A COMPARISON BETWEEN POSTOPERATIVE TROPONIN ELEVATION IN AN OFF-PUMP VERSUS CONVENTIONAL CORONARY ARTERY BYPASS GRAFT IN PREDICTING THE SHORT-TERM OUTCOME

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(Received: December 18, 2022; Accepted for Publication: March 28, 2023)

ABSTRACT

Background: Although, advancements in techniques and perioperative management in coronary artery bypass surgery the elevation of postoperative troponin still occurs commonly. In this regard, we aimed to assess the degree of myocardial injury by measuring and comparing the levels of cardiac troponin I in the postoperative period of conventional versus off-pump coronary artery bypass graft and identify the most associated factors.

Patients and methods: This prospective cohort study included the patients who underwent conventional coronary artery bypass surgery (46 patients) and off-pump coronary artery bypass surgery (34 patients), at Azadi heart Center in Duhok province during the period between 25th November 2021 and 25th May 2022.

Results: The total amount of cardiac troponin release was significantly higher in the conventional than in the off-pump group. At one hour, the conventional means was 7.13 ng/ml while the off-pump was 1.56 ng/ml, $p < 0.0001$and at 24 hours, the convention mean was 5.51 ng/ml while the off-pump was 1.24 ng/ml, $p < 0.001$. The most associated factors in the conventional compared to the off-pump were advanced age, male gender, hypertension, renal impairment, Previous myocardial infarction, and timing of surgery. the main independent factors associated with cardiac troponin I elevation within 24 hours following conventional coronary artery bypass surgery were overweight, chronic renal failure, Smoking, and urgent procedure status.

Conclusion: This study showed that the patients who underwent the conventional group had significantly higher levels of troponin I at 1 hour and 24 hrs, postoperatively. The higher postoperative troponin I among patients who underwent the conventional group was associated with being overweight, smoking, having chronic renal failure, and using urgent procedure status.

KEYWORDS: cardiac troponin I, On-pump and Off-pump coronary artery bypass, Cardiopulmonary bypass.

CHAPTER ONE: INTRODUCTION

Coronary artery disease (CAD) or ischemic heart disease (IHD) is the most common cause of death worldwide. The primary pathological process that leads to CAD is atherosclerosis due to multiple risk factors. More than 70% of at-risk individuals have multiple risk factors for CAD, and only 2%-7% of the general population have no risk factors. The global prevalence of CAD is rising, it was estimated that in 2020, 244.1 million people live with CAD, and it was more prevalent in males than in females (141.0 and 103.1 million people), and mortality rates were 112.37 per 100,000 globally (Lozano *et al.*, 2012, Khan *et al.*, 2020, Feigin *et al.*, 2022).

Coronary artery disease can be managed by lifestyle modifications, conservative management with medications, interventions (PCI), and coronary artery bypass graft surgery. Both angioplasty and CABG are used to treat coronary artery disease revascularization when conservative management fails (Lukkarinen Hentinen, 2006, Doenst *et al.*, 2019).

Coronary artery bypass graft (CABG) remains the most common cardiac surgical procedure and effective revascularization strategy for CAD. The coronary artery is bypassed via harvested venous or arterial conduits to regain blood flow to the ischemic myocardium, decrease angina symptoms, and increases long-term survival in patients with severe CAD. according to ACC/AHA CABG guidelines, CABG is the preferred procedure for

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treating left main (LMCA), triple vessel coronary artery diseases (LAD, LCX, and RCA), diffuse diseases that cannot be managed with a PCI, and other high-risk patients with severe ventricular dysfunction (Deb *et al.*, 2013, Wolff *et al.*, 2017, Members *et al.*, 2022).

Currently, there are two techniques available for CABG. One of these is called a "Conventional CABG" (CCAB), which requires the use of a cardiopulmonary bypass (CPB), aortic cross-clamp, and cardioplegia. The other is called an "off-pump CABG" (OPCAB), which does not require a CPB machine (Emerson Trachiotis, 2016, Kuwahara Tashiro, 2020).

Conventional CABG has been regarded as a standard surgical procedure for the improvement of CAD. The procedure is associated with several side effects mostly due to the use of cross-clamp, cardioplegic arrests, and CPB such as systemic insults (systemic inflammatory response) and deleterious effects including multiple organ dysfunction, neurocognitive dysfunction, and coagulation abnormalities. To avoid these deleterious effects of CPB a resurgence of CABG on an off-pump CABG (Shaefi *et al.*, 2019).

