Original Article

Any Target Value of LDL-cholesterol before Elective PCI? A study at NICVD on Association of LDL-Cholesterol levels with Myocardial Injury during Elective PCI

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Abstract:

Background: Raised LDL cholesterol has already been established as a strong risk factor the for pathogenesis of atherosclerotic plaque leading to coronary heart disease. During PCI procedure, many patients develop peri-procedural myocardial injury due to mainly atherosclerotic plaque disruption, side branch occlusion and distal small vessel embolization which subsequently affects the mortality and morbidity of patients. Objectives: To find out the association of pre-procedural LDL cholesterol levels with myocardial injury in elective PCI patients. Methods: This Cross-sectional observational study was conducted at National Institute of Cardiovascular Diseases (NICVD), Dhaka from July 2020 to June 2021. The sample size was 170. LDL cholesterol and troponin-I were measured before the procedure and troponin I was measured 6 hours after PCI procedure. On the basis of pre-procedural cholesterol level, the study population were categorized into two groups: Group I: patients with normal LDL-C level (≤70mg/dl) and Group II :patients with raised LDL-C (>70mg/dl). Results: Total 54(31.8%) patients developed peri-procedural myocardial injury, among them 15(19.7%) were in normal LDL-C group and 39(41.5%) were in raised LDL-C group. Elevation of troponin I after PCI was higher in group II than group I patients with statistically significant difference (p<0.001). Multivariate logistic regression analyses showed that raised LDL-C was an independent predictor of PMI (OR 4.71; 95% CI, 2.072-10.658; *p*<0.001). There was positive correlation found between pre-procedural LDL-C and myocardial injury (*r*=0.44, *p*<0.001) by Pearson's correlation coefficient test. Conclusion: Pre-procedural raised LDL-C level was positively and independently associated with myocardial injury after elective percutaneous coronary intervention (PCI).

Key words: *Percutaneous Coronary Intervention (PCI), Low density lipoprotein (LDL) cholesterol, Peri-procedural myocardial injury (PMI).*

(Bangladesh Heart Journal 2023; 38(1): 70-80)

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DOI: https://doi.org/10.3329/bhj.v38i1.67221

Introduction:

Intervention (PCI) remains an important approach for the treatment of occlusive coronary artery disease (CAD)[1]. Since the first description of coronary angioplasty in man by Andreas Gruentzig in 1977, the procedure has been extensively modified. The technical advances coupled with the use of coronary stents and adjuvant drug therapy have resulted in high procedural success rates and low restenosis rates. Older patients are now being treated, more complex multiple coronary lesions deemed appropriate for PCI

About one-third of all elective PCI procedures are associated with significant myocardial injury (termed peri-procedural myocardial injury, PMI) which has been associated with increased subsequent mortality[2]. In 2012, the third universal definition of MI[3] was the first to provide a clinically oriented definition of both type 4a MI and myocardial injury. According to 4th universal definition, myocardial injury should be used when there is evidence of elevated cardiac troponin values (cTn) with at least one value above the 99th percentile upper reference limit (URL).

The elevation of cardiac marker after PCI mainly results from incidental minor side branch occlusion around target lesions and distal embolization of plaque debris or thrombus from target lesion.

Troponin (Troponin-I and Troponin-T) are more sensitive and specific markers of cardiac injury than CK-MB[4]. Troponin increases following PCI had originally thought to carry less prognostic importance than CK-MB elevations, although recent studies and meta-analysis have shown that troponin elevations post PCI are prognostically significant. Nienhuis et al. (2008) in their meta-analysis of 15581 patients from 20 studies over a 19 year period reported the incidence of troponin release post PCI in elective PCI to be 33% and increased mortality was significantly associated with troponin elevation after PCI (4.4 vs 3.3%, p=0.001; OR=1.35)[5] . Peri-procedural MI can be difficult to rule out as the symptoms, electrocardiographic changes, angiography and others imaging modalities can be uncertain due to older ischemic injuries and discomfort associated with the procedure itself. A study showed that on angiography only approximately 60% of peri-procedural MI could be explained[6]. Clinicians must therefore rely considerably on cardiac biomarkers.

In Bangladesh about one-third of all elective PCI procedures are associated with significant myocardial injury[7]. Traditional risk factors for PMI are advanced age (>50years), female gender, DM, BMI, hypertension, smoking, dyslipidaemia ,type C lesion, multiple stents, post dilatation and hs-CRP. Ahmed et al. (2015) reported that those patient had hs-CRP > 3mg/dl has 20% more chance (33.06% vs 11.52%) of myocardial injury than normal hs-CRP (d"3 mg/dl) leveled patients[8]. This is probably due to sustained inflammatory response of coronary artery which subsequently leads to distal micro embolization. Stent length has also impact on myocardial injury. In 2014 a study was done in NICVD and that study showed that those patient had been implemented 20 mm or more stent length has more chance of myocardial injury[7]. This is due to side branch occlusion. It has been reported in 12.5%-19% of cases in which a stent was placed across a major side branch[9]. Herrmann (2005) in his review article, classified it as type-1 or proximal PMI. Another type, Type-2 PMI or distal PMI is due to atherosclerotic plaque disruption , local vessel trauma and distal embolization. Type 2 PMI constitutes 50%-75% of PMI cases which is directly related to the process of atherosclerosis[10].

