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# Effects of Previous Percutaneous Coronary Artery Interventions (PCI) on Myocardial Functions Post Coronary Artery Bypass Grafting, Should Previous PCI be Included in the Euroscore?

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## Abstract

**Background:** Previous reports indicated that patients who underwent CABG operation after previous stenting had a higher incidence of early death and major adverse cardiac events.

**Aim of the work:** In our study, we tried to evaluate the effects of previous PCI on the myocardial function as estimated by echocardiography. As improvements in myocardial functions are a necessary argument for undergoing revascularization, it is critical to conclude preoperatively all the risk factors that might hinder this improvement. By doing such evaluation, we tried to conclude if it is necessary to include previous coronary artery stenting as a part of the EUROSCORE for risk evaluation before coronary artery bypass surgery if it really had a negative impact on postoperative myocardial function following CABG revascularization surgery.

**Patients and methods:** After approval of the ethical committee of Ain Shams University, a prospective comparative randomized study on a cohort of 100 consecutive patients who underwent CABG in the period between January 2015 and December 2017 in Ain Shams University Hospitals, Cairo, Egypt. The patients were randomly assigned to the groups according to the specified inclusion and exclusion criteria. Patients were divided into two groups, GROUP I (number=50) patients who underwent CABG without previous left anterior descending artery stenting, and GROUP II (number=50) patients who underwent CABG with previous single or multiple LAD stenting. ECHO WITH 2D STAIN (speckle tracking) was used to evaluate the cardiac functions. Echocardiography was done pre-operatively, after one week, three months and six months postoperatively in both groups.

**Results:** The results revealed that there is no statistically significant difference between both groups in the Pre-operative risk factors: age, smoking, DM, HTN, family history, dyslipidemia, liver function, renal function, and hemoglobin levels. EuroSCORE values were comparable between the two groups. However, there was a statistically significant difference in preoperative MI, as there were 78% in group II that have history of preoperative MI in the 3-months period before surgery while in group I there were only 22%. Moreover, there is a statistically significant difference in the LAD calcification and atheroma severity between the two groups as 78% in group II vs. 22% in group I had extensive LAD disease with poor vessel quality.

There was a statistically significant difference between both groups regarding the incidence of postoperative arrhythmia and bleeding postoperatively with higher values in group II. More importantly, the results revealed that there was a statistically significant difference between both groups in ECHO dimensions, EF and FS which are higher and better in group I *vs.* group II. Also, there is a statistically significant difference between both groups in ECHO wall motion values in most of the segments especially apical anterior septum segment and apex which reflect the viability of these segments. These motion values were better in group I *vs.* group II indicating better revascularization.

**Conclusion:** Previous PCI has a negative impact on the outcome of subsequent CABG. This effect was independent of any preoperative risk variables. Myocardial functions estimated by echocardiography measured dimensions such as EDD, ESD, EF, and RSWMA have been shown to improve better in the group having CABG without previous PCI. So, the decision to use Percutaneous Coronary Interventions should be carefully weighed against the higher risk it provides for subsequent CABG. The guidelines for intervention should be strictly followed especially in patients with complex coronary lesions who have higher incidence to be referred for CABG. We also advise inclusion of the PCI procedures as an independent risk category to be added to the risk factors already measured in the current EuroSCORE system.

**Keywords:** Coronary artery bypass graft; Percutaneous coronary artery interventions; EUROSCORE

## Abbreviations

MACE: Major Adverse Cardiac Events; CABG: Coronary Artery Bypass Graft; LAD: Left Anterior Descending; ECHO: Echocardiography; DM: Diabetes Mellitus; HTN: Hypertension; ECG: Electrocardiography; EDD: End Diastolic Diameter; ESD: End Systolic Diameter; EF: Ejection Fraction; SWMA: Systolic Wall Motion Abnormality; PCI: Percutaneous Coronary Intervention; LV: Left Ventricle; ICU: Intensive Care Unit; ACT: Activated Clotting Time; LITA: Left Internal Thoracic Artery; LVEF: Left Ventricular Ejection

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Fraction; ECG: Electrocardiography; CNS: Central Nervous System; RCA: Right Coronary Artery; MI: Myocardial Infarction

## Introduction

CABG offers greater freedom from angina and myocardial infarction than percutaneous coronary stenting when used in the treatment of multi-vessel ischemic heart disease. CABG has a significant role even with previous treatment with other modalities. Multiple studies have suggested that 8% to 20% of patients undergoing coronary stenting will eventually have coronary artery bypass surgery within five years of stent insertion. Unfortunately, the patients who underwent CABG operation after stenting had a higher in-hospital incidence of death and more adverse outcomes. Multiple reviews in the literature have demonstrated a negative impact of previous coronary artery stenting on short- and long-term outcomes in patients who require subsequent CABG [1].