Off-pump CABG (OPCAB) technique was introduced many years ago but has been abandoned with the advent of CPB. Before the advent of CPB, cardiac surgery was done on an off-pump, but the procedure was very difficult due to the lack of necessary immobilizing equipment. Immobilization has become easier due to the development of new stabilization devices like the octopus, and off-pump surgery has once again become common. The technique was offered as an alternative to the standard on-pump technique in high-risk patients. This type of surgery needs much more patience and requires very skilled surgeons than CCAB as the risk of anastomotic bleeding and suboptimal revascularization is increased as well as restricted access to certain coronary vessels (Bainbridge *et al.*, 2005, Sahdev *et al.*, 2023).

Cardiac troponin (cTn) is recommended as the preferred biomarker for the diagnosis of type 5 MI and myocardial ischemia during cardiac, due to its superior sensitivity and specificity compared to traditional biomarkers such as creatine kinase. By measuring cardiac Troponin-I levels (cTn-I), even smaller myocardial injuries can be detected with greater diagnostic accuracy. The myocardial injury occurs in cases following cardiac bypass surgery. Therefore, after any CABG operation, elevations in troponin I levels should be expected (Vermes *et al.*, 2000, Lim *et al.*, 2011, Thielmann *et al.*, 2017). The purpose of this study is to assess the degree of myocardial injury by measuring the cTn-I levels in the postoperative period of conventional versus off-pump CABG within 1 hour and 24 hours and identify the most associated factors post-operatively

CHAPTER TWO: PATIENTS AND METHODS

Study design

In this prospective cohort study, the patients who underwent CABG surgery were included. The medical records of the patients with CABG at a tertiary heart center were reviewed for the eligibility criteria. The patients were undergoing medical investigations by cardiologists. The patients who were diagnosed with CAD were referred to Azadi Heart Center for clinical management either by CABG or PCI. The patients who underwent CCAB and off-pump management met the initial eligibility for this study. The cases were included from Azadi Heart Center in Duhok province in the period from 25th November 2021 to 25th May 2022. This study included 80 elective and urgent patients after excluding no eligible patients from the analysis. The patients were divided into two groups based on measuring and comparing the cardiac Troponin-I levels in the postoperative period.

Population and setting

The population in this study were those who underwent coronary artery bypass surgery at Azadi Heart Center. The patients had different medical and socio-demographic characteristics within Duhok province. The Azadi Heart Center is the only tertiary specialized center for diagnostic and therapeutic services for cardiac patients in Duhok province. In this region, this setting was established in 2011. The setting accepts a wide range of patients with cardiac surgery. Therefore, we expect that we have included as many patients as possible who met the eligibility criteria in this area. Only a few numbers of patients attend the private sector for therapeutic services in this region. The researchers had no access to the medical records of the private sector due to administrative difficulties.

Inclusion and exclusion criteria

The patients met the initial eligibility criteria if they underwent CABG surgery. Further, the

patient's records were screened accordingly. In this cohort study, all Patients requiring CABG surgery who underwent conventional technique and off-pump technique during data gathering were included. we included 80 patients, off-pump CABG n=34, and conventional CABG n=46. The participant with mechanical heart complications post-myocardial infarction including ruptured ventricular septal defect, and ischemic papillary muscle rupture were excluded from the analysis. The Patients who require only valve surgery, redo surgery and require Combined CABG with valve surgery were excluded as well. Furthermore, the patients who had more than 20% missing information in their medical records were excluded from the analysis.

