UNIVERSITY OF MEDICINE AND PHARMACY OF TIRGU MURES

DOCTORAL SCHOOL

PhD Thesis

Lactate Level in Coronary Sinus – as Prognostic Factor of Postoperative Morbidity and Mortality in Cardiac Surgery

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Abstract

Background

Cardiac dysfunction occurring after technically successful surgical correction of congenital or acquired heart disease is usually caused by inadequate intraoperative myocardial protection and is the major cause of morbidity and mortality in open heart surgery. Postoperative cardiac dysfunction is usually attributed to injuries occurred during myocardial ischemia and reperfusion. Clinically, it is manifested as low cardiac output and hypotension. Post-ischemic myocardial injuries may be reversible (myocardial stunning) or in more severe cases, irreversible (myocardial necrosis).

Objectives

During aortic crossclamp, progressive accumulation of lactate and intracellular acidosis are well known phenomena that occur and manifest despite intermittent or continuous administration of cardioplegic solution. The aim of my research was to study the efficiency of coronary sinus lactate as a predictor of postoperative hemodynamic outcome in patients undergoing open-heart surgery .

Methods

We conducted a prospective clinical study in adult patients undergoing cardiac surgical interventions at the Clinic of Cardiovascular Surgery of the Institute of Cardiovascular Diseases and Transplantation of Tg-Mures, between 20.10. 2009- 15.11.2013. We included 142 adult patients scheduled for open-heart surgery with cardioplegic cardiac arrest. 82 patients received antegrade cardioplegia and in 60 patients retrograde cardioplegic solution was administred (intermittently in 30 patients, continuous in 30 patients). There were no significant differences between the three groups in terms of age, length of myocardial ischemia and cardiopulmonary bypass. Patients with pre-existing coronary lesions, patients in whom valvular correction was performed without clamping the aorta, emergency surgical interventions and patients with severe depression of left ventricular contractile function were excluded from the study. In order to determine markers of ischemia, blood was withdrawn

from the coronary sinus when anterograde cardioplegic solution was administred and from aortic root in retrograde administration. Statistical analysis was performed using GraphPad Prism, version 5.0.

Results

Lactate level in blood collected from coronary sinus or aortic root (outflow) showed an increase in its values with increasing time of myocardial ischemia, the highest values being registred at 60 and 80 minutes of aortic crossclamp, with their rapid decline after aortic cross clamp removal.

Comparing the three groups, we observed that lactate level increases less during aortic crossclamp in patients who received retrograde continuous cardioplegia versus the other 2 groups. Changes in pH and bicarbonate-level showed the same trend as lactate-level.

There was a positive correlation between lactate levels and myocardial ischemia ($p = 0.0371$). In patients with hemodynamic instability in the early postoperative period, lactate levels were significantly higher ($p = 0.0001$) than in stable patients. Other frequent complications were: respiratory distress syndrome (in 30 patients), renal dysfunction/ failure (19 patients) posthypoxic encephalopathy (9 patients). The number and severity of postoperative complications was lower (but not statistically significant) in patients who received continuous retrograde cardioplegia, in the other 2 groups the incidence of complications was nearly identical.

Postoperative lactate showed higher values (up to 6 mmol/ l) and slower recovery in patients who died in early postoperative period.

Conclusions

In conclusion, we can state that monitoring the lactate level in coronary sinus (in antegrade cardioplegia) or aortic root (in retrograde administration) is a reliable method with high prognostic value regarding postoperative mortality and outcome of the patients undergoing open-heart surgery. Continuous retrograde administration of the cardioplegic solution seems to be the safest method of myocardial protection in cases where the administration technique is properly used.

Keywords: lactate, coronary sinus, cardioplegia, myocardial protection, myocardial dysfunction