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# CORONARY REVASCULARIZATION TECHNIQUES AND THEIR IMPACTS ON CHRONIC KIDNEY DISEASE (CKD) PATIENTS, SERVICES HOSPITAL, LAHORE

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**Abstract:**

***Background and Objective:*** *Coronary heart diseases are being treated by surgical and non-surgical procedures like Coronary Artery Bypass Graft (CABG) and Percutaneous Coronary Intervention (PCI). The impact of these techniques on the patients with Chronic Kidney Disease (CKD) is a debatable issue. The risk factors (mortality and morbidity) associated with the application of these methods in CKD patients are brought to light in this study.*

***Methods:*** *The study was carried out at Services Hospital, Lahore from Jan 2016 to Aug 2017. A total of 159 CKD patients were selected from the revascularization center of the hospital. They had to undergo either from CABG or PCI. The main results after the treatment were loss of life, Myocardial Infarction (MI) heart attack, or stroke. We analyzed the mode of coronary revascularization having least risk factors of medical results.*

***Results:*** *Among 159 patients with CKD, 85 patients (53.5%) received PCI and 74 patients (46.5%) received CABG. The study revealed that patient with higher intensity of kidney disease were given PCI treatment and surgical procedure (CABG) was adopted in case of patients with mild CKD. However, the medical findings were not much different in both cases. The PCI method was preferred on the basis of factors like patients' age, heart attack by complete blockage of artery (STEMI), heart attack by partial blockage (NSTEMI) and number of coronary arteries in patients with intense renal problems.*

***Conclusion:*** *The medical results seen in both cases were comparable for CKD patients. No significant difference was noticed in the patients for both methods. Therefore, Percutaneous Coronary Intervention can be agreeable and least intrusive treatment with respect to CABG, especially among patients with higher risks of kidney disease.*

**Key Words:** *Chronic kidney disease, Creatinine clearance, Coronary revascularization, percutaneous coronary intervention, Coronary artery bypass graft.*

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## INTRODUCTION:

Chronic Renal Disease is prevailing almost everywhere in the world. It is sometimes associated with other disease such as diabetes and hypertension [1]. CKD is considered a primary cause of death in patients with coronary artery disease and undergoing revascularization [2]. Coronary revascularization comes with the package of complications which might include death, heart attacks, repeat revascularization and blood loss. The rate and intensity of these complications might differ for different patients depending upon some variable factors [3]. Patients having Chronic Kidney Disease are at a higher risk of mortality because the renal disease can alone cause the stroke and heart attack resulting in the loss of life [4].

Medical science has validated the reduction in mortality rate and prognosis in the patients undergoing revascularization. The results were matched with the CKD patients having artery diseases and found that the mortality rate in CKD patients was higher [5]. The decision to choose between the surgical and non-surgical procedures for revascularization among CKD patients is often hard. Factors like Major Adverse Cardiac and Cerebral Events (MACCE), kidney functioning and hemodialysis are to be closely examined for selection of the mode of revascularization. Moreover, hospital stay is a major concern for CKD patients.

Former studies conducted on the topic advocated that Chronic Kidney Disease is associated with high mortality rate after CABG procedure [6]. This happens because such patients require more time on artificial ventilation, increased bleeding and transfusion requirements. Non-surgical treatment such as PCI is also high-risk due to its worse effects on kidney function, repeat revascularization and mortality [7]. The death rate doubles in a year for marginal renal inefficiencies [8]. The optimal strategy for favorable medical results in cases of CKD patients with CAD (Coronary Artery Disease) is not obvious and riskless. The morbidity and mortality associated with CKD for such patients is a challenge for countries with scarce resources like Pakistan. The main objective of the study was to assess the risk factors in CKD patients having Coronary Artery Diseases and to vote for the surgical or non-surgical methods for coronary revascularization. The analysis is based on the risk factors associated with PCI and CABG in patients with chronic kidney disease.

