CHANGES IN CARDIAC ENZYMES DURING CORONARY BYPASS SURGERY

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The enzymes creatine phosphokinase (CPK), serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), and lactate dehydrogenase (LDH) had been studied during perioperative periods in 36 patients undergoing coronary artery bypass surgery. Significant increases occured during the stages of operation in all enzymes, but SGPT. Increase in CPK-MB started after induction of anesthesia, indicating an infrequently known vulnarable period. CPK-MB values showed significant difference between preoperative and postinduction values (P <0.05). Also, the postoperative values of CPK-MB, SGOT and LDH showed a strong correlation with the length of aortic cross clamping and total perfusion time (r=0.504, r=0.586, r=0.542 respectively).

Key Words: Cardiac enzymes, CPK - MB, myocardial damage, coronary artery surgery.

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In 1954 La Due et al first noted rises in serum glutamic oxaloacetic transaminase (SGOT) enzyme following myocardial infarction[1]. Evaluation of this and other serum enzyme systems appeared sensitive indicators for acute myocardial damage. Creatine phosphokinase (CPK) appeared more sensitive than others, although false-positive results were seen frequently [2-4].

Lactate dehydrogenase (LDH) and other conventional enzymes have also been used to evaluate myocardial damage.

CPK and LDH isoenzymes have offered greater spesificity for diagnosing myocardial infarction. Myocardium contains significant amount of CPK-MB. In the literature, following coronary bypass surgery, the incidence of perioperative myocardial infarction was reported between 5-23% [5,6], and the clinical diagnosis is usually made on the basis of electrocardiographic evidence of infarction combined with elevated CPK and its spesific fraction CPK-MB.

There are many reports indicating the increase in cardiac enzymes, especially CPK in the literature[5,9-11]. They usually claim that reasons of increase in cardiac enzymes are sternotomy, trauma to the atrium during cannulation and etc[10,12].

We designed this prospective clinical study to evaluate the changes in cardiac enzymes, especially CPK-MB, during the different stages of coronary artery bypass surgery.

Materials and Methods

Thirty-six consecutive patients with coronary heart disease who underwent elective coronary bypass surgery, were studied. Thirty-four men and 2 women, between the ages of 37 and 68 (mean 50.4) were evaluated. Indication for surgery was stable angina in 24, unstable angina in 12. Associated cardiac disease was mitral stenosis in one patient, and mitral insufficiency in an other. Four patients were diabetic, and 3 patients were hypertensive. Angiographically, 3 patients had single vessel, 11 patients had double vessel, and 22 patients had triple vessel disease.

Premedication was made with intramuscular flunitrazepam. Induction of anesthesia was made with intravenous fentanyl and pancuronium bromide and was maintened with fentanyl and pancuronium bromide. Standard cardiopulmonary bypass (CPB) techniques were used in all patients. In 7 patients single, in 8 patients double, in 13 patients triple, in 6 patients quadriple, and in 2 patients 5 coronary bypasses were performed. Additional procedures in addition to coronary by pass were open mitral valvotomy in 1 patient, coronary endarterectomy in 5 patients, left ventricular aneurysmectomy in 8 patients. At the end of CPB, 18 hearts started to beat spontaneously, 9 hearts got a 20 joules of DC shock once, 7 hearts twice, 1 heart 4 times and 1 heart 9 times before starting to beat.

SGOT, serum glutamic pyruvic transaminase (SGPT), LDH and CPK-MB were studied in all. Three blood samples (preoperative, 3 and 6 hours after operation) for SGOT, SGPT and LDH, and 6 samples (preoperative, after induction, after sternotomy, after CPB, and 3 and 6 hours after operation) for CPK-MB were obtained in all patients.

Results are expressed as mean values ± SD. Difference of the means and regression correlation were studied, and a p value below 0.05 were considered to be significant.

Results

There was no perioperative myocardial infarction. All patients survived surgery and were discharged from the hospital in good conditions. There was no postoperative complication.