Diagnostic and Measurements tools

The patient usually presents with a history of chest pain, then coronary artery disease is confirmed by taking a bedside ECG, Echocardiography, and sending a baseline sample for serum troponin I level and CK: MB, then a planned diagnostic coronary angiography is performed by a cardiologist after standard coronary artery angiography (stenosis more than 50%). If the patient was approved to have criteria for coronary artery bypass surgery, then he was transferred to a surgeon to give an appointment for surgery. The decision of which surgical technique to apply (OPCAB or CCAB) was based on the operating surgeon depending on the general well-being of the patient, comorbidities, and left ventricular function

Data collection methods

After getting the permission from Duhok General Directorate of Health and the selected hospital administrations in Duhok province. The information was entered into a pre-designed questionnaire. preoperative information was taken from the patient and the postoperative was taken from the medical records and was used to fill out a questionnaire. The designated questionnaire consists of the patient's characteristics, intraoperative variables, and postoperative events, each patient had the same questionnaire and technique. Additionally, the filling of the questionnaire for each patient took around 30 minutes on the 1st day of preoperative examination and 40 minutes at each of the two follow-up visits in immediate postoperative and on day one postoperative. the researcher told them that all data will be confidential and will be only used for research purposes.

Measurement of troponin I level

Cardiac Troponin-I (cTn-I) is routinely measured pre and post-cardiac surgery at our center. Preoperatively, direct venipuncture was used to take blood samples from patients. and from the arterial lines when they went back to the intensive care unit for assessing cTn-I level. Each patient had at least two serum cTn-I tests at various times. Patients were admitted to the surgical intensive care unit, the first postoperative blood test for measuring cTn-I was taken immediately following surgery, and the second sample of blood was taken 24 hours following surgery. All tests were done in the Clinical Chemistry Department of the Azadi Hospital on Elecsys and cobas e immunoassay analyzers. In our lab, the serum cTn-I normal range was 0.00–0.03 ng/ml.

Statistical analyses

The general information of the patients of both procedures was presented in mean (SD) or number (%). The prevalence of outcomes and troponin abnormalities was determined in number (%). The comparisons of general, medical, and complications between conventional and beating CABG were examined in an independent t-test or Pearson chi-squared tests. The association of troponin elevation with the preoperative ejection fraction was examined in Pearson chi-squared test. Analysis of cardiopulmonary bypass time (minute) by postoperative complications in conventional CABG was examined in ANOVA one-way test. The significant level of difference was determined by a p-value of less than 0.05. The statistical calculations were performed in JMP Pro 14.3.0 (Statistical Software | JMP).

Ethical views

The ethical approval of this protocol was obtained from the Ethical committee statement from the Duhok Directorate General of Health on 24-October-2021 with a reference number: 24102021-10-26. Email: scientific.research@duhokhealth.org.

CHAPTER THREE: RESULTS

The study shows that There were significant differences in gender between the two groups,

the majority of patients were males in two groups males: 82.35%, whereas 17.65% of them were females who underwent off-pump group. 58.70% were males, however, 41.30% of them were females who underwent the conventional group, p = 0.0240b. Patients who underwent conventional CABG were older compared to those who underwent off-pump CABG 61.93 vs. 57.09, p=0.0035. But the patients in the conventional group had larger body surface area compared to off-pump CABG P=0.0027. The patients in both groups were similar in BMI P=0.3644, smoking P=0.7947, and Procedure status P=0.4860**.**

Table **(*1***

Table (1): Comparisons of general information between conventional and off-pump CABG

General information	Procedure no (%)		p-value
	off-pump-CABG (n=34)	Conventional-CABG (n=46)	
Age means (SD) Rang 45-78 years	57.09 (5.78)	61.93 (7.69)	0.0035[a]
Age category			0.0094
41-50	5 (14.71)	5 (10.870	
51-60	21 (61.76)	13 (28.26)	
61-70	6 (17.65)	22 (47.83)	
71-80	2 (5.88)	6 (13.04)	
Gender			0.0240[b]
Male	28 (82.35)	27 (58.70)	
Female	6 (17.65)	19 (41.30)	
BMI mean (SD)	28.67 (3.49)	27.85 (4.05)	0.3644[a]
BMI category no (%)			
Normal weight	4 (11.76)	13 (28.26)	
Overweight	18 (52.94)	16 (34.78)	0.1330[b]
Obese	12 (35.29)	17 (36.96)	
Smoking no (%)			0.7947[b]
No	16 (47.06)	23 (50.00)	
Yes	18 (52.94)	23 (50.00)	
Body surface area mean (SD)	1.92 (0.12)	1.82 (0.16)	0.0027[a]

For statistical analysis, [a] an independent t-test and [b] Pearson chi-squared tests were done.
CABG= Coronary Artery Bypass Graft, BMI=Body mass index. SD= standard deviation, n=number.

