INTRODUCTION

Percutaneous coronary angioplasty is one of the most widely practiced invasive procedures for myocardial revascularization. Drug-eluting stents have further reduced angina, re-stenosis and long-term morbidity. In spite of these advances, raised levels of cardiac enzymes have been reported in 5-30% of successful precautionary coronary interventions suggesting myocardial damage and cell death. Most patients, though asymptomatic with no changes in cardiac functions, have raised levels of cardiac markers, which are directly proportional to the extent of myocardial damage and are associated with increased long-term mortality and morbidity. Rise of enzyme creatinine kinase (CK) and enzyme creatinine kinase MB (Myocardium Band—an isoenzyme) by more than 5 times the normal limits following percutaneous coronary angioplasty is associated with worse prognosis.

Cardiac markers level rise after the percutaneous coronary angioplasty reaching peak on day 1. Troponin-T or I levels rise after percutaneous coronary angioplasty ranges from 13-44% depending on the number of stents used. Troponins T and I are more sensitive than CK-MB for detection of minor myocardial damage after percutaneous coronary angioplasty.

Increased cardiac troponins postprocedurally were seen in one-third of a stable patient population undergoing elective percutaneous coronary angioplasty and were independently and significantly predictive of an increased risk of adverse events at 18 months, mostly in the form of repeat percutaneous coronary angioplasty. Follow-up for all cause mortality following first year after stent deployment revealed that unsuccessful procedure was the key event, which decided the postprocedural mortality. It has been established beyond doubt that any increase in enzyme creatinine kinase MB after...
percutaneous coronary angioplasty is associated with statistically and clinically significant increase in the subsequent risk of death. In addition to that, it is more economical in the local setup to follow creatinine kinase MB levels than the troponin-T or I levels. The current definition of myocardial infarction given by Joint ESC/ACCF/AHA/WHF Task Force for the re-definition of myocardial infarction has designated elevation of cardiac biomarkers greater than 3 times of 99th percentile upper reference limit as defining percutaneous coronary angioplasty-related myocardial infarction.

No data exists on the postcoronary angioplasty rise of creatinine kinase and creatinine kinase MB fraction in our setup. The purpose of this study is to measure creatinine kinase and creatinine kinase MB fraction, after successful stent deployment and find out the relationship of myocardial damage with percutaneous coronary angioplasty. Furthermore, the association of common modifiable risk factors (hypertension, diabetes mellitus, low density lipoproteins level and smoking) with myocardial damage was evaluated in patients undergoing single vessel coronary angioplasty. This information will be the platform to carry out further studies to make the process of stent deployment as myocardial friendly as possible.

PATIENTS AND METHODS

In the period from September 2006 to September 2007, 50 patients were evaluated, while undergoing elective and successful percutaneous coronary angioplasty carried out at Armed Forces Institute of Cardiology/National Institute of Heart Disease, Rawalpindi. It was a descriptive study and non-probability convenient sampling technique was utilized for collection of relevant blood samples. Inclusion criteria were presence of typical stable effort angina, positive stress test (ECG, stress echocardiogram or nuclear scan) and indication for angioplasty. Exclusion criteria were acute myocardial infarction (< 3 months), unstable angina, any rise of cardiac enzymes at presentation, and left ventricle ejection fraction of < 30%. Patients having a significant side branch artery (> 2.5 cm) at the target lesion, co-morbidity state like renal failure with creatinine of > 3 mg, refractory diabetes mellitus, hypertension or chronic obstructive airway disease were excluded. Patients who developed instant thrombosis during the procedure evident by clinical presentation and ECG changes were confirmed by re-angiography and excluded from the study. Angiographic success was defined as final angiographic residual stenosis of < 20% by visual estimation. Standard drug regimen was given to all patients before the procedure. Postpercutaneous coronary angioplasty and its result were recorded for every case. Data was expressed as means ± standard deviation for continuous variables and as frequencies for categorical variables using SPSS. The association of certain risk factors (hypertension, diabetes mellitus, LDL levels and smoking) and raised creatinine kinase levels was calculated along with statistical significance using Pearson chi-square tests. Informed written consent was taken from each patient and the study details were explained to the patient in the language that he understood. The study was approved by ethical committee of Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi.

