmed WA, Alqahtani AH, Al Garni T, Hashmani S, Dahdouh Z, Refaat W, Kazim HM, Ghani MA, Amin H, Hiremath N, Elmahrouk Y, Selim E, Aithal J, Qutub MA, Alama MN, Ibrahim AM, Elganady A, Abohasan A, Asrar FM, Farghali T, Jameel Naser M, Hassan T, Balghith M, Hussien AF, Abdulhabeeb IAM, Ahmad O, Ramadan M, Ghonim AA, Shawky AM, Noor HA, Haq E, Alqahtani AM, Al Samadi F, Abualnaja S, Khan M, Alhamid S, Lotfi A

ISSN: 1420-4096 (Print), eISSN: 1423-0143 (Online)
https://www.karger.com/KBR
Kidney and Blood Pressure Research

Left Main Coronary Artery Revascularization in Patients with Impaired Renal Function; Percutaneous Coronary Intervention vs. Coronary Artery Bypass Grafting

Impaired Renal Function And LMCA Revascularization

Amin Daoulah, MD,[a*] Rasha Taha Baqais, MD ,[b] Alwaleed Aljohar, MD,[c] Abdulkarim Alhassoun, MD,[d] Ahmad S. Hersi, MD ,[c] Wael Almahmeed, MD,[e] Nooraldaem Yousif, MD,[f] Abdulaziz Alasmari, MD,[a] Mohammed Alshehri, MD,[g] Fakhreldein Eltaieb, MD,[h] Badr Alzahrani, MD,[i] Ahmed Elmahrouk, MD,[a,j] Amr A. Arafat, MD,[i,j] Ahmed Jamjoom, MD,[a] Khalid Z. Alshali, MD,[k] Reda Abuelatta, MD,[l] Waleed A. Ahmed, MD,[m] Abdulrahman H. Alqahtani, PhD,[n] Turki Al Garni, MD,[i] Shahrukh Hashmani, MD,[e] Ziad Dahdouh, MD,[o] Wael Refaat, MD,[p] Hameedullah M. Kazim, MD,[q] Mohamed Ajaz Ghani, MD,[l] Haitham Amin, MD,[f] Niranjan Hiremath,MD,[e] Youssef Elmahrouk, MD,[r] Ehab Selim, MD,[q] Jairam Aithal, MD,[s] Mohammed A. Qutub, MD,[t] Mohamed N. Alama, MD,[t] Ahmed M. Ibrahim, MD,[u] Abdelmaksoud Elganady, MD,[v] Abdulwali Abohasan, MD,[w] Farhan M. Asrar, MD,[x,y] Tarek Farghali, MD,[z] Maryam Jameel Naser, MD,[aa] Taher Hassan, MD,[bb] Mohammed Balghith, MD,[cc] Adnan Fathey Hussien, MD,[dd] Ibrahim A M Abdulhabeeb, MD,[ee] Osama Ahmad, MD,[o] Mohamed Ramadan, MD,[p] Ahmed A. Ghonim, MD,[t] Abeer M. Shawky, MD,[v] Husam A. Noor, MD,[f] Ejazul Haq, MD,[a] Abdulrahman M. Alqahtani, MD,[ff] Faisal Al Samadi, MD,[ff] Seraj Abualnaja, MD,[dd] Mushira Khan, MBChB,[gg] Sameer Alhamid, MD,[hh] Amir Lotfi, MD,[ii]

aDepartment of Cardiovascular Medicine, King Faisal Specialist Hospital & Research Center, Jeddah, Kingdom of Saudi Arabia;
bDepartment of Cardiac Surgery, King Fahd Armed Forces Hospital, Jeddah, Kingdom of Saudi Arabia;
cDepartment of Cardiac Sciences, King Fahad Cardiac Center, King Saud University, Riyadh, Kingdom of Saudi Arabia;
dDepartment of Anesthesia, King Faisal Specialist Hospital & Research Center, Jeddah, Kingdom of Saudi Arabia;
eHeart & Vascular Institute, Cleveland Clinic Abu Dhabi, UAE;
fDepartment of Cardiology, Mohammed Bin Khalifa Specialist Cardiac Center, Awali, Kingdom of Bahrain;
gDepartment of Cardiology, Prince Khaled Bin Sultan Cardiac Center, Khamis Mushait, Kingdom of Saudi Arabia;
hDepartment of Medicine, Section of Nephrology, King Faisal Specialist Hospital & Research Center, Jeddah, Kingdom of Saudi Arabia;
iDepartment of Cardiology, Prince Sultan Cardiac Center, Riyadh, Kingdom of Saudi Arabia;
jDepartment of Cardiothoracic Surgery, Faculty of Medicine, Tanta University, Egypt;
kDepartment of Medicine, Faculty of Medicine, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia;
lDepartment of Cardiology, Madinah Cardiac Center, Madinah, kingdom of Saudi Arabia;
mDepartment of Medicine, Security Forces Hospital, Mecca, Kingdom of Saudi Arabia;
nDepartment of Emergency Medicine, King Abdulaziz Medical City, Riyadh, Kingdom of Saudi Arabia;
oDepartment of Cardiovascular Medicine, King Faisal Specialist Hospital & Research Center, Riyadh, Kingdom of Saudi Arabia;
pDepartment of Cardiology, Prince Sultan Cardiac Center, Al Hassa , Kingdom of Saudi Arabia;
qDepartment of Cardiology, Alhada Armed Forces Hospital, Taif, Kingdom of Saudi Arabia;
rFaculty of Medicine, Tanta University, Tanta, Egypt;
sDepartment of Cardiology, Yas Clinic, Khalifa City A, Abu Dhabi, UAE;
tCardiology Center of Excellence, Department of Medicine, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia;
uDepartment of Cardiology, Saudi German Hospital, Jeddah, Kingdom of Saudi Arabia;
vDepartment of Cardiology, Dr Erfan and Bagedo General Hospital, Jeddah, Kingdom of Saudi Arabia;

wDepartment of cardiology, Prince Sultan Cardiac Center, Qassim, Kingdom of Saudi Arabia;
xDepartment of Family and Community Medicine, Faculty of Medicine and Division of Clinical Public Health, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada;
yCredit Valley Family Medicine Teaching Unit and Summerville Family Medicine Teaching Unit, Trillium Health Partners and University of Toronto, Mississauga, Ontario, Canada;
zDepartment of Cardiology, Saudi German Hospital, Ajman, UAE;
aaDepartment of Internal Medicine, Baystate Medical Center, 759 Chestnut St,Springfield, Massachusetts, USA.
bbDepartment of Cardiology, Bugshan General Hospital, Jeddah, Kingdom of Saudi Arabia;
ccKing Abdulaziz Cardiac Center, College of Medicine, King Saud Bin Abdulaziz University for Health Science, Riyadh, kingdom of Saudi Arabia;
ddDepartment of Cardiology, International Medical Center, Jeddah, Kingdom of Saudi Arabia;
eeDepartment of Cardiology, King Abdulaziz Specialist Hospital, Al Jawf, Kingdom of Saudi Arabia;
ffDepartment of Cardiology, King Salman Heart Center, King Fahad Medical City, Riyadh, Kingdom of Saudi Arabia;
ggAl Faisal University, Riyadh, Kingdom of Saudi Arabia;
hhDepartment of Emergency Medicine, King Fahad Medical City, Riyadh, Kingdom of Saudi Arabia;
iiDepartment of Cardiovascular Medicine, University of Massachusetts Chan Medical School - Baystate Medical Center, Springfield, Massachusetts, USA 01199;

Address for correspondence: Amin Daoulah, M.D.
Department Cardiovascular Medicine
King Faisal Specialist Hospital & Research Center, Jeddah
P.O. Box: 40047, Jeddah 21499
Kingdom of Saudi Arabia
Phone: +966 12 6677777, Ext. 65824

Keywords: PCI; CABG; LMCA; outcomes; impaired renal function; gulf
Word count: 2777
Number of tables: 5
Number of figures: 1
Number of references: 24

Abstract

Introduction: The evidence about the optimal revascularization strategy in patients with left-main coronary artery (LMCA) disease and impaired renal function is limited. Thus, we aimed to compare the outcomes of LMCA disease revascularization (PCI vs. CABG) in patients with and without impaired renal function.