EuroSCORE is a scoring system used to evaluate risks after CABG. It consists of multiple factors that have different weights on the postoperative morbidity and mortality after open heart CABG. The EuroSCORE scale considers previous cardiac surgery as a risk factor. However, although the history of previous angioplasty has a significant adverse impact on the results after CABG, it is not included in the scale measurement [2].

In our study, we compared the results of CABG after previous LAD stenting, and those of the primary CABG with regards to the echocardiography estimated LV functions after one week, three months and six months following CABG surgery. The aim was to demonstrate the effects of the previous PCI on the success of CABG in the treatment of ischemic heart disease as indicated by improvement of the function of the myocardial muscle due to successful revascularization. We tried in our study to conclude if it is necessary to include the previous stenting as a part of the EUROSCORE for risk evaluation before coronary artery bypass surgery if such adverse effect was demonstrated by our study.

## Patients and Methods

After approval of the ethical committee of Ain Shams University, a prospective comparative study on a sample of 100 consecutive patients who underwent CABG in the period between January 2015 and December 2017 in Ain shams university hospitals, Cairo, Egypt.

The patients were randomly sampled and assigned to the study groups according to the specified inclusion and exclusion criteria. Patients were divided into two groups, GROUP I (number=50) patients underwent CABG without previous LAD stenting, and GROUP II (number=50) patients underwent CABG with previous single or multiple LAD stenting.

We included patients who underwent primary elective isolated CABG procedures and who planned for at least three grafts.

We excluded patients with extremes of age (less than 40 years old or more than 65 years old), patients with associated chronic systemic diseases, e.g., Liver disease, kidney disease or malignancy. We excluded patients with poor LV myocardial function (EF less than 35%) before surgery. Emergency and redo procedures were also excluded. We excluded patient undergoing associated procedures like valve surgery or aortic surgery. We excluded patients having stents less than a month before surgery or patients with known post PCI complications or failures. Patients having less than three grafts post CABG surgery were also excluded.

Demographic, cardiac history and perioperative data were collected from hospitals medical records. Coronary angiography and angioplasty data were recorded from procedure reports and data files. All the operations were performed by a dedicated surgical and cardiology team after taking informed consent from all patients that were included in the study.

### Surgical techniques

Midline sternotomy was used to expose the heart and to setup the patient for cardiopulmonary bypass. We started by cannulating the aorta and right atrium. The aortic area selected for cannulation must be soft and non-atherosclerotic to avoid plaque breakdown and embolization during insertion. The venous cannula was inserted into the right atrial appendage with the end of the cannula positioned in the inferior vena cava. Heparin was given, and adequate anticoagulation was confirmed by assessing the ACT; once the ACT was above 300, the cardiopulmonary bypass could be safely commenced.

The aorta was cross-clamped distal to the cannula, and intermittent cold blood enriched crystalloid cardioplegia solution was infused via the aortic cannula every 20 minutes for myocardial protection, moderate systemic hypothermia was used at 30°C.

After the initiation of cardiopulmonary bypass, the distal coronary bypass targets were identified. As a rule, anastomoses to the right coronary artery and the obtuse marginal branches of the circumflex artery are completed first followed by diagonal branches and Left anterior descending arteries. Saphenous vein segments were used for completing the anastomoses in all targets with the left internal thoracic (mammary) artery (LITA) anastomosed to the LAD if possible. A saphenous vein graft may be placed to the LAD artery for expediency or in case of problems with LITA itself such as spasm, injury or length issues. Polypropylene monofilament sutures, either 7-0 or 8-0, were used to complete the distal coronary anastomosis. Technically, an end-to-side anastomosis was completed to the distal targets. When all the distal anastomoses were completed, rewarming was initiated, the aortic cross-clamp was removed, and a partially side-occluding clamp was placed on the ascending aorta where the grafts were to be anastomosed. Before the cross-clamp was finally removed, air was evacuated from the grafts and ascending aorta. The patient is then weaned off the bypass.

When the normal rhythm was recommenced, the patient was once again mechanically ventilated, and the cardiopulmonary bypass was gradually weaned with the aid of inotropic support or an intra-aortic balloon if required. Protamine was given to reverse the heparin after completion of the procedure.

### Echocardiographic techniques

Echocardiography with 2D STRAIN (Speckle Tracking) was the main investigation that we used to evaluate the cardiac functions. It is a non-invasive technique that yields exact information about the cardiac contractility and motion in different segmental areas of the heart. The echo assessment is done pre-operatively and again one week, 3 months and 6 months following the CABG procedure in both groups.