Low density lipoprotein cholesterol (LDL) is most atherogenic cholesterol. It was found that LDL cholesterol is directly related to atherosclerosis. It was also found that 1% rise in serum total cholesterol level leads to 2% increase in ischaemic heart disease (IHD). Regarding Bangladeshi population mean LDL cholesterol level is 119mg/dl[11]. In NICVD a study was done regarding the LDL cholesterol level in ACS patient during 2016 to 2018 period. That study reported that LDL cholesterol level was found high (>130mg/dl) in 58% patients. Similar study was done in some tertiary level hospital in Bangladesh, showed that patient admitted with acute myocardial infarction had dyslipidaemia in the form of raised LDL cholesterol (> 100mg/dl) in 75% cases[12]. More lipo-protein in blood is associated with more bigger SYNTAX score which means the coronary vessel lesion more complex. LDL cholesterol is also a direct predictor for coronary plaque progression. Patients with LDL-C bellow 70 mg/dl displayed a significant attenuation in plaque progression as compared with those follow-up LDL-C levels e" 70 mg/dl (12.7±38.2 mm^3 vs 44.2±73.6 mm^3 , respectively; p=0.014)[13]. Coronary artery plaque is the hallmark for peri-procedural myocardial injury (especially type-2 PMI). Kabir et al. (2019) reported that dyslipidaemia is an important target for prevention of periprocedural myocardial injury[14]. The ARMYDA-RECAPTURE trial showed that reloading patients who are already receiving statin treatment (application of 80mg of atorvastatin > 12h prior to procedure and application of an additional pre-procedural dose of 40mg)

markedly reduces the primary end point of cardiac death, MI or unplanned revascularization at 30 days (3.7% vs 9.4%). Statin pretreatment also reduces the rate of peri-procedural myocardial injury and Major Adverse Cardiac Events (MACE) following stent implantation[15]. Chronic treatment with statin can reduce fibrous-cap thickness of lipid rich plaque and this explain why patients receiving chronic statin treatment experiences less PMI during PCI. This current study was aimed to evaluate the association between pre-procedural LDL cholesterol levels with myocardial injury in elective cases.

Methods:

This Prospective observational study was conducted in the Department of Cardiology, National Institute of Cardiovascular Diseases, Dhaka during the period from July 2020 to June 2021. Patients admitted with Coronary Artery Disease (CAD) who were undergoing for elective Percutaneous Coronary Intervention (PCI) included in this study. Initially 190 patients were enrolled. Among them, 12 patients were found CTO lesion during CAG, 3 patients developed VT during the procedure, TIMI grade-3 flow was not produced in 2 patients, 1 patient died just after the procedure. Finally total number (n) of patient was 170. Patients with primary PCI, pharmaco-invasive PCI, primary PCI strategy, angiographic failure or death <24 hours after PCI, raised troponin I before the procedure, cardiac arrest during and after procedure, history of aortic dissection, CABG, valvular heart disease, Chronic Liver Disease (CLD), Chronic Kidney Disease (CKD), malignancy, advanced Chronic Obstructive Pulmonary Disease (COPD), asthma, coronary dissection during procedure, major side branch (≥ 02 mm) occlusion during procedure, no/slow reflow after procedure, acute stent thrombosis, multi-vessels PCI (>2), use of ≥3 stents, Complex PCI (LM/bifurcation lesion/ CTO lesion/Calcified lesion/Thrombus burden) were excluded. Informed written consent was taken from each patient before enrollment. LDL-C level was measured by Serum LDL cholesterol (Beckman Coulter Analyzer (Model- OLYMPUS AU480). In established CAD, target LDL-C level ≤70 mg/dl (ACC dyslipidaemia guideline, 2018). So I divided the patient into two groups according to the target level of LDL cholesterol. In group-1 patients with LDL cholesterol ≤70 mg/dl and group-2 patients with LDL cholesterol > 70 mg/dl. Meticulous history was taken and detailed clinical examination was done and recorded in predesigned structured questionnaire. Demographic data like Age, Gender, height, body weight were recorded. Risk factor profile for CAD, Smoking Hypertension, Diabetes Mellitus, Family history of coronary artery disease (CAD) were noted. Routine laboratory investigations like Hb level, RBS, serum creatinine, serum electrolytes and screening blood tests were measured. Pulse and BP were recorded both before and after intervention. 12 lead resting ECG was done before sending the patient to cath laboratory and one hour after the procedure. Troponin I value was measured by Immulite 1000 troponin I (Siemens medical solutions diagnostics, Los Angeles, USA) in the morning before the procedure. Patient with normal Troponin I (< 0.2 ng/ml) was selected for the study. The troponin kit used had a cut off value of ≥0.2 ng/ml for diagnosis of myocardial injury. Premedication was done by operator choice i.e loading doses of aspirin 300mg, clopidogrel 300mg, atorvastatin 40mg. Procedural variables i.e number of vessels involvement, procedural duration, amount of dye used, any use of eptifibatide, number of used stents, peri-procedural arrhythmia, peri-procedural cardiogenic shock, were noted. PCI was carried out in an artery having ≥70% guided by ischaemia protocol. During PCI procedure ACT was maintained between 250-350s. Low molecular weight heparin was continued for 48 hours after the procedure. Following PCI procedure patient was brought to CCU for 24 hours and monitored for any arrhythmia or cardiogenic shock. Blood sample was collected for troponin-I, 6 hours after but within 24 hours of PCI. Analysis was conducted on SPSS 23.0 for windows software (SPSS Inc., Chicago, IL, USA, 2015).Nature of the data were explored. Quantitative data was expressed as mean and standard deviation and comparison was done by “student t” test. Qualitative data was expressed as frequency and percentage and comparison was done by Chi-square(x2) Test and Fisher’s Exact Test. Logistic regression analysis was done (both univariate and multivariate). To see the correlation between LDL levels and myocardial injury, Pearson’s Correlation Test was done. Value of $p<0.05$ was considered statistically significant. Observations are expressed as tables and bar diagram. The study protocol was approved by ethical review committee of NICVD. Confidentiality regarding all information and records was maintained strictly and the patients had the right to withdraw him/herself from the study at any time during the study period.

