Section: Miscellaneous

Original Research Article

ASSOCIATION OF HIGH SENSITIVITY CARDIAC TROPONIN ASSESSED AT EMERGENCY AND COMPLICATIONS OF EMERGENCY CORONARY ARTERY BYPASS GRAFTING

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ABSTRACT

Background: hs-cTnI (high-sensitivity cardiac troponin) is a biomarker that is used widely in the identification and assessment of ischemic heart pain in the emergency departments of Indian Institutes. However, the clinical effect of the eCABG (emergency coronary artery bypass grafting) is underestimated. **Aim:** The present study was aimed to evaluate the clinical effect of measuring high-sensitivity cardiac troponin at the emergency department by comparison of eCABG in subjects with (NSTE-ACS) non-ST-segment elevation acute coronary syndrome that includes UA (unstable angina) and NSTEMI (non–ST-segment– elevation myocardial infarction).

Materials and Methods: The present study assessed 484 subjects who underwent emergency coronary artery bypass grafting and were divided into groups based on serum high-sensitivity cardiac troponin levels. The primary outcome assessed was a major cardiovascular cerebral event (MACCE) defined as stroke, repeat revascularization, myocardial infarction, and all-cause death collectively. The incidence of each MACCE along with postoperative complications such as hospital duration, atrial fibrillation, re-surgery, and acute kidney injury were compared.

Results: 484 subjects were divided into 2 groups unstable angina with <0.04 ng/ml and comprised of 204 subjects and NSTEMI with ≥0.04 ng/ml and comprised of 280 subjects. MACCE incidence showed no difference in the two study groups. In the NSTEMI group, postoperative acute kidney injury was more frequently seen with p=0.03. Also, hospital stay duration was significantly higher in the NSTEMI group compared to the UA group with p=0.007.

Conclusions: The present study concludes that emergency coronary artery bypass grafting in non–ST-segment–elevation myocardial infarction and unstable angina subjects result in comparable outcomes. However, elevated levels of hd-cTnI in an emergency can be correlated to immediate postoperative complications.

Keywords: coronary artery bypass grafting, eCABG, MACCE, NSTEMI, hs-cTnI (high-sensitivity cardiac troponin).

INTRODUCTION

It is challenging and critical to satisfy subjects with ischemic heart symptoms in the emergency department, particularly, subjects from subgroups of NSTE-ACS (non–non-ST-segment–elevation acute coronary syndrome) which includes NSTEMI (non–ST-segment–elevation myocardial infarction) and UA (unstable angina) that show electrocardiographic and clinical features that are

inseparable and indistinguishable. However, there is uncertainty concerning the clinical impact of eCABG (emergency coronary artery bypass grafting) on these subgroups.[1]

For these cardiac biomarkers, serial testing has depicted excellent diagnostic performance, and the reclassification of NSTE-ACS2 has resulted from the development of a high-sensitivity cardiac troponin assay. This can be seen as subjects with resting chest pain that were earlier considered to have unstable angina were then reclassified as NSTEMI subjects. Previous literature data showed that the clinical significance of high-sensitivity cardiac troponin was validated in subjects with ACS (acute coronary syndrome) in emergency settings. It has also been seen that subjects in subgroups of NSTE-ACS classified using high-sensitivity cardiac troponin showed varied clinical outcomes in placebo or medical therapy.[2]

The current clinical guidelines have deficient details of surgical coronary revascularization. However, the overall outcomes from CABG (coronary artery bypass grafting) have shown significant improvement over time with well-aware benefits with complex lesions and multi-vessel disease. CABG for ACS subjects represents a subgroup as challenging owing to their high-risk characteristics. Current guidelines report that there is a limited role of eCABG in the acute phase of (STEMI) ST-segment-elevation myocardial infarction.[3]

Hence, the understanding of the clinical impact of high-sensitivity cardiac troponin on eCABG can be helpful in the evaluation of treatment strategies for NSTE-ACS subjects in the emergency.[4] The present study aimed to evaluate the clinical effect of measuring high-sensitivity cardiac troponin at the emergency department by comparison of eCABG in subjects with (NSTE-ACS) non-ST-segment elevation acute coronary syndrome that includes UA (unstable angina) and NSTEMI (non–ST-segment– elevation myocardial infarction).