Non-Doppler 2D strain imaging is simple to perform as it requires only one cardiac cycle to be acquired; further processing and interpretation can be done after image data acquisition. Because it is not based on tissue Doppler measurements, images are more accessible to obtain as they are angle independent. It is not necessary for the main motion vector to be parallel to the beam. The 2D loops from the routine echocardiographic examination are processed offline. The software is dependent on high-resolution image quality. Strain imaging, or more appropriately called 'myocardial deformation imaging,' offers a means to quantify the extent of myocardial contraction directly and promises to overcome many of the limitations of LVEF measured by classic ECHO techniques. The strain is the percentage change in the length of a myocardial segment during a given period of time and presented as percent change. Strain rate is the rate at which shortening or lengthening is taking place and presented as a velocity unit. As the myocardium shortens during systole, the strain and strain rate have negative value, but when there is stretch or lengthening of the myocardium, the strain and strain rate becomes positive (Figure 1).

The strain is measured in longitudinal axis using the apical long-axis images. The radial and circumferential strains are also measured from short axis images. The procedure starts by tracing the endocardial border manually in the end-systolic frame. The software then follows the changes in this area of interest and concludes various measurements during different phases of the cardiac cycle [3].

### Statistical analysis

Descriptive statistics were shown for categorical variables as percentages and compared between groups with $x^2$ or Fisher exact test. Continuous variables were expressed as mean ± SD and compared between groups with the t-Student's test. A value of p (a)<0.05 was considered significant. The sample size was calculated with a confidence interval of 95% and an 8% margin of error.

## Results

### Preoperative risk factors

The results revealed that there was no statistically significant difference between both groups in the risk factors: age, smoking, DM, HTN, family history, dyslipidemia, liver function, renal function, and hemoglobin level. EuroSCORE was comparable between the two groups with (4.2 ± 1.1, 3.9 ± 1.4, p=0.16) for group I and II respectively (Tables 1a and 1b).

However, there was a statistically significant difference in pre-operative MI, as there was 78% in group II who had history of MI in the three months period before surgery while in group I there is only 22%. Also, there is a statistically significant difference in LAD calcification and atheroma severity as estimated from the preoperative coronary angiogram through the Graham scoring system. In group II, 78% of the patients had extensive LAD calcification and atheroma with poor surgical quality *vs.* only 22% in group 1. Mean Graham score for the LAD was (2.4 ± 1.1, 3.8 ± 1.5, p<0.05) for group I and II respectively.

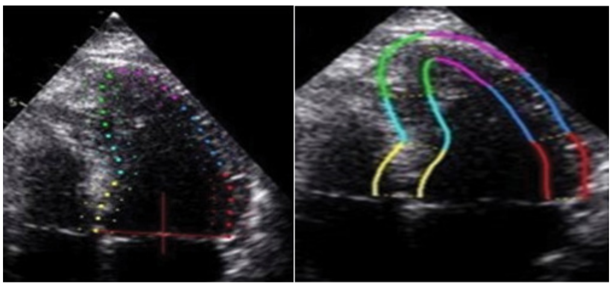

**Figure 1:** Demonstrate endocardial tracing in the end-systolic phase and generation of segments for strain echo analysis.

| | Group I | | | Group II | | | |
|---|---|---|---|---|---|---|---|
| | Min | Max | Mean ± SD | Min | Max | Mean ± SD | P value |
| Age | 39 | 75 | 58.20 ± 8.70 | 42 | 72 | 58.54 ± 7.16 | 0.832 |

