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Does Preoperative Troponin Level Impacts Outcomes after Coronary Artery Bypass Grafting?

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Abstract

Background: The populations presenting for coronary artery bypass grafting surgeries (CABG) has been increasing in age, comorbidities and complexity of coronary diseases in current history. For cases to receive reliable data as well as to assess the accomplishments of the surgeons and the institution, risks predictions has become more crucial.

Aim of Study: To assess whether elevated preoperative cardiac troponin level impacts the outcomes after coronary artery bypass graft (CABG) or not.

Patients and Methods: This prospective study included 40 patients separated into two groupings depending on the preoperative cTnI which was measured 24 hours before the operation: Group I: 20 patients will undergo CABG with Troponin I <0.04ng/ml. Group II: 20 patients will undergo CABG with Troponin I ≥0.04ng/ml.

Results: There was no significant difference among both groups as per the in-hospital mortality. Patients with elevated preoperative cTnI had longer ICU and hospital stay and prolonged ventilation time.

Conclusion: Elevated preoperative troponin in patients presenting with acute coronary syndrome is not an independent factor that predicts the postoperative mortality. However, elevated cTnI is associated with more postoperative complications. Delaying CABG till normalization of cTnI levels seems to be better to avoid postoperative complications.

Key Words: *Troponin level – Coronary artery bypass grafting – Acute myocardial infarction.*

Introduction

IT is ambiguous when coronary artery bypass grafting (CABG) procedures should be performed on individuals who have just suffered an acute myocardial infarctions (AMI). According to numerous researches, CABGs done soon after an AMI have an increased probability of postoperative deaths and morbidities than those done later. Furthermore, it has not been shown why postponing the CABG makes the procedure safer. It is still unclear when people with severe AMI, stabilized medical circumstances, and an echocardiography indications for surgical revascularization should have CABG procedures **[1]**.

The preoperatively risks estimator from the Society for Thoracic Surgeons (STS) is a very precise risks modelling that forecasts either short-term death or postoperatively complications. The STS risk assessment takes into account the existence of acute MI, how long it takes from MI to operation, and whether the myocardial infarctions had ST-segmental elevations (STEMI) versus not (NSTEMI). Unfortunately, the evaluation does not take the level of troponin increase into account **[2]**.

Cardiac troponins isoforms I or T (cTnI, cTnT) are enzymes that are a part of the contractile complex's thin filament regulation mechanism. They become the gold standard for the diagnosis of acute myocardial infarction. However, cardiac troponins have not only improved AMI detection, but also enabled risk stratification in a variety of clinical settings **[3-6]**.

A number above the 99th percentiles of a normally references populations [upper references limits] is referred to as an elevated cTn level (URL) **[7]**. Peak troponin levels during MI have been shown to correlate with infarct size and left ventricular ejection fraction, which are major determinants of mortality after infarction.

Patients and Methods

This is a prospective study examining 40 patients undergoing CABG procedure and presented

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with acute coronary syndrome in Ain Shams University Hospitals and Aswan Heart Center from 2019 to 2022. 20 patients had high preoperative troponin levels, while the other 20 patients had normal troponin levels.

All selected individuals were divided into two groups:

1- 20 patients had CABG with Troponin I <0.04ng /ml.

2- 20 patients had CABG with Troponin I >0.04ng /ml.

The procedures were performed using the standard cardiopulmonary bypass, using antegrade cold blood cardioplegia. After median sternotomy, patients underwent conventional multivessel CABG. We excluded any patient with new left bundle branch block, previous cardiac surgery operations, any concomitant heart surgery besides CABG and any patient with AMI complications.

Cardiac troponin I level was measured 24 hours before the operation. The cut of point of high troponin I level was >0.04ng/ml.

The primary outcome of interest is operative mortality defined as in-hospital or 30-day mortality. Secondary outcomes include permanent stroke, renal failure, reoperation, deep sternal wound infection, prolonged ventilation, the need for intra-aortic balloon pump, failed weaning of inotropic support and post-operative bleeding.

Statistical analysis:

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (SPSS 23). Data was presented and suitable analysis was done according to the type of data obtained for each parameter.

Descriptive statistics: Mean, Standard deviation (± SD) and range for parametric numerical data, while Median and Interquartile range (IQR) for non-parametric numerical data. Frequency and percentage of non-numerical data.

Analytical statistics: Student *t* and Mann-Whitney tests were used to assess the statistical significance of the difference between group means. Chi-Square and Fisher's exact test was used to examine the relationship between two qualitative variables.

p-value: Level of significance:

- $p>0.05$: Non significant (NS).
- $p<0.05$: Significant (S).