Results:

The general objective of the study was to evaluate the association between pre-procedural LDL cholesterol and myocardial injury in patients undergoing elective PCI. The findings were shown below:

Table-I

Comparison of age distribution of the study patients

Age group (years)	Group-1(n=76)		Group-2(n=94)		Total (n=170)		p- value
	Number	%	Number	%	Number	%	
20 – 29	1	1.3	0	0.0	1	0.6	
30 – 39	7	9.2	11	11.7	18	10.6	
40 – 49	24	31.6	21	22.3	45	26.5	
50 – 59	21	27.6	37	39.4	58	34.1	
60 – 69	19	25.0	19	20.2	38	22.4	
70 – 79	3	3.9	5	5.3	8	4.7	
e”80	1	1.3	1	1.1	2	1.2	
Mean±SD	51.7±.10.8		52.4±10.7		52.1±10.7		0.66^{ns}

Unpaired t-test was done.
ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.

The above table illustrates age distribution among the study patients. Most of the patients were in the age range of 50-59 years of 27.6% in group-1 and 39.4% in group-2. The following highest age range was 40-49 years of 31.6% in group-1 and 22.3% in group-2. The mean age of Group-I was 51.7±.10.8 years and Group-II was 52.4±10.7 years. Analysis displays statistically no significant (p =0.66) mean age difference between the study groups. The mean age of the total patients was 52.1±10.7 years.

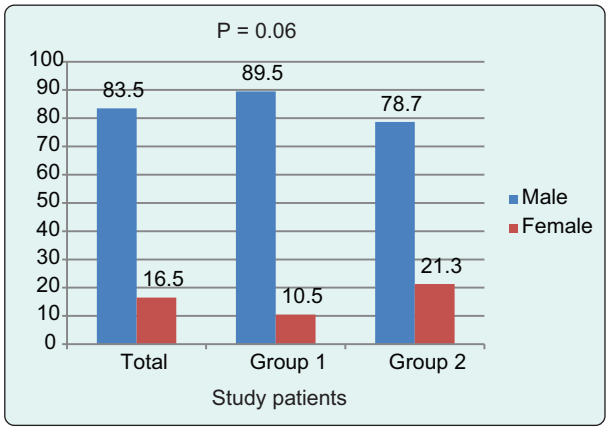

Fig.-1: *Bar diagram showing gender distribution of the study patients.*
Chi-square test was done.
ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.

Table-II

Comparison of risk factors among the study patients

Risk factors	Group-1 (n=76)		Group-2 (n=94)		Total (n=170)		p- value
	Number	%	Number	%	Number	%	
Smoker	27	35.5	38	40.4	65	38.2	0.51^{ns}
Hypertension	24	31.6	26	27.7	50	29.4	0.58^{ns}
Diabetes mellitus	27	35.5	38	40.4	65	38.2	0.51^{ns}
F/H of CAD	8	10.5	7	7.4	15	8.8	0.48^{ns}
BMI kg/m(mean±SD)	26.0±3.7		25.7±2.4		25.9±3.0		*0.51^{ns}

Chi-square test and *unpaired-t test were done.
Ns= not significant (p>0.05)
Group-1: Patients with LDL cholesterol d”70mg/dl
Group –2: Patients with LDL cholesterol >70mg/dl

The above table shows that all characteristics of risk factors had almost identical in group-1 compared to group-2 with no statistical significant difference (p>0.05).

Table-III

Comparison of study patients by diagnosis

Diagnosis	Group-1(n=76)		Group-2(n=94)		Total (n=170)		p- value
	Number	%	Number	%	Number	%	
CSA	38	50.0	42	44.7	80	47.1	0.49^{ns}
OMI	38	50.0	52	55.3	90	52.9	0.51^{ns}

Chi-square test was done.
ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.
Patients having CSA had higher in group-1 compare to group-2 (50% vs. 44.7%). On the contrary, OMI old patients had more in group-2 than group-1 (55.3% vs. 50%). There was no significant difference in terms of diagnosis (p=0.49) between the groups.