In table I and fig. 1, SGOT, SGPT, LDH, and table II and fig. 2, CPK-MB enzyme changes are shown during the surgical procedure. As seen in table I, statistically significant difference was found between the values measured preoperative and 3-6 hours after operation ($t= 8.2213$, and $p< 0.001$, $t= 11.0188$ and $p<0.001$), but no difference obtained between the SGOT values 3 and 6 hours after operation ($t = 1.4667$, $p > 0.05$) . Comparison of 3 values for SGPT did not show any significant difference ($t= 0.2806$, $p> 0.05$, $t=1.3776$, $p>$

Table I. Changes in SGOT, SGPT, and LDH enzymes.

	SGOT (U/L)	SGPT (U/L)	LDH (U/L)
Preoperative	18.1 ± 6.5	18.5 ± 8.3	176.1 ± 54.3
	p < 0.001	p > 0.05	p < 0.01
3 hours after operation	52.6 ± 24.3	19.1 ± 8.4	442.2 ± 173.0
	p > 0.05	p > 0.1	p < 0.05
6 hours after operation	60.6 ± 22.2	21.3 ± 8.6	528.8 ± 148.7

SGOT: Serum glutamic oxaloacetic transaminase
SGPT: Serum glutamic pyruvic transaminase
LDH: Lactate dchydrogenase