MATERIALS AND METHODS

The present prospective clinical study was aimed to evaluate the clinical effect of measuring high-sensitivity cardiac troponin at the emergency department by comparison of eCABG in subjects with (NSTE-ACS) non-ST-segment elevation acute coronary syndrome that includes UA (unstable angina) and NSTEMI (non–ST-segment– elevation myocardial infarction). The study subjects were from the Department of Cardio Vascular and Thoracic Surgery, Government Medical College & Super Specialty Hospital, Nagpur, Maharashtra. Verbal and written informed consent were taken from all the subjects before study participation.

The inclusion criteria for the study were subjects who underwent emergency coronary artery bypass grafting, were willing to participate in the study, and subjects with stable mental states. The exclusion criteria for the study were subjects who did not give consent for study participation, subjects on drugs that could affect the cardiac status, and subjects with a previous history of cardiac surgery.

The included 484 subjects were divided into 2 groups based on serum high-sensitivity cardiac troponin levels as unstable angina with <0.04 ng/ml and comprised 204 subjects and NSTEMI with ≥0.04 ng/ml and comprised 280 subjects. The primary outcome assessed was a major cardiovascular cerebral event (MACCE) defined as stroke, repeat revascularization, myocardial infarction, and all-cause death collectively. The incidence of each MACCE along with postoperative complications such as hospital duration, atrial fibrillation, re-surgery, and acute kidney injury were compared.

The data gathered were analyzed statistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, t-test, Shapiro-Wilk test, and Mann Whitney U test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered statistically significant.

RESULTS

The present prospective clinical study was aimed to evaluate the clinical effect of measuring high-sensitivity cardiac troponin at the emergency department by comparison of eCABG in subjects with (NSTE-ACS) non-ST-segment elevation acute coronary syndrome that includes UA (unstable angina) and NSTEMI (non–ST-segment– elevation myocardial infarction). 484 subjects were divided into 2 groups unstable angina with <0.04 ng/ml and comprised of 204 subjects and NSTEMI with ≥0.04 ng/ml and comprised of 280 subjects. The mean age of study subjects in the NSTEMI and UA groups was 63.3±10.6 and 63.6±10.2 years respectively which was statistically comparable with p-0.36. Gender distribution among the two groups was statistically non-significant with p=0.47. Hemoglobin was significantly higher in the UA group with p=0.02. Preoperative anemia was significantly higher in the NSTEMI group with p-0.01. The ejection fraction was significantly higher in the UA group with p=0.01. Creatinine was significantly higher in the NSTEMI group with p<0.001. Chronic kidney disease was significantly higher in the NSTEMI group with p=0.01. Smoking, peripheral vascular disease, stroke, COPD, diabetes, and hypertension showed non-significant differences in the two groups with p=0.14, 0.53, 0.43, 0.55, 0.93, and 0.56 respectively (Table 1).

On assessing the disease characteristics in two study groups, in laboratory parameters, Hs-cTnI (mg/ml) was significantly higher in the NSTEMI group compared to the UA group with p=0.001. INR,

platelets, and hemoglobin levels were comparable in the two groups with p=0.08, 0.621, and 0.07 respectively. Concerning diseased vessels, single vessel disease, double vessel disease, triple vessel disease, and left main disease were statistically comparable in the two groups with p=0.67, 0.33, 0.37, and 0.83 respectively. In medications, antiplatelet agents and stains were taken by statistically comparable subjects with p=0.36 and 0.27 respectively. In prior revascularization, PCI and CABG were comparable in NSTEMI and UA groups with p=0.64 and 0.53 respectively (Table 2).