Table-IV

Comparison of study patients by Left Ventricular Ejection Fraction

LVEF in %	Group-1(n=76)		Group-2(n=94)		Total (n=170)		p- value
	Number	%	Number	%	Number	%	
Reduced EF(<40%)	12	15.8	20	21.3	32	18.8	0.36^{ns}
Mid Range EF(40-50)	40	52.6	46	48.9	86	50.6	0.63^{ns}
Preserved EF (>50%)	24	31.6	28	29.8	52	30.6	0.81^{ns}

Chi-square test was done.
Ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.
The above table indicates that left ventricular ejection fraction between the two groups was almost similar with no significant difference (p>0.05).

Table-V

Comparison of biochemical status of the study patients

Variables	Group-1 (n=76) mean±SD	Group-2 (n=94) mean±SD	p value
Total cholesterol mg/dl	129.4±20.7	181.9±53.3	<0.001^{s}
Triglyceride mg/dl	142.7±84.7	178.6±77.7	0.005^{s}
HDL mg/dl	41.5±24.1	39.2±10.2	0.42^{ns}
LDL mg/dl	62.1±8.2	122.3±30.2	

s= significant (p<0.05) and ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.

The above biochemical characteristics were higher in group-2 than group-1 with significant difference (p<0.05) except HDL cholesterol. HDL was found higher in group-1 than group-2 with no significant difference (p=0.42).

Table-VI

Comparison of procedural characteristics among the study patients

Variables	Group-1(n=76)		Group-2(n=94)		Total (n=170)		p- value
	Number	%	Number	%	Number	%	
Vessel involvement							
SVD	54	71.1	61	64.9	115	67.6	0.39^{ns}
DVD	22	28.9	33	35.1	55	32.4	
Procedural duration							
d"60 minute	50	65.8	60	63.8	110	64.7	0.79^{ns}
>60 minute	26	34.2	34	36.2	60	35.3	
No. of stent used							
Single stent	50	65.8	61	64.9	111	65.3	0.90^{ns}
Double	26	34.2	33	35.1	59	34.7	
Amount of Dye used							
d"300 ml	52	68.4	69	73.4	121	71.2	0.48^{ns}
>300 ml	24	31.6	25	26.6	49	28.8	
Use of Eptifibatide							
Yes	10	13.2	10	10.6	20	11.8	0.61^{ns}
No	66	86.8	84	89.4	150	88.2	

Chi-square test was done.
ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.
The above table indicates that CAG characteristics had almost identical in group I compared to group II with no statistical significant association (p>0.05).

Table-VII

Comparison of peri-procedural complications among the study patients

Variables	Group-1(n=76)		Group-2(n=94)		Total (n=170)		p- value
	Number	%	Number	%	Number	%	
Arrhythmia	4	5.3	10	10.6	14	8.2	0.20^{ns}
Cardiogenic shock	4	5.3	9	9.6	13	7.6	0.29^{ns}

Fisher's Exact test was done.
ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group –2: Patients with LDL cholesterol >70mg/dl.
Among the post procedural characteristics arrhythmia was insignificantly occurred in group II patients in compared to group I patients with p value 0.20. Cardiogenic shock was occurred in group II in compared to group I with statistically insignificant association (p=0.29).

Table-VIII

Association between pre-procedural LDL-C and myocardial injury among the study population

Study population	Group-1 =(LDL-C ≤70mg/dl)	Group-2 (LDL-C >70mg/dl)	P –value
Troponin I Positive (≥0.2)	15(19.7)	39(41.5)	<0.002^{s}
Troponin I Negative (<0.2)	61(80.3)	55(58.5)	
Troponin I (ng/dl)	0.37±0.16	2.52±1.50	*0.001^{s}

Paired t-test and *Chi-square test were done.
s= significant (p<0.05) and ns= not significant (p>0.05).
Group-1: Patients with LDL cholesterol ≤70mg/dl.
Group-2: Patients with LDL cholesterol >70mg/dl.
Mean value of troponin I was higher in Group-2 than Group-1 with statisttically significant difference (p<0.001). Proportion of PMI is also higher in Group-2 than Group-1 which is also statistically significant (p=0.002).

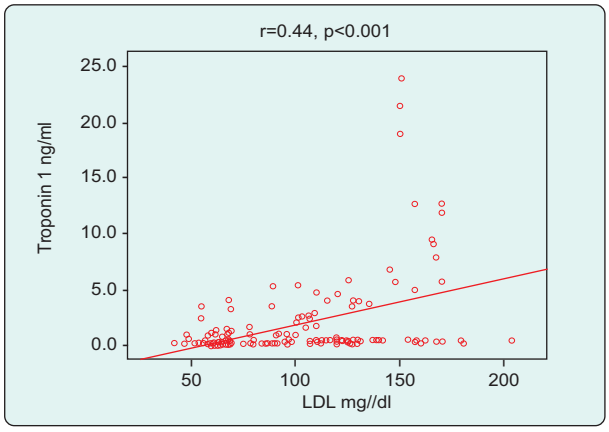

Fig.-2: *Correlation between LDL cholesterol and Troponin I ng/ml among the study patients by scatter plot diagram*

The figure shows that there is a moderate positive correlation between LDL cholesterol and Troponin I by Pearson's Correlation (r=0.44). The figure indicates that LDL level is increasing as well as Troponin I is also increasing. It was observed that the correlation statistically significant (p<0.001) by correlation t-test.

