Surgical Revascularization in Elderly Patients with and Without Cardiopulmonary Bypass

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The number of patients undergoing coronary artery bypass grafting (coronary artery bypass grafting-CABG) older than 70 years is increasing. Cardiac surgeons are investigate applicability of alternative and less invasive methods such as surgery without the use of cardiopulmonary bypass (CPB). The aim of this study was to compare the peri- and postoperative results of CABG in elderly patients operated with and without CPB.

Patients and Methods: The study included subjects older than 70 years, who underwent coronary bypass surgery at the BH Heart Center Tuzla in the period from August 2008 to August 2010, divided into two groups. Group A consisted of 50 patients operated without CPB, group B 50 patients operated with CPB, adjusted by sex, left ventricular ejection fraction values, EuroSCORE, and the number of bypass grafts was made.

Results: In the group treated without the use CPB there were significantly lower values of the time-duration of mechanical ventilation, length of stay in the Intensive Care Unit (ICU), the amount of postoperative bleeding and blood recovered, the length of hospital stay, levels of serum creatinine, C-reactive protein and creatine kinase MB fraction. Conclusion: CABG without the use of CPB has a number of advantages over the method with CPB in elderly patients, which is evident from the lower values of renal and inflammatory parameters and markers of myocardial lesion, less time spent on a ventilator, shorter length of stay in the ICU and total hospitalization time, less postoperative bleeding and blood transfusion.

Key words: coronary artery bypass grafting, cardiopulmonary bypass, elderly patients.

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1. INTRODUCTION
The number of patients undergoing coronary artery bypass grafting (CABG) of the age of 70 years and older is increasing. Despite the continued trend of reduced incidence of perioperative morbidity and mortality in CABG (1, 2), age still represents an independent risk factor in this sense. Older patients undergoing CABG have a higher incidence of comorbidity (diabetes mellitus, chronic obstructive pulmonary disease, cerebrovascular and peripheral vascular disease) while at the same time they have a reduced physiological reserve, which inevitably leads to increased incidence of perioperative complications and increased consumption of resources (3). Age over 70 years is one of the main predictors of postoperative morbidity and mortality and thus operational risk in these patients can multiply (4). Results of numerous studies published in the literature over the past 20 years in conjunction with the results of CABG without the use of CPB illustrate the benefits of this method compared to the conventional method of CABG with the use of CPB (5). However, despite this, there is a substantial number of authors who state that most of these studies investigated low-risk and younger patients, and the mostly good results achieved are thanks to these facts (6).
the thoracic drain from the time of leaving the operating room to relocation to the hospital ward, expressed in milliliters)
- The amount of administered blood transfusions (total amount recovered in blood hematocrit of less than 0.25, in milliliters)
- Levels of serum creatinine, C-reactive protein (CRP) and creatine kinase MB (CK-MB) preoperatively, first and second postoperative day
- Basic peri and postoperative complications and their frequency
- Length of hospitalization (time from surgery to patient discharge from the hospital, expressed in days).

Continuous variables were expressed as the mean±standard deviation and were compared using an unpaired two-tailed t test. Categorical variables, expressed as percentage, were analyzed with Chi-Square test. Statistical significance was definite as a p value less than 0.05. All analyses were performed using SPSS version 17.0 software (SPSS, Inc., Chicago, IL, USA).

4. RESULTS

Analysis of perioperative and postoperative results indicate significant differences between groups in the time spent on the ventilator (4.9 vs. 6.6 hours, \( p = 0.008 \)), length of stay in the ICU (1.8 vs. 2.5 days, \( p = 0.011 \)), the amount of postoperative bleeding (470.5 vs. 663.7 ml, \( p = 0.000 \)), the amount of administered blood transfusions (154.6 vs. 411.9 ml, \( p = 0.001 \)), and the length of hospital stay (7.5 vs. 8.4 days, \( p = 0.024 \)). Duration of surgery was shorter in group B, but with no significant difference (253.2 vs. 246.7 minutes, \( p = 0.054 \) ) (Table 1).

Analysis of the incidence of perioperative complications in both groups indicates the small occurrence of them in group A, but without statistical significance. In both groups, the most common complication was atrial fibrillation (24.0 vs. 28.0%, \( p = 0.819 \)), and wound infection (6.0 vs. 8.0%, \( p = 1.000 \)), prolonged bleeding that required repeated surgery (2.0 vs. 6.0%, \( p = 0.609 \)) and myocardial infarction (4.0 vs. 4.0%, \( p = 0.609 \)). The frequency of deaths was not significantly lower in group A (0.0 vs. 2.0%, \( p = 1.000 \)).