## METHODS:

In this comparative study, a hundred and fifty-nine patients (with renal and artery diseases) were selected for coronary revascularization at Services Hospital, Lahore. The study was conducted between January 2012 and August 2013 (1.5 years approx.). The methods used for unblocking of the arteries were PCI and CABG. One or more stents were used in PCI technique with the exception of POBA (Plain Old Balloon Angioplasty). The subjects having deficiency of red blood cells and liver diseases were dropped during the sample selection. The sample consisted of 122 men and 37 women (159). The age range for the sample was between 38-88 years resulting in the mean age of 65 ± 9.6 years. The sample was distributed into three batches on the basis of Creatinine Clearance (CrCl). Medical findings and angiographic results were collected to establish baseline demographics. Ethical approval was obtained from ethical review committee of Aga Khan University Hospital, Karachi. Serum creatinine results were measured 1 -2 days prior to the procedure. Cockcroft-Gault formula was applied to assess the kidney function [9]. Patients were categorized according to creatinine clearance levels in accordance with National Kidney Foundation classification [10]. Creatinine clearance (CrCl) < 90 ml/min was defined as having Chronic Kidney Disease (CKD). The patients were hospitalized and observed after the PCI and CABG procedures. Patients faced deaths, MI and strokes during their stay as hospital. During first seven days after the procedure, patients reflected MI on the basis of new abnormal Q-Wave [11] plus a ratio of serum creatinine kinase MB (CK-MB) iso- enzyme to total cardiac enzyme >0.1 three times greater than the top limit of the standard range. After a week, MI was clearly diagnosed with the help of abnormal Q-waves and/or enzymatic changes [12]. The baseline was established under consideration of various factors like number of diseased coronary vessels, luminal diameter narrowing >70%. If stenosis drops down to >70%, within the luminal diameter > 2mm, revascularization is considered as complete. The results of the analysis were recorded as mean ± standard deviation and percentages for different variable factors. Chi-square test and Fisher test were used where suited. For persistent factors, means difference was calculated by independent t-test. Favorable results were analyzed by Logistic regression. The subjects were divided into 3 batches based on Creatinine Clearance (CrCl). Batches were compared by Pearson chi-square test for definite variables and ANOVA test for other variables. Data analysis was done with the help of SPSS (1989-02). A p value of <0.005 was endorsed as significant.

## RESULTS:

The subjects of the study were prescribed for revascularization with the presence / indication of Non-STEMI (43.3%, 69), STEMI (21.4%, 34), stable

angina (19.5%, 31) and unstable angina (17%, 24). PCI method was used in 53.5% CKD patients whereas 46.5% CKD patients were treated through CABG procedure. The indications and the baseline demographics (Smoking history, hemorrhage, prior revascularization and MI etc.) were almost alike among three batches. CKD patients, in all groups, were diagnosed with CAD in multiple vessels. 33.9% patients in severe CKD group were having prior hemodialysis. The numbers for prior dialysis in mild and moderate CKD patient arrangements were 2 (9.5%) and 3 (3.8%) respectively.