Methods: This retrospective cohort study included 2138 patients recruited from 14 centers between 2015 to 2019. We compared patients with impaired renal function who had PCI (n= 316) to those who had CABG (n= 121) and compared patients with normal renal function who had PCI (n= 906) to those who had CABG (n= 795). The study outcomes were in-hospital and follow-up major adverse cardiovascular and cerebrovascular events (MACCE).

Results: Multivariable logistic regression analysis showed that the risk of in-hospital MACCE was significantly higher in CABG compared to PCI in patients with impaired renal function (OR: 8.13 (95% CI: 4.19- 15.76), P<0.001) and normal renal function (OR: 2.59 (95% CI: 1.79- 3.73); P<0.001). There were no

differences in follow-up MACCE between CABG and PCI in patients with impaired renal function (HR: 1.14 (95% CI: 0.71- 1.81), P= 0.585) and normal renal function (HR: 1.12 (0.90- 1.39), P= 0.312).
Conclusions: PCI could have an advantage over CABG in revascularization of LMCA disease in patients with impaired renal function regarding in-hospital MACCE. The follow-up MACCE was comparable between PCI and CABG in patients with impaired and normal renal function.

Introduction

Chronic kidney disease (CKD) is associated with an increased risk of death and cardiovascular disease [1]; CKD negatively impacts the outcome of medical, interventional, and surgical treatment of coronary artery disease [2]. CKD patients undergoing coronary artery bypass grafting (CABG) are associated with poor prognosis because of the progression of kidney disease or the associated comorbidities [3,4]. The contrast media used during the percutaneous coronary intervention (PCI) is a risk factor for acute renal failure [5]. Patients with CKD are underrepresented in coronary revascularization clinical trials despite the relatively high prevalence of the disease in patients with coronary artery disease [6]. Better survival was reported in patients undergoing PCI or CABG for left-main coronary artery (LMCA) and multi-vessel disease compared to medical treatment [7]. CKD patients are less likely to undergo revascularization because of the increased procedural risk [3]. There is a paucity of studies comparing PCI vs. CABG in the revascularization of LMCA disease in patients with CKD [8]. The risk of post-procedural acute renal failure and bleeding compromises the treatment outcomes [2]. Evidence about the optimal revascularization strategy in those patients is limited but growing [9,10]. We aimed to compare the outcomes of left-main coronary artery disease revascularization (PCI vs. CABG) in patients with impaired and normal renal function.

Methods

Patient data

The Gulf-left-main registry contains data about significant LMCA revascularization with either PCI or CABG from 14 cardiac centers in 3 Gulf countries: the Kingdom of Saudi Arabia (12 centers), the United Arab Emirates (1 centers), and the Kingdom of Bahrain (1 center). Patients were recruited from January 2015 to December 2019. This registry identified a total of 2657 patients with significant LMCA disease. We included 2138 patients with unprotected left-main coronary artery (ULMCA) disease, 437 had impaired renal function, and 1701 had normal renal function. The study flowchart is presented in Figure 1. We compared patients with impaired renal function who had PCI (n= 316) to CABG (n= 121) and compared patients with normal renal function who had PCI (n= 906) to those who had CABG (n= 795). The following cases were excluded; patients with protected LMCA disease (PCI n=116, CABG n=20, medical therapy n=38), concomitant valvular or aortic surgery (n=115), previous left main PCI (n=37) and ULMCA disease treated medically (poor target n=55, multiple co-morbidity n=28, patient preference n=66, do not resuscitate (DNR) code status n=12, active cancer n=8, non-viable myocardium n=13, revascularization not recommended based upon fractional flow reserve (FFR) greater than 0.8 n=11).

Definitions

Impaired renal function was defined and classified according to creatinine clearance (CrCl) into; mildly impaired renal function (CrCl <90-60ml/min), moderately impaired renal function (CrCl <60-30 ml/min), severely impaired renal function (CrCl <30-15 ml/min) and renal failure on dialysis (CrCl< 15 ml/min) [11]. Creatinine clearance was calculated according to the Cockcroft-Gault formula.

Outcomes

The primary outcomes were in-hospital and follow-up all-cause mortality (cardiac and non-cardiac) and the composite endpoint of myocardial infarction (MI), congestive heart failure (CHF), target vessel and target lesion revascularization, and cerebrovascular events (major adverse cardiac and cerebrovascular events (MACCE)). Further details about the study population and definitions were previously published [12,13].

Clinical assessment and clinical follow-up

The data pertaining to the patient's baseline demographics, length of hospital stay, and in-hospital outcomes and follow-up events were analyzed according to the renal function status. Baseline data were retrieved from patients' records at the time of the indexed admission for intervention. Hospital presentation refers to the presentation at the time of the indexed hospitalization. In-hospital outcomes were recorded post intervention. Follow-up events and duration were estimated from the date of hospital discharge. The mechanism by which in-hospital outcomes and post discharge events were recorded was based on both ICD 9 and 10 coding according to the participating centers with clinical diagnosis provided by admitting physicians in the electronic health record (EHR). (Supplementary Table 1) Follow-up duration was left to the individual centers until the end of the study period.

Ethical approval

The study was performed after the approval of the Ethical Committee of the participating centers, and the need for patient consent was waived because of the retrospective design.

Statistical analysis

In this analysis, we compared PCI with CABG in patients with impaired and normal renal function. Nominal data were expressed as percentages and numbers and were compared with the Chi-squared or Fisher exact test. Continuous data were expressed as mean and standard deviation or median and interquartile range. The student t-test or Wilcoxon test was used to compare the continuous data. Time-to-event data were compared with the log-rank test. A stepwise multivariable logistic regression analysis was used for in-hospital MACCE. Preprocedural and procedural variables were included in the regression analysis, and a P-value of <0.05 was required to retain variables in the final model. The odds ratio and confidence intervals were reported. Multivariable Cox regression was used to evaluate factors affecting the follow-up MACCE. Model selection was performed in the same way as logistic regression, and hazard ratio and confidence intervals were reported. The analyses were performed using Stata 17 (Stata Corp-College Station- TX- USA), and a P-value of less than 0.05 was considered statistically significant.

