FEATURES OF PERIOPERATIVE MANAGEMENT OF PEDIATRIC PATIENTS WITH CONGENITAL HEART DEFECTS


1Pirogov Russian National Research Medical University, Russia, 117997, Moscow, Ostrovitianov str. 1
2Sechenov First Moscow State Medical University (Sechenov University), Russia, 119991, Moscow, Trubetskaya str., 8/2
3RUDN University, 117198, Moscow, Miklukho-Maklaya str.6

*Corresponding author: filosoff123@list.ru

Abstract

The paper analyzes the features of perioperative management of pediatric patients with congenital heart defects. The authors note that the perioperative period is the period starting from the moment of the beginning of the operation and ending with the moment of transfer of the patient to the ward after the operation. This period is very important for the recovery of children after surgery for a heart defect. In the perioperative period, indicators such as blood pressure, pulse, oxygen saturation, respiratory rate and other indicators are monitored to make sure that the patient is in a stable condition and there are no complications.

In the perioperative period, measures are taken to prevent complications such as infections, bleeding, thrombosis, etc. Doctors also monitor the balanced administration of fluids and electrolytes to maintain the stability of the patient, and try to minimize the time of surgery to reduce stress for the patient and reduce the risk of complications. During the period under review, procedures are also carried out to support the postoperative period, such as the administration of medications and infusion solutions, maintaining body temperature and other procedures.

In general, the perioperative period is of critical importance for the recovery of children after surgery for a heart defect. Proper monitoring of health indicators, prevention of complications, proper anesthesia and other procedures help children recover faster after surgery and reduce the risk of complications.

Keywords

Congenital heart defects, Children’s patients, Surgical treatment, Individual approaches.

Imprint


Introduction

Surgical treatment of heart defects in children is an effective way to restore the normal functioning of the heart. Heart defects in children can be congenital or acquired. Congenital heart defects are usually detected in the first months of life, and some acquired heart defects can develop over several years.

Surgical treatment of heart defects in children is carried out in specialized cardiac surgery centers. Before surgery, children undergo a number of studies, including ECG, EchoCG and CT or MRI of the heart. The operation can be performed both in an open heart and using minimally invasive methods [1].

Open-heart surgery includes a number of procedures, such as closing defects in the interventricular and atrial septa, installing and replacing heart valves, as well as reconstructing the aorta and other large vessels. Minimally invasive methods of surgical treatment of heart defects in children include the use of small incisions in the chest or intra-thoracic access [2].

After surgery, children usually spend several days in the intensive care unit and intensive care unit, where their condition and heart function are monitored. After discharge from the hospital, children are prescribed a regime of physical activity and recommended periodic consultations with a cardiologist to monitor the condition of the heart.

The relevance of perioperative management of children with severe heart disease is due to the fact that the surgical correction of heart disease is a complex and risky procedure. The perioperative period (the period before, during and after surgery) is a critical period for these children, as they may face many
Complications that can lead to death or serious consequences [3].

The key tasks of perioperative management of children with severe heart disease are monitoring and maintenance of cardiovascular function, prevention and treatment of complications, as well as ensuring optimal conditions for recovery after surgery. Monitoring of cardiovascular function includes measurement of pulse, blood pressure, central venous pressure, blood oxygen level, electrocardiogram and other parameters. If a patient has problems with cardiovascular function, then appropriate measures should be taken, such as the introduction of inotropic drugs to improve cardiac function or additional support for respiratory function [4].

Complications that may occur in children with severe heart disease in the perioperative period include arrhythmias, bleeding, hypoxia, infections and others. To prevent these complications, it is necessary to carefully monitor their condition and take appropriate measures.

Recovery after surgery can be lengthy and require an individual approach. This may include rehabilitation measures, drug therapy and other measures. In general, perioperative management of children with severe heart disease is critically important for achieving good results of surgery.

The aim of the study was to analyze the features of perioperative management of pediatric patients with congenital heart defects.

Materials and methods

The analysis of the features of perioperative management of pediatric patients with congenital heart defects is based on the study of theoretical research and scientific and practical experience of practicing specialists in the field of cardiovascular surgery, operating both in Russia and abroad. When writing the study, a comparative method of research was used, as well as the method of induction.

Results

Congenital heart defects (CHD) are various abnormalities of the development of the heart and blood vessels that are present from the moment of birth. There are many different types of congenital heart defects, and they can be classified according to different criteria. Some of the most common classifications include:

- classification by type of defect: in this classification, heart defects are divided into several types, including septal defects, valve defects, vascular defects and combined defects;
- classification by anatomical location: heart defects can be classified based on where they are in the heart, including defects of the left and right halves of the heart, vascular defects and mixed-type defects;
- classification by severity: heart defects can be classified into mild, moderate and severe, depending on the degree of influence on the work of the heart and respiratory system;
- classification by functional disorders: heart defects can be classified based on how they affect the functioning of the heart;
- classification by hereditary characteristics: heart defects can be classified based on their heredity, for example, hereditary heart defects and non-hereditary heart defects;
- classification by reason of occurrence: heart defects can be classified by reason of occurrence, for example, genetic factors, environmental factors, the influence of drugs and others [5].

All these classifications are additional tools for more accurate diagnosis and treatment of congenital heart defects in patients of all ages. They allow the attending physicians to determine the most appropriate method of treatment, which may include surgical interventions, drug therapy, rehabilitation and other measures.