**Table 1a:** Comparison between pre-operative risk factors in both groups.

| | | | Group I | Group II | Xx | P-value |
|---|---|---|---|---|---|---|
| Smoking | Yes | No. | 34 | 28 | 1.528 | 0.216 |
| | | % | 0.68 | 0.56 | | |
| | No | No. | 16 | 22 | | |
| | | % | 0.32 | 0.44 | | |
| HTN | Yes | No. | 42 | 38 | 1 | 0.317 |
| | | % | 0.84 | 0.76 | | |
| | No | No. | 8 | 12 | | |
| | | % | 0.16 | 0.24 | | |
| DM | Yes | No. | 33 | 33 | 0 | 1 |
| | | % | 0.66 | 0.66 | | |
| | No | No. | 17 | 17 | | |
| | | % | 0.34 | 0.34 | | |
| Family history | Yes | No. | 10 | 13 | 0.508 | 0.476 |
| | | % | 0.2 | 0.26 | | |
| | No | No. | 40 | 37 | | |
| | | % | 0.8 | 0.74 | | |
| Myocardial infarction | Yes | No. | 11 | 32 | 17.993 | 0 |
| | | % | 0.22 | 0.64 | | |
| | No | No. | 39 | 18 | | |
| | | % | 0.78 | 0.36 | | |
| Dyslipidemia | Yes | No. | 17 | 20 | 0.386 | 0.534 |
| | | % | 0.34 | 0.4 | | |
| | No | No. | 33 | 30 | | |
| | | % | 0.66 | 0.6 | | |
| Liver function | Yes | No. | 0 | 0 | 0 | 1 |
| | | % | 0 | 0 | | |
| | No | No. | 50 | 50 | | |
| | | % | 1 | 1 | | |
| Renal function | Yes | No. | 0 | 0 | 0 | 1 |
| | | % | 0 | 0 | | |
| | No | No. | 50 | 50 | | |
| | | % | 1 | 1 | | |
| Hemoglobin | <11 gms | No. | 4 | 10 | 2.99 | 0.084 |
| | | % | 0.08 | 0.2 | | |
| | >11 gms | No. | 46 | 40 | | |
| | | % | 0.92 | 0.8 | | |
| ECG (S.T changes) | Yes | No. | 11 | 34 | 21.374 | 0 |
| | | % | 0.22 | 0.68 | | |
| | No | No. | 39 | 16 | | |
| | | % | 0.78 | 0.32 | | |
| LAD calcification, atheroma | Yes | No. | 11 | 31 | 16.42 | 0.000* |
| | | % | 0.22 | 0.62 | | |
| | No | No. | 39 | 19 | | |
| | | % | 0.78 | 0.38 | | |

**Table 1b:** Comparison between pre-operative risk factors in both groups.

### Post-operative evaluation results

Mortality was equal between the two groups with a single case for each group. There was no significant difference between both groups in the mechanical ventilation time, total ICU stay, and hospital stay. However, more patients from group II required higher inotropic support with more use of adrenaline above 100 ng/kg/min. Also, there was a statistically significant difference between both groups regarding the incidence of post-operative arrhythmias (new-onset Atrial fibrillation) and mediastinal bleeding with group II having higher values probably due to more antiplatelet therapy before surgery (Tables 2, 3, Figures 2 and 3).

### Echocardiography results: Pre-operative evaluation and Post-operative follow up after one week, 3 months, and 6 months

Pre-operatively, Group I showed better EF and dimensions in comparison with group II with statistically significant difference as shown in Table 4. Post-operatively, the results revealed better results in the EF and dimensions in group I in comparison with group II, indicating better revascularization and recovery of the ischemic insult.

| | | | Groups | | P-value |
|---|---|---|---|---|---|
| | | | Group 1 | Group 2 | |
| Mortality | Yes | No. | 1 | 1 | 1 |
| | | % | 2.00% | 2.00% | |
| | No | No. | 49 | 49 | |
| | | % | 98.00% | 98.00% | |
| Arrhythmias | Yes | No. | 3 | 22 | 0.032 |
| | | % | 6.00% | 44.00% | |
| | No | No. | 47 | 28 | |
| | | % | 94.00% | 56.00% | |
| CNS | Yes | No. | 2 | 2 | 1 |
| | | % | 4.00% | 4.00% | |
| | No | No. | 48 | 48 | |
| | | % | 96.00% | 96.00% | |
| Chest | Yes | No. | 3 | 5 | 0.715 |
| | | % | 6.00% | 10.00% | |
| | No | No. | 47 | 45 | |
| | | % | 94.00% | 90.00% | |
| Wound | Yes | No. | 4 | 8 | 0.233 |
| | | % | 8.00% | 16.00% | |
| | No | No. | 46 | 42 | |
| | | % | 92.00% | 84.00% | |
| Bleeding | Yes | No. | 2 | 16 | 0.04 |
| | | % | 4.00% | 32.00% | |
| | No | No. | 48 | 34 | |
| | | % | 96.00% | 68.00% | |
| Hosp. Dur. | >9 days | No. | 4 | 6 | 0.741 |
| | | % | 8.00% | 12.00% | |
| | <9 days | No. | 46 | 44 | |
| | | % | 92.00% | 88.00% | |

**Table 2:** Post-operative complications.

| | | | Group I | Group II | P value |
|---|---|---|---|---|---|
| **Ventilation duration** | >1 day | No. | 8 | 11 | 0.444 |
| | | % | 0.16 | 0.22 | |
| | <1 day | No. | 42 | 39 | |
| | | % | 0.84 | 0.78 | |
| **Inotropic drugs** | >100 ng adrenaline | No. | 12 | 21 | 0.06 |
| | | % | 0.24 | 0.42 | |
| | <100 ng adrenaline | No. | 38 | 29 | |
| | | % | 0.76 | 0.58 | |