**Table - I: Characteristics of patients with CKD after PCI and CABG**

| | *Total (n=159)* | | *PCI (n=85)* | | *CABG (n=74)* | | *p value* |
|---|---|---|---|---|---|---|---|
| | *Number* | *Percentage* | *Number* | *Percentage* | *Number* | *Percentage* | |
| Age (years) | | | 67±9 | | 63±9 | | 0.003 |
| Male | 122 | 76.7 | 63 | 74.1 | 59 | 79.7 | 0.45 |
| Female | 37 | 23.3 | 22 | 25.9 | 15 | 20.3 | |
| Hemoglobin | 11.5 ± 1.76 | | 11.4±1.8 | | 11.6±1.6 | | 0.66 |
| WBC | 11.1 ± 5.1 | | 12.4±6.2 | | 9.5±2.8 | | < 0.001 |
| Baseline creainine(mg/dl) | 2.3 ± 1.5 | | 2.7±1.7 | | 1.7±0.9 | | < 0.001 |
| Creatinine on admission(mg/dl) | 2.6 ± 2.0 | | 3.4±2.3 | | 1.8±1.04 | | < 0.001 |
| **Creatinine Clearance (ml/min)** | | | | | | | |
| < 30 | 59 | 37.1 | 51 | 60 | 8 | 10.8 | <0.001 |
| 30-59 | 79 | 49.7 | 28 | 32.9 | 51 | 68.9 | |
| 60-89 | 21 | 13.2 | 6 | 7.1 | 15 | 20.3 | |
| Current smoking history | 159 | 100 | 5 | 5.9 | 13 | 17.6 | 0.02 |
| Hypertension | 144 | 90.6 | 77 | 90.6 | 67 | 90.5 | 0.99 |
| Diabetes mellitus | 108 | 67.9 | 60 | 70.6 | 48 | 64.9 | 0.99 |
| History of ischemic stroke | 16 | 10.1 | 11 | 12.9 | 5 | 6.8 | 0.27 |
| History of hemorrhagic stroke | 1 | 0.6 | 0 | 0 | 1 | 1.4 | 0.36 |
| Valvular heart disease | 34 | 21.4 | 19 | 22.4 | 15 | 20.3 | 0.84 |
| Prior MI | 59 | 37.1 | 36 | 42.4 | 23 | 31.1 | 0.18 |
| Prior kidney disease | 157 | 98.7 | 85 | 100 | 72 | 97.3 | 0.21 |
| with dialysis | 25 | 15.7 | 21 | 24.7 | 4 | 5.4 | 0.001 |
| without dialysis | 134 | 84.3 | 64 | 75.3 | 70 | 94.6 | 0.001 |
| Peripheral vascular disease | 1 | 1.2 | 1 | 1.2 | 0 | 0 | 0.99 |
| Prior revascularization | 40 | 25.2 | 31 | 36.5 | 9 | 12.2 | <0.001 |
| LVEF < 40% | 77 | 48.4 | 41 | 48.2 | 36 | 49.3 | 0.99 |
| Indications for revascularization | | | | | | | |
| Stable angina | 31 | 19.5 | 5 | 5.9 | 26 | 35.1 | <0.001 |
| Unstable angina | 27 | 17 | 10 | 11.8 | 17 | 23 | 0.08 |
| NSTEMI | 69 | 43.4 | 44 | 51.8 | 25 | 33.8 | 0.02 |
| STEMI | 34 | 21.4 | 26 | 30.6 | 8 | 10.8 | 0.003 |
| Number of diseased vessels | | | | | | | |
| 1 | 25 | 15.7 | 23 | 27.1 | 2 | 2.7 | <0.001 |
| 2 | 45 | 28.3 | 28 | 32.9 | 17 | 23.3 | <0.001 |
| 3 | 88 | 55.3 | 34 | 40 | 54 | 74 | < 0.001 |
| Creatinine after 48 hours of procedure | 2.9 ± 1.7 | | 3.2 ± 2.1 | | 2.5 ± 0.9 | | 0.004 |
| Required Heamodialysis after procedure | 159 | 100 | 12 | 14.1 | 0 | 0 | 0.001 |
| Length of stay(days) | 7.8 ± 6.8 | | 5.4 ± 3.9 | | 10.6 ± 6.9 | | < 0.001 |