Results

Baseline and pre-procedural characteristics at the time of the indexed admission for intervention

In the impaired renal function category, PCI patients were older and had a significantly higher prevalence of atrial fibrillation (AF), peripheral arterial disease (PAD) and cerebral vascular accidents (CVA) in comparison to CABG patients. In the normal renal function category, PCI patients were older, had a higher body mass index (BMI), and more likely to have history of congestive heart failure (CHF), AF, PAD, and previous myocardial infarction in comparison to CABG patients. CABG patients with impaired or normal renal function were more likely to be male and have history of diabetes mellitus. History of hypertension, dyslipidemia, and smoking were not different between PCI and CABG patients with impaired or normal renal function. There was no difference in EuroSCORE II between PCI and CABG patients with impaired renal function. In patients with normal renal function, EuroSCORE II was significantly higher in PCI as compared to CABG. Hospital presentation and the range of left ventricular ejection fraction percentage (LVEF%) were not significantly different between PCI and CABG patients with impaired renal function. Presentation with cardiac arrest and cardiogenic shock was more common in PCI patients with normal renal function. In addition, LVEF <50% were seen more in PCI patients with normal renal function. (Table 1)

Procedural findings at the time of the indexed admission for intervention

CABG patients with impaired or normal renal function had significantly higher SYNTAX scores, multi-vessel disease, and ostial lesions than PCI patients. Intra-aortic balloon pump was required more frequently in patients with impaired renal function who underwent CABG. (Table 2)

In-hospital outcomes after the procedure

The primary endpoint of in-hospital MACCE was significantly higher in CABG patients with impaired and normal renal function. In both renal function categories, CABG patients had significantly more MI and longer hospital stay. In-hospital mortality was significantly higher in patients with CABG and impaired

renal function as compared to PCI. There was no difference in mortality between CABG and PCI in patients with normal renal function. Hemoglobin at discharge was lower in patients who had CABG. Hospital stay was significantly longer in CABG patients. (Table 3)

Follow-up events after hospital discharge

The median follow-up time was 20 months (25^{th}- 75^{th} percentiles: 10- 37). The primary endpoint of follow-up MACCE was not significantly different between PCI and CABG in patients with impaired renal function. MACCE occurred more frequently with PCI as compared to CABG in patients with normal renal function. Follow-up MI and target vessel revascularization were significantly higher in patients with impaired renal function who had CABG compared to PCI. In patients with normal renal function, CHF was significantly higher with PCI. There were no differences in mortality between PCI and CABG in patients with impaired and normal renal function. (Table 4). Multivariable logistic regression analysis showed that the risk of in-hospital MACCE was significantly higher in CABG compared to PCI in patients with impaired renal function (OR: 8.13 (95% CI: 4.19- 15.76), P<0.001) and normal renal function (OR: 2.59 (95% CI: 1.79- 3.73); P<0.001). There were no differences in follow-up MACCE between CABG and PCI in patients with impaired renal function (HR: 1.14 (95% CI: 0.71- 1.81), P= 0.585) and normal renal function (HR: 1.12 (0.90- 1.39), P= 0.312). (Table 5)

Discussion

In this study, we performed a subgroup analysis of the Gulf-left-main registry and compared PCI vs. CABG in patients with impaired and normal renal function. The primary outcomes were in-hospital and follow-up MACCE. By multivariable analysis, CABG was significantly associated with in-hospital MACCE in patients with impaired renal function (OR: 2.45 (95% CI: 1.74- 3.45), P<0.001) and normal renal function (OR: 6.12 (95% CI: 3.43- 10.91); P<0.001). However, there were no differences in follow-up MACCE between CABG and PCI in patients with impaired renal function (HR: 1.07 (95% CI: 0.87- 1.32), P= 0.519) and normal renal function (HR: 1.13 (0.71- 1.80), P= 0.603).

Kidney disease affects 1 to 10 individuals worldwide [14]. There is a paucity of studies addressing the optimal LMCA revascularization strategies in patients with impaired renal function. Additionally, this subset of patients is usually excluded or underrepresented in clinical trials despite the relatively high prevalence of chronic kidney disease in patients with coronary artery disease [15]. Baber et al. compared PCI vs. CABG to revascularize non-LM multi-vessel disease in patients with diabetes and chronic kidney disease in patients recruited from the FREEDOM trial [16]. They reported a reduction of major adverse cardiovascular and cerebrovascular events with CABG. In our study, in-hospital MACCE was significantly higher with CABG. The fundamental difference between retrospective studies and randomized trials is the difference in patients' characteristics between study arms. In real-life experience, patients with higher Syntax scores undergo CABG. Despite adjusting for baseline data, unmeasured variables remain that could affect the outcomes in retrospective studies. Moreover, CABG is associated with several maneuvers that could increase the risk of early stroke, such as aortic cannulation and clamping [17]. The probability of complete revascularization is higher with CABG, which decreases the chances of future MI and revascularizations [18]. In-hospital stay post CABG is longer than PCI which allows for more in-hospital events and documented MACCE for this group. Most of post PCI complications are likely to have occured after hospital discharge. The effects of these factors could be more evident in the early postoperative period and fade during the mid-term follow-up, which explains the results of this study. Bangalore et al. compared PCI with drug-eluting stents to CABG in patients with chronic kidney disease and multi-vessel disease [19]. Short-term death, revascularization, and stroke were higher with CABG, while PCI was associated with an increased risk of long-term revascularization, with no difference in mortality. In a meta-analysis of randomized trials comparing PCI and CABG in patients with CKD, CABG was associated with reduced MI and revascularization risk with no difference in mortality [20]. CABG and PCI could affect renal function in different ways. The inflammatory response to the cardiopulmonary bypass and

the hypoperfusion during surgery might lead to the progression of kidney disease [21]. Conversely, the contrast media used during PCI, especially in emergency procedures without prior preparation, might jeopardize renal functions [5,8]. Both techniques affect renal function, which impacts the outcomes after revascularization to a variable degree. Cavalcante et al. performed a pooled analysis of patients with unprotected LMCA disease included in the PRECOMBAT and SYNTAX trials [22]. They found that CABG and PCI had comparable results regarding the composite endpoint of death, myocardial infarction, or stroke in patients with and without CKD. Giustino et al. compared PCI and CABG in patients with CKD who had revascularization for LMCA disease from the EXCEL trial [8]. They reported higher rates of acute renal failure and mortality in patients with impaired renal function compared to those with normal renal function. The rates of death, MI, and stroke were comparable between PCI and CABG regardless of the renal function. Impaired renal function is associated with an increased risk of stent failure, and Baber et al. found that chronic kidney disease is an independent risk factor for MACCE in PCI patients [23]. Lu et al. reported an improved outcome with drug-eluting stents compared to bare metal stents in patients with chronic kidney disease [24]. In our study, all patients had second generation drug-eluting stents, and PCI had better in-hospital outcomes, with no difference in the follow-up events. This real-world experience showed a comparable follow-up events between PCI and CABG in patients with impaired and normal renal function. Future randomized trials on this subset of patients are highly recommended to study the optimal revascularization strategy for those patients.

Study limitations

Retrospective studies have inherent selection and referral biases. The patients were not randomized into treatment arms, and the potential for residual confounding bias cannot be excluded. In addition, being a multicenter study, the heterogeneity of practices could not be fully accounted for in the statistical analysis even though they may be significant.

