Heart, Lung and Circulation (2016) **xx**, 1–5
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2016.09.006

ORIGINAL ARTICLE

Which Mechanism is Effective on the Hyperamylasaemia After Coronary Artery Bypass Surgery?

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Received 6 July 2016; received in revised form 7 September 2016; accepted 12 September 2016; online published-ahead-of-print xxx

Background and Aim Acute pancreatitis is one of the less frequently diagnosed lethal abdominal complications. The incidence of early postoperative period hyperamylasaemia was reported to be 30–70% of patients who underwent coronary artery bypass grafting (CABG) with cardiopulmonary bypass (CPB). The mechanism of pancreatic enzyme elevation after cardiac surgery is not clear. Our aim was to determine the relationship between ischaemia associated temporary renal dysfunction and elevation of pancreatic enzymes after CABG.

Methods Forty-one consecutive patients undergoing CABG under CPB were prospectively studied to determine serum total amylase, phospholipase A2, macroamylase, Cystatin C and urine NAG levels.

Results Hyperamylasaemia was observed in 88% of the cases, with a distribution of 6% at the beginning of cardioplegic arrest, 5% at the 20th minute after cardioplegic arrest, 7% at the 40th minute after cardioplegic arrest, 14% when the heart was re-started, 26% at the 6th hour of intensive care and 30% at the 24th hour of intensive care. All of these patients were asymptomatic isolated hyperamylasaemia, and none of them presented with clinical pancreatitis. As indicators of renal damage; Cystatin C and NAG levels were higher compared to baseline values.

Conclusion Amylase began to rise during initial extracorporeal circulation and reached a maximum level postoperatively at 6 and 24 hours. Decreased amylase excretion is the main reason for post CABG hyperamylasaemia.

Keywords Amylase • Coronary artery bypass grafting • Cystatin C • Hyperamylasaemia • Lipase • Renal dysfunction

Introduction

It is reported that the incidence of abdominal complications after coronary artery bypass grafting (CABG) surgery with cardiopulmonary bypass (CPB) is between 0.4% and 3.7% [1–3]. However, development of complications leads to remarkably increased mortality, morbidity, prolonged hospitalisation and cost [1–4]. Acute pancreatitis is one of the less frequently observed lethal abdominal complications. It is reported that the frequency of hyperamylasaemia in patients who underwent CABG with CPB is 19–73% in the early postoperative period [5–8]. The mechanism of pancreatic enzyme

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elevation, which is frequently observed after cardiac surgery, is not yet clear. A temporary impairment occurs in renal function, secondary to ischaemia, after CAGB [9]. Our study was conducted to determine whether there is a relationship between elevated pancreatic enzymes after CABG surgery and the temporary impairment of excretion mechanisms of renal function secondary to ischaemia, and to evaluate the results from this point of view.

Materials and Methods

After obtaining consent from the institutional ethics committee, our study was carried out on 41 sequential cases that prospectively underwent CABG in the Department of Cardiovascular Surgery. Emergencies, reoperations, cases with EF values lower than 40%, renal failure, pancreatitis and hypertriglyceridaemia, and cases using steroids were excluded from the study, since these conditions may likely cause pseudo-negativity in serum amylase values. Preoperative demographics of patients are given in Table 1.

Total serum amylase and pancreatic phospholipase A_2 levels were measured using a Hitachi 747 autoanalyser with a calorimetric method at eight different time points: preoperatively, after inducing anaesthesia, at the beginning of perfusion, at the 30th minute of perfusion, at the end of perfusion, at the end of surgery, and at the 6th and 24th postoperative hours. Moreover, blood macroamylase levels were measured using the Hitachi 747 autoanalyser (Hitachi-Roche, Tokyo, Japan) following sedimentation with polyethylene glycol according to the Ventrucci method. Additionally, serum Cystatin-C levels were measured using the Hitachi 912 autoanalyser (Roche Diagnostics, Basel, Switzerland) with a turbidimetric method at the same time points. Urine N-acetyl-β-D-glucosaminidase (NAG) activity was measured with a spectrophotometric method preoperatively and at the postoperative 24th hour as a marker of renal tubular function.

To constitute a standard, since low haematocrit (Htc) levels are studied due to haemodilution effects on CPB, Htc levels were measured during the measurement of every blood parameter, and the results were calculated with respect to Htc level, using the following formula [9]:

$$Absolute\ Value = \frac{Measured\ Value \times Htc \times (1 - Htc\,2)}{Htc\,2 \times (1 - Htc\,1)}$$

Htc 1: Initial Haematocrit level.

Htc 2: Haematocrit level at time of sampling.

Amylase/Creatinine clearance ratio (*Cam/Ccre*) was calculated using the following formula:

$$Cam/Ccre(\%) = \frac{Urine\ Isoamylase \times Blood\ Creatinine}{Blood\ Isoamylase \times Urine\ Creatinine} \times 100$$

The ratio of creatinine filtered by the kidneys to amylase was calculated with this test. It was used to assess pancreatic damage and to screen for a condition called macroamylasaemia (normal value range is 1–5).

Standard anaesthesia and surgical techniques were used for all cases. In all cases, the LIMA and saphenous vein were prepared as grafts following sternotomy, and CPB was carried out after aortic and two-stage venous cannulation. Cold blood cardioplegia solution was routinely applied, at 20 minute intervals, to achieve and maintain cardiac arrest and cardiac protection. Extracorporeal circulation was carried out using a fibre oxygenator non-pulsatile roller (Sarn'S) pump. The perfusion pressure was maintained between 50 and 70 mmHg. The cardiac index was maintained between 2.1 and 3.2 L/min during perfusion (Table 1). Moderate hypothermia (~32 °C) was performed. Cases where the perioperative cardiac inotrope requirement was above the renal dose (2.5–7.5 mcg/kg/min) were excluded from the study.

Table 1 Preoperative, operative and postoperative patient variables.

Variables	Value
Preoperative variables	
Number of patients, n	41
Age, year*	65.2±11.3
Female/male, %	20 / 80
Hypertension, %	35
DM, type I / type II, %	5 / 5
COLD, %	5
Smoking, %	49.5
Alcohol addiction, %	12.2
Rhythm, NSR, %	100
Operative variables	
CPB time, min*	103.6±28.1
Cross-clamp time, min*	50.5±16.2
Cardiac index, L/min*	2.1±3.4
Postoperative variables	
ICU stay, day*	2.5±1.9
Ventilation time, hour*	19.3±23.3
Hospitalisation time, day*	10.3±3.9
Blood product transfusion rate, %	92.5
Postoperative rhythm	
AF, %	12.3
SR + APB, %	7.3
Pace, %	2.4
Revision rate, %	-
Postoperative LCO, %	12.3
IABP usage, %	12.3
Infection, %	-
Mortalite, (≤30 day), %	-

* Values are mean±SD. AF: Atrial fibrillation, APB: Atrial premature beats, COLD: Chronic obstructive lung disease, DM: Diabetes mellitus, HT: Hypertension, IABP: Intra aortic balloon pump, ICU: Intensive Care Unit, LCO: Low cardiac output, SR: sinus rhythm.

Statistical Method

Continuous variables are presented as mean ± standard deviation and were compared using the ANOVA test. The

Please cite this article in press as: Algin HI, et al. Which Mechanism is Effective on the Hyperamylasaemia After Coronary Artery Bypass Surgery? Heart, Lung and Circulation (2016), http://dx.doi.org/10.1016/j.hlc.2016.09.006