It was seen that for operative variables in two study groups, aortic modulation was used in a significantly higher number of subjects from the NSTEMI group with p=0.002, and the Off-pump technique was used in a significantly higher number of subjects from the UA group with p<0.0001. In graft usage, total graft use was comparable in two groups with p=0.42. SVG (Saphenous vein graft) was used in 1% (n=2) subjects from UA group, radial artery graft was not used in any subject, RGEA (right gastroepiploic artery) graft was used in comparable subjects from NSTEMI and UA groups with p=0.42, RITA (right internal thoracic artery) graft also showed comparable use in two groups with p=0.52, and LITA (left internal thoracic artery) graft also showed comparable use in two groups with p=0.403 (Table 3).

The study results showed that for clinical outcomes in two groups of study subjects, stroke, MI (myocardial infarction), repeat revascularization, all-cause death, MACCE within follow-up, MACCE within hospital stay, MACCE within 30 days, and MACCE within 1 year showed statistically comparable results in NSTEMI and UA groups with p=0.95, -, 0.52, 0.76, 0.94, 0.44, 0.74, and 0.53 respectively. Postoperative acute kidney injury was significantly higher in the NSTEMI group with 23.6% (n=660 subjects compared to 6.9% (n=140 subjects from the UA group with p=0.03. Stage 2 and stage 3 acute kidney injury was seen in 5% (n=140 and 1.4% (n=4) study subjects (Table 4).

It was also seen that in clinical outcomes, hospital stay duration was significantly higher in the NSTEMI group with p=0.007. ICU stay duration and inotropes use were also significantly higher in the NSTEMI group with p<0.001 for both. Inotropic use, wound complications, other complications, re-surgery, and atrial fibrillation were statistically comparable in the two groups with p=0.56, 0.42, 0.45, 0.15, and 0.12 respectively (Table 5).

Table 1: Demographic data of study participants at baseline

S. No	Characteristics	NSTEMI (n=280)	UA (n=204)	p-value
1.	**Mean age (years)**	63.3±10.6	63.6±10.2	0.36
2.	**Male gender n (%)**	162 (79.4)	212 (75.7)	0.47
3.	**Hemoglobin (g/dl)**	13.4±2.2	13.9±1.8	**0.02**
4.	**Preoperative anemia**	76 (27.1)	28 (13.7)	**0.01**
5.	**Ejection fraction (%)**	48.4±12.7	56.4±11.3	**0.01**
6.	**Creatinine (mg/dl)**	1.26±1.33	0.96±0.27	**<0.001**
7.	**Chronic kidney disease**	24 (8.6)	2 (1)	**0.01**
8.	**Smoking**	118 (42.1)	68 (33.3)	0.14
9.	**Peripheral vascular disease**	30 (10.7)	16 (7.8)	0.53
10.	**Stroke**	34 (12.1)	32 (15.7)	0.43
11.	**COPD**	2 (0.7)	4 (2)	0.55
12.	**Diabetes**	128 (45.7)	94 (46.1)	0.93
13.	**Hypertension**	188 (67.1)	94 (63.7)	0.56

Table 2: Disease characteristics of study participants at baseline

S. No	Disease characteristics	NSTEMI (n=280)	UA (n=204)	p-value
1.	**Laboratory parameters**			
a)	Hs-cTnI (mg/ml)	9.885±30.2	0.011±0.006	**0.001**
b)	INR	1.01±0.14	1.00±0.06	0.08
c)	Platelet ($x10^3/\mu l$)	208±50	203±49	0.621
d)	Hemoglobin	13.4±2.2	13.9±1.8	0.07
2.	**Diseased vessels**			
a)	Single vessel disease	20 (7.1)	12 (5.9)	0.67
b)	Double vessel disease	58 (20.7)	56 (27.5)	0.33
c)	Triple vessel disease	202 (72.1)	136 (66.7)	0.37
d)	Left the main disease	74 (26.4)	56 (27.5)	0.83
3.	**Medications**			
a)	Antiplatelet agent	212 (75.7)	164 (80.4)	0.36
b)	Statin	102 (36.4)	88 (43.1)	0.27
4.	**Prior revascularization**			
a)	PCI	44 (15.7)	28 (13.7)	0.64
b)	CABG	0	4 (1.4)	0.53