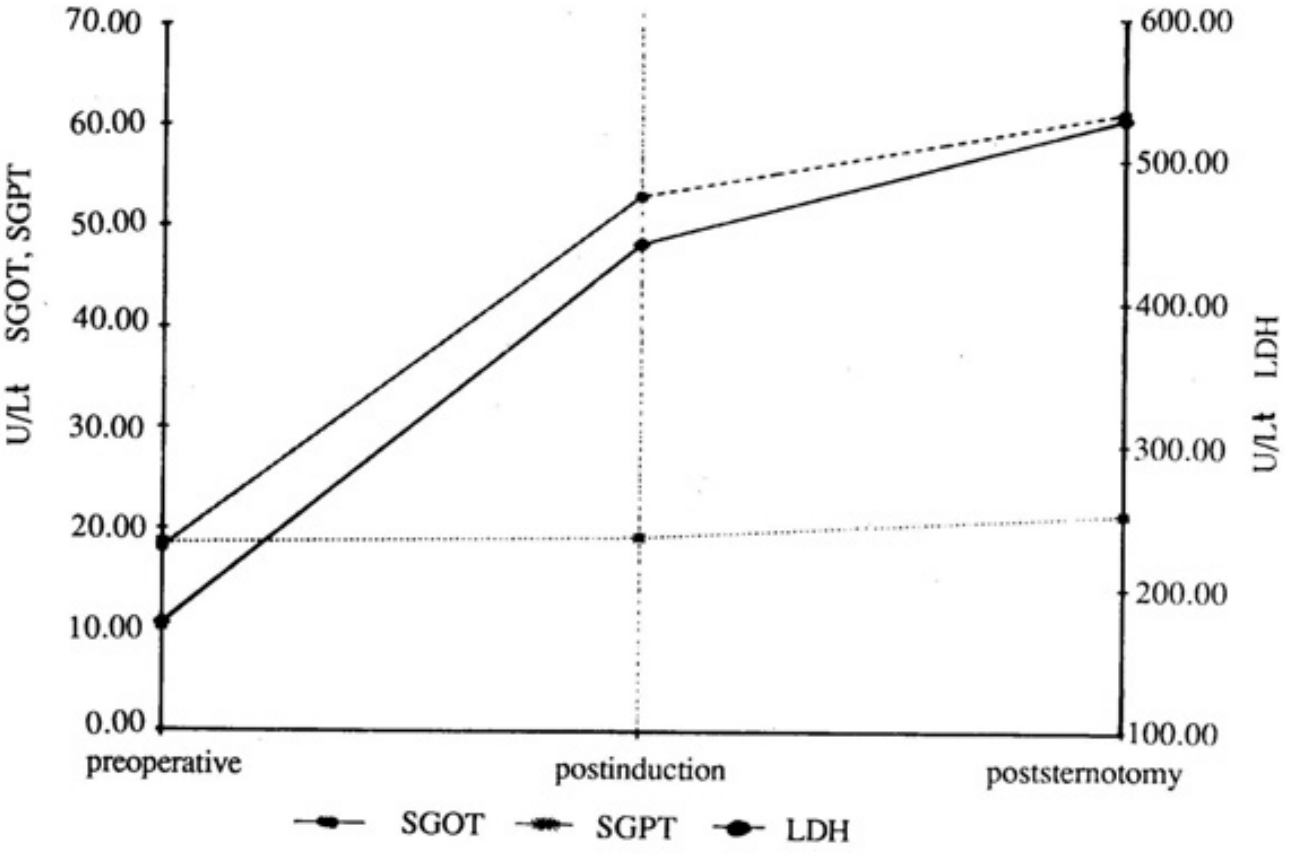

Figure 1. SGOT, SGPT, and LDH Values

0.05 and t= 1.0892, p> 0.1). Results of LDH measurements showed statistically significant difference in all comparisons (t= 8.8028, p< 0.001, t= 13.3701, p< 0.01, and t= 2.2790, p< 0.05 between preoperative and 3 hours after operation, preoperative and 6 hours after operation, 3 hours and 6 hours after operation, respectively).

Comparison of CPK-MB results is shown in table II. Excluding the values between induction and sternotomy, there was statistical significance among all comparisons (t= 1.9633,

Table II. Changes in CPK-MB enzyme (U/L)

Preoperative	8.25	±	0.00	
After induction	9.39	±	3.50	p < 0.05
After sternotomy	9.85	±	3.85	p > 0.1
After CPB	18.10	±	3.59	p < 0.001
3 hours after operation	26.87	±	13.29	p < 0.001
6 hours after operation	33.04	±	11.53	p < 0.05

