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Anesthesia in Cardiac Surgery in Young Children, 3 Years Experience

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ABSTRACT

The aim of this study was to study and analyze the anesthetic management of cardiac surgery in young children with congenital heart defects under cardiopulmonary bypass. The material of the study was clinical studies for the period 2020-2022 in the Department of Cardiac Surgery of the Clinic of the Tashkent Pediatric Medical Institute. The survey included 1685 children with a verified diagnosis: congenital heart disease, who underwent surgery for congenital heart disease. The exclusion criteria from the study were: children with severe genetic diseases and stigmas of dysembryogenesis, the presence of infectious and inflammatory diseases.

Key words: *children with congenital heart defects, cardiac anesthesia, cardiopulmonary bypass (EC), hemodynamics.*

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INTRODUCTION

One of the urgent problems of modern cardioanesthesiology is the anesthetic management and management of the postoperative period after open heart surgery in young children with congenital heart defects (CHD). Its complexity is due to a complex of reasons that lie, on the one hand, in the numerous features of the physiology of children in the first year of life. On the other hand, compensatory changes in the cardiovascular, pulmonary and other body systems that occur due to the presence of congenital heart disease leave their mark on the features of the postoperative period.

Currently, cardiac surgery is a common and effective treatment for congenital heart disease (CHD) in children [2,4,7]. Good treatment results, which were achieved already at the dawn of pediatric cardiac surgery, but in fact opened a new era in the treatment of CHD and stimulated the development and symbiosis of such specialists as pediatric cardiologists and cardiac surgeons [3,5,8]. As a result of cooperation, significant progress has been made in the diagnosis and surgical treatment of CHD [1,6,9]. As a consequence, specialists such as pediatric cardiac anesthesiologists have emerged, whose competence includes the pathophysiology of CHD, the diagnostic procedures and surgical interventions used in their treatment, as well as pediatric and cardiovascular anesthesiology and intensive care. Currently, pediatric cardiac anesthesiology attracts clinicians as an exciting and technically advanced sub-specialty based on physiological principles [2,10,12].

Cardiac surgery in children is often performed under non-standard physiological conditions, which are rare in other areas of clinical medicine [3,13,14]. Examples include hypothermia up to 15 - 18°C, acute hemodilution of more than 50% of the extracellular fluid volume, complete circulatory arrest for up to 1 hour. The ability to maintain and manage the patient's condition in these extreme conditions is a necessary professional quality of a pediatric cardiac anesthesiologist. As in other areas of medicine, the application of modern technologies requires a thorough knowledge of their physiological effects [5,9,11]. Of paramount importance for a pediatric cardiac anesthesiologist is information gleaned from studies performed in children with CHD in real conditions of intensive care units and operating rooms.

The aim of the study to study and analyze the anesthetic management of cardiac surgery in young children with congenital heart defects under cardiopulmonary bypass.

MATERIAL AND METHODS

From 2020-22, 1685 children were operated on in the Department of Cardiac Surgery of TashPMI, of which 742 were children under 1 year old. The distribution of patients by nosology, age and nature of the operation is given in Table 1. According to the data presented, the majority of those operated on are represented by patients with "pale" defects (81.7% of the total number of patients), and children with "blue" defects accounted for 18.3% , it is basically a radical and palliative correction of the tetrad of Fallot. Children under 1 year of age account for approximately 44% of the total number of children with congenital heart disease operated on at TashPMI.

All patients underwent central analgesia with fentanyl, benzodiazepines in combination with inhalation anesthetics (isoflurane, sevoflurane). Anesthesiological support was carried out on the Fabius Plus device (Germany). Cardiopulmonary bypass was performed on a Stockert S5 device (Germany) in normal and pulsating modes in combination with simple and modified ultrafiltration. The state of hemodynamics (ECG, invasive pressure, CVP, temperature, saturation) during and after the operation was monitored using the NIHON COHDEN device (Japan). Activated clotting time (ABC) was monitored during IR using a Hemochrom device (USA) and maintained above 400 seconds.