The study showed that the patients who underwent convention CABG had a greater number of co-morbidities compared to those who underwent off-pump CABG. hypertensive 97.83 vs 85.29, p=0.0354. renal impairment 23.91 vs 2.94, p-0.0094. the previous history of MI 60.87 vs 38.24%, p-0.0453. On another hand, the study didn't find any significant difference in preoperative ejection fraction (P= 0.3721), DM (P=0.4256), preoperative stroke (p=0.4136), preoperative carotid artery stenosis (p=0.6696), number of graft (P=0.1148), and preoperative elevated Troponin (P=0.1401).

Table (2

By transthoracic echocardiography, we stratified patients according to preoperative ejection fraction categories {Good (> 50%), Moderate (50-30%), and Poor (<30%)} and found no statistically significant difference in any category (P= 0.4663).

Table **(*2***

Table (2): Preoperative patient Profile by group

Variables	Procedure no (%)		p-value
	Off-pump CABG (n=34)	Conventional CABG (n=46)	
Ejection fraction			

Poor	0 (0.00)	2 (4.35)	
Moderate	12 (35.29)	16 (34.78)	0.4663 [b]
Good	22 (64.71)	28 (60.87)	
Ejection fraction mean (SD)	53.45 (7.55)	51.52 (10.58)	0.3721
Range: 25-65%	30-64	25-65	
DM			
No	5 (14.71)	10 (21.74)	0.4256 [b]
Yes	29 (85.29)	36 (78.26)	
Hypertension			
No	5 (14.71)	1 (2.17)	0.0354 [b]
Yes	29 (85.29)	45 (97.83)	
Renal impairment			
Normal	33 (97.06)	35 (76.09)	0.0094 [b]
Elevated	1 (2.94)	11 (23.91)	
Preoperative acute renal failure			
No	32 (94.12)	43 (93.48)	0.9070
Yes	2 (5.88)	3 (6.520	
Preoperative chronic renal failure			
No	32 (94.12)	42 (91.30)	0.6367
Yes	2 (5.88)	4 (8.70)	
Previous MI			
No	21 (61.76)	18 (39.13)	0.0453 [b]
Yes	13 (38.24)	28 (60.87)	
Preoperative stroke			
No	31 (91.18)	44 (95.65)	0.4136 [b]
Yes	3 (8.82)	2 (4.35)	
Preoperative carotid artery			
stenosis	23 (67.65)	29 (63.04	0.6696 [b]
No	11 (32.35)	17 (36.96	
Yes			
Number of graft			
1	1 (2.94)	0 (0.00)	0.1148 [b]
2	3 (8.82)	2 (4.35)	
3	16 (47.06)	13 (28.26)	
4	8 (23.53)	23 (50.00)	
5	5 (14.71)	8 (17.39)	
6	1 (2.94)	0 (0.00)	
Preoperative Troponin I level ng/ml	0.13 (0.09)	0.10 (0.03)	0.1401 [a]

For statistical analysis, [a] an independent t-test and [b] Pearson chi-squared tests were done.
DM=Diabetes Mellitus, MI=Myocardial Infarction.

Baseline characteristics- intra-operative variables and Postoperative morbidity

The mean extracorporeal circulation time in the conventional group was 137.24 minutes. Ischemic time, in the conventional group, was measured by aortic cross-clamp time and the mean was 86.13 minutes. In the off-pump group, it was considered the period of coronary occlusion by coronary snaring which is about a few seconds so it is negligible. The study showed that the mean value of operating time was significantly longer in patients of the conventional CABG compared to patients in the off-pump CABG; 5.78 vs. 4.65, P<0.0001.***table 3***

Post-Operative Bleeding

Bleeding even was recorded postoperatively, measuring the exact thoracic tube output. significant bleeding was defined as total blood loss of 1500 ml in the first 6 hours with hemodynamic instability mandating reoperations. Patients who operated on the off-pump-CABG group had less total blood loss compared to the conventional CABG group; only 1 patient had postoperative bleeding in the off-pump group, compared to 6 in the Conventional group p = 0.1139. ***Table (3***

Other Morbidities or Variables:

The study showed that the mean value of operating time was significantly longer in patients of the conventional CABG group compared to patients in the off-pump-CABG; 5.78 vs. 4.65, P<0.0001.

