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Research Article

Heart Bypass Surgery Carries and Heart Attacks

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Abstract:

The method focused on how blood breakdown during surgery, changes in iron levels, oxidative stress, and nitric oxide levels are connected to these complications. Heart bypass surgery carries a risk of serious complications, sometimes fatal. These complications can include heart attacks, worsening heart failure, irregular heartbeats, stroke, and inflammation of the sac surrounding the heart.

keywords: heart surgery; blood; stroke; cardiovascular

Introduction

The study enrolled 123 patients undergoing CABG. Patients were categorized into three groups based on the degree of intraoperative hemolysis. Blood samples were collected pre- and post-operatively to assess various parameters related to iron metabolism, oxidative stress, and nitric oxide. These included indicators of iron transport (serum iron, transferrin, total and latent iron-binding capacity), iron storage (ferritin), nitric oxide metabolites (NOx), and oxidative stress markers (malondialdehyde (MDA), diene conjugates, α-tocopherol, and retinol). Using statistical analyses (multiple logistic regression and receiver operating characteristic (ROC) curve analysis), the researchers found that levels of MDA, transferrin, and NOx were significantly associated with the development of early postoperative complications. Critically, the study observed a strong correlation between the severity of intraoperative hemolysis and the rate of complications. The high hemolysis group exhibited a substantially higher incidence of complications (57.9%) compared to the low hemolysis group (11.9%) and the no hemolysis group (4.7%). The proposed method offers a valuable tool for predicting early postoperative complications in patients undergoing CABG for IHD. The predictive model incorporates MDA, NOx, and transferrin levels. These markers reflect oxidative stress, free iron levels, and potentially, endothelial dysfunction all factors implicated in the development of post-operative complications. This predictive capability can assist in making timely decisions regarding patient management, potentially enabling the implementation of preventative measures or specific interventions to address oxidative processes and endothelial dysfunction in high-risk individuals. This study investigated the early cardiac complications that can arise after coronary artery bypass grafting (CABG) surgery in patients with coronary artery disease. Previous research has explored the link between the frequency of these complications and factors such as the degree of intraoperative hemolysis (blood breakdown during surgery), changes in iron metabolism, oxidative stress levels, and nitric oxide metabolites. The primary goal of this research was to develop a method for predicting the probability of developing cardiovascular complications in the early postoperative period following CABG. The prediction method focuses on how changes in iron levels, oxidative stress, and nitric oxide levels are influenced by the degree of intraoperative hemolysis. The researchers aimed to identify indicators that could be used to anticipate the risk of these complications. Previously conducted studies have examined the dependence of the frequency of complications of CABG in patients with coronary artery disease on the level of intraoperative hemolysis [3], as well as changes in the indicators of transport and deposited iron pools [4], oxidative stress [5] and stable metabolites of nitric oxide [6]. This study employed a multi-faceted approach to investigate the relationship between intraoperative hemolysis (IOH) and the development of early postoperative cardiac complications after CABG.

Research methods

A total of 123 patients with coronary artery disease (CAD), who underwent CABG, were categorized into three groups based on the degree of IOH, measured by free hemoglobin (Hb) levels in blood plasma at the conclusion of the CABG procedure using a HemoCue Plasma/Low Hb analyzer. Groups were: no significant intraoperative hemolysis (n=43), low intraoperative hemolysis (n=42), and high intraoperative hemolysis (n=38). Comprehensive clinical evaluations were conducted, including electrocardiography (ECG), coronary angiography, echocardiography,

and monitoring of blood pressure and pulse. Biochemical analyses of blood samples were performed before surgery and within 5-7 days post-surgery. These analyses included a complete blood count, complete urinalysis, lipid profile, protein profile, C-reactive protein, and levels of residual nitrogen (creatinine and urea). The researchers meticulously tracked cardiac complications during the first month after surgery (including the perioperative period), specifically noting myocardial infarction, stroke, arrhythmias, and death. Assessment of Iron Metabolism, Nitric Oxide, and Oxidative Stress: Blood samples were collected from the cardiopulmonary bypass (CPB) machine at the start and end of the CABG procedure to evaluate various markers. These markers included indicators of iron transport (serum iron, transferrin, total and latent iron-binding capacity), iron storage (ferritin), nitric oxide metabolites (nitrite/nitrate ions [NOx]), and oxidative stress parameters (malondialdehyde, diene conjugates, α-tocopherol, and retinol). The collected data were analyzed statistically using non-parametric methods in the Statistica 10.0 software package. The researchers also employed logistic regression analysis within the R programming environment, utilizing the Boruta package to identify significant predictors of cardiac complications.