Despite matching the measured variables, several factors could have affected the outcomes and were not measured. These factors include the surgeons' experience and the volumes of the participating centers. Another limitation is the number of patients with impaired renal function. We included all grades of kidney disease in one group, and the outcomes could be different with various grades of impaired renal function.

Conclusions

PCI could have an advantage over CABG in revascularization of LMCA disease in patients with impaired renal function regarding in-hospital MACCE. The follow-up MACCE was comparable between PCI and CABG in patients with impaired and normal renal function.

Acknowledgments: Dr. Eric Anderson, MD MBA FACEP FAAEM. Assistant Professor of Emergency Medicine, Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, Ohio for his assistance in final editing of this manuscript. We also express our profound appreciation and thanks to all the nurses and cardiac catheterization technologists who helped in collecting the data from all the participating centers.

Author Contributions: Amin Daoulah, Rasha Taha Baqais, Alwaleed Aljohar, Abdulkarim Alhassoun, Ahmad S. Hersi, Wael Almahmeed, Nooraldaem Yousif, Abdulaziz Alasmari Mohammed Alshehri, Fakhreldein Eltaieb, Badr Alzahrani, Ahmed Elmahrouk, Amr A. Arafat, Ahmed Jamjoom, Khalid Z. Alshali, Reda Abuelatta, Waleed A. Ahmed, Abdulrahman H. Alqahtani, Turki Al Garni, Shahrukh Hashmani, Ziad Dahdouh, Wael Refaat, Hameedullah M. Kazim, Mohamed Ajaz Ghani, Haitham Amin, Niranjan Hiremath, Youssef Elmahrouk, Ehab Selim, Jairam Aithal, Mohammed A. Qutub, Mohamed N. Alama, Ahmed M. Ibrahim, Abdelmaksoud Elganady, Abdulwali Abohasan, Farhan M. Asrar, Tarek Farghali, Maryam Jameel Naser,Taher Hassan, Mohammed Balghith, Adnan Fathey Hussien, Ibrahim A M Abdulhabeeb, Osama Ahmad, Mohamed Ramadan, Ahmed A. Ghonim, Abeer M. Shawky, Husam A. Noor, Ejazul Haq, Abdulrahman M. Alqahtani, Faisal Al Samadi, Seraj Abualnaja, Mushira Khan, Sameer Alhamid, Amir Lotfi: ***study design, development, data collection*.** Amin Daoulah, Rasha Taha Baqais, Abdulkarim

Alhassoun, Amr A. Arafat, Amir Lotfi: ***produced the initial draft of the manuscript*.** Ahmad S. Hersi, Amr A. Arafat: ***analysis and interpretation of data*.** Amin Daoulah, Amr A. Arafat, Amir Lotfi: ***reviewed the manuscript and provided critical revision and final editing*.**

Data availability statement: The data is not publicly available due to ethical reasons. Further enquiries can be directed to the corresponding author.

Conflict of Interest Statement: The authors have no conflict of interest to declare.

Funding Sources: The authors have no funding sources to disclose.

Statement of Ethics: This study was approved by the Institutional Review Board of King Faisal Specialist Hospital and Research Center in Riyadh (12 November 2020 – RAC # 2201226: Gulf-LM Registry) and was carried out in accordance with the local guideline and ethical guidelines of the Declaration of Helsinki 1975. Informed consent was waived by the IRB for this study due to its retrospective and observational nature and the absence of any patient identifying information.

References

1. Go AS, Chertow GM, Fan D, McCulloch CE, Hsu C. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. N Engl J Med. 2004 Sep;351(13):1296–305.
2. Bangalore S. Diagnostic, Therapeutic, and Clinical Trial Conundrum of Patients With Chronic Kidney Disease∗. JACC Cardiovasc Interv [Internet]. 2016;9(20):2110–2. Available from: https://www.sciencedirect.com/science/article/pii/S1936879816314194
3. Volodarskiy A, Kumar S, Amin S, Bangalore S. Optimal Treatment Strategies in Patients with Chronic Kidney Disease and Coronary Artery Disease. Am J Med [Internet]. 2016;129(12):1288–98. Available from: https://www.sciencedirect.com/science/article/pii/S0002934316307343
4. Mathew RO, Bangalore S, Lavelle MP, Pellikka PA, Sidhu MS, Boden WE, et al. Diagnosis and management of atherosclerotic cardiovascular disease in chronic kidney disease: a review. Kidney Int [Internet]. 2017;91(4):797–807. Available from: https://www.sciencedirect.com/science/article/pii/S0085253816306251
5. Giustino G, Baber U, Mastoris I, Vlachojannis GJ, Yu J, Teirstein PS, et al. One-year results of the ICON (ionic versus non-ionic contrast to obviate worsening nephropathy after angioplasty in chronic renal failure patients) Study. Catheter Cardiovasc Interv [Internet]. 2016;87(4):703–9. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/ccd.26106
6. O'Gara PT. PCI or CABG for LMCA Revascularization in Patients With CKD. J Am Coll Cardiol [Internet]. 2018;72(7):766–8. Available from: https://www.jacc.org/doi/abs/10.1016/j.jacc.2018.05.056
7. Ramadan R, Boden WE, Kinlay S. Management of Left Main Coronary Artery Disease. J Am Heart Assoc [Internet]. 2018;7(7):e008151. Available from: https://www.ahajournals.org/doi/abs/10.1161/JAHA.117.008151
8. Giustino G, Mehran R, Serruys PW, Sabik JF, Milojevic M, Simonton CA, et al. Left Main Revascularization With PCI or CABG in Patients With Chronic Kidney Disease. J Am Coll Cardiol [Internet]. 2018;72(7):754–65. Available from: https://www.jacc.org/doi/abs/10.1016/j.jacc.2018.05.057
9. Milojevic M, Head SJ, Mack MJ, Mohr FW, Morice M-C, Dawkins KD, et al. The impact of chronic kidney disease on outcomes following percutaneous coronary intervention versus coronary artery bypass grafting in patients with complex coronary artery disease: five-year follow-up of the SYNTAX trial. EuroIntervention J Eur Collab with Work Gr Interv Cardiol Eur Soc Cardiol. 2018 May;14(1):102–11.
10. Yang Y-G, Li N, Chen M-H. Survival outcomes and adverse events in patients with chronic kidney disease after coronary artery bypass grafting and percutaneous coronary intervention: a meta-analysis of propensity score-matching studies. Ren Fail. 2021 Dec;43(1):606–16.
11. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J kidney Dis Off J Natl Kidney Found. 2002 Feb;39(2 Suppl 1):S1-266.
12. Daoulah A, Abozenah M, Alshehri M, Hersi AS, Yousif N, Garni T Al, et al. Unprotected Left Main Revascularization in the Setting of Non-coronary Atherosclerosis: Gulf Left Main Registry. Curr Probl