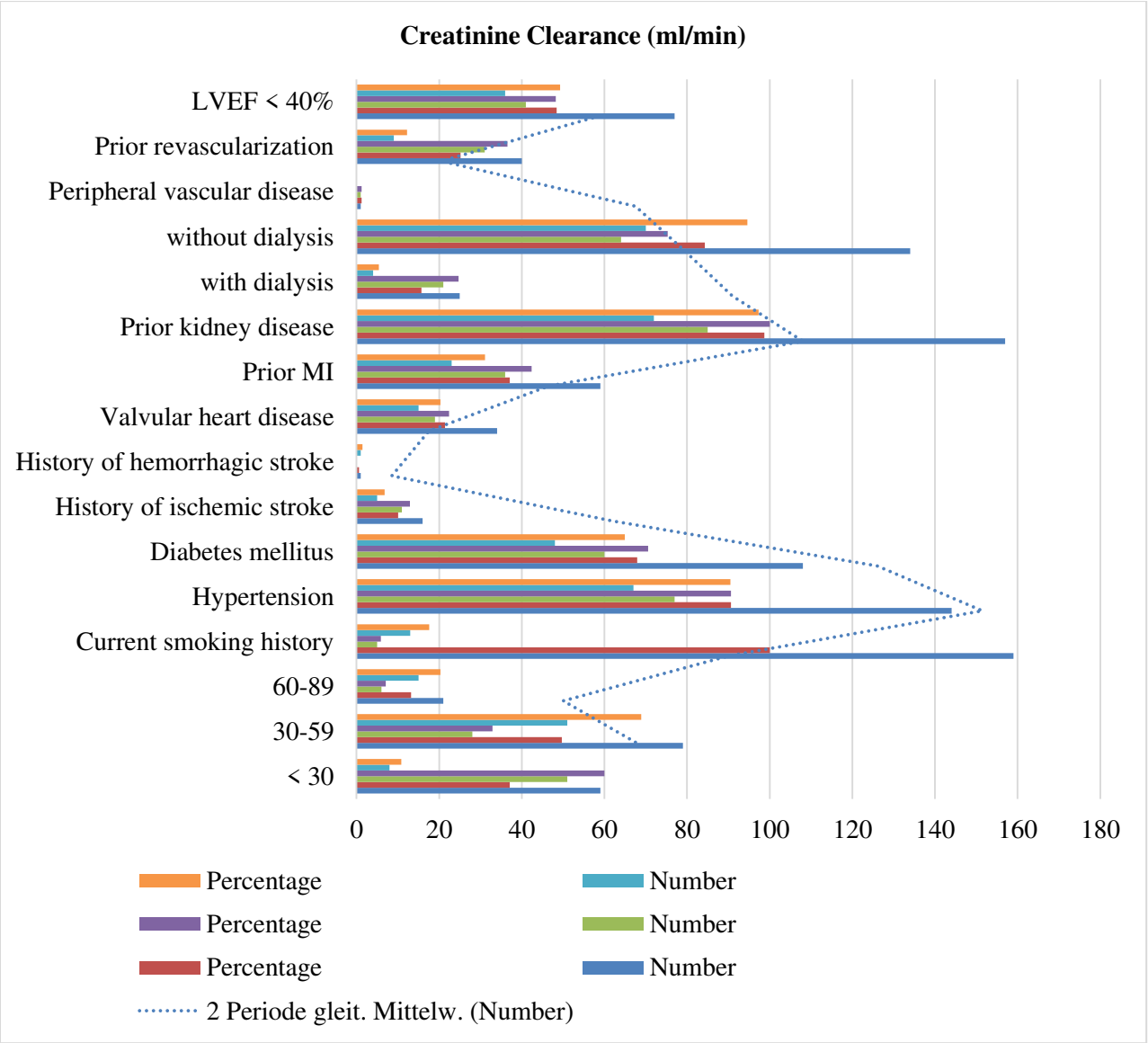
