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# Formation of Heart Failure in Children with Fallot Tetrad with Hypoplasia of the Fibrous Ring of the Pulmonary Artery in the Early Postoperative Period

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**Abstract** The article presents the results of our own studies aimed at analyzing changes in biochemical parameters in patients with Tetralogy of Fallot with hypoplasia of the valve ring of the pulmonary artery in the early stages after radical correction. The work is based on clinical and laboratory data obtained in the period from 2022 to 2024 on the basis of the cardiac surgery departments of the RSNPMC named after. Academician V. Vakhidov and Tashkent State Medical University. The study included 21 patients with congenital Tetralogy of Fallot. It was revealed that the concentrations of myocardial damage markers - troponin T and MV fraction of creatine phosphokinase - have a direct relationship with the clinical manifestations of heart failure. The analyzed laboratory parameters can be considered as indicators of intracellular metabolic disorders.

**Keywords** Tetralogy of Fallot, Postoperative period, Heart failure, Troponin T, MV-creatine phosphokinase

## 1. Introduction

The current stage of development of pediatric cardiac surgery is characterized by the active use of surgical methods for eliminating congenital heart defects, especially complex, multicomponent forms, which is a tetrad Fallot's tetralogy is characterized by hypoplasia of the pulmonary artery fibrous ring, which brings to the forefront the issues of patient management in the postoperative period [1,3,5]. Even with successful surgical correction, functional disorders often persist in children, primarily manifested by signs of heart failure, as well as a spectrum of early postoperative complications [2,4]. Adaptation of the cardiovascular system to new hemodynamic conditions after radical correction of Fallot's tetralogy may be accompanied by decompensation of myocardial contractile function and the development of systemic and tissue homeostasis disorders [1,2,3,5]. In this regard, the study of biochemical markers of cardiac muscle damage, in particular the concentration of troponin-T (Tr -T) and the activity of the MB fraction of creatine phosphokinase (MB-CPK) in the blood serum, is of particular diagnostic value [4,6,7]. The level of these indicators reflects the extent of myocardial damage and can serve as a criterion for assessing the severity of postoperative changes. The combination of these factors necessitates analyzing these biochemical parameters in children with congenital heart defects during the perioperative period.

**Purpose of the study.** To evaluate changes in biochemical markers depending on the severity of heart failure in patients with teradle of Fallot with hypoplasia of the fibrous pulmonary artery rings in the early stages after radical correction.

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## 2. Material and Methods

The clinical trial was conducted from 2022 to 2024 at the cardiac surgery departments of the V.Vakhidov Russian Scientific and Practical Medical Center of Surgery and the Sino Professional Medical Clinic at Tashkent State Medical University. The study included 21 patients with congenital heart defects and tetralogy of Fallot. fibrous hypoplasia pulmonary artery rings (PAR) of dysembryogenesis, as well as acute or chronic infectious and inflammatory diseases in patients. Diagnosis of congenital heart disease was carried out in the postnatal period, mainly in the first months of life, based on a comprehensive clinical and instrumental examination. During the study, anamnesis data, clinical features of congenital heart defects, as well as the results of instrumental diagnostic methods, including electrocardiography (ECG), echocardiography (EchoCG) and Doppler echocardiography were analyzed. To biochemically characterize the functional

state of the myocardium, the concentration of troponin-T in the blood serum was determined using test systems from Boehringer Mannheim, as well as the activity of the MB fraction of creatine phosphokinase, determined by enzyme-linked immunosorbent assay. Statistical processing of the obtained data was performed using variation statistics methods. Cardiovascular function in children with congenital heart disease (CHD) after cardiac surgery was assessed dynamically, taking into account heart rate, respiratory movements at rest and during moderate physical exertion, as well as cardiac borders and chamber sizes based on echocardiography. Clinical manifestations of heart failure included dyspnea and tachycardia of varying severity, enlarged heart size, chamber dilation, ventricular myocardial thickening, and a moderate decrease in myocardial contractility based on echocardiography. The overall group included 61 patients who underwent radical correction of tetralogy of Fallot, 33 of whom had no clinical or instrumental signs of heart failure. The remaining 18 patients showed signs of stage I–II A–B heart failure after surgery.

## 3. Result and Discussion

In patients without clinical and instrumental signs of heart failure, tetralogy of Fallot was presented by a pale form, mild dextroposition of the aorta and mild infundibular hypertrophy of the right ventricle and moderately significant stenosis of the pulmonary arteries without hypoplasia of the fibrous ring.