**Table 3:** Comparison between both groups in ventilation duration and inotropic drugs.

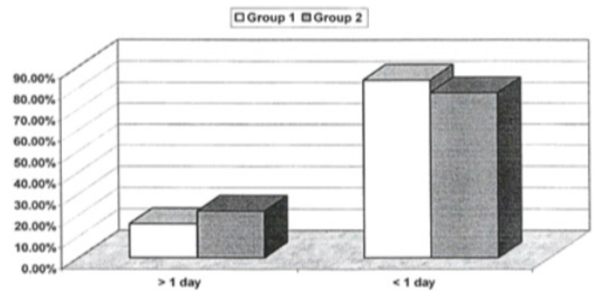


**Figure 2:** Comparison between both groups in ventilation duration.

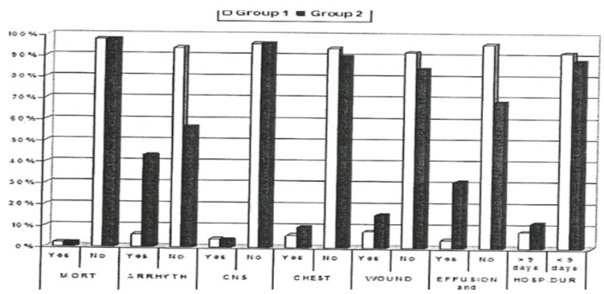


**Figure 3:** Comparison between the two groups regarding post-operative complications.

The maximal difference was noticed after 6 months as group I had the best recovery of LV functions and dimensions in most of the cardiac segments that were analyzed . In summary, group I showed gradual improvement in the 6 months follow-up period with a significant increase in function from the baseline preoperative values . Also , group I had better values at every point of assessment in comparison to group II.

Analysis of the segmental wall motions through strain-based echo measurements of the different 17 segments of the heart revealed the following: (Table 6).

Group I had significantly better preoperative wall motion values especially in the segments supplied by the left anterior descending artery. Additionally, group I had better recovery of the wall motion of the different regional areas reaching statistical significance. This was noticed starting from the third month up to the sixth month. The LAD and RCA areas recovered the best in the non-PCI group (group I) and almost equal recovery were found in the circumflex artery supplied areas.

## Discussion

Patients who undergo myocardial revascularization by PCI may require surgical intervention subsequently. PCI is often preferred to surgery; the initial choice of PCI is reinforced by the perception that the patients can safely be referred to surgery later on. A study by Chocron et al. [4] illustrated that there is a general perception adapted by most interventionists that PCI stenting will not affect the course or the results of subsequent CABG. This concept was challenged by recent reviews in the literature that provided evidence against this strategy. There is growing evidence that PCI may adversely affect the outcome in patients with repeated PCIs [5-9] and even in patients undergoing non-cardiac surgery. The study of Loponen et al. [5] which compared

| | Pre-op | | | | | 1 week | | | | | 3 months | | | | | 6 months | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group I | | Group II | | | Group I | | Group II | | | Group I | | Group II | | | Group I | | Group II | | |
| | mean | SD | mean | SD | p-value | mean | SD | mean | SD | p-value | mean | SD | mean | SD | p-value | mean | SD | mean | SD | p-value |
| EDD | 50.38 | 5.68 | 54.32 | 7.44 | 0.00367 | 50.3 | 5.65 | 53.52 | 7.42 | 0.01643 | 49.58 | 5.99 | 53.22 | 7.74 | 0.00992 | 45.76 | 5.97 | 53.12 | 7.78 | 0 |
| ESD | 32.48 | 4.64 | 35.34 | 6.04 | 0.00925 | 32.82 | 6.94 | 35.18 | 5.96 | 0.07117 | 31.82 | 7.01 | 35.46 | 6.13 | 0.00682 | 30.76 | 7.07 | 35.5 | 6.14 | 0.00054 |
| EDV | 82.58 | 33.38 | 89.32 | 20.39 | 0.22598 | 99.74 | 18.35 | 100.16 | 18.07 | 0.90842 | 89.26 | 20.41 | 99.78 | 18.31 | 0.00788 | 88.74 | 20.24 | 95.04 | 20.22 | 0.12265 |
| ESV | 32.82 | 6.63 | 35.56 | 10.15 | 0.11324 | 40.76 | 14.36 | 41 | 14.05 | 0.93285 | 35.92 | 6.67 | 40.86 | 14.27 | 0.02889 | 32.8 | 6.66 | 38 | 6.7 | 0.00018 |
| FS | 33.68 | 5.88 | 29.18 | 5.57 | 0.00016 | 33.06 | 5.9 | 24.34 | 4.59 | 0 | 34.34 | 5.95 | 24.28 | 4.6 | 0 | 35.16 | 4.67 | 33.42 | 5.98 | 0.10785 |
| EF | 54.32 | 6.6 | 50.64 | 7.78 | 0.0123 | 53.74 | 7.39 | 48.24 | 7.22 | 0.00028 | 55.44 | 7.34 | 50.94 | 7.15 | 0.00249 | 57.64 | 7.37 | 50.74 | 7.05 | 0.00001 |