Cardiol [Internet]. 2023;48(1):101424. Available from:
https://www.sciencedirect.com/science/article/pii/S0146280622003218
13. Daoulah A, Alasmari A, Hersi AS, Alshehri M, Garni T Al, Abuelatta R, et al. Percutaneous Coronary Intervention Vs Coronary Artery Bypass Surgery for Unprotected Left Main Coronary Disease: G-LM Registry. Curr Probl Cardiol [Internet]. 2021;101002. Available from:
https://www.sciencedirect.com/science/article/pii/S0146280621002176
14. Zhang Q-L, Rothenbacher D. Prevalence of chronic kidney disease in population-based studies: systematic review. BMC Public Health. 2008 Apr;8:117.
15. Herzog CA, Asinger RW, Berger AK, Charytan DM, Díez J, Hart RG, et al. Cardiovascular disease in chronic kidney disease. A clinical update from Kidney Disease: Improving Global Outcomes (KDIGO). Vol. 80, Kidney international. United States; 2011. p. 572–86.
16. Baber U, Farkouh ME, Arbel Y, Muntner P, Dangas G, Mack MJ, et al. Comparative efficacy of coronary artery bypass surgery vs. percutaneous coronary intervention in patients with diabetes and multivessel coronary artery disease with or without chronic kidney disease. Eur Heart J [Internet]. 2016;37(46):3440–7. Available from: https://doi.org/10.1093/eurheartj/ehw378
17. Gaudino M, Angiolillo DJ, Di Franco A, Capodanno D, Bakaeen F, Farkouh ME, et al. Stroke After Coronary Artery Bypass Grafting and Percutaneous Coronary Intervention: Incidence, Pathogenesis, and Outcomes. J Am Heart Assoc. 2019 Jul;8(13):e013032.
18. Fosbøl EL, Zhao Y, Shahian DM, Grover FL, Edwards FH, Peterson ED. Repeat Coronary Revascularization After Coronary Artery Bypass Surgery in Older Adults. Circulation [Internet]. 2013;127(16):1656–63. Available from:
https://www.ahajournals.org/doi/abs/10.1161/CIRCULATIONAHA.113.001882
19. Bangalore S, Guo Y, Samadashvili Z, Blecker S, Xu J, Hannan EL. Revascularization in Patients With Multivessel Coronary Artery Disease and Chronic Kidney Disease: Everolimus-Eluting Stents Versus Coronary Artery Bypass Graft Surgery. J Am Coll Cardiol. 2015 Sep;66(11):1209–20.
20. Charytan DM, Desai M, Mathur M, Stern NM, Brooks MM, Krzych LJ, et al. Reduced risk of myocardial infarct and revascularization following coronary artery bypass grafting compared with percutaneous coronary intervention in patients with chronic kidney disease. Kidney Int. 2016 Aug;90(2):411–21.
21. Li X, Zhang S, Xiao F. Influence of chronic kidney disease on early clinical outcomes after off-pump coronary artery bypass grafting. J Cardiothorac Surg [Internet]. 2020;15(1):199. Available from:
https://doi.org/10.1186/s13019-020-01245-5
22. Cavalcante R, Sotomi Y, Lee CW, Ahn J-M, Farooq V, Tateishi H, et al. Outcomes After Percutaneous Coronary Intervention or Bypass Surgery in Patients With Unprotected Left Main Disease. J Am Coll Cardiol. 2016 Sep;68(10):999–1009.
23. Baber U, Giustino G, Sartori S, Aquino M, Stefanini GG, Steg PG, et al. Effect of Chronic Kidney Disease in Women Undergoing Percutaneous Coronary Intervention With Drug-Eluting Stents: A Patient-Level Pooled Analysis of Randomized Controlled Trials. JACC Cardiovasc Interv [Internet]. 2016;9(1):28–38. Available from: https://www.sciencedirect.com/science/article/pii/S1936879815015757
24. Lu R, Tang F, Zhang Y, Zhu X, Zhu S, Wang G, et al. Comparison of Drug-Eluting and Bare Metal Stents in Patients With Chronic Kidney Disease: An Updated Systematic Review and Meta-Analysis. J Am Heart Assoc [Internet]. 2016;5(11):e003990. Available from:
https://www.ahajournals.org/doi/abs/10.1161/JAHA.116.003990

Figure 1: The study flowchart
LMCA: left main coronary artery, **ULMCA:** unprotected left main coronary artery, **CABG:** coronary artery bypass grafting, **PCI:** percutaneous coronary intervention, **MACCE:** major adverse cardiovascular and cerebrovascular events

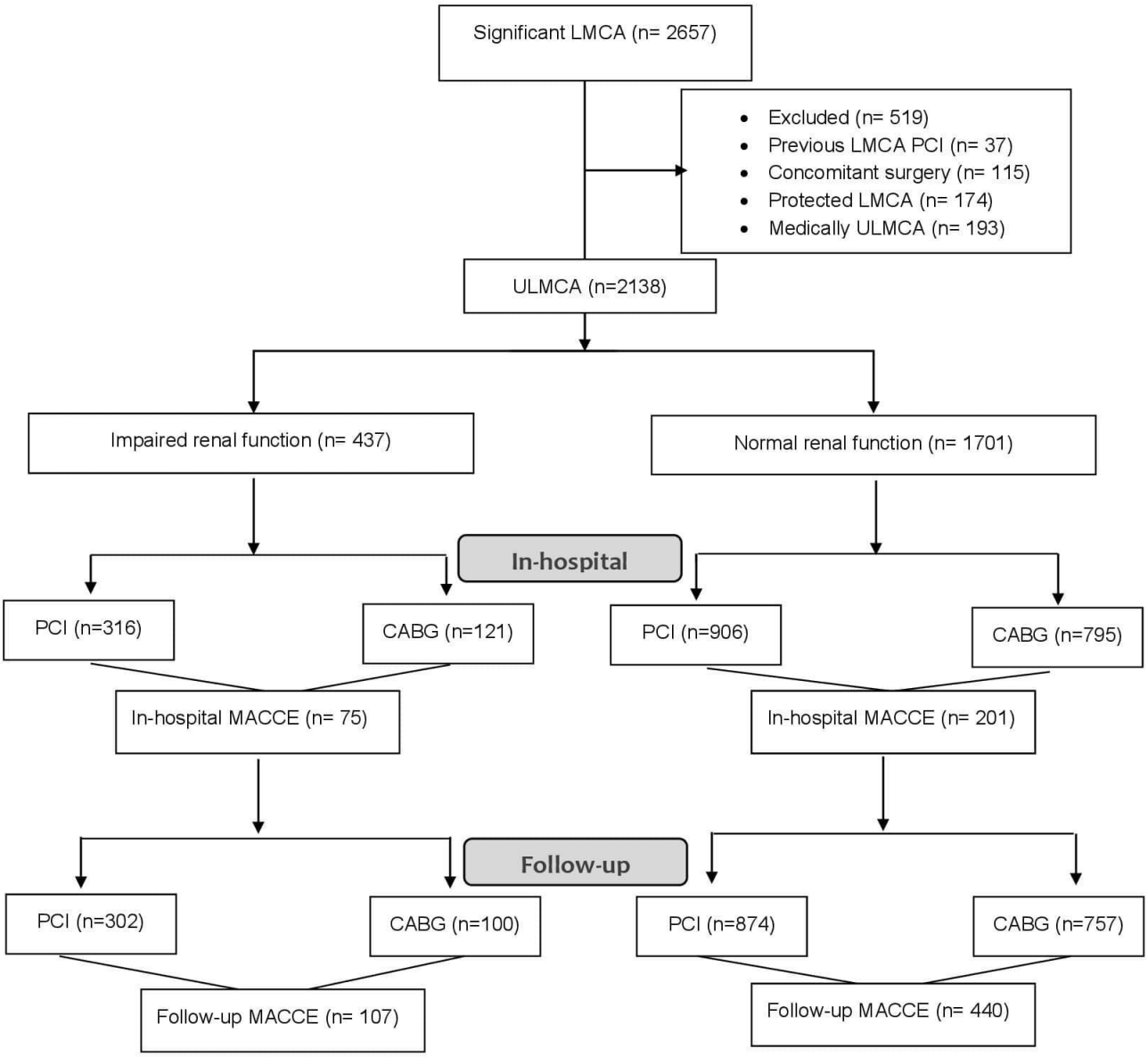
Significant LMCA (n= 2657)
Excluded (n= 519)
Previous LMCA PCI (n= 37)
Concomitant surgery (n= 115)
Protected LMCA (n= 174)
Medically ULMCA (n= 193)
ULMCA (n=2138)
Impaired renal function (n= 437)
Normal renal function (n= 1701)
In-hospital
PCI (n=316)
CABG (n=121)
PCI (n=906)
CABG (n=795)
In-hospital MACCE (n= 75)
In-hospital MACCE (n= 201)
Follow-up
PCI (n=302)
CABG (n=100)
PCI (n=874)
CABG (n=757)
Follow-up MACCE (n= 107)
Follow-up MACCE (n= 440)