Results

The current study included 40 participants, 90% were males and 10% were females with mean age of the study group was 55.48 ±9.74 years ranged from 36 to 70 years and with mean weight 79.95 ± 12.19Kg ranged from 50 to 104Kg (Table 1). The most common diagnosis in the study group was NSTEMI 35%, Anterior STEMI 27.5%, Inferior STEMI 25% and the least common diagnosis was unstable angina 12.5% (Table 2).

Table (1): Demographic characteristics of the studied group.

	N / Mean	% / SD	Median (IQR)	Range
Sex:				
Male	36	90.0%		
Female	4	10.0%		
Age (Year)	55.48	9.74	57 (49.5-63)	(36-70)
Weight (Kg)	79.95	12.19	82 (70.5-89.5)	(50-104)

Table (2): Diagnosis for the study group.

	N	%
Diagnosis:		
NSTEMI	14	35.0
Anterior STEMI	11	27.5
Inferior STEMI	10	25.0
Unstable angina	5	12.5

1- *Preoperative variables:*

The study included 2 groups of patients with normal and elevated preoperative troponin level Group (I) included 20 patients with normal preoperative troponin (<0.04ng/ml), all of them were males (100%), with mean age of 53.3 ±9.26 and mean weight of 82.9 ± 13.36. While group (II) included 20 patients with elevated preoperative troponin (≥0.04ng/ml), four of them were females (20%), the mean age of this group was 57.65 ±9.96 and their mean weight was 77 ± 10.41. There was no significant difference between the two groups regarding sex, age or weight (Table 4).

Table (3): Preoperative assessment for the study group.

	N / Mean	% / SD	Median (IQR)	Range
Preoperative troponin:				
Normal	20	50.0%		
Elevated	20	50.0%		
Preoperative EF	46.78%	10.63%	45% (38%-55%)	(30%-68%)

Table (4): Relation between both groups and demographic data.

	Preoperative troponin		Test of significance	
	Normal N (%) Mean±SD	Elevated N (%) Mean±SD	*p*-value	Sig.
Gender:				
Male	20 (100%)	16 (80%)	0.106(F)	NS
Female	0 (0%)	4 (20%)		
Age (Year)	53.3±9.26	57.65±9.96	0.161(T)	NS
Weight (Kg)	82.9±13.36	77±10.41	0.128(T)	NS

(T) Student *t*-test of significance.

(F) Fisher's Exact test of significance.

Among patients with normal troponin, there were 6 patients diagnosed as NSTEMI (30%), 5 unstable angina (25%) and 11 patients presented as STEMI (45%). While patients with elevated troponin, there were 8 patients presented with NSTEMI (40%), and 12 patients with STEMI (60). There was no significant difference between the two groups regarding the preoperative diagnosis (*p*-value 0.131) (Table 5).

Table (5): Relation between elevated troponin and diagnosis & preoperative echo.

	Preoperative troponin		Test of significance	
	Normal N (%) Mean±SD	Elevated N (%) Mean±SD	*p*-value	Sig.
Diagnosis:				
NSTEMI	6 (30%)	8 (40%)	0.131(F)	NS
Anterior STEMI	5 (25%)	6 (30%)		
Inferior STEMI	4 (20%)	6 (30%)		
Unstable angina	5 (25%)	0 (0%)		
Preoperative EF	48.1%± 9.9%	45.5%± 11.5%	0.455(T)	NS

(F) Fisher's Exact test of significance.

(T) Student *t*-test of significance.

2- *Intra-operative variables:*

The number of grafts per patient ranged from two to four grafts in both groups. In group I the mean number of grafts was 3.3 graft, while in group II the mean number of grafts was 3.15. Endarterectomy was done in 1 patient in group I and 3 patients in group II. As regard cardiopulmonary bypass time, the median for group I was 100.5 minutes and 94.5 minutes for group II (Table 6).

Table (6): Comparison between both groups as regard intra operative variables.

	Preoperative troponin		Test of significance	
	Normal N (%) Median (IQR)	Elevated N (%) Median (IQR)	*p*-value	Sig.
Number of grafts:				
Two grafts	2 (10%)	3 (15%)	0.824(F)	NS
Three grafts	10 (50%)	11 (55%)		
Four grafts	8 (40%)	6 (30%)		
Cross clamp time (min)	69.5 (55.5-97)	58.5 (51.5-86)	0.218(M)	NS
Cardiopulmonary bypass time (min)	100.5 (84-138.5)	94.5 (82-126)	0.425(M)	NS
Endarterectomy	1	3		
High inotropic support	1	3		
IABP	0	2		

(F) Fisher's Exact test of significance.
(M) Mann-Whitney test of significance.