Table-IX

Univariate association of relevant risk factors with myocardial injury events

Variables of interest (Confunding Variables)	Odds Ratio (OR)	95% CI of OR	p value
Age>50 yrs	0.88	0.456 – 1.681	0.70^{ns}
Female gender	0.52	0.197 – 1.361	0.18^{ns}
Smoking	0.51	0.266 – 0.986	0.05^{ns}
Hypertension	1.77	0.836 – 3.739	0.13^{ns}
Diabetes mellitus	2.60	1.810 – 4.168	0.002^{s}
Raised BMI	0.96	0.865 – 1.066	0.44^{ns}
EF<40%	1.56	0.708 – 3.457	0.26^{ns}
OMI	2.05	1.537- 5.089	0.001^{s}
DVD	1.30	0.663 – 2.573	0.44^{ns}
Use of 2 stent	1.11	0.569 – 2.179	0.75^{ns}
Procedural duration>60 min	1.07	0.548 – 2.094	0.84^{ns}
Amount of dye>300 ml	2.62	1.813 – 3.226	0.003^{s}
Use of eptifibatide (Yes)	0.67	0.229 – 1.939	0.45^{ns}
Low HDL	0.97	0.941 – 1.011	0.14^{ns}
Elevated TG	1.23	1.234– 2.003	0.004^{s}
Elevated TC	1.18	1.135 – 1.876	0.002^{s}
Arrhythmia	0.44	0.148 – 1.337	0.14^{ns}
Cardiogenic shock	1.08	0.318 – 3.682	0.89^{ns}
Raised LDL	4.89	1.500 - 13.050	0.002^{s}

ns= Not significant (p>0.05), s= Significant (p<0.05)

The above table describes that Diabetes, previous history of MI , elevated LDL-C, TC TG, use of more dye (>300ml) during PCI procedure univariately associated to develop myocardial injury .

Table-X

Multivariate logistic regression analysis of myocardial injury events with relevant risk factors

Variables of interest	Standardized regression coefficient (β)	Odds Ratio (OR)	95% CI of OR	p value
Increased TC	-0.008	0.992	0.983 – 1.001	0.07^{ns}
Increased TG	0.000	0.999	0.995 – 1.004	0.74^{ns}
Raised LDL-C	1.549	4.71	2.072 - 10.658	<0.001^{s}
Diabetes	-0.004	0.887	0.913-1.002	0.16^{ns}
OMI	0.0224	0.998	0.998-1.009	0.15^{ns}
Use of > 300ml dye	-0.002	0.913	0.967-1.005	0.82^{ns}

ns= Not significant (p>0.05)

The above table describes sex distribution among the study patients. In group-1, 68 (89.5%) were male and 8(10.5%) were female. In group-2, 74(78.7%) were male and 20(21.3%) were female. Statistically no significant difference was found in term of sex between the groups (p=0.06). Male: Female ratio was 5.1:1. Male patients had predominant in the study.

The above table provides the binary logistic regression analysis of Odds Ratio for characteristics of the subjects likely to myocardial injury cardiac events. The above mentioned variables of interest are all entered into the model directly as confounding independent exposures for the developing of myocardial injury (dependent variable). The raised LDL-C was found to be significantly associated with myocardial injury with the ORs being 4.71. Hence it can be concluded that an odds of having myocardial injury for raised LDL-C had 4.71 times that of taget level LDL-C in this study.

Discussion:

All patients with chronic coronary syndrome undergoing PCI were considered for the study after considering inclusion and exclusion criteria during the period of July 2020 to June 2021 admitted in NICVD. Procedural characteristics were recorded during the procedure. A total number of 170 patients were included in the study. On the basis pre-procedural LDL cholesterol levels, study subjects were categorized into two groups. Patients with target LDL cholesterol level (≤70 mg/dl) were considered as Group 1 and patients with raised LDL cholesterol level (> 70mg/dl) were considered as Group 2.

The mean (±SD) age of the study population was 52.1±10.7 years ranging from 26 to 80 years, 51.7±10.8 in group 1 and 52.4 ± 10.7 in group 2. The mean age difference was not statistically significant (P= 0.66) between two groups. This finding was very close to the other relevant studies in our country[16]. Studies done by Chaowalit et al. (2007) and Mustelier et al.(2011) found that mean age was respectively 68 ± 13 years and 61.3 ± 8 years which was higher than present study probably due to longer life expectancy, geographical and racial difference[17]. In BRAVE study among 4500 cases of first MI admitted into NICVD, mean age of the patients was 53 ± 10 years[18].