Table 1: Baseline and pre-procedural characteristics at the time of hospital admission in patients with impaired and normal renal function

	Overall, n=2138	Impaired renal function, n=437 (20.4%)			Normal renal function, n=1701 (79.6%)		
		PCI (n=316)	CABG (n=121)	P-Value	PCI (n=906)	CABG (n=795)	P-Value
Baseline characteristics							
Age (years), mean ± SD	63.7 ± 10.2	67.60 ± 8.07	65.17 ± 10.50	0.010	64.57 ± 10.74	60.83 ± 9.64	< 0.001
Body mass index (kg/m^2), mean ± SD	28.8 (5.10)	28.48 ± 5.28	28.34 ± 5.69	0.817	29.53 ± 4.96	28.47 ± 5.18	< 0.001
Gender (male), n (%)	1678 (78.5%)	210 (66.50%)	95 (78.50%)	0.014	684 (75.50%)	689 (86.70%)	< 0.001
Smoker, n (%)	849 (39.7%)	128 (40.50%)	43 (35.50%)	0.341	351 (38.70%)	327 (41.10%)	0.315
Diabetes mellitus, n (%)	1468 (68.7%)	211(66.80%)	101(83.50%)	0.001	593 (65.50%)	563 (70.80%)	0.018
Hypertension, n (%)	1495 (70.4%)	276 (88.50%)	104 (86.00%)	0.474	583 (65.10%)	532 (66.90%)	0.441
Dyslipidemia, n (%)	1463 (69.0%)	216 (69.20%)	91 (75.20%)	0.219	605 (67.70%)	551 (69.30%)	0.491
Congestive heart failure, n (%)	261 (12.2%)	86 (27.20%)	28 (23.10%)	0.385	110 (12.10%)	37 (4.70%)	< 0.001
Peripheral arterial disease, n (%)	246 (11.5%)	102 (32.30%)	15 (12.40%)	< 0.001	82 (9.10%)	47 (5.90%)	0.015
Cerebral vascular accident, n (%)	222 (10.4%)	129 (40.80%)	9 (7.40%)	< 0.001	50 (5.50%)	34 (4.30%)	0.238
Atrial fibrillation, n (%)	183 (8.6%)	61 (19.30%)	10 (8.30%)	0.005	93 (10.30%)	19 (2.40%)	< 0.001
Previous myocardial infarction, n (%)	613 (28.7%)	113 (35.80%)	36 (29.80%)	0.236	305 (33.70%)	159 (20.00%)	< 0.001
EuroSCORE score, mean (SD)	3.9 (4.9)	5.7 ± 5.93	6.08 ± 6.68	0.646	3.95 ± 5.03	2.84 ± 3.48	< 0.001
Hospital presentation							
Cardiac arrest, n (%)	70 (3.3%)	13 (4.10%)	6 (5.00%	0.698	38 (4.20%)	13 (1.60%)	0.002
Type of cardiac arrest, n (%)							
Ventricular fibrillation	39 (55.7%)	6 (46.20%)	4 (66.70%)	0.406	21 (55.30%)	8 (61.50%)	0.696
Pulseless electrical activity/Asystole	31 (44.3%)	7 (53.80%)	2 (33.30%	0.406	17 (44.70%)	5 (38.50%)	0.696
Arrhythmia, n (%)	147 (6.8%)	37 (11.7%)	17 (14%)	0.506	71 (8.00%)	21 (2.60%)	<0.001
Type of arrhythmia, n (%)							
Atrial arrhythmia	48 (32.9%)	13 (35.10%)	4 (23.50%)	0.395	22 (31.00%)	9 (42.90%)	0.312
Ventricular arrhythmia	81 (55.5%)	20 (54.10%)	13 (76.50%)	0.116	37 (52.10%)	11 (52.40%)	0.984
Brady arrhythmia	17 (11.6%)	4 (10.80%)	0 (0.00%)	0.158	12 (16.90%)	1 (4.80%)	0.161

Cardiogenic shock, n (%)	134 (6.3%)	30 (9.50%)	8 (6.60%)	0.334	71 (7.80%)	25 (3.10%)	< 0.001
Acute coronary syndrome, n (%)							
ST-elevation myocardial infarction	389 (18.2%)	40 (12.70%)	23 (19.00%)	0.091	174 (19.20%)	152 (19.10%)	0.955
Non-ST-elevation acute coronary syndrome	1084 (50.7%)	223 (70.60%)	75 (62.00%)	0.085	405 (44.80%)	381 (47.90%)	0.19
Stable coronary artery disease	277 (13.0%)	23 (7.30%)	9 (7.40%)	0.954	117 (12.90%)	128 (16.10%)	0.063
Silent ischemia/Others	387 (18.1%)	30 (9.50%)	14 (11.60%)	0.519	209 (23.10%)	134 (16.90%)	0.001
Left ventricular ejection fraction (LVEF), mean (SD)	44.8 ± 11.6	45.47 ± 11.48	46.28 ± 12.69	0.538	42.37 ± 11.14	47.13 ± 11.50	<0.001
LVEF < 40%, n (%)	585 (27.4%)	86 (27.20%)	28 (23.10%)	0.384	303 (33.40%)	161 (20.30%)	< 0.001
LVEF 40-49%, n (%)	625 (29.2%)	79 (25.00%)	29 (24.00%)	0.825	308 (34.00%)	202 (25.40%)	< 0.001
LVEF > 50%, n (%)	927 (43.4%)	151 (47.80%)	64 (52.90%)	0.337	295 (32.60%)	432 (54.30%)	< 0.001
Creatinine clearance (CrCl) (ml/min), mean (SD) (pre-revascularization)	76.2±24.2	69.06 ± 27.55	49.94 ± 27.72	< 0.001	78.10 ± 24.75	80.81 ± 17.51	0.010
Mild renal impairment CrCl >60, n (%)	244 (56.00%)	194 (61.60%)	50 (41.30%	< 0.001	NA	NA	NA
Moderate renal impairment CrCl 30-60, n (%)	126 (28.90%)	91 (28.90%)	35 (28.90%)	0.992	NA	NA	NA
Severe renal impairment CrCl <30-15, n (%)	55 (12.60%)	29 (9.20%)	26 (21.50%)	< 0.001	NA	NA	NA
CrCl <15/dialysis, n (%)	11 (2.50%)	1 (0.30%	10 (8.30%)	< 0.001	NA	NA	NA
Hemoglobin (g/L), mean (SD)	13.2 (1.8)	13.46 ± 1.86	12.52 ± 2.10	<0.001	13.53 ± 1.89	12.94 ± 1.97	<0.001