3- *Postoperative variables:*

Regarding in-hospital mortality, 7.5% of patients died (3 patients), the mean ICU stay was 129.6± 147.63 hrs ranged from 48 to 888 hrs and with mean hospital stay 231.6 ± 155.4 hrs raged from 96 to 888 hrs. 20% of patients needed high inotropic support while 15% needed IABP insertion. The most common postoperative complication was prolonged ventilation 30% (12 patients) and the least common was stroke 2.5% (1 patient).

Table (7): Post-operative assessment for the study group.

	N / Mean	% / SD	Median (IQR)	Range
Mortality:				
No	37	92.5%		
Yes	3	7.5%		
ICU Stay (Hours)	129.60	147.63	72 (60 - 132)	(48-888)
Hospital Stay (Hours)	231.60	155.40	192 (120 - 252)	(96-888)
High inotropic support	8	20.0%		
IABP Insertion	6	15.0%		
Postop EF	46.75%	11.35%	0.5 (0.4 - 0.55)	(15%-60%)
Stroke	1	2.5%		
Postoperative bleeding	4	10.0%		
Prolonged ventilation	12	30.0%		
Renal impairment	3	7.5%		
Wound infection	4	10.0%		

(F) Fisher's Exact test of significance.
(M) Mann-Whitney test of significance.

Postoperative complications were found in elevated group more than normal group without significant difference between two groups as *p*-value was (>0.05) except cases who needed prolonged ventilation (more than 12 hours) 15% and 45% in normal group and elevated level group respectively, with significant difference between two groups as *p*-value was (<0.05).

Table (8): Relation between both groups and post-operative variables.

	Preoperative troponin		Test of significance	
	Normal N (%) Median (IQR) Mean ± SD	Elevated N (%) Median (IQR) Mean ± SD	*p*-value	Sig.
Mortality:				
No	20 (100%)	17 (85%)	0.231(F)	NS
Yes	0 (0%)	3 (15%)		
ICU Stay (Hours)	72 (48-84)	96 (72-204)	0.007(M)	S
Hospital Stay (Hours)	144 (120-204)	228 (156-360)	0.009(M)	S
High inotropic support	2 (10%)	6 (30%)	0.235(F)	NS
IABP Insertion	1 (5%)	5 (25%)	0.182(F)	NS
Postop EF	48.5%±8.9%	45%±13.4%	0.336(T))	NS
Stroke	0 (0%)	1 (5%)	1.00(F)	NS
Postop bleeding	0 (0%)	4 (20%)	0.106(F)	NS
Prolonged ventilation	3 (15%)	9 (45%)	0.038(C)	S
Renal impairment	0 (0%)	3 (15%)	0.231(F)	NS
Wound infection	2 (10%)	2 (10%)	1.00(F)	NS

(F) Fisher's Exact test of significance.
(M) Mann-Whitney test of significance.
(T) Student *t*-test of significance.
(C) Chi-Square test of significance.

Discussion

The decision of how long should we delay CABG in participants with recent AMI, who are in stable condition and not suitable for PCI, is still debatable. Till now it is the surgeon preference that determines the time between the AMI and the operation, and there is no specific guidelines recommendation regarding the optimal timing of CABG. Hence several studies were conducted to look for the factors that can be assessed to achieve the optimal timing of CABG **[8-10]**.

Weiss et al. **[11]**, reviewed California Discharge Data of 40, 159 participants who underwent CABG after AMI and stratified the patients by the timing of CABG into early (0-2 days) and late (3 or more days) groups. They found that patients who had CABG through two days of acute myocardial infarction experienced higher mortality and recommended delaying coronary artery bypass grafting for 3 or more days.

This study was conducted to compare the impact of elevated troponin versus normal troponin on the outcomes of CABG. We included patients presented with acute coronary syndrome, who are not candidates for PCI and have a stable hemodynamics. Hence, we excluded patients undergoing emergency CABG and patients undergoing any concomitant cardiac surgery with CABG. The cut-off value to elevated troponin was ≥0.04ng/ml and it was measured 24 hours before the operation.

Thielmann et al. **[12]**, examined the prognostic value of preoperative troponin in 57 patients with STEMI and 197 patients with NSTEMI and demonstrated that based on the preoperative cTnI levels, individuals who underwent urgent CABG in the presence of preoperative severe STEMI or NSTEMI had substantially increased in-hospital death and MACE.

Paparella et al. **[1]**, evaluated 187 participants who underwent non-urgent CABG within 21 days of having an AMI were split into two groupings based on their preoperatively cTnI concentrations: 117 individuals had troponin levels less than 0.15ng/mL and 67 having levels greater than 0.15ng/mL. This demonstrates that preoperatively troponin levels are a more reliable predictor of outcome than the duration between an AMI and surgery.