Two patients in the conventional revascularization needed intra-aortic balloon pump initiation during or after surgery, while none in the off-pump revascularization group needed it, p = 0.2182.***Table (3***

Table (3): Comparisons of compilations and intraoperative events between conventional and off-pump CABG

compilations and intraoperative event	Procedure no (%)		p-value
	Off-pump-CABG (n=34)	Conventional-CABG (n=46)	
Cross-clamp time (minute) mean (SD) 55-126		86.13 (16.79)	NA
Cardiopulmonary bypass time (minute) mean (SD) 82-215		137.24 (27.10)	NA
Operating Time (hrs.) mean (SD) 2.5-8.5	4.65 (1.20) 2.5-7.75	5.78 (1.18) 3.75-8.5	<0.0001[a]
Post-operative bleeding			0.1139[b]
No	33 (97.06)	40 (86.96)	
Yes	1 (2.94)	6 (13.04)	
Postoperative complications			0.0525[b]
Death	0 (0.00)	1 (2.17)	
No	29 (85.29)	28 (60.87)	
Yes	5 (14.71)	17 (36.96)	
Intra-aortic balloon pump			0.2182[b]
No	34 (100)	44 (95.65)	
Yes	0 (0.00)	2 (4.35)	

For statistical analysis, [a] an independent t-test and [b] Pearson chi-squared tests were done.

Myocardial Infarction

At 1 hr, and 24 hours postoperatively, cardiac troponin-I was measured. The study showed that there was a significant elevation in troponin I level postoperatively in all participants. however, when comparing conventional CABG to off-pump-CABG there was a significant difference in the level of troponin elevation. conventional vs off-pump group is 1.56, p<0.0001, and this significant difference continued after 24hrs of surgery the mean value of 5.51 seen in conventional vs 1.24 in off-pump, p-values <0.001.

Table *(4* and ***Fig.* (*1*** below show the p-values, mean difference, and standard deviation. The biggest difference may be shown at 1 hour, where a mean value of 7.13 is shown in the

Table (4): Troponin level elevation in patients undergoing Convention CABG versus off-pump CABG procedures at 1-hr and 24 hours postoperatively

Post-operative levels	**All patients (n=80)**	**Type of procedure**		**P-value**
		Convention CABG	Off-pump CABG	
Troponin I at 1-hr (ng/ml)	3.55 (2.8)	7.13 (6.68)	1.56 (1.60)	<0.0001
Troponin I at 24-hr (ng/ml)	2.97 (2.65)	5.51 (4.26)	1.24 (0.92)	<0.001

An independent t-test was performed for statistical analyses.

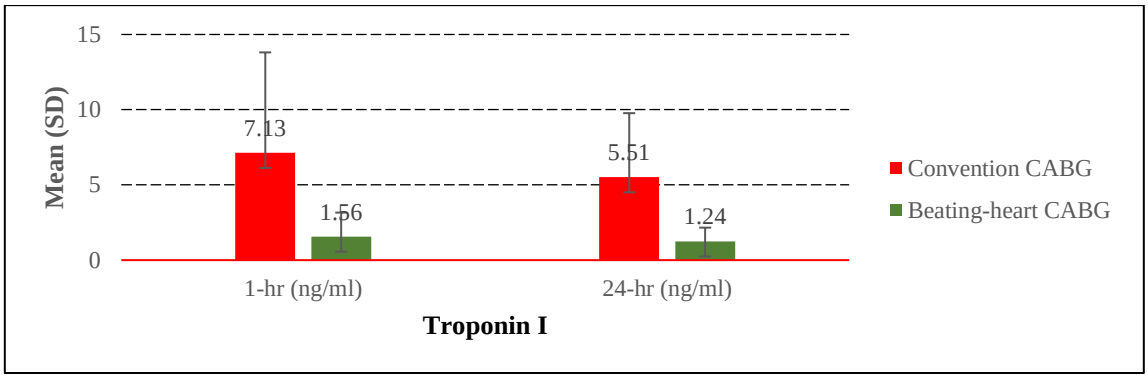


Fig. (1): Troponin level elevation in patients undergoing Convention CABG versus off-pump CABG procedures at 1-hr and 24 hours postoperatively

The study shows that the main independent factors associated with troponin elevation at 24 hrs postoperative in patients with the different characteristics following conventional CABG surgery were overweight p=0.0252, smoking p=0.0437, chronic renal failure p=0.0164, and urgent procedure status p=0.0234, and the other factors were not associated with the troponin level are shown in ***Table (5*** below.