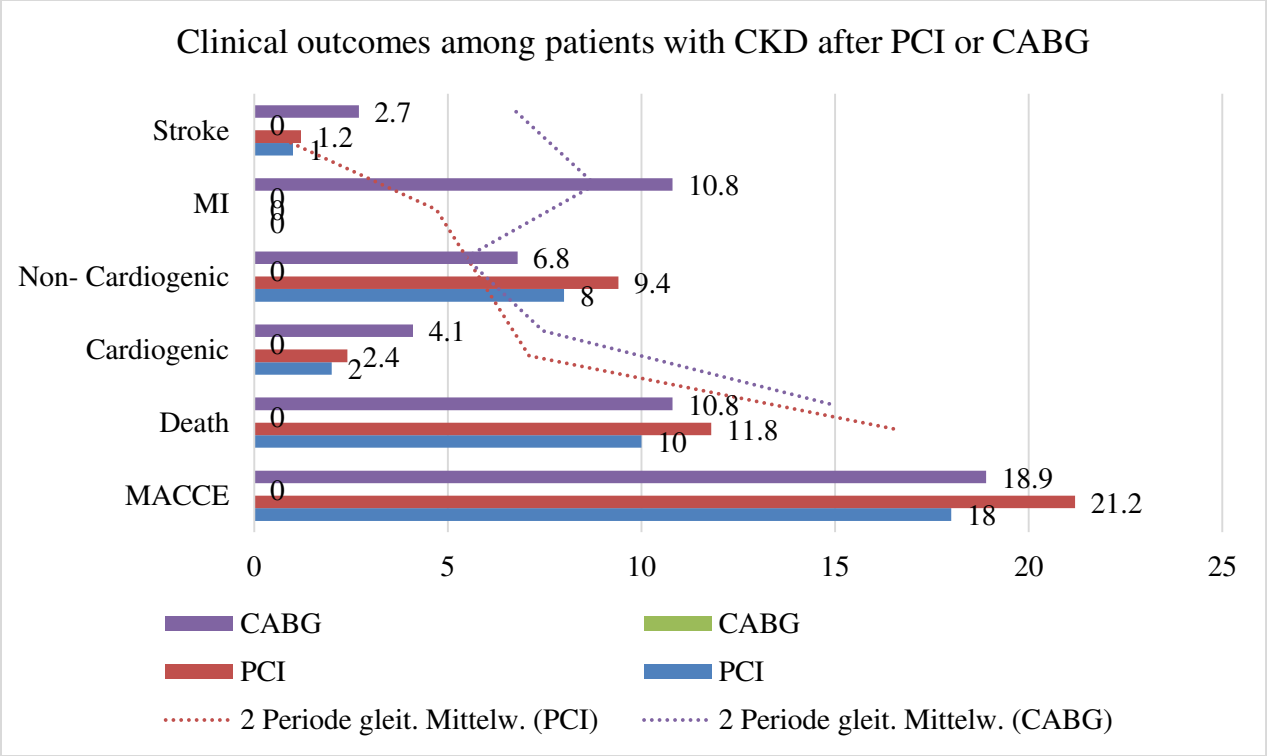