**Table 4:** Comparison between the two groups regarding Echo-derived cardiac dimensions and functions.

the quality of life following CABG surgery in comparison to use of stents for treatment of chronic angina; found that CABG offered a better quality of life in comparison to PCI use. Preoperatively the stent group was younger than the CABG group. The risk of major adverse events after surgical intervention was demonstrated to be significantly increased with a history of previous PCI; this was attributed to a stent-induced injury of the coronary artery [6].

There was no statistically significant difference between preoperative risk factors between both groups. Having this fact may help us to conclude that the only differing effect was due to pre-operative stent use between both groups.

Group II had more ECG changes and more myocardial infarction events, indicating that stent use increased the liability of patients for ischemic events which might be attributed to a proposed stent injury. Putting stents in native vessels induces a local inflammatory reaction in the coronary vessel both locally at the site of the stent insertion and in the distal site of the vessel upfront the stent site. A proliferative reaction leading eventually to in-stent stenosis ensues with stent deployment [7-20]. Recent research of Thielmann et al., [20] Velicki [21] demonstrated that patients with PCI underwent more unplanned CABG procedures. This may be due to coronary stents which are causing arterial wall injury, leading to more dysfunctional and denuded coronary endothelium with the chronic inflammatory response, and platelet adhesion causing a series of adverse events. This concedes with our study. Also, after PCI the collateral circulation will be closed, and it doesn't have enough time to reopen during stent thrombosis or restenosis. This theory may also emphasize the cause of increasing number of MI in the PCI group by Thielmann et al., Velicki and Tran et al. [20-22].

Taking into consideration the LAD quality in the preoperative angiogram, more calcifications and extensive atheroma were found in the PCI group. This was translated to more aggressive surgical techniques to achieve revascularization of the diseased coronary vessels. Examples of these techniques include endarterectomy and extensive saphenous venous patching of the target distal sites. These will negatively affect the surgical course with difficult anastomoses, friable walls with more risk of bleeding, longer times to complete the anastomoses, prolonged bypass time and surgery time. Intra-operatively, we noticed that the LAD pathology was more severe at the site of the stent and extended even distal to the stent site. This might be due to either propagation of post-stent thrombosis to occlude the vessel totally, which is more common, or due to the propagation of atherosclerosis in the previously diseased vessel left without intervention [22].

In the study by Tran et al. [22], post-operative inotropic support was found to be used more with previous PCI use which comes in harmony with our results. This may be related to difficulties in total revascularization, higher EDD in these patients and a higher incidence of pre-operative MI.

On further analysis of post-operative morbidity, the PCI group showed higher incidence of mediastinal bleeding with more incidence of surgical re-exploration. The reasons are not clear; however, the PCI group patients were presented for surgery with more advanced symptoms and greater urgency with continuous use of antiplatelet medications. More patients in group II had new onset atrial fibrillation probably due to more ischemic events in these patients and more aggressive disease with more difficult revascularization.

The total hospital stay, and ICU stay were the same in both groups. However, this was different from the study by Thielmann et al. [20] which had longer ICU stays for the PCI group of patients.

The two groups were comparable in the rate of mortalities with one case for each group. The study of Sánchez et al. [23] 2013 had the same result as regards in-hospital mortality while others Mack et al. [24]; Pliam et al., [25] stated that PCI group had higher mortality [22].

In our study, there was a statistically significant difference between both groups especially EF and FS which reached statistical significance. This might reflect the fact that the PCI group patients suffered more infarctions and ischemia than the other group. This is due to single or multiple in-stent restenoses. The study by Kanemitsu et al. [26] however found no difference between both groups regarding EF, FS, ESD, EDD.

Considering pre-operative ECHO segmental wall motion, there is a statistically significant difference between both groups in most of the segments especially apex segment. This reflects that the viability of these segments is more in non-PCI group. Also, we found that in non-PCI group there was a statistically significant difference between one week, 3 months, and 6 months post-operative values in most of the segmental regions the apex segment. The values increased after 6 months thus reflecting successful recovery after proper surgical revascularization. Also, we found that in PCI group there was a slower recovery in the segmental wall motion of most regions. The values were always less than group I. This may reflect failure of complete revascularization due to the preoperative injury of the stent and the technical difficulties imposed by the previous stent use.