RESULTS

All patients were over 20 years of age and target lesions had a stenosis of more than 60% by visual quantitative angiography. All percutaneous coronary angioplasties were elective and successful. Some of the variables are shown in Table I. All patients had normal renal functions as evaluated by serum creatinine measurement, the day before percutaneous coronary angioplasty and had normal values of serum creatinine/creatinine kinase MB before percutaneous coronary angioplasty.

<table>
<thead>
<tr>
<th>Table I: Selected demographic variables of the study population (n=50).</th>
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<td><strong>Age (years) and range</strong></td>
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<td><strong>Gender (M/F)</strong></td>
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<tr>
<td><strong>Previous MI n (%)</strong></td>
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<td><strong>CABG n (%)</strong></td>
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<td><strong>Treated hypertension n (%)</strong></td>
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<td><strong>Diabetes mellitus n (%)</strong></td>
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<td><strong>Smoking n (%)</strong></td>
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<td><strong>Prior PTCA n (%)</strong></td>
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PTCA = Primary coronary angioplasty.
There were no in-hospital major complication (death or need for urgent re-vascularization) in the study. As is obvious in Table II, out of 50 patients, 9 had raised creatinine kinase at 8 hours (18%) and 10 had raised creatinine kinase (20%) at 1st day following coronary angioplasty. Whereas, 7 (14%) patients and 8 (16%) patients had raised creatinine kinase MB levels at 8 hours and 1st day following coronary angioplasty respectively. Considering the target lesion, 2 (4%) patients of type-A target lesion had raised creatinine kinase MB levels as compared to 1 (2%) patients of type-B lesion and 3 (6%) patients of type-C target lesions, 8 hours following percutaneous coronary angioplasty. Similarly, 3 (6%) patients of type-A target lesion had raised creatinine kinase MB levels as compared to 3 (6%) patients of type-B lesion and 2 (4%) patients of type-C target lesions on first day following percutaneous coronary angioplasty. Raised creatinine kinase MB was seen in 15 patients with diabetes mellitus (30%), 11 patients with hypertension (22%) and 13 patients were smokers (26%). No patient showed rise of either enzyme by more than 5 times above the normal limits. There was a significant association between diabetes mellitus and raised creatinine kinase MB levels (p=0.006) in patients undergoing coronary angioplasty. Similarly, there was significant association between raised LDL (low density lipoprotein) levels and raised creatinine kinase MB levels (p=0.009) in patients undergoing coronary angioplasty but no significant association was found between hypertension (p=0.57), smoking (p=0.34) and raised creatinine kinase levels (Table II). In patients with raised creatinine kinase MB levels following percutaneous coronary angioplasty, the average length of stent deployed was 23 mm (ranging from 12-31 mm) in comparison with 25 mm (ranging from 12-56 mm) in patients with normal creatinine kinase MB levels following percutaneous coronary angioplasty. Raised creatinine kinase MB was seen in those patients.

<table>
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<tr>
<th>Risk Factors</th>
<th>No of pts with raised CK-MB at 24 hrs following PCI n (%)</th>
<th>p-values*</th>
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<tbody>
<tr>
<td>Smoking</td>
<td>13 (26%)</td>
<td>0.34</td>
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<tr>
<td>Hypertension</td>
<td>11 (22%)</td>
<td>0.570</td>
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<tr>
<td>Diabetes mellitus</td>
<td>15 (30%)</td>
<td>0.006</td>
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<tr>
<td>Raised LDL levels</td>
<td>16 (32%)</td>
<td>0.009</td>
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*P value < 0.05 is statistically significant; PCI= Percutaneous coronary intervention; CK= Creatinine kinase; CK-MB= Creatinine kinase MB fraction.