Table (5): Comparisons of postoperative troponin level (24 hrs.) in patients with different characteristics in the conventional study group

Characteristic (n=46)	Statistics			Pairwise comparisons
	Mean	Std Dev	P-value	
Age Category			0.7966	
41-50	9.18	8.89		
51-60	7.19	5.88		
61-70	6.15	5.36		
71-80	7.87	9.61		
Gender			0.7826[a]	
Male	6.79	5.31		
Female	7.33	7.82		
BMI category			0.0252[b]	Overweight vs. Normal weight (P=0.0071)
Normal weight	2.87	1.58		
Overweight	8.95	7.85		
Obese	6.10	3.94		
Smoking			0.0437[a]	
No	4.80	4.01		
Yes	8.62	7.48		
Ejection fraction			0.7545[b]	
Poor	3.92	1.04		
Moderate	7.28	5.39		
Good	7.74	7.84		
DM			0.5733[a]	
No	6.31	3.90		
Yes	7.72	7.51		
HTN			0.2472[a]	
No	0.58	0.0		
Yes	5.63	4.24		
Renal impairment			0.7821[a]	
No	5.40	4.35		
Yes	5.84	4.17		
Previous MI			0.2427[a]	
No	5.92	4.50		
Ye	8.37	7.94		

Preoperative stroke	6.28	5.30	0.5786[a]
No	4.16	1.39	
Yes			
Preoperative chronic renal failure			0.0164[a]
No	5.66	4.31	
Yes	12.54	11.76	
Preoperative carotid artery stenosis			0.9174[a]
No	5.92	4.36	
Yes	5.76	5.54	
No of graft			0.2954[b]
2	6.74	6.02	
3	3.30	2.75	
4	5.85	4.16	
5	6.43	5.02	
Preoperative troponin			0.4684
Abnormal	7.99	9.21	
Normal	6.31	4.98	
Previous MI			0.2427
No	5.92	4.60	
Yes	8.37	7.94	
Procedure status			0.0234
Elective	5.39	4.35	
Urgent	10.26	8.42	

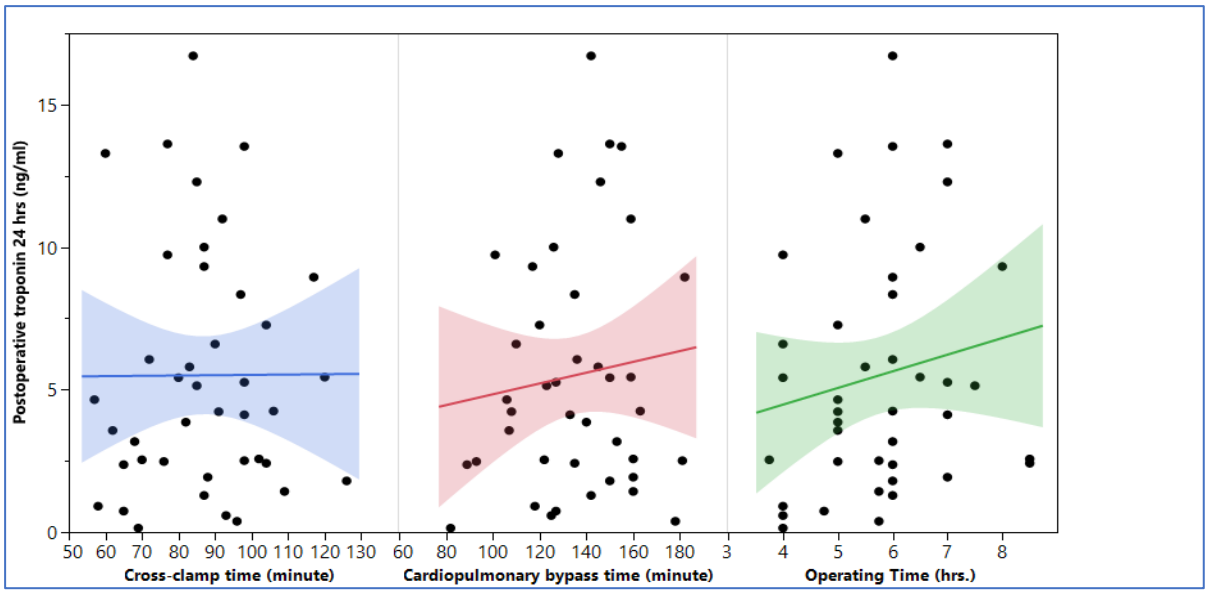
[a] an independent t-test and [b] ANOVA one-way were performed for statistical analyses.