CPK: Creatine phosphokinase
CPB: Cardiopulmonary bypass

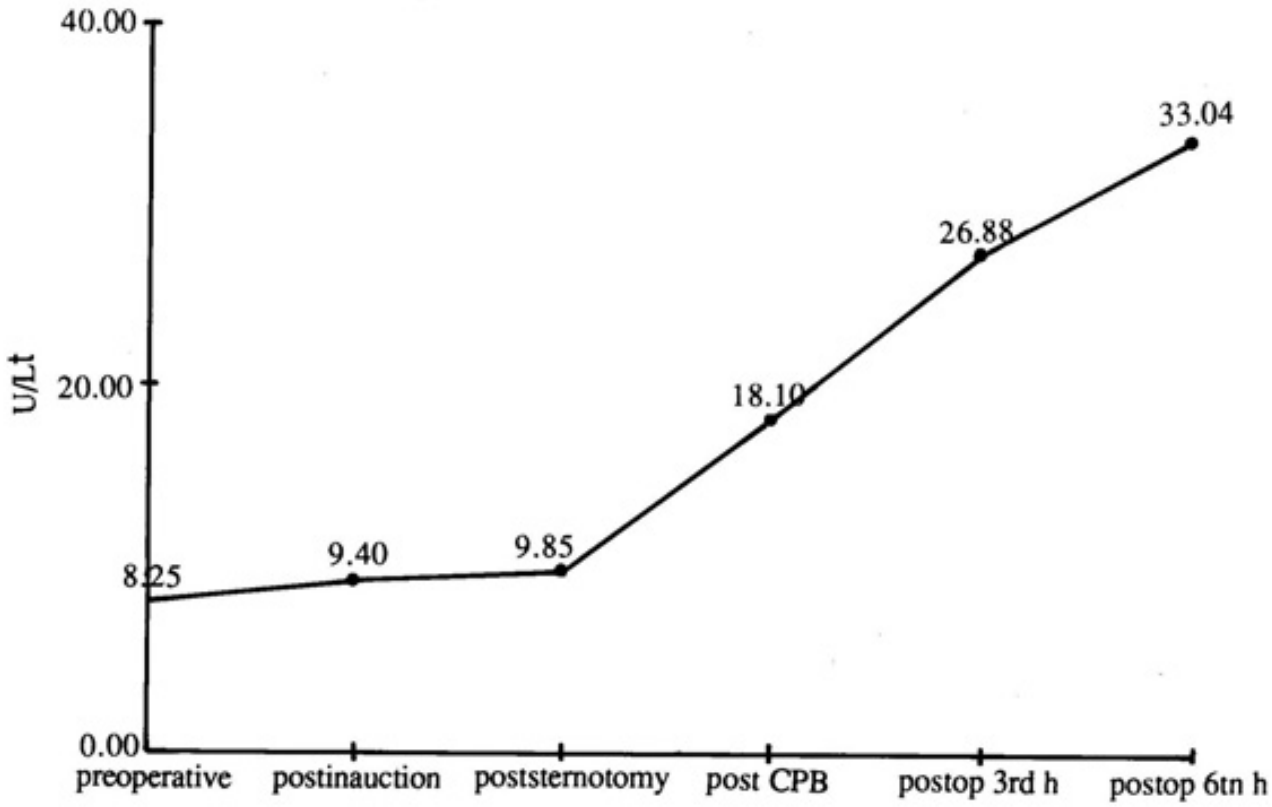

Figure 2. CPK-MB values (CPB: Cardiopulmonary bypass)

p<0.05, t=0.5281, p<0.1, t=5.8138, p<0.001, t =3.4372, p<0.001, t =2.1024, p<0.05 between preoperative-postinduction, postinduction-poststernotomy, poststernotomy-post CPB, post CPB-3 hours and 3 hours-6 hours after the operation respectively).

The comparison of CPK-MB values between the patients who had an additional procedure such as coronary endarterectomy, aneurysmectomy and open mitral valvotomy and the ones who had an isolated coronary bypass has shown no significant difference (p > 0.05).

According to the correlation study, postoperative CPK-MB, SGOT and LDH values showed a strong correlation with the duration of aortic cross-clamping and total perfusion time (for aortic cross-clamping r values are 0.504, 0.586, and 0.542, and for total perfusion time 0.537, 0.518, and 0.504 respectively).

Discussion

It has been documented that cardiac enzymes increase following many surgical procedures or trauma to the tissues. The appearence of increase in CPK-MB early after coronary artery bypass surgery in the absence of electrocardiographic or schintigraphic evidence of myocardial infarction has been documented in many studies [7,8,13,14].

CPK-MB increase during coronary bypass surgery has usually been explained by sternotomy or trauma to the atrium and other cardiac tissues, or defibrillation of the heart[10,15,16]. Isom and coworkers reported in 1975 that myocardial injury as shown by release of the myocardial spesific isoenzyme CPK-MB, often occured during the critical induction and pre-CPB periods[17].

In our study, we have found that there is a significant increase in preoperative and post-

induction CPK-MB levels ($p< 0.001$), and this significant difference has persisted between the values measured after sternotomy and CPB; CPB and 3 hours after operation; and 3 hours and 6 hours after operation ($p<0.01$, $p< 0.01$, $p <0.05$ respectively), but not between the post-induction and post-sternotomy values ($p<0.5$). This finding indicates that, contrary to the some publications in the literature[10-15,16], increase in CPK-MB value starts immediately after induction, and support the findings of Isom et al.[17]. It seems that the reason of first significant increase in CPK-MB values during coronary by-pass surgery is the induction itself, not the sternotomy. Highest CPK-MB values, as expected, was encountered 6 hours after operation.

We alsó have found a statistically significant difference between preoperative and 3 hours and 6 hours postoperative values for SGOT, LDH enzymes, but not for SGPT .

On correlation studies, although a poor correlation has been found, findings support the results obtained by student's t test. One interesting observation that was encountered in this part was the correlation between CPK-MB values and defibrillation number and amount of DC power given to the heart, which are contrary to the findings of Lockerman et al.[9] Postoperative SGOT, LDH, and CPK-MB values also, showed a strong correlation with the duration of aortic cross-clamp time and total perfusion time.

In conclusion, our study shows clearly that there is a steady increase in CPK-MB values during coronary bypass surgery, increasing to the highest value 6 hours after operation. Contrary to some previous reports in the literature, first significant increase starts with induction, not with sternotomy itself. SGOT, LDH enzyme levels also increase during coronary bypass surgery, but SGPT does not increase.

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