Levels of serum creatinine preoperatively were similar (89.9 vs. 88.2, \( p = 0748 \)), and on the first and second postoperative day the same was significantly lower in patients in group A (116.5 vs. 137.7, \( p = 0.035 \) and 129.4 vs. 163.9, \( p = 0.009 \) ) (Table 2). Analyzing the levels of CRP, the same tendency is evident, meaning that contrary to the preoperative levels which were similar between patients of both groups (6.1 vs. 5.2, \( p = 0.225 \)), on the first and second postoperative day, the CRP levels were significantly lower in patients of group A (57.7 vs. 90.9, \( p = 0.002 \) and 126.7 vs. 156.7, \( p = 0.009 \) ) (Table 3). A similar conclusion can be with the analysis values of CK-MB. Preoperative values were similar among the patients of both group (1.20 vs. 1.27, \( p = 0.089 \)), while on the first and second postoperative days they were significantly lower in group A (3.78 vs. 5.8, \( p = 0.002 \) and 22.3 vs. 5.8, \( p = 0.000 \) ) (Table 4).

5. DISCUSSION

Changing demographic characteristics and selection of patients for CABG with inevitable advances in surgical techniques have led to the fact that these operations are increasingly performed in elderly patients (7). This has also contributed to the fact that for the patients with coronary artery disease now, the first choice is percutaneous methods of revascularization (stent or balloon angioplasty) as a treatment modality, which inevitably delays CABG, and patients seem older and more complex for treatment. Almost all of the reports over the last 10 years regarding elderly CABG patients include those with 70 years of age or older. Patients in this group have the highest incidence of left main coronary artery stenoses, multivessel coronary artery disease left ventricular dysfunction and repeated surgery.

Age inevitably leads to changes in the large and small arterial blood vessels and the heart itself (8). Older patients show an increased incidence of comorbidity, such as: diabetes, hypertension, COPD and kidney disease. Previous results of CABG in the treatment of patients in this age group are burdened with a high rate of morbidity and mortality (9), which has prompted cardiac surgeons to investigate the applicability of alternative and less invasive methods such as surgery without the use of CPB (10).

Acute renal failure related to CABG occurs in about 2.5% of cases, while about 1% of cases require hemodialysis (11). The negative effects of CPB on renal function are indirectly assessed by measuring serum creatinine before and after surgery (12). Our results also suggest that the use of CPB is associated with negative effects on renal function. On the first postoperative day, serum creatinine levels were significantly higher in the group treated with the use of CPB (116.4 ± 41.5 vs. 137.7 ± 43.5, \( p = 0.035 \)). The same trend continued during the second postoperative day (129.4 ± 47.8 vs. 163.9 ± 69.0, \( p = 0.009 \) ). The use of
CPB during CABG increases inflammatory response (13). In our study, on the first postoperative day CRP levels were significantly higher in the group treated with the use of CPB (57.7 ± 31.3 vs. 90.9 ± 64.5, p = 0.002). The same trend continued during the second postoperative day (126.7 ± 44.2 vs. 156.7 ± 62.7, p = 0.009). Ischemia that occurs during CABG results in functional and structural damage of myocytes. In all patients undergoing CABG with or without the use of CPB, an increase in levels of biohumoral markers of myocardial lesion occurs, with an increase in these values more pronounced in patients operated with use of CPB (14). On the first postoperative day, CK-MB levels were significantly higher in the group treated with the use of CPB (3.78 ± 3.12 vs. 1.5 ± 1.76, p = 0.002), which was also the case on the second postoperative day (22.3 ± 2.5 vs. 8.5 ± 2.50, p = 0.000). Increased patient age prolongs the period of mechanical ventilation (15, 16). Results of this study indicate that there is a significant difference in the time spent on the ventilator, which was shorter in the group treated without the use of CPB (4.9 ± 2.5 vs. 6.6 ± 3.4 hours, p = 0.008). Age of the patient also plays a big role in the time spent in ICU (17). According to our study time spent in ICU is significantly shorter in patients operated without the use of CPB (1.8 ± 0.9 vs. 2.5 ± 1.7 days, p = 0.011). There is also a significant difference in the length of hospital stay in favor of patients operated without the use of CPB (7.5 ± 1.7 vs. 8.4 ± 2.0 days, p = 0.024). The negative effects of CPB and the greater amount of heparin applied in the activity of blood components and markers of myocardial lesion, less ventilation time, a shorter length of stay in the ICU and hospital stay, less postoperative bleeding and less blood transfusion in comparison to CABG with the use of CPB.

6. CONCLUSION

According to the results of this study, CABG without the use of CPB has numerous advantages over the method with the use of CPB in patients older than 70. It is evident that CABG without the use of CPB is associated with lower levels of renal and inflammatory parameters and markers of myocardial lesion, less ventilation time, a shorter length of stay in the ICU and hospital stay, less postoperative bleeding and less blood transfusion in comparison to CABG with the use of CPB.