The gender distribution of this study population in group-1, 68(89.5%) patients were male and 8(10.5%) were female. In group-2, 74(78.7%) were male and 20(21.3%) were female. Male female ratio was 5.1:1. No significant (p = 0.06) difference was observed between two groups. Gender distribution of this study population was not comparable to the overall population of Bangladesh because there were fewer female in this study. Male patients were predominant in both groups which correlates to study done by Herrmann et al. (2012) and de Winter et al. (2003). They also showed male predominance in their study population[19]. In almost all studies related to coronary artery disease (CAD) similar male preponderance was found[20]. As females were given less attention and access for them to the health care facilities particularly in low socioeconomic population like Bangladesh may contribute for this male predominance. Moreover, smoking as a risk factor of IHD is less common in our country among female, which may also explain male predominance of IHD. Among two groups, female was more in group-2 than group-1, though the difference was not statistically significant (p>0.05). Li, et al. (2014) also reported a higher prevalence of female gender in patients with raised LDL cholesterol[21].

Regarding risk factors, patient with raised pre-procedural LDL cholesterol had highest percentage of smoking (38.2%) and diabetes (38.2%) followed by hypertension (29.4%) and family history of premature coronary artery

disease (8.8%). Similarly patients with target level pre-procedural LDL cholesterol group smoking (35.5%) and diabetes (35.5%) were predominant followed by hypertension (31.6%) and family history of premature coronary artery disease (10.5%). Cross lab analysis found no statistically significant differences between two groups (p>0.05). Ahmed et al. had done a study on PMI and found the similar dominance of characteristics of risk factors among the subjects in our country also consistent with those found by Hermann et al. (2005)[8,10]

Proportions of different values of left ventricular ejection fraction in both group-1 and group-2 are almost similar with no significant difference (p >0.05)

Regarding stenting, single vessel stenting was done in 71.1% in group-1 and 64.9% in group-2, double vessel stenting was done in 28.9% in group-1 and 35.1% in group-2. Though proportion is more in group-2 but there was no statistical significance (p.0.05) which is consistent with those found by Li et al. (2014)[21].

In this study, during PCI procedure, number of vessel involvement, total procedural duration, extent of dye used, use of eptifibatide were assessed.. Single vessel involvement in group-1 and group-2 are 71.1% and 64.9% respectively; On the other hand, double vessel involvement are 28.9% and 35.1%.

Duration of procedure > 60 minutes (34.2% vs 36.2%). Use of more dye (>300ml) (31.6% vs 26.6%) , use of eptifibatide (13.2% vs 10.6%) were similar in both groups which were not statistically significant. This findings were consistent with study done by li et al. (2014)[21].

Regarding biochemical analysis of this study, mean value of HDL cholesterol is 41.5±24.1 and 39.2 ±10.2 in group-1 and group-2 respectively and found insignificant (p=0.42), Though mean value of total cholesterol, TG, LDL cholesterol in group-1 & group-2 were (129.4±20.7 vs 181.9±53.3), (142.7±84.7 vs 178.6±77.7), (62.1±8.2 vs 122.3±30.2) respectively and found statistically significant (p<0.001).

Following PCI, total 54(31.7%) population develop PMI . Proportion of PMI in our study is consistent with studies in our country (Ahmed et al., 2015 and Kabir et al., 2012) also some international studies like li et al., 2014 and Neinhuis et al., 2008[5,8,10,21]. In normal LDL-C level, 15(19.7%) patient develop PMI out of 76 . In raised LDL-C group , there was PMI in 39(41.5%) out of 94 cases. The mean rise of troponin I was significantly higher in group-2 than group-1 (2.52±1.50 vs 0.37±0.16, p<0.001). Also there was moderate positive linear correlation between pre-procedural LDL cholesterol level and rise of troponin I value (r=0.44) following procedure and it was statistically significant (p<0.001). Li et al. (2014) studied on 2529 patients with normal pre-procedural cardiac troponin I who was successfully underwent elective PCI, found that 142(25.5%) out of 559 patients are associated with PMI when LDL cholesterol level ≤70 mg/dl and 758 (38.5%) out of 1970 patients with LDL cholesterol level >70 mg/dl which was consistent with our study[21].

In a recent analysis, Patti et al. (2005) showed that , statin therapy reduced peri-procedural MI. This relationship suggests that LDL cholesterol may predict the risk of plaque vulnerability and distal embolization[22].

Nienhuis et al. (2008) in their meta-analysis of 15581 patients from 20 studies over a 19-year period reported the incidence of troponin release post-PCI in elective PCI to be 33.0% and increased mortality was significantly associated with troponin elevation after PCI (4.4% vs 3.3%, p=0.001;OR=1.35)[5].

Tanaka et al. (2009) in their recent meta-analysis of 15 studies incorporating 7578 patients observed that elevation of troponin-I occurred 28.7% of procedures and 14.5% patients met the new criteria for peri-procedural myocardial infarction and these patients are at high risk of further adverse events both during the hospital stay and at 18 months.