Table 3: Operative variables in two groups of study subjects

S. No	Parameters	NSTEMI (n=280)	UA (n=204)	p-value
1.	**Techniques**			
a)	Aortic modulation	60 (21.4)	14 (6.9)	**0.002**
b)	Off-pump technique	186 (66.4)	184 (90.2)	**<0.0001**
2.	**Graft**			
a)	Total	4.12±1.42	3.98±1.29	0.42
b)	SVG	0	2 (1)	-
c)	Radial artery	0	0	0.42
d)	RGEA	16 (5.7)	8 (3.9)	0.74
e)	RITA	244 (87.1)	184 (90.2)	0.52
f)	LITA	272 (97.1)	202 (99)	0.403

Table 4: Clinical outcomes in two groups of study subjects

S. No	Parameters	NSTEMI (n=280)	UA (n=204)	p-value
1.	**Stroke**	8 (2.9)	4 (2)	0.95
2.	**MI**	0	4 (2)	-
3.	**Repeat revascularization**	16 (5.7)	8 (3.9)	0.52
4.	**All-cause death**	10 (3.6)	4 (2)	0.76
5.	**MACCE within follow-up**	32 (11.4)	18 (8.8)	0.94
6.	**MACCE within hospital stay**	18 (6.4)	6 (2.9)	0.44
7.	**MACCE within 30 days**	14 (5)	8 (3.9)	0.74
8.	**MACCE within 1-year**	24 (8.6)	10 (4.9)	0.53
9.	**Postoperative acute kidney injury**	66 (23.6)	14 (6.9)	**0.03**
a)	Stage 2	14 (5)	0	-
b)	Stage 3	4 (1.4)	0	-

Table 5: Clinical outcomes in NSTEMI and unstable angina subjects

S. No	Outcomes	NSTEMI (n=280)	UA (n=204)	p-value
1.	**Hospital stay duration**	15.2±22.5	9.2±10.4	**0.007**
2.	**ICU stay**	3.7±5.6	1.6±1.3	**<0.001**
3.	**Ionotrope use (days)**	3.2±5.2	1.2±2.2	**<0.001**
4.	**Inotropic use**	178 (63.6)	96 (47.1)	0.56
5.	**Wound complications**	20 (7.1)	12 (5.9)	0.42
6.	**Others**	16 (5.7)	2 (1)	0.45
7.	**Bleeding**	10 (3.6)	0	-
8.	**Re-surgery**	24 (8.6)	2 (1)	0.15
9.	**Atrial fibrillation**	74 (26.4)	32 (15.7)	0.12

DISCUSSION

The present study assessed 484 subjects and was divided into 2 groups unstable angina with <0.04 ng/ml and comprised of 204 subjects and NSTEMI with ≥0.04 ng/ml and comprised of 280 subjects. The mean age of study subjects in the NSTEMI and UA group was 63.3±10.6 and 63.6±10.2 years respectively which was statistically comparable with p-0.36. Gender distribution among the two groups was statistically non-significant with p=0.47. Hemoglobin was significantly higher in the UA group with p=0.02. Preoperative anemia was significantly higher in the NSTEMI group with p-0.01. The ejection fraction was significantly higher in the UA group with p=0.01. Creatinine was significantly higher in the NSTEMI group with p<0.001. Chronic kidney disease was significantly higher in the NSTEMI group with p=0.01. Smoking, peripheral vascular disease, stroke, COPD, diabetes, and hypertension showed non-significant differences in the two groups with p=0.14, 0.53, 0.43, 0.55, 0.93, and 0.56 respectively. These data were comparable to the studies of Machado M N et al,[5] in 2014 and Min JJ et al,[6] in 2016 where authors assessed subjects with demographic data comparable to the present study.

