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THE AFFECT OF SURGICAL MODIFICATIONS ON EARLY RESULTS OF PULMONARY AUTOGRAFT OPERATION

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**The study examines the role of surgical modifications of the pulmonary autograft operation to improve immediate results. Retrospective analysis of 151 operated patients was reviewed, in 82 (54 3%) of these technical innovations have been used: sinus reinforcement of autograft’s root, double suture for aortic anastomosis and creation of the pulmonary artery during ischemic time. The results showed a significant decrease in the number of intraoperative complications, mortality, early complications and improvement in the postoperative period in patients who used the new surgical techniques pulmonary autograft surgery.**

**Key words. Ross operation, pulmonary autograft, aortic root.**

The pulmonary autograft operation is considered to be effective, but technically difficult and risky procedure (1). Major problems of early post-operative period are potentially high operational risk and significant number of complications (2). The decrease of mortality and morbidity of the pulmonary autograft operation are main items, which are solved through perfecting the surgical techniques and implementing new technical modifications of the operation (2,3). We analyzed the affect our modifications of the pulmonary autograft operation on the morbidity and mortality of early perioperative period.

**Material.** A retrospective review of 151 patients who underwent the Ross or Ross-Konno operation between 1996 and 2014 was performed.

**Surgical innovations.** Several surgical innovations were define as a *modified surgical approach.* It contains

* double suture of proximal and distal anastomoses when implanting the autograft;
* method of creating of neopulmonary artery, the meaning of which is to perform this stage during the period of cardioplegic heart arrest and using method of strengthening posterior wall of right ventricle-pulmonary connection;
* root reinforcement of pulmonary autograft (non-coronary and parts of coronary sinuses) by aortic wall.

**Result.** Patients (n=151) were divided into two groups: group I of *modified surgical approach*, which included 82 (54.3%), and group II of *standard approach*  – 69 (45.7%) of patients.

Preoperative characteristics did not differ statistically between two groups; the groups were homogeneous in age at the moment of operation (*p=0.648*), weight (*p=0.547*), BSA *(p=0.247*)

Patients also did not differ in diagnosis quantity of patients with aortic stenosis (AS) and aortic insufficiency (AI) (*p=0.286).* Congenital aortic pathology, infective endocarditis and rheumatism were also evenly dispersed in both groups of patients. The groups also did not differ in quantity of previous surgeries and presence of accompanying pathology, which needed surgical corrections. Reliably more frequent in group I than in group II was bicuspid aortic valve (71 case versus 49 respectively; *р=0.031*).

Analysis of the intraoperative stage was based upon the estimation of artificial blood circulation duration, ischemic time, operation duration and intra-operational blood loss. CPB duration and operation time duration were reliably higher in group II than in group I (207 and 555 min versus 138 and 390 min respectively; *p<0.001*). Ischemic time in both groups did not differ statistically (109.5 min versus 117 min, *p=0.143*).

There was a significant difference in the volume of intraoperative blood loss: 2.6 ml/kg in the first group and 5 ml/kg in the second group, p<0.001. Also, there was a significant intraoperative mortality in group II in comparison with group I (0 and 5.7% respectively, p=0.042).

Heart failure required inotropic support at 65 (79.3%) of patients in group I and at 62 (95.4%) of patients in group II, in group I the number of patients with inotropic medications was lower than in group II (79.3% versus 95.4% respectively, *p=0.023)*. The average dose of Dopamine in group I was reliably lower than in group II (p<0.001), also there was a difference in groups in distribution of patients by dose of inotropic medication (Dopamine), which was prescribed to them. The majority of patients in group I (75.4%) received small doses of inotropic support (up to 3 mkg/kg/min), which statistically reliably differed from group II (35.4% patients), patients in group II basically were prescribed medium and high doses of inotropic medications (*p<0.001*). More than 3 days sympathomimetic support was continued only for 30.7% patients in group I and 61.3% patients in group II, which was also a significant difference (*p<0.001*). The duration of inotropic support in the post-operation period for patients also reliably differed, in group I it was significantly smaller than in group II (46 hrs. versus 86 hrs. in average, *p=0.02*) (tab 4).

In-hospital mortality among the patients of group I was substantially smaller, it was 1.2 % (1 patient) in comparison to 8.7% (6 patients) in group II (*p<0.001*). The average time of artificial pulmonary ventilation in group I was 7 hrs (5-16,75;95%СІ) in average, which was reliably smaller (*p=0.001)* than the analogical index in group II – 14 hours (7-48;95%СІ). Also, the average time of stay in the ICU and the period of hospitalization was also substantially lower for patients of group I – 112 hours (72-192;95%СІ) and 11.5 hours (9-15;95%СІ) versus 90 (68,25-116,2 5;95%СІ) and 18 hours (13-25,5;95%СІ) in group II (p=0.009 and *p<0.001*).

Statistically significant was number of of early postoperative complications in patients of group II: low cardiac output syndrome – 11 causes versus 2 in group I (*p=0.013*), and the quantity of patients with continued time of mechanical lung ventilation (more than 7 days) – 8 in group II versus 1 in group I (*p=0.027*). Other complications, such as stroke and neurological complications, arrhythmia, infectious complication did not display prevalence in frequency in any group of patients.

**Discussion.** The operation of pulmonary autograft consists of two main steps – creating ‘new’ arterial valve by pulmonary valve re-implantation and renewing the connection between the right ventricle and pulmonary artery, that is creating a ‘new’ pulmonary valve. Traditionally, implantation of pulmonary valve is run on the arrested heart during cardioplegia, and the creation of right ventricle-pulmonary connection on beating heart with CPB. Such approach decreases ischemic time that is the important predictor of save of myocardial function. Creating a neoaortal and neopulmonary valves during cardioplegia became one of the most important parts in our own modifications of the operation. During the period of cardioplegic arrest were performed autograft root reinforcement by double suture of proximal anastomosis (basal ring), and distal anastomosis (sinotubular junction), the full reconstruction of ‘new’ pulmonary artery performed also. Theoretically, such modifications should have increased the ischemic time of aorta clamping, CPB time and operation time. However, the research has stated an extraordinarily important fact, that the usage of our own surgical modification *did not increase ischemic time* (109 min in group I versus 117 min in group II in average, *p=0.143*). Meanwhile, *CPB time* and *operation time* for patients with modified surgical approach were lowerthan for the patients with standard surgical record *(p<0.001)*. The decrease CPB time and operation time was mostly influenced with higher hemostasis of the suggested personal modifications of neo-aortal root reinforcement by double suture and aortic wall, and reconstruction RVOT on the arrested heart. Intraoperative data proved this: the volume of intra-operational blood loss in the group of modified record was significantly lower (2.6 ml/kg versus 5 ml/kg, p<0.001).

Surgical modifications have significantly improved the early results, the in-hospital mortality (1.2% versus 8.7% among the patients with standard surgical record, p<0.001), frequency of development and the degree of cardiac failure, time of mechanical ventilation and time of ICU stay appeared to be significantly lower. Frequency of early postoperative complications was also significantly lower for patients with modified surgical approach – in 17.1% of cases they were documented among the patients of modified record and in 65.2% of cases among the patients with standard approach. The main influential factor, which determined the improvement in the results of modified operation of pulmonary autograft, became the optimization of intra-operational procedure.

Conclusions. Our surgical modifications demonstrated effectiveness on the intra- and postoperative periods. Surgical innovations leaded to decrease in quantity of intra-operative complications, related to bleeding and hemotransfusional blood loss compensation, decrease in general operation time and CPB, that directly affected on decrease morbidity and mortality during early postoperative period after pulmonary autograft operation.

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