Buratto et al. **[13]**, reviewed retrospectively the relationship between preoperative cTnI as a part of the preoperative work-up and the outcomes after elective CABG. Normal group (cTnI <0.03mg/L) was present in 331, while the elevated group (cTnI >0.03mg/L) was present in 47 patients (12.4%). The preoperative cTnI was measured 72 hours or more before the operation.

On the other hand Beller et al. **[2]**, retrospectively reviewed 1, 272 patients who underwent urgent or emergent isolated CABG. 835 patients (65.6%) had positive preoperative cardiac troponin.

Other authors proposed that there is certain level of troponin that may affect the postoperative outcomes. Morone et al. **[14]**, investigated all the patients who had isolated CABG between 2009 and 2016. They also suggested that if the peak level of cTnI is above 5.74 [redacted] at any point in the preoperative period, there will be a greater risk of more postoperative complications. Also, Petäjä et al. **[15]**, found no additional predictive value of elevated preoperative troponin over (Euroscore II) to predict mortality after CABG.

In the context of recent acute myocardial infarction, there is an increased number of patients receiving coronary angiography and hence there Is increased number of patients who are candidates for CABG. Most of those patients do not need emergency operation and are transferred to surgical wards as a matter of urgency **[1]**. In our study we found that the level of preoperative cTnI did not predict the postoperative in-hospital mortality,

however patients with elevated preoperative cTnI had longer hospital stay, ICU stay and were more vulnerable to prolonged ventilation. In a conclusion, the level of preoperative cTnI in patients with recent AMI is not an independent predictor of postoperative in-hospital mortality, however elevated preoperative cTnI is associated with more postoperative complications. Hence, it might be better to wait till the preoperative troponin level normalize before the operation.

Conclusion:

Elevated preoperative troponin in patients presenting with acute coronary syndrome is not an independent factor that predicts the postoperative mortality. However, elevated cTnI is associated with more postoperative complications. Delaying CABG till normalization of cTnI levels seems to be better to avoid postoperative complications.

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هل يؤثر تركيز التروبونين بالدم قبل الجراحة على نتائج جراحة ترقيع الشرايين التاجية؟

المقدمة : يعتبر تركيز إنزيم التروبونين بالدم من أكثر الفحوضات دقة وخصوصية لتشخيص جلطات القلب. وبالرغم من وجود العديد من الدراسات والأنظمة للتنبؤ بمضاعفات ما بعد جراحة ترقيع الشرايين التاجية إلا أن هذه الأنظمة لا تتضمن قياس نسبة التروبونين قبل الجراحة.

من الناحية النظرية يمكن استخدام تركيز التروبونين للتنبؤ بالمرضى المعرضون لحدوث مضاعفات ما بعد الجراحة والذين قد يحتاجون إلى درجة أكبر من الرعاية بعد إجراء الجراحة والتى قد تشمل كمية كبيرة من العلاج لدعم القلب أو إلى تركيب بالون بالشريان الأورطى.

الهدف من الرسالة : تحديد ما إذا كان ارتفاع نسبة إنزيم التروبونين بالدم قبل إجراء جراحة تر قيع الشرايين التاجية يؤثر على نتائج ما بعد الجراحة أم لا.

طرق الدراسة ومكوناتها : ٤٠ حالة تعانى من جلطة حادة بالقلب فى مستشفيات جامعة عين شمس ومستشفى قلب أسوان.

وقت الدراسة : فى الفترة ما بين يناير ٢٠١٩ ومارس ٢٠٢٢.

حجم العينات : الدراسة شملت ٢٠ مريض كان يعانى من ارتفاع نسبة التروبونين بالدم قبل الجراحة و ٢٠ مريض كانت نسبة التروبونين طبيعية قبل الجراحة.

معايير الاقصاء : المرضى المقرر إجراء جراحة أخرى بالقلب أثناء جراحة الشرايين التاجية، حدوث مضاعفات بالقلب بسبب انسداد الشرايين التاجية، والمرضى الذين سبق لهم إجراء جراحة بالقلب.

معايير الانضمام : المرضى الذين يعانون من انسداد الشرايين التاجية وسيخضعون لجراحة ترقيع الشرايين التاجية.

التوصيات : ارتفاع نسبة التروبونين بالدم قبل إجراء جراحة ترقيع الشرايين التاجية لا يؤثر على نتائج الجراحة، ولكن تأخير الجراحة حتى تعود نسبة التروبونين بالدم إلى النسبة الطبيعية يقلل من حدوث المضاعفات بعد الجراحة.