DISCUSSION

Creatinine kinase MB is a purely cytosol enzyme mainly in myocardium. It may start to rise in few hours after an ischemic event but minor myocardial injury like unstable angina can be associated with release of creatinine kinase MB. It has a half life of 10-20 hours and returns to normal value in 24-72 hours after myocardial infarction. In this study, 20% and 14% patients had raised creatinine kinase levels after 8 hours and at 1st day following single vessel coronary angioplasty respectively. Similarly, 12% and 16% patients had raised creatinine kinase MB after 8 hours and 1st day following single vessel coronary angioplasty respectively. None of the patient had rise of creatinine kinase MB by more than 3 times of normal. During successful single vessel coronary angioplasty, there was some myocardial damage evident by mild increase of cardiac enzymes but since rise of creatinine kinase MB fraction was no greater than 3 times the normal range, which could signify worse prognosis. This may have been observed because patients with a significant side branch artery (> 2.5 cm) at the target lesion site were excluded.
Similarly, complicated coronary interventions (intra-coronary dissections, stent stenosis and perforations) were also not included in the study.

There was a significant association between diabetes mellitus, LDL levels and myocardial damage in patients undergoing coronary angioplasty but no significant association was found between hypertension, smoking and myocardial damage following single vessel coronary angioplasty. It emerges that deployed stent length or pre-dilation has no correlation with raised creatinine kinase MB levels following coronary angioplasty but maximum stent deployment pressure and average balloon inflation time is correlated with raised creatinine kinase levels. However, this correlation observed was not statistically significant.

Karim et al. selected 25 patients undergoing single vessel percutaneous transluminal coronary angioplasty involving one vessel dilatation. They reported elevated creatinine kinase MB levels in 16% and 28% just after and at 1st day following transluminal coronary angioplasty respectively. They further claimed higher diagnostic sensitivity of troponin-T than creatinine kinase but it is difficult to decide whether their results represented reversible or irreversible ischemia. In a similar study, Ravkilde et al. reported raised creatinine kinase MB in 6 of 23 (26%) patients following coronary angioplasty while evaluating every 6 hours for 48 hours and then after on 4th and 8th day. As expected strategies which reduce the peri-procedural myocardial damage by anti-thrombotic, anti-inflammatory measures and prevention of embolization decrease the peri-procedural myonecrosis. Addressing the same issue Cutlip et al. debated that the low to moderate level creatinine kinase MB elevation does not predict the mortality but the peri-procedural complications decide the future outcome. It seems that during single vessel coronary angioplasty, the myocardial damage is usually small but clinically significant. A meta analysis of seven studies with creatinine kinase MB measurements and subsequent mortality was carried out, which showed an increase in creatinine kinase MB after coronary angioplasty, which was associated with small but statistically and clinically significant increase in mortality following the procedure.

ECG is comparatively insensitive in detecting minor irreversible myocardial injury. Likewise, only 3 of the present patients had transient non-specific ST changes. The transient ECG changes can not be fully explained but myocardial stunning can be a possibility. It can be safely commented that in majority of cases only a small release of myocardial enzymes can be detected without ECG changes or cardiac function impairment.

This study was a single-center non-randomized small selective patient study having a limited statistical power to detect a significant difference in creatinine kinase MB levels in patients undergoing coronary angioplasty. Furthermore, only single vessel coronary angioplasty has been studied that also in the absence of a major off shoot branch at the lesion. Still, this study can provide a framework and a platform for a bigger larger prospective study on patient undergoing variety of stent deployment in bonanza of circumstances. Larger patient population with multi-vessel stenting can unveil the true significance of myocardial enzymes and their prognostic implications.

CONCLUSION

We concluded that successful elective, uncomplicated, single vessel coronary angioplasty results in some myocardial damage evident by mild rise in cardiac enzymes but rise of creatinine kinase MB above the 3 times of normal, which signifies percutaneous coronary angioplasty related myocardial infarction is not seen. There was a significant association between diabetes mellitus, LDL levels and myocardial damage in patients undergoing coronary angioplasty but no significant association was found between hypertension, smoking and myocardial damage following single vessel coronary angioplasty.

REFERENCES