**Table – II: Clinical outcomes among patients with CKD after PCI or CABG**

| | PCI | | CABG | | OR (95% CL) | p value |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | | |
| **MACCE** | 18 | 21.2 | 14 | 18.9 | 1.15 [0.52 – 2.51] | 0.72 |
| **Death** | 10 | 11.8 | 8 | 10.8 | 1.10 [0.41 – 2.95] | 0.85 |
| **Cardiogenic** | 2 | 2.4 | 3 | 4.1 | 1.31 [0.21 – 8.10] | 0.76 |
| **Non- Cardiogenic** | 8 | 9.4 | 5 | 6.8 | 1.43 [0.44 – 4.59] | 0.54 |
| **MI** | 9 | 10.6 | 8 | 10.8 | 0.97 [0.35 – 2.67] | 0.96 |
| **Stroke** | 1 | 1.2 | 2 | 2.7 | 2.33 [0.20 – 26.26] | 0.49 |




The evidence of lesions (proximal, ostial lesion and long lesion or complex lesion) was appeared to be identical among all CKD groups. Severe CKD patients were subjected to PCI method whereas lower intensity CKD patients were treated through CABG procedure. The failure rate of PCI technique in all the batches was same whereas complete revascularization was observed in mild and moderate CKD groups. Creatinine values at the time of admission were higher in the PCI (3.4±2.3) as compared to surgical procedure (1.8 ± 1.04). The decision to choose the mode of revascularization was dependent on the creatinine clearance (CrCl) levels. The patients diagnosed with moderate to severe renal disease underwent PCI whereas those who were diagnosed with mild kidney disease were given CABG treatment. Most of the patients having prior hemodialysis were included in PCI group (21, 24.7%) A small number of patients who underwent CABG were also on hemodialysis prior to the procedure (4, 5.4%) with a p-value of 0.001.

CABG treatment is recommended for revascularization of CKD patients having stable angina whereas PCI is recommended in case of STEMI and Non-STEMI. Serum creatinine readings were measured after procedure and found higher in PCI mode (3.2 ± 2.1). Creatinine readings for CABG group were (2.5 ± 0.9). The hospital stay was lower in case of PCI (5.4 ± 3.9) as compared to CABG (10.6 ± 6.9) days with $p<0.001$(Table – I). Medical results after the procedure were almost similar for both PCI and CABG modes (Table – II). Certain factors (age, heart attack due to complete and partial blockage, prior dialysis and number of coronary arteries) voted for PCI as treatment strategy for patients with severe CKD (Table – III).

## DISCUSSION:

The study delivered that patients with intense CKD were given PCI (Non-surgical) treatment and surgical procedure (CABG) was considered the treatment of choice for mild CKD patients. The medical results were identical. Chen YY conducted a study and stated that the renal function was affected in the beginning due to procedural outcome. The rate of mortality was much lower in the patient's already on dialysis and treated by PCI [15]. Conflictingly, another study led by Zhong Q reported that patients with slight renal problems and normal creatinine readings were treated with PCI. IxJH et al worked out the same topic and produced the same results for both modes of revascularization. Similar death rates, MI, number of arteries were treated either by PCI or CABG [17]. The former studies on this topic have shown different results. Another scholar Szczech reported that 51.9% of patients who were treated by PCI survived for 2 years as compared to patients treated by CABG (77.4%) [18]. Percutaneous Coronary Intervention involves greater utilization of stents and therefore CABG procedure has a survival advantage over PCI mode. The situation becomes more favorable if kidney function is improved [19]. The intervention technique provides same survival benefits in mild to moderate CKD group [19].

**Table – III: Multivariate analysis of factors predicting PCI among CKD patients**

| | *OR (95% CI)* | *p value* |
|---|---|---|
| **Age** | 1.06 (1.001-1.14) | 0.04 |
| **NSTEMI** | 18 (3.22-100) | 0.001 |
| **STEMI** | 8.54 (1.46-50) | 0.01 |
| **Prior revascularization** | 21 (3.59-119.2) | 0.001 |
| **Complete revascularization Number of disease vessels** | 0.004 (0-0.04) | <0.001 |
| **2** | 0.03(0.005-0.25) | 0.001 |
| **3** | 0.005 (0.001-0.04) | <0.001 |

Most of the subjects having severe or intense renal disease were given PCI treatment and those with minor renal problems were treated by CABG technique. It was noted that most of the CKD patients undergoing PCI were aged. Moreover, in our study medical effects (short term) are not different between PCI and CABG. The results collected did not refer to a particular solution for revascularization despite the new developments in interventional cardiology. The limitation of the study was that the creatinine clearance was judged by using a formula (Cockcroft - Gault Formula) The formula does not present perfect measure of kidney malfunction.

## CONCLUSION:

The medical results seen in both cases were comparable for CKD patients. No significant difference was noticed in the patients for both groups. Therefore, PCI can be agreeable and least intrusive choice elective to CABG, especially in patients with higher risks of kidney disease. The treatment strategy ca be PCI due to its non-invasive nature. However, more controlled trial and enhanced follow ups are needed for deciding the mode of coronary revascularization.

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