The scatter diagram below demonstrates a non-significant correlation seen between cross-clamp time, cardiopulmonary bypass time, operating time in the conventional group, and the total mean troponin I over 24 hours postoperatively. Table (***6*** below shows the p-values for the regression lines.

Table (6): Correlations of postoperative troponin level (24 hrs.) with surgery-related time in the conventional study group

	Cross-clamp time (minute)			
	Value	**Lower 95%**	**Upper 95%**	**p-value (two-sided)**
Correlation	0.0046	-0.303	0.3118	0.9771
	Cardiopulmonary bypass time			
Correlation	0.1093	-0.205	0.4034	0.4962
	Operating Time (hrs.)			
Correlation	0.1682	-0.147	0.4525	0.2930

Bivariate regression was performed for statistical analyses.



Scatter matrix correlations of postoperative troponin level (24 hrs.) with surgery-related time in the conventional study group.

CHAPTER FOUR: DISCUSSION

In this prospective cohort study, we found that the cTn-I level is higher within 24 hours following conventional CABG and is significantly related to being overweight followed by smoking, having chronic renal failure, and using urgent procedure status. Many preoperative factors were associated with troponin elevation in the conventional group compared to the off-pump group namely: advanced age, male gender, comorbidities, preoperative renal impairment, Previous MI, and Body surface area. Furthermore, intraoperative events: the timing of surgery.

Recent studies have confirmed our findings, showing that there was a significant elevation in cTn-I levels postoperatively in all patients. however, when comparing conventional CABG (CCAB) to the off-pump-CABG (OPCAB) technique the cTn-I release was increased significantly in each sample taken from patients undergoing conventional CABG surgery within 1 hour and 24 hours.

Table* (*4 shows the p-values. where a p-value of <0.0001 is shown at 1 hour, and a p-value of <0.001 is seen at 24 hours. Additionally, this finding has been supported by the literature. This shows that the CCAB group has more widespread myocardial damage, whereas the OPCAB group has a more limited myocardial injury as shown by the less cTn-I release (Alwan *et al.*, 2004, Badruzzaman *et al.*, 2010, Abdo Gamil, 2022).

In agreement with the previous study, the present study shows that troponin I level significantly increased immediately postoperatively and slightly come down within 24 hours in both groups. ***Fig.* (*1*** shows the mean difference and standard deviation. The biggest difference may be shown at 1 hour, where a mean value of 7.13 is shown in the conventional vs off-pump group is 1.56, and this significant difference continued until 24hrs of surgery the mean value of 5.51 seen in conventional vs 1.24 in off-pump. According to the existing literature, a possible reason for more myocardial injury in CCAB is due to the cross-clamp and ischemic time rather than the pump itself (Kathiresan *et al.*, 2003, Brown *et al.*, 2007).

There is less release of cTn-I in the post periods of the off-pump group. The possible reason to suspect that patients could derive maximum benefit from avoiding CPB includes a lower risk of myocardial infarction, and arrhythmias due to its potential to prevent the damage induced by cardiopulmonary bypass, aortic cannulation, and cross-clamping. The technique of OPCAB requires a period of coronary artery occlusion, which causes local ischemia. However, to avoid accidentally suturing the posterior coronary wall, intracoronary shunts were used that keep

coronary perfusion, prevent ischemia, reduced back-bleeding, and show the suture line (van Dijk *et al.*, 2001, Ascione *et al.*, 2002, Rivetti Gandra, 2007).