In univariate logistic regression analysis, Diabetes, previous history of MI , elevated LDL-C, TC, TG and use of more dye (>300ml) during PCI procedure were found significant for the cause of PMI. But when multivariate logistic regression analysis was done among these predictors of PCI outcome like diabetes mellitus, previous history of MI ,TG, total cholesterol and use of >300 ml during procedure; Only raised LDL-C was found as independent predictors of peri-procedural myocardial injury during PCI with OR 4.71 and p=0.001. This study findings were similar with the study done by Lin li et al. (2014)[21].

Previously very limited study was available in Bangladesh to find out the association of LDL cholesterol and myocardial injury. Results of this study established significant and independent association of pre-procedural LDL cholesterol levels with myocardial injury in patients undergone elective PCI.

Conclusion:

The present study demonstrated that pre-procedural raised LDL cholesterol in patients of Chronic coronary syndrome was associated with more incidence of

significant troponin I elevation after percutaneous coronary intervention (PCI). Pre-procedural raised LDL cholesterol may be considered as a predictor of cardiac injury in patients undergoing with elective PCI.

Limitations of study:

Although the results of this study supports the hypothesis, there are some facts to be considered which might have affected the result of the current study-

- PCI were done by various operators.
- It was a single centered study.
- Sampling was done by non-randomized sampling method.
- Sample size was small.

References:

1. Doyle, B. J., Rihal, C. S., Gastineau, D. A. and Holmes, D. R., 2009. Bleeding, blood transfusion, and increased mortality after percutaneous coronary intervention: implications for contemporary practice. *Journal of the American College of Cardiology,* 53(22), pp. 2019–2027.

2. Ioannidis, J. P. A., Karvouni, E. and Katritsis, D. G., 2003. Mortality risk conferred by small elevations of creatine kinase-MB isoenzyme after percutaneous coronary intervention. *Journal of the American College of Cardiology,* 42(8), pp. 1406–1411.

3. Thygesen, K., Alpert, J. S., Jaffe, A. S., Simoons, M. L., Chaitman, B. R., White, H. D., Katus, H. A., Apple, F. S., Lindahl, B., Morrow, D. A., Chaitman, B. A., Clemmensen, P. M., Johanson, P., Hod, H., Underwood, R., Bax, J. J., Bonow, R. O., Pinto, F., Gibbons, R., Topol, E. J., Leya, F., Pinkerton, C. A., Whitlow, P. L., Hofling, B., Simonton, C. A., Masden, R. R., Serruys, P. W., Leon, M. B. and Williams, D. O., 1993. A comparison of directional atherectomy with coronary angioplasty in patients with coronary artery disease. The CAVEAT Study Group. *The New England Journal of Medicine,* 329(4), pp. 221–227.

4. Katus, H. A., Remppis, A., Neumann, F. J., Scheffold, T., Diederich, K. W., Vinar, G., Noe, A., Matern, G. and Kuebler, W., 1991. Diagnostic efficiency of troponin T measurements in acute myocardial infarction. *Circulation,* 83(3), pp. 902–912.

5. Nienhuis, M. B., Ottervanger, J. P., Bilo, H. J. G., Dikkeschei, B. D. and Zijlstra, F., 2008. Prognostic value of troponin after elective percutaneous coronary intervention: A meta- analysis. *Catheterization and Cardiovascular Interventions : Official Journal of the Society for Cardiac Angiography & Interventions,* 71(3), pp. 318–324.

6. Muschart, X., Slimani, A., Jamart, J., Chenu, P., Dangoisse, V., Gabriel, L., Guédès, A., Marchandise, B. and Schröder, E., 2012. The different mechanisms of periprocedural myocardial infarction and their impact on in-hospital outcome. *The Journal of Invasive Cardiology,* 24(12), pp. 655–660.

7. Mandal, M.R.N., Rahman, M.A., Akanda, M.A.K., Ullah, M., Kar, N., 2014. Influence of stent length on peri-procedural myocardial injury after percutaneous coronary intervention. *Cardiovascular Journal* 2014; 6(2):143-148.

8. Ahmed, M., Ahmed, N.C., Rahman, A., Rahman, Amin, M.G., Jannat, S., Mollah, R.I., 2015. Elevated plasma high sensitivity C-reactive protein (hs-CRP) level is a predictor of periprocedural myocardial injury during percutaneous coronary intervention (PCI). *Bangladesh Heart Journal* 2015; 30(1): 5-12.

9. Aliabadi, D., Tilli, F. V., Bowers, T. R., Benzuly, K. H., Safian, R. D., Goldstein, J. A., Grines, C. L. and O'Neill, W. W., 1997. Incidence and angiographic predictors of side branch occlusion following high-pressure intracoronary stenting. *The American Journal of Cardiology,* 80(8), pp.994–997.

10. Herrmann, J., 2005. Peri-procedural myocardial injury: 2005 update. *European Heart Journal,* 26(23), pp. 2493–2519.

11. Afrin, S.F., Al-Mahmood, A.K., Fatima, B. K., Rahman, F., Hassan, Z., 2017. Pattern of lipid levels of subjects seeking laboratory services in an established laboratory in the Dhaka city. *Bangladesh Journal of Medical Science*, 16(03), pp. 375-379.