RESULTS AND DISCUSSIONS

The principles of anesthesia were based on knowledge of the pathophysiology of congenital heart disease. The choice of anesthesia induction technique depended on the severity of cardiac dysfunction, the type of congenital heart disease, and the degree of sedation provided by premedication. With a moderate cardiac reserve, the principle of fractional (i.e., in several doses) administration of an induction agent was more important than the use of one or another drug or induction technique. Currently, we successfully use a wide range of induction techniques using a variety of anesthetics: sevoflurane, isoflurane, fentanyl, propofol, midazolam or sibazon [8]. For neonates undergoing open-heart interventions, induction of anesthesia based on opioids and muscle relaxants is preferred. Ketamine remains the most popular induction agent in patients with cyanotic CHD, as it increases TPVR and cardiac output, thereby decreasing right-to-left shunt. Ketamine can be administered intravenously or intramuscularly, but in the second case, the injection can cause pain, agitation and a subsequent drop in SaO2. An individual plan was developed for each patient, which was in harmony with the global perioperative task, leading to the development of optimal anesthesia tactics. In patients with complex CHD who required inotropic support and mechanical ventilation in the preoperative period, induction and maintenance of anesthesia based on fentanyl at a dose of 10–15 μg/kg/min, carefully controlled according to hemodynamic parameters, are most justified. On the contrary, in patients with uncomplicated ASD and VSD, small doses of fentanyl (5-10 μg/kg/min) were combined with large doses of inhalation anesthetics. Inhalational anesthetic regimens allow early extubation of the patient and shorten the length of stay in the intensive care unit.

Cardiopulmonary bypass (EC) affects the body of newborns, young children and older children in a significantly different way than on the body of adults. During EC, children find themselves in extreme conditions that are not found in adults: deep hypothermia (up to 18 - 20 ° C), excessive hemodilution (exceeding the BCC by 3 - 15 times), low perfusion pressure (20 - 30 mm Hg. Art.) , significant fluctuations in the volumetric perfusion rate (from 200 ml / kg / min to a complete stop), as well as various methods of managing the acid-base state (alpha-stat or pH-stat, or both methods in series).

Table 1. Number of cardiac surgeries in children over a 3-year study period (abs).

№	Type of operation	Average возраст (лет)	Number of operations by years			
			2020	2021	2022	Всего
1	VSD	1,8±0,2	182	146	139	467
2	DMZHP.VLG	1,2±0,1	45	36	25	106
3	ASD	1,5±0,1	159	181	136	476
4	TF (bypass)	1,6±0,1	54	37	42	133
5	TF (radical)	2,4±0,2	30	47	41	118
6	PDA ligation	1,7±0,1	42	56	50	148
7	Narrowing LA	1,3±0,1	38	42	30	110
8	CHADLV	1,2±0,1	15	18	12	45
9	TADLV	1,3±0,1	6	8	10	24
10	TMS	1,2±0,1	-	-	5	5
11	DOMS from PZH	1,7±0,1	8	20	18	46
12	Others	1,1±0,1	1	2	4	7
Total (to total)			580 (34,4%)	593 (35,2%)	512 (30,4%)	1685 (100%)
Death			18 (1%)	16 (0,95%)	14 (0,84%)	48 (2,8%)

These parameters significantly differ from the physiological norm, which disrupts the function of many organs during EC and after the transition to independent circulation. Myocardial function when disconnected from EC was assessed by direct visual observation of the work of the heart, or by intraoperative echocardiography. Pulse oximetry can be used to assess the adequacy of cardiac output [10]. After correction of complex congenital heart diseases, the anesthesiologist and surgeon had difficulties with disconnecting the patient from the AIC.

The list of possible causes of this complication included the following conditions: 1) Residual surgical defect requiring immediate correction (68% of cases);

2) Pulmonary hypertension (14%);

3) Dysfunction of the right or left ventricles (26%).

4) Low perfusion pressure (27%)

5) Fluctuations in the volumetric perfusion rate (18%)

6) Multidirectional fluctuations in acid-base balance (22%)

CONCLUSION

Anesthesia performed during cardiac surgery in children requires close attention to the condition of patients in the peri-postoperative periods, with a targeted correction of homeostasis. Anesthesia benefits should be carried out with inhalation anesthetics against the background of relative hemodilution. Non-inhalation anesthetics are preferably used for "blue defects". With prolonged surgical interventions, the use of fentanyl reduces the risk of surgical complications.

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