There is an increase in cTn-I following the conventional group. The possible reason to suggest that Conventional CABG with cardioplegic arrest induces global ischemia-reperfusion and myocardial lesions occur in patients who are most at risk for undergoing CPB such as those who have had their myocardium dissected to show their intramyocardial arteries, manipulation of the myocardium during positioning or placement of the purse string sutures for cannulation. However, free oxygen radicals, the inability to re-perfuse myocardial regions not supplied by graft vessels, and insufficient myocardial protection, including the effects of CPB and cardioplegia in the case of CCAB, might cause myocardial injury. These injuries could be the cause of the early increase in cTn-l and the ability to detect it immediately before aortic declamping (Bonnefoy *et al.*, 2004, Munshi *et al.*, 2020)

A high-quality meta-analysis of 18,908 individuals found greater cTn-I levels in the first 24 hours following CABG were independently linked to higher early and long-term mortality rates. Although it is simple to neglect, numerous adverse events may happen immediately following CABG, requiring quick therapeutic efforts to improve these patients' prognoses. It is necessary to measure postoperative troponin levels earlier rather than later because the opportunity for successful treatment quickly narrows (Domanski *et al.*, 2011).

In contrast to the findings of our study, Bappu et al. showed a significant elevation of cTn-I level from baseline, but when levels were measured at some of the other periods, there was no significant difference between the two groups (Bappu *et al.*, 2006). The possible reason for this non-significant association is the small sample size of that study (n=22).

Recently published studies examining the effect of body mass index (BMI) on adverse postoperative outcomes after CABG have yielded conflicting results. Some studies suggested that obesity was an independent negative predictor of morbidity and mortality when comparing CCAB versus OPCAB (Caliskan *et al.*, 2014). However, none of the previous studies specifically investigated how BMI affected troponin levels after CABG s urgery. In the present cohort, being overweight has a significant correlation with an increased risk of postoperative troponin elevation within 24hrs in patients who underwent conventional CABG surgery. In addition, overweight or obese patients are more likely to have more comorbidities compared to other patients. Therefore, they are more likely to develop adverse complications during surgical management.

Regarding chronic renal disease (CKD), A recent study found that preoperative chronic renal failure was associated with troponin rise in the conventional group 24 hours after surgery (p=0.0164). Additionally, compared to the off-pump group, patients undergoing conventional CABG were significantly more likely to have preoperative hypertension, renal impairment, and previous MI. This is supported by earlier studies (Wießner *et al.*, 2008, Koppen *et al.*, 2019). It is reasonable to assume that off-pump CABG is still the better option for CKD patients because it protects renal function during surgery by avoiding cardiopulmonary bypass and lowers the risk of troponin elevation related to postoperative complications (Albatrek *et al.*, 2022, Phothikun *et al.*, 2022).

According to the present study, there is a clear significant correlation between current smoking and troponin elevation at 24 hours following CCAB surgery and supports the idea that CABG surgery appears to endanger a patient who had currently smoking before surgery. In addition, our results confirm that this technique, adjusted baseline smoking status, can identify the link between smoking and poor outcomes after revascularization. Although some studies have reported opposing results which looked at the effect of smoking in patients undergoing CABG have suggested that smoking status at baseline (pre-surgery) was not associated with adverse outcomes but smoking status at follow-up (post-surgery) predicted poor outcomes (van Domburg *et al.*, 2000, Utley *et al.*, 2001).

In line with the current study, previous studies showed that the majority of literature documented less bleeding with off-pump procedures than with conventional CABG, this fact happen in the present study but it was not significant when compared with the conventional group, only one patient had postoperative bleeding in the off-pump group, compared to six in the conventional group p=0.1139. probably because the operation lasted a short operative time, which might be a result of

the partial heparinization technique used in off-pump revascularization compared with the full heparinization used in conventional revascularization (Ascione *et al.*, 2001, Nader *et al.*, 2010).

Consistent with other studies, a current study found that preoperative urgent patients were significantly associated with troponin elevation 24 hours postoperatively p=0.0234. Because the myocardium in this situation is in more critical condition when reflected by elevated troponin levels (Brown *et al.*, 2007).

CONCLUSIONS

This study showed that the patients who underwent conventional CABG had significantly higher levels of troponin I at 1 hour and 24 hr. postoperatively. The higher postoperative troponin I among patients who underwent conventional CABG was associated with being overweight, smoking, having chronic renal failure, and using urgent procedure status.

Conflict of interest: There is no conflict of interest
to be declared.

Funding: The authors are the source of funding.

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