Patients with signs of heart failure in the postoperative period included those with tetralogy of Fallot with pronounced anatomical and morphological changes, i.e., pronounced infundibular stenosis of the right ventricle, pronounced fibrous hypoplasia rings with Z - score values of - 2; - 3; pronounced dextraposition of the aorta (n=21), as well as with combined defects, tetralogy of Fallot + atrioventricular communication full form. The above mentioned signs were identified in as a result of the conducted Echocardiography and MSCT studies.

Radical correction of tetralogy of Fallot was performed using the standard method in 40 patients and the remaining 21 patients underwent radical correction of tetralogy of Fallot using the transannular method plastics with expansion of the hypoplastic fibrous ring and pulmonary trunk arteries with formation of the third neovalves (Table 1; Table 2).

In patients with in patients with pale tetralogy of Fallot, significant deviations in biochemical parameters from reference values were recorded in the first 3–6 hours after CTRF, with the greatest changes observed in the form of an increase in troponin-T concentration (Table 1). Over the next 1–2 days, a downward trend in troponin-T levels and creatine phosphokinase MB activity was observed, which persisted on days 5–6 after surgery. By days 9–10 after surgery, the values of these parameters reached normal levels. The data obtained indicate that significant changes in biochemical markers are characteristic mainly of the early postoperative period. Subsequently, during the recovery phase, cardiac adaptation processes in patients in this group proceed without significant shifts in biochemical parameters. This indicates the possibility of a temporary disruption of tissue homeostasis even in clinically normal conditions. This fact should be taken into account in the practical activities of a specialist, using monitoring of biochemical parameters for the timely correction of identified disorders. In patients with tetralogy of Fallot and severe hypoplasia of the cerebral artery, serum troponin-T levels and creatine phosphokinase MB activity were significantly elevated and remained elevated for 5-6 days after surgery. These changes were accompanied by clinical manifestations of heart failure. Normalization of biochemical parameters occurred only 5-6 days after surgery, amid improved cardiovascular function. Thus, the severity and duration of changes in biochemical markers of myocardial injury in the postoperative period are significantly related to the presence and severity of clinical manifestations of heart failure. At the same time, the determination of these indicators remains informative even in the absence of clinical signs of heart failure. Disturbances in tissue homeostasis must be considered during the recovery phase, especially after RK with reconstructive interventions on the RVOT and PA trunk in patients. tetralogy of Fallot with severe obstructions at the outflow tract of the right ventricle and pronounced hypoplasia of the fibrous ring of the pulmonary artery.

**Table 1.** Laboratory parameters in patients with tetralogy of Fallot without hypoplasia of the cervical canal

| Patients with tetralogy of Fallot pale form (40) | | | | |
|---|---|---|---|---|
| Time interval | 3-6 hours p /o | 24 hours p /o | 48 hours p/o | 72 hours p/o |
| T-G (ng /ml) | 1.31 ±0.05** | 0.37 ±0.05** | 0.22 ±0.05 | 0.12 ±0.06 |
| MV – KFK mkkat /l | 0.068 ±0.006 | 0.078 ±0.005** | 0.053 ±0.004* | 0.048 ±0.006 |

**Table 2.** Laboratory parameters in patients with tetralogy of Fallot with severe hypoplasia of the cervical canal

| | Patients with tetralogy of Fallot with hypoplasia of the cerebral artery and the pulmonary trunk. (21) | | | | |
|---|---|---|---|---|---|
| Time interval | 3-6 hours p /o | 24 hours p /o | 48 hours p/o | 72 hours p/o | 96 hours of training |
| T-G (ng /ml) | 0.18 ±0.05 | 7.4 ±1.1*** | 6.2 ±1.1** | 6.2 ±0.7** | 0.22 ±0.05 |
| MV – KFK mkkat /l | 0.068 ±0.006 | 0.083 ±0.004*** | 0.081 ±0.005*** | 0.072 ±0.005*** | 0.062 ±0.005*** |

Note: the p-value (reliability) was obtained by comparing the indicators of the corresponding groups of patients. * - significant difference from the control group ($p< 0.05$); * * - ($p< 0.01$); * * * - ($p< 0.001$). In other cases, the differences are not significant. ($p>0.05$)

## 4. Conclusions

The study showed that the analyzed laboratory parameters are informative and objectively characterize the state of homeostatic balance in children with congenital heart defects. Creatine phosphokinase MB activity can be considered as biochemical indicators of tissue homeostasis disturbances. The obtained results indicate that in patients with tetralogy of Fallot after Even after radical correction, recovery processes can be complicated by the development of heart failure caused by disruptions in biochemical and metabolic mechanisms, primarily at the myocardial level. In this regard, determining troponin-T concentration and creatine phosphokinase MB activity can be used as additional criteria for a comprehensive assessment of myocardial condition and metabolic changes in the body as a whole.

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