Thus, it is noticeable that previous PCI before CABG surgery had a negative impact on recovery of the myocardial segments supplied by different coronary arteries. This effect was pronounced both pre- and post-operatively. The response to CABG revascularization was slowed down in the PCI group probably due to a chronic inflammatory mechanism and secondary insult to the collateral circulation.

## Study Limitation and Recommendation

The number of enrolled patients limits the explanatory power of our study. It is also more conclusive to study the long-term outcome (more than five years) to complete the results and the final outcome.

| | | | PRE-OP | | | | | | | | 1 WK | | | | | | 3 MONTHS | | | | | | 6 MONTHS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Normal | | Group I | | Group II | | T-Test | | Group I | | Group II | | T-Test | | Group I | | Group II | | T-Test | | Group I | | Group II | | T-Test | |
| | | | MEAN | SD | MEAN | SD | MEAN | SD | T statistic | P VALUE | MEAN | SD | MEAN | SD | T statistic | P VALUE | MEAN | SD | MEAN | SD | T statistic | P VALUE | MEAN | SD | MEAN | SD | T statistic | p value |
| LAD | Anterior | 14 | 19.4 | 5.4 | 14.04 | 8.09 | 9.56 | 3.45 | 3.601896 | 0.0005 | 15.34 | 3.65 | 11.78 | 3.29 | 5.122795 | 0 | 16.22 | 4.4 | 16 | 3.34 | 0.281609 | 0.77884 | 18.12 | 3.26 | 11.78 | 4.52 | 8.044286 | 0 |
| | Septal | 13 | 22.3 | 4.8 | 11.68 | 3.41 | 10.76 | 3.86 | 1.263057 | 0.20957 | 18.5 | 3.89 | 13.86 | 4.7 | 5.377774 | 0 | 19.72 | 4 | 13.7 | 4.8 | 6.812815 | 0 | 21.3 | 3.8 | 16.5 | 4.2 | 5.992514 | 0 |
| | Anteroseptal | 8 | 19.4 | 3.2 | 12.72 | 5.95 | 8.96 | 5.24 | 3.3534 | 0.00114 | 16.86 | 3.62 | 11.82 | 5.3 | 5.552601 | 0 | 17.4 | 3.83 | 14.38 | 5.37 | 3.237564 | 0.00165 | 18.7 | 3.76 | 15.5 | 3.6 | 4.346799 | 0.00003 |
| | Anterior | 7 | 18.8 | 3.4 | 9.94 | 5.8 | 8.76 | 4.39 | 1.147069 | 0.25415 | 14.06 | 3.22 | 10.02 | 4.37 | 5.262728 | 0 | 16.2 | 3.18 | 11.84 | 4.44 | 5.64513 | 0 | 17.89 | 3.2 | 15.6 | 3.6 | 3.361836 | 0.00111 |
| | Anteroseptal | 2 | 18.3 | 3.5 | 14.65 | 4.5 | 12 | 5.23 | 2.715902 | 0.00781 | 16.48 | 4.31 | 13.06 | 3.11 | 4.550045 | 0.00002 | 16.7 | 4.41 | 14.98 | 3.17 | 2.239363 | 0.02739 | 17.9 | 4 | 15.7 | 3.11 | 3.070273 | 0.00277 |
| | Anterior | 1 | 20.1 | 4 | 10.7 | 4.8 | 10 | 2.8 | 0.890727 | 0.37526 | 18.92 | 5.87 | 9.98 | 3.07 | 9.542898 | 0 | 19.06 | 6.01 | 11.8 | 3.14 | 7.570744 | 0 | 19.6 | 5.9 | 13.1 | 2.9 | 6.991268 | 0 |
| CX | Lateral | 16 | 19.2 | 5.4 | 16.7 | 3.4 | 15.8 | 4 | 1.212238 | 0.22834 | 16.78 | 3.69 | 15.2 | 5.13 | 1.767975 | 0.08018 | 16.92 | 4.07 | 15.04 | 5.09 | 2.039794 | 0.04406 | 18.1 | 3.7 | 17.8 | 4.1 | 0.384111 | 0.70173 |
| | Anterolateral | 12 | 18.1 | 3.5 | 15.08 | 5.22 | 12.1 | 3.29 | 3.415038 | 0.00093 | 16.6 | 2.7 | 11.46 | 3.11 | 8.82487 | 0 | 16.8 | 2.72 | 11.34 | 3.02 | 9.49923 | 0 | 17.1 | 2.33 | 11.98 | 3.5 | 8.61048 | 0 |
