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Varying Degrees of Hemolysis during Coronary Artery Bypass Grafting Operations

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Abstract **Original Research Article**

Coronary artery bypass grafting (CABG) improves the quality of life in patients with coronary artery disease (CAD), but complications may arise due to reperfusion syndrome, oxidative stress, and artificial circulation. This study aimed to investigate the impact of intraoperative hemolysis (IOH) on endothelial function in CABG patients. A total of 34 patients undergoing CABG with artificial circulation were evaluated for hemolysis levels and endothelial function using a reactive hyperemia test, both preoperatively and on the fifth postoperative day. Patients with higher hemolysis levels (0.6-0.8 g/L) exhibited a 28% worsening of endothelial dysfunction ($p < 0.05$), whereas those with lower hemolysis (0.1-0.2 g/L) showed only a 5% decline ($p > 0.05$). Significant differences between groups were observed. The study also found that the guanylate cyclase-mediated vasodilation mechanism was impaired in all patients. These findings suggest that CABG exacerbates endothelial dysfunction in proportion to IOH severity, likely due to oxidative stress and cytotoxic effects of red blood cell destruction products. Endothelial dysfunction may serve as a marker of reperfusion-related myocardial damage in CABG patients.

Keywords: Coronary Artery Bypass Grafting, Hemolysis, Arrhythmias

INTRODUCTION

Coronary artery bypass grafting (CABG) in patients with coronary artery disease (CAD) improves the quality of life of patients, but various complications may develop. Their pathogenesis is due to reperfusion syndrome. The most important mechanism is oxidative stress [1,2]. Another factor of complications of coronary artery bypass grafting is the use of artificial circulation. Carrying out CABG is accompanied by hemolysis of erythrocytes because of mechanical damage [3,4].

PURPOSE OF THE STUDY

To study the vasoactive properties of the endothelium in patients with varying degrees of hemolysis during coronary artery bypass grafting operations under artificial circulation (AC).

RESEARCH METHODS

The studies were conducted in 34 patients with CABG. The degree of hemolysis was assessed during coronary artery bypass grafting with artificial circulation. The study of the vasoactive properties of the endothelium was carried out using a reactive hyperemia test. Determination of the vasoactive properties of the endothelium was carried out one day before the operation and on the fifth day after CABG.

RESULTS OF THE RESEARCH

In patients with coronary artery bypass grafting under artificial circulation, worsening of endothelial dysfunction was revealed in patients with a hemolysis value of 0.6-0.8 g / l ($n = 8$) compared to

the preoperative period by 28% ($p < 0.05$), while in patients with hemolysis of 0.1-0.2 g / l ($n = 10$), worsening of endothelial dysfunction was 5% ($p > 0.05$). These differences between the groups were significant. In 18 patients, the degree of hemolysis was 0.3-0.5 g / l. After the test with nitroglycerin using endothelium-independent vasodilation of vessels was not revealed. It was shown that in all groups of patients, the guanylate cyclase mechanism of vasodilation was absent.

CONCLUSIONS

Thus, the conducted studies have shown the aggravation of endothelial dysfunction after CABG depending on the degree of intraoperative hemolysis (IOH), and these results also indicate an adverse effect of red blood cell destruction products on the vascular endothelium. This may be due to the initiation of circulating red blood cell debris, free hemoglobin, heme, iron in the bloodstream, which can enhance oxidative stress, the leading mechanism of reperfusion damage to tissues and organs caused by the restoration of blood flow. The conducted studies have shown the adverse effect of CABG on the vasoactive properties of the vascular endothelium and their dependence on the degree of intraoperative hemolysis, the level of free iron and nitric oxide, as well as the activity of oxidative stress. Based on the above, the degree of vascular endothelial dysfunction can act as a kind of marker indicating the aggressiveness of cytotoxic reperfusion mechanisms and can be the cause of indirect myocardial damage after restoration of blood flow because of CABG using CPB.

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