CABG: coronary artery bypass graft surgery, **PCI:** percutaneous coronary intervention, **EuroSCORE score:** european system for cardiac operative risk evaluation, **SD:** standard deviation

Table 2: Angiographic characteristics at the time of hospital admission in patients with impaired and normal renal function

	Overall, n=2138	Impaired renal function, n=437 (20.4%)			Normal renal function, n=1701 (79.6%)		
		PCI (n=316)	CABG (n=121)	P-Value	PCI (n=906)	CABG (n=795)	P-Value
Angiographic characteristics							
Medina classification, n (%)							
1,1,1	760 (35.5%)	152 (48.10%)	48 (39.70%)	0.116	278 (30.70%)	282 (35.50%)	0.030
1,1,0	162 (7.6%)	62 (19.60%)	8 (6.60%)	< 0.001	248 (27.40%)	84 (10.60%)	< 0.001
1,0,1	393 (18.4%)	15 (4.70%)	17 (14.00%)	< 0.001	33 (3.60%)	97 (12.20%)	< 0.001
0,1,1	402 (18.8%)	52 (16.50%)	17 (14.00%)	0.541	180 (19.90%)	144 (18.10%)	0.379
1,0,0	202 (9.4%)	19 (6.00%)	15 (12.40%)	0.025	97 (10.70%)	71 (8.90%)	0.230
0,1,0	160 (7.5%)	10 (3.20%)	13 (10.70%)	0.001	46 (5.10%)	91 (11.40%)	< 0.001
0,0,1	59 (2.7%)	4 (1.30%)	2 (1.70%)	0.756	7 (0.80%)	8 (1.00%)	0.603
Lesion characteristics							
Multi-vessel disease, n (%)	1202 (56.2%)	186 (58.90%)	91 (75.20%)	0.002	393 (43.40%)	532 (66.90%)	< 0.001
LAD, n (%)	287 (13.4%)	48 (15.20%)	1 (0.80%)	< 0.001	203 (22.40%)	35 (4.40%)	< 0.001
LCX, n (%)	35 (1.6%)	5 (1.60%)	1 (0.80%)	0.541	25 (2.80%)	4 (0.50%)	< 0.001
LAD and LCX, n (%)	327 (15.3%)	42 (13.30%)	19 (15.70%)	0.515	146 (16.10%)	120 (15.10%)	0.561
RCA, n (%)	10 (0.5%)	1 (0.30%)	0 (0.00%)	0.535	6 (0.70%)	3 (0.40%)	0.417
RCA + (LAD or LCX), n (%)	139 (6.5%)	14 (4.40%)	5 (4.10%)	0.889	50 (5.50%)	70 (8.80%)	0.008
Isolated left main disease, n (%)	138 (6.5%)	20 (6.30%)	4 (3.30%)	0.214	83 (9.20%)	31 (3.90%)	< 0.001
SYNTAX score							
Low (≤ 22), n (%)	430 (20.2%)	50 (15.80%)	13 (10.70%)	0.177	254 (28.10%)	113 (14.40%)	< 0.001

Intermediate (23-32), n (%)	1107 (52.0%)	199 (63.00%)	50 (41.30%)	< 0.001	482 (53.30%)	376 (47.80%)	0.024
High (≥ 33), n (%)	592 (27.8%)	67 (21.20%)	58 (47.90%)	< 0.001	169 (18.70%)	298 (37.90%)	< 0.001
SYNTAX score, mean (SD)	29.0 (8.4)	29.68 ± 7.77	32.42 ± 9.25	0.002	26.92 ± 7.72	30.62 ± 8.76	< 0.001
Lesion location							
Distal bifurcation, n (%)	536 (25.1%)	262 (82.90%)	83 (68.60%)	0.001	725 (80.00%)	532 (66.90%)	< 0.001
Ostial/shaft only, n (%)	1602 (74.9%)	54 (17.10%)	38 (31.40%)	0.001	181 (20.00%)	263 (33.10%)	< 0.001
Procedure							
Intra-aortic balloon pump, n (%)	200 (9.4%)	26 (8.30%)	26 (21.50%)	< 0.001	72 (7.90%)	76 (9.60%)	0.239
Impella, n (%)	14 (0.7%)	6 (1.90%)	1 (0.80%)	0.422	6 (0.70%)	1 (0.10%)	0.085

CABG: coronary artery bypass graft surgery, **PCI:** percutaneous coronary intervention, **LM:** left main, **LAD:** left anterior descending, **LCX:** left circumflex, **RCA:** right coronary, **SYNTAX:** The **SYNergy** between percutaneous coronary intervention with TAXus and cardiac surgery, **SD:** standard deviation

Table 3: In-hospital outcomes post procedure in patients with impaired and normal renal function

	Overall, n=2138	Impaired renal function, n=437 (20.4%)			Normal renal function, n=1701 (79.6%)		
		PCI (n=316)	CABG (n=121)	P-Value	PCI (n=906)	CABG (n=795)	P-Value
In-hospital outcomes							
Cardiac death, n (%)	81 (3.8%)	10 (3.20%)	12 (9.90%)	0.004	29 (3.20%)	30 (3.80%)	0.52
Non-cardiac death, n (%)	24 (1.1%)	4 (1.30%)	9 (7.40%)	0.001	3 (0.30%)	8 (1.00%)	0.083
Myocardial infarction, n (%)	73 (3.4%)	5 (1.60%)	14 (11.60%)	< 0.001	13 (1.40%)	41 (5.20%)	< 0.001
Target lesion revascularization, n (%)	11 (0.5%)	1 (0.30%)	1 (0.80%)	0.481	4 (0.40%	5 (0.60%)	0.595
Target vessel revascularization, n (%)	15 (0.7%)	2 (0.60%)	2 (1.70%)	0.318	5 (0.60%)	6 (0.80%)	0.603
Cerebrovascular events, n (%)	48 (2.2%)	10 (3.20%)	11 (9.10%)	0.01	9 (1.00%)	18 (2.30%)	0.036
Congestive heart failure, n (%)	89 (4.2%)	10 (3.20%)	9 (7.40%)	0.05	39 (4.30%)	31 (3.90%)	0.675
Major bleeding, n (%)	313 (14.6%)	31 (9.80%)	25 (20.70%)	0.002	133 (14.70%)	124 (15.60%)	0.598
Minor bleeding, n (%)	157 (7.3%)	21 (6.70%)	12 (9.90%)	0.251	46 (5.10%)	78 (9.80%)	< 0.001
Total mortality, n (%)	105 (4.9%)	14 (4.40%)	21 (17.40%)	< 0.001	32 (3.50%)	38 (4.80%)	0.196
MACCE, n (%)	276 (12.92%)	33 (10.44%)	42 (34.71%)	<0.001	88 (9.71%)	113 (14.21%)	0.004
Duration of hospital stay, median (IQR (Days)	7 (9)	3 (7)	14 (17)	< 0.001	3 (5)	11 (7)	< 0.001
Creatinine clearance (ml/min), mean (SD) (at discharge)	74.5 (25)	68.83 ± 27.39	48.41 ± 28.51	< 0.001	77.48 ± 25.56	78.40 ± 18.84	0.403
Mild renal impairment CrCl >60, n (%)	243 (55.70%)	192 (61.00%)	51 (42.10%)	< 0.001	**NA**	**NA**	**NA**
Moderate renal impairment CrCl 30-60, n (%)	120 (27.50%)	93 (29.50%)	27 (22.30%)	0.136	**NA**	**NA**	**NA**
Severe renal impairment CrCl <30-15, n (%)	61 (14.00%)	28 (8.90%)	33 (27.30%)	< 0.001	**NA**	**NA**	**NA**
CrCl <15/dialysis, n (%)	12 (2.80%)	2 (0.60%)	10 (8.30%)	< 0.001	**NA**	**NA**	**NA**
Hemoglobin (g/L), mean (SD) (at discharge)	12.2(2)	13.00 ± 2.05	10.78 ± 2.24	< 0.001	12.97 ± 2.16	10.86 ± 2.11	< 0.001