| | Inferolateral (posterior ) | 11 | 16.8 | 5 | 15.04 | 8.09 | 16.56 | 3.45 | 1.222072 | 0.22461 | 16.34 | 3.65 | 12.78 | 3.29 | 5.122795 | 0 | 16.22 | 4.4 | 16.34 | 3.43 | 0.152094 | 0.87943 | 16.4 | 4.2 | 15.8 | 3.8 | 0.749064 | 0.45561 |
| | Anterolateral | 6 | 17.3 | 5 | 15.6 | 5.1 | 14.8 | 3.5 | 0.91454 | 0.36268 | 14.38 | 3.79 | 14.78 | 3.67 | 0.536124 | 0.59309 | 14.74 | 4 | 12.46 | 3.62 | 2.988412 | 0.00354 | 15.7 | 4.3 | 15.4 | 4.1 | 0.357042 | 0.72183 |
| | Inferolateral (posterior ) | 5 | 14.5 | 7.6 | 14 | 3.2 | 14.4 | 6.1 | 0.410608 | 0.68226 | 14.92 | 4.8 | 14.8 | 2.6 | 0.155438 | 0.8768 | 15.14 | 4.97 | 14.56 | 2.79 | 0.719568 | 0.4735 | 14.9 | 4.7 | 14.7 | 3.4 | 0.243794 | 0.8079 |
| RCA | Inferior | 15 | 22.5 | 4.5 | 20.98 | 4.86 | 19.12 | 3.27 | 2.245287 | 0.027 | 19.78 | 2.47 | 11.36 | 3.27 | 14.52856 | 0 | 20.74 | 2.54 | 11.4 | 3.32 | 15.79922 | 0 | 21.6 | 2.2 | 15.9 | 4.4 | 8.193174 | 0 |
| | Inferior | 10 | 20.4 | 3.5 | 20.9 | 3.81 | 19.12 | 3.4 | 2.464811 | 0.01545 | 19.72 | 3.87 | 11.16 | 3.5 | 11.60004 | 0 | 19.96 | 4.02 | 11.08 | 3.43 | 11.88226 | 0 | 19.89 | 3.7 | 14.3 | 4.1 | 7.157262 | 0 |
| | Inferoseptal (septal) | 9 | 18.7 | 3 | 18.44 | 4.12 | 17.7 | 2.7 | 1.062263 | 0.29073 | 12.36 | 5.59 | 14.76 | 2.7 | 2.733702 | 0.00743 | 16.52 | 5.84 | 14.78 | 2.64 | 1.919749 | 0.0578 | 17.6 | 4.7 | 15.5 | 3.1 | 2.637392 | 0.00972 |
| | Inferior | 4 | 17.1 | 3.9 | 17.1 | 3.1 | 16.9 | 3.2 | 0.31742 | 0.7516 | 16.8 | 3.64 | 13.18 | 2.83 | 5.551716 | 0 | 16.92 | 3.67 | 13.4 | 3.5 | 4.907965 | 0 | 16.5 | 4.5 | 14.8 | 3.2 | 2.176984 | 0.03188 |
| | Inferoseptal (septal) | 3 | 13.7 | 4 | 12.9 | 5 | 13 | 4.2 | 0.108287 | 0.91399 | 11.72 | 3.17 | 11.16 | 3.21 | 0.877726 | 0.38224 | 12.76 | 3.2 | 11.08 | 3.24 | 2.608645 | 0.01051 | 13 | 5.7 | 12.9 | 4.2 | 0.09987 | 0.92065 |
| | GLB AVG | | | | 14.8 | 5.2 | 13.54 | 4.6 | 1.283311 | 0.202409 | 16.5 | 3.5 | 12.57 | 3.2 | 5.8598 | 0 | 17 | 4.5 | 13.4 | 4.7 | 3.912119 | 0.000169 | 17.76 | 4.8 | 14.8 | 5.1 | 2.988527 | 0.003543 |

**Table 5:** Comparison between the two groups regarding segmental wall motion determined by strain Echocardiography.

## Conclusion

Previous PCI has a negative impact on the outcome of subsequent CABG regarding morbidity. This effect is not related to any preoperative variable. Myocardial function in the form of EDD, ESD, EF, and RSWMA has improved after CABG in the patients who had previous PCI less than in patients who have no previous PCI. Percutaneous coronary revascularization should be carefully considered against the higher risk it provides for subsequent CABG. The guidelines for intervention should be strictly followed especially in patients with complex coronary lesions who have higher incidence to be referred for CABG. Previous stent use is considered a risk factor which we suggest integrating into the EuroSCORE analysis of preoperative risk evaluation for CABG patients.

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