Concerning the disease characteristics in the two study groups, in laboratory parameters, Hs-cTnI (mg/ml) was significantly higher in the NSTEMI group compared to the UA group with p=0.001. INR, platelets, and hemoglobin levels were comparable in the two groups with p=0.08, 0.621, and 0.07 respectively. Concerning diseased vessels, single vessel disease, double vessel disease, triple vessel disease, and left main disease were statistically comparable in the two groups with p=0.67, 0.33, 0.37, and 0.83 respectively. In medications, antiplatelet agents and stains were taken by statistically comparable subjects with p=0.36 and 0.27 respectively. In prior revascularization, PCI and CABG were comparable in NSTEMI and UA groups with p=0.64 and 0.53 respectively. These findings were in line with the studies of Bavry AA et al,[7] in 2006 and Twerenbold R et al,[8] in 2015 where disease characteristics similar to the present study were reported by the authors in their respective studies.

The study results showed that for operative variables in two study groups, aortic modulation was used in a significantly higher number of subjects from the NSTEMI group with p=0.002, and the Off-pump technique was used in a significantly higher number of subjects from the UA group with p<0.0001. In

graft usage, total graft use was comparable in two groups with p=0.42. SVG (Saphenous vein graft) was used in 1% (n=2) subjects from UA group, radial artery graft was not used in any subject, RGEA (right gastroepiploic artery) graft was used in comparable subjects from NSTEMI and UA groups with p=0.42, RITA (right internal thoracic artery) graft also showed comparable use in two groups with p=0.52, and LITA (left internal thoracic artery) graft also showed comparable use in two groups with p=0.403. These results were consistent with the studies of Thygesen K et al,[9] in 2018 and Lamy A et al,[10] in 2013 where authors reported operative variables in their study subjects similar to the present study.

It was seen that for clinical outcomes in two groups of study subjects, stroke, MI (myocardial infarction), repeat revascularization, all-cause death, MACCE within follow-up, MACCE within hospital stay, MACCE within 30 days, and MACCE within 1 year showed statistically comparable results in NSTEMI and UA groups with p=0.95, -, 0.52, 0.76, 0.94, 0.44, 0.74, and 0.53 respectively. Postoperative acute kidney injury was significantly higher in the NSTEMI group with 23.6% (n=660 subjects compared to 6.9% (n=140 subjects from the UA group with p=0.03. Stage 2 and stage 3 acute kidney injury was seen in 5% (n=140 and 1.4% (n=4) study subjects. These findings were in agreement with the results of Gallagher S et al,[11] in 2014 and Davierwala PM et al12 in 2015 where clinical outcomes similar to the present study were reported by the authors in their respective studies.

It was also seen that in clinical outcomes, hospital stay duration was significantly higher in the NSTEMI group with p=0.007. ICU stay duration and inotropes use were also significantly higher in the NSTEMI group with p<0.001 for both. Inotropic use, wound complications, other complications, re-surgery, and atrial fibrillation were statistically comparable in the two groups with p=0.56, 0.42, 0.45, 0.15, and 0.12 respectively. These results correlated with the findings of Tan M et al,[13] in 2012 and Keller T et al,[14] in 2011 where authors reported hospital stay duration was significantly higher in the NSTEMI group compared to the unstable angina group as seen in the present study.

CONCLUSION

Considering its limitations, the present study concludes that emergency coronary artery bypass grafting in non–ST-segment–elevation myocardial infarction and unstable angina subjects result in comparable outcomes. However, elevated levels of hd-cTnI in an emergency can be correlated to immediate postoperative complications. Further longitudinal studies with larger sample sizes and longer monitoring are needed to reach a definitive conclusion.

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