CABG: coronary artery bypass grafting, **IQR:** interquartile range, **MACCE:** major adverse cardiovascular and cerebrovascular events, **PCI:** percutaneous coronary intervention, **SD:** standard deviation

Table 4: Follow-up events post hospital discharge in patients with impaired and normal renal function

	Overall, n=2138	Impaired renal function, n=437 (20.4%)			Normal renal function, n=1701 (79.6%)		
		PCI (n=316)	CABG (n=121)	P-Value	PCI (n=906)	CABG (n=795)	P-Value
Follow-up events							
Cardiac death, n (%)	14 (0.7%)	3 (1.00%)	2 (2.00%)	0.447	5 (0.60%)	4 (0.50%)	0.871
Non-cardiac death, n (%)	25 (1.3%)	3 (1.00%)	1 (1.00%)	0.988	9 (1.10%)	12 (1.60%)	0.355
Myocardial infarction, n (%)	50 (2.6%)	7 (2.50%)	8 (8.10%)	0.015	17 (2.10%)	18 (2.50%)	0.62
Target lesion revascularization, n (%)	55 (2.9%)	7 (2.50%)	5 (5.10%)	0.215	28 (3.50%)	12 (1.70%)	0.026
Target vessel revascularization, n (%)	60 (3.1%)	5 (1.80%)	7 (7.10%)	0.01	26 (3.20%)	19 (2.60%)	0.489
Cerebrovascular events, n (%)	31 (1.6%)	4 (1.50%)	4 (4.70%)	0.082	11 (1.40%)	10 (1.60%)	0.731
Congestive heart failure, n (%)	415(19.4%)	60 (19.00%)	22 (18.20%)	0.847	235 (25.90%)	98 (12.30%)	< 0.001
Major bleeding, n (%)	8 (0.4%)	1 (0.40%)	1 (1.20%)	0.388	4 (0.50%)	1 (0.20%)	0.28
Minor bleeding, n (%)	32 (1.6%)	5 (1.80%)	5 (5.80%)	0.051	11 (1.40%)	10 (1.60%)	0.731
Total mortality, n (%)	39 (2.0%)	6 (2.10%)	3 (3.10%)	0.605	14 (1.70%)	16 (2.20%)	0.111
MACCE, n (%)	547 (25.58%)	76 (24.05%)	31 (25.62%)	0.859	287 (31.68%)	153 (19.25%)	0.003
Median follow-up time (IQR) (months)	20 (27)	16 (20)	19 (32)	0.228	22 (28)	17 (29)	0.014
Creatinine clearance (ml/min), mean (SD) (during the last follow-up)	74.9 (24)	67.33 ± 30.11	47.35±28.64	< 0.001	77.16±26.48	78.60 ± 19.31	0.207
Mild renal impairment CrCl >60, n (%)	238 (54.70%)	191 (60.60%)	47 (39.20%)	< 0.001	**NA**	**NA**	**NA**
Moderate renal impairment CrCl 30-60, n (%)	110 (25.30%)	80 (25.40%)	30 (25.00%)	0.928	**NA**	**NA**	**NA**
Severe renal impairment CrCl <30-15, n (%)	71 (16.30%)	40 (12.70%)	31 (25.80%)	< 0.001	**NA**	**NA**	**NA**
CrCl <15/dialysis, n (%)	16 (3.70%)	4 (1.30%)	12 (10.00%)	< 0.001	**NA**	**NA**	**NA**
Hemoglobin (g/L), mean (SD) (during the last follow-up)	12 (2)	13.14 ± 1.96	11.03 ± 2.20	< 0.001	13.06 ± 2.10	11.28 ± 2.10	< 0.001

CABG: coronary artery bypass grafting, **IQR:** interquartile range, **MACCE:** major adverse cardiovascular and cerebrovascular events, **PCI:** percutaneous coronary intervention, **SD:** standard deviation

Table 5: Multivariable analysis for factors affecting in-hospital and follow-up MACCE

	Normal renal function		Impaired renal function	
In-hospital MACCE	**OR (95% CI)**	**P**	**OR (95% CI)**	**P**
CABG vs. PCI	2.59 (1.79- 3.73)	<0.001	8.13 (4.19- 15.76)	<0.001
Shock	15.81 (9.33- 26.80)	<0.001	5.20 (1.99- 13.58)	0.001
Arrest	-	-	15.51 (3.24- 74.26)	0.001
Previous myocardial infarction	1.65 (1.15- 2.27)	0.007	2.43 (1.29- 4.60)	0.006
Previous CVA	2.36 (1.29- 4.31)	0.005	-	-
EuroSCORE	1.05 (1.01- 1.08)	0.013	1.06 (1.02- 1.10)	0.005
Ejection fraction	-	-	0.65 (0.45- 0.93)	0.018
Age	-	-	1.04 (1.01- 1.07)	0.022
Follow-up MACCE	**HR (95% CI)**	**P**	**HR (95% CI)**	**P**
Age	1.01 (1.001- 1.02)	0.028	-	-
Dyslipidemia	0.51 (0.41- 0.64)	<0.001	-	-
EuroSCORE	1.03 (1.004- 1.06)	0.022	-	-
Arrest	2.94 (1.68- 5.13)	<0.001	-	-
Ejection fraction	0.12 (0.09- 0.15)	<0.001	0.12 (0.08- 0.20)	<0.001
Previous myocardial infarction	-	-	2.07 (1.33- 3.20)	0.001
CABG vs. PCI	1.12 (0.90- 1.39)	0.312	1.14 (0.71- 1.81)	0.585

MACCE: major adverse cardiovascular and cerebrovascular events**, CABG:** coronary artery bypass graft surgery, **CVA**: cerebrovascular accident, **PCI:** percutaneous coronary intervention, **EuroSCORE score:** european system for cardiac operative risk evaluation, **OR:** odds ratio, **STEMI:** ST-elevation myocardial infarction