12. Kabir, C.M.S., Haq, M.M., Rashid, M.A., Dawood S., Taimur, M., Rahman, M.H., Gomes,M.H., Jahan, M.N., 2012. Periprocedural Myocardial Injury during percutaneous coronary intervention : How can it be prevented? *Ibrahim Card Med J,* 2(1), p. 51-56.

13. McKechnie, R. S., Smith, D., Montoye, C., Kline-Rogers, E., O'Donnell, M. J., DeFranco, Mehran, R., Dangas, G., Mintz, G. S., Lansky, A. J., Pichard, A. D., Satler, L. F., Kent, K. M., Stone, G. W. and Leon, M. B., 2000. Atherosclerotic plaque burden and CK-MB enzyme elevation after coronary interventions :

intravascular ultrasound study of 2256 patients. *Circulation,* 101(6), pp. 604–610.

14. Kabir, S., Majumder, A. A.S., Khair, A., Hasan, Z., Islam, K., Chowdhury, A. K., Shaha, G. K., Ali, M., Rahman, A., Akanda, A. K. and Rashid, M., 2015. Outcomes of primary percutaneous coronary intervention (PCI) in NICVD, Dhaka, Bangladesh, our initial experiences. *University Heart Journal,* 9(2), p. 83–83.

15. Briguori, C., Visconti, G., Focaccio, A., Golia, B., Chieffo, A., Castelli, A., Mussardo, M., Montorfano, M., Ricciardelli, B. and Colombo, A., 2009. Novel approaches for preventing or limiting events (Naples) II trial: impact of a single high loading dose of atorvastatin on periprocedural myocardial infarction. *Journal of the American College of Cardiology,* 54(23), pp. 2157–2163.

16. Rafiquzzaman K., Ali, M., Rahman, M. T., Alam, N., Hossain, M. A., Jafar, A.H. and Rahmann, M. A., 2015. Association of body mass index with angiographic severity of coronary artery disease in patients acute ST segment elevation myocardial infarction. *Cardiovascular Journal,* 9(2), pp. 106–106.

17. Chaowalit, N., Somers, V. K., Pellikka, P. A., Rihal, C. S. and Lopez-Jimenez, F., 2007. Adipose tissue of atrial septum as a marker of coronary artery disease. *Chest,* 132(3), pp. 817–822.

18. Chowdhury, Rajib., Dewan. S., Alam,I., Ibrahim, F., Sheikh, D., A., Aliya, N., Shrat, T., Monower, M.M., Farzana, H.F., Hossain, M.., Rahman, M.M., Sadia , A.A., Roy, K., Minara, A., Sima A.S., Ajoy, K.B., Lisa, P., Praveen, S.R.D., Young,S.A., Spackman, K.H., Eric, H., Nasir, S., Richard, H., Danish, S., Joanna, M.M.H., Adam, S., Butterworth, R. R., Majumder, A.A.S., John, D., Emanuele, D. A., 2015. The Bangladesh Risk of Acute Vascular Events (BRAVE) Study: objectives and design *Eur J Epidemiol*. 30 p: 577-587

19. Winter, R. J., de, Windhausen, F., Cornel, J. H., Dunselman, P. H. J. M., Janus, C. L., Bendermacher, P. E. F., Michels, H. R., Sanders, G. T., Tijssen, J. G. P. and Verheugt, F.W. A., 2005. Early invasive versus selectively invasive management for acute coronary syndromes. *The New England Journal of Medicine,* 353(11), pp. 1095–1104.

20. Islam, A. K. M. M. and Majumder, A. A. S., 2013. Coronary artery disease in Bangladesh: a review.

21. Li, X.L., Li, J.J., Guo, Y.L., Zhu, G.G., Xu, R.X., Li, S., Qing, P., Wu, N.Q., Jiang, L.X., Xu, B., Gao, R.L., 2014. association between pre-procedural LDL cholesteroal and myocardial injury in patients undergoing elective PCI. *Journal of clinical lipidology* 2014.04.002

22. Patti, G., Colonna, G., Pasceri, V., Pepe, L. L., Montinaro, A. and Di Sciascio, G., 2005. Randomized trial of high loading dose of clopidogrel for reduction of periprocedural myocardial infarction in patients undergoing coronary intervention: results from the ARMYDA-2 (Antiplatelet therapy for Reduction of MYocardial Damage during Angioplasty) study. *Circulation,* 111(16), pp. 2099–2106.

23. Tanaka, A., Imanishi, T., Kitabata, H., Kubo, T., Takarada, S., Tanimoto, T., Kuroi, A., Tsujioka, H., Ikejima, H., Komukai, K., Kataiwa, H., Okouchi, K., Kashiwaghi, M., Ishibashi, K., Matsumoto, H., Takemoto, K., Nakamura, N., Hirata, K., Mizukoshi, M. and Akasaka, T., 2009. Lipid-rich plaque and myocardial perfusion after successful stenting in patients with non-ST-segment elevation acute coronary syndrome: an optical coherence tomography study. *European Heart Journal,* 30(11), pp. 1348–1355.