Results and discussion

Of the 123 patients examined with coronary artery bypass grafting, cardiovascular complications of varying severity were observed in 29 (23.6%) patients: arrhythmia (atrial fibrillation, paroxysms of ventricular tachycardia, supraventricular and ventricular extrasystoles) in 27 patients (21.95%), progression of heart failure (decrease in ejection fraction) in 13 patients (9.8%), myocardial infarction in 5 patients (4.1%), acute cerebrovascular accident in 2 patients (1.6%). The highest incidence of complications was observed in the group with iIOG ($p<0.001$) – 57.9%, which is more than in the group with nIOG – in 11.9% of patients ($p<0.001$) and in the group without IOG – in 4.7% of operated patients ($p<0.001$) [4].

Based on the analysis, a formula was obtained for assessing the probability (p) of complications after CABG surgery, which has the general form:

$$p = \frac{1}{1 + exp^{-(b0+b1*X1+b2*X2)}}$$

where: exp is the base of the natural logarithm (exp = 2.718);

z = b0 +b1 X1+b2 X2+ b3 X3, b0 is the free term (intercept); b1 , b2 , b3 – logistic regression coefficients

X1, X2, X3 – values of the variables [MDA], [ΔNOx] and [Tr] selected in the equation, respectively.

As a result, $z= 0.799\cdot[MDA] + 0.192\cdot[\Delta NOx] - 0.062\cdot[Tr]$, where

[MDA] is the concentration of malondialdehyde in blood plasma, μm/l;

[ΔNOx] is the difference between the 2nd and 1st samples of nitrate/nitrite levels in blood plasma, μmol/l;

[Tr] is the level of transferrin in blood plasma, mg/dl.

As a result, the equation for determining the probability of developing complications after CABG surgery took the following form:

$$\rho = \frac{1}{1 + \exp^{-(0,799 \text{ x } [MDA]+0.192 \text{ x } [\Delta NOx]-0,062 \text{ x } [Tr])}}$$

With a calculated value of $p\geq0.54$, patients with coronary artery disease after CABG are at high risk of developing complications in the early period.

Assessments of the quality of the multiple logistic regression model: Hosmer-Lemeshow test ($\chi2 = 11.1$; $p = 0.194$); The sensitivity of the method is 96.5%, the specificity is 100%, the PPV (positive predictive value) = 100%, the NPV (negative predictive value) = 98.9%, the area under the ROC curve (AUC) = 0.992. The odds ratio (OR) for MDA = 2.22, for ΔNOx – 1.21, for Tr – 0.94.

Conclusions:

1. The possibility of predicting the development of complications in high-risk patients suggests, along with generally accepted therapeutic measures, supplementing them with correction of the activity of oxidative processes and endothelial dysfunction.

2. The proposed method allows determining the risk of developing cardiovascular complications in patients with coronary heart disease after CABG in the early period, based on the values of indicators characterizing the activity of oxidative stress, the level of free iron, the degree of endothelial dysfunction, which is important for timely management decisions.

3. The use of MDA and NOx indicators in the model reflects the relationship of CABG complications with the development of oxidative and nitrosative stress, while the transferrin level indirectly reflects the involvement of free iron in the mechanisms of complication development. The revealed dependence of the occurrence of complications on changes in these indicators in the blood plasma is consistent with the literature data on the development of heart failure under oxidative and nitrosative stress.

References

1. Maksimovich Y. Stelmakh A., Dubovik A., ChmaraN., Kashcheua Y. (2017) Nitrites and nitrates concentration in patients with coronary artery bypass. *International Scientific University*, Moscow, Russia – P.137.
2. Maksimovich Ye., Chmara N, (2017). Early complications after coronary bypass operation Abstr. the 16th International congress of medical sciences (ICMS) for students and young doctors. –Bulgaria. – P.254.
3. Maksimovich, Ye.N. T.P. Pronko (2018). Endothelial vasoactive properties in patients after coronary artery bypass surgery with different level of hemolysis. *Pathophysiology*, – Vol. 25(3). – P.177.
4. Maksimovich, Ye. N. T.P. Pronko, V.A. Yanushko, Yu. A. Kashcheyeu, V.A. (2020). Snezhitski Association of hemolysis with the incidence of heart rhythm disturbances following coronary artery bypass graft surgery Вестник аритмологии — Т. 27 – С.33 – 38.

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