The field of surgical treatment of heart defects in children is actively developing, and various treatment methods are currently available, including traditional open surgical interventions, minimally invasive methods and robotic surgery. A review of the literature shows that these techniques have their advantages and disadvantages, and the choice of a particular method depends on many factors, including the type of heart defect, age and general condition of the patient [6].

Heart surgery in children with heart defects is a complex procedure, and the choice of optimal surgical technique plays an important role in ensuring the safety and effectiveness of the procedure. A review of the literature shows that there are several different surgical techniques used to treat heart defects in children, including the following:

- open surgery is a classic surgical technique in which the surgeon opens the chest to have direct access to the heart. This technique is often used for com-
plex heart operations, such as valve replacement and reconstruction of major vessels;

– minimally invasive surgery is a technique that allows for heart surgery while minimizing damage to surrounding tissues. This is achieved by using small incisions in the chest and special tools that allow the surgeon to work inside the chest cavity. This technique is often used for less complex heart operations, such as closing atrioventricular defects;

– endovascular surgery is a technique that allows performing heart surgery using catheters and other minimally invasive instruments. This technique is often used to treat heart defects that can be eliminated without the need for open surgery;

– hybrid surgery is a combination of open and minimally invasive surgery, which allows for heart surgery, combining the advantages of both techniques. For example, in hybrid surgery, a surgeon may use small incisions in the chest to access the heart, and then switch to open surgery to perform more complex procedures [7].

A review of the literature shows that the choice of the optimal surgical technique depends on many factors, such as the type of heart defect, age and general condition of the patient, experience

Minimally invasive methods are also becoming increasingly popular in the treatment of heart defects in children. These methods include cardiac catheterization procedures that are performed through small incisions. They can be used to treat many heart defects, including ventricular septal defects, atrial septal defects and pulmonary artery stenosis. However, they may be less effective for the treatment of more complex heart defects, such as transposition of the great vessels [8].

One of the minimally invasive surgical procedures is a rhinotomy, a surgical procedure in which an incision is made in the chest to access the heart and perform operations on it. In the surgery of heart defects in children, a rhinotomy can be used to access the heart and perform the necessary corrective operations [9].

A study conducted in 2018 in China describes the results of the treatment of 83 children with transposition of the great vessels using a rhinotomy. Correction of the defect by arterial switching was performed in all patients. The results have shown that a rhinotomy is a safe and effective method of surgical treatment of transposition of the great vessels in children [10].

Another study published in 2019 in the United States examines the experience of using a rhinotomy to treat children with hypoplasia of the left heart. The study included 61 patients who underwent Norwood surgery (reconstruction of the right ventricle). A rhinotomy was used to access the heart. The results showed a high survival rate and the absence of serious complications [11].

A study was also conducted in 2020 in Germany, which examined the results of the treatment of 48 children with various degenerate heart defects who were operated on by the method of rhinotomy. In the study, it was noted that rhinotomy can be a safe and effective method of treating heart defects in children, especially in patients with more complex defects [12].

Thus, a review of the literature shows that rhinotomy is a safe and effective method of treating degenerate heart defects in children, which is confirmed by the results of various studies.

Robotic surgery is also a promising technique in the treatment of heart defects in children. It can be effective for the treatment of some complex heart defects, such as ventricular septal defects and transposition of the main vessels. The use of robots during the operation of children for heart disease is a new direction in cardiac surgery and is at the stage of active research and development. However, there is already initial data on the possibilities of using robots in this area.

Robots in cardiac surgery can be used as assistants for surgeons, allowing them to perform complex heart operations more accurately and precisely, such as valve repair or replacement, correction of defects and other procedures. The use of robots can reduce the risk of complications, improve the accuracy and results of surgery, as well as reduce the recovery time and hospitalization.

Despite this, there are also a number of limitations and complications associated with the use of robots in heart surgery. Some of these limitations include the high cost of equipment, limited access to technology in many regions, the possibility of technical failures, the risk of damage to surrounding tissues and complications associated with anesthesia.

In general, the use of robots in the operation of children for heart disease has the potential to become an important tool in cardiac surgery and facilitate the implementation of complex procedures, but requires additional research and development to determine the effectiveness and safety of the use of robots in this area.

Surgical treatment of heart defects in children is a rather complicated procedure that carries certain
To reduce these risks, it is necessary to adjust the risk of surgical intervention. Risk adjustment involves an assessment of various factors that may affect the success of the operation and the postoperative period. Such factors include the age of the child, the presence of concomitant diseases, the severity of heart disease, lung condition, heart function, the presence of infections and other factors [13].

There are several risk assessment methods that are used in preparation for surgical treatment of heart defects in children. One of the most common methods is the STAT (Surgical Treatment for Aortic Stenosis and Aortic Regurgitation in Children) scoring system, which allows assessing the risk of surgical treatment of heart disease in children based on a number of parameters, such as age, weight, presence of concomitant diseases, etc.

In addition, in preparation for surgery, additional studies are conducted, such as ECG, ultrasound, MRI and others, which allow you to get more complete information about the state of the cardiovascular system and identify possible complications.

A review of the literature shows that there are a number of risks associated with various surgical techniques in the treatment of heart defects in children, including the following:

– the risks of open surgery include damage to surrounding tissues, bleeding, infection, cardiac arrhythmia, as well as the risk of developing systemic inflammatory response syndrome (SIRS) and acute stress response phase (SIRS), which can lead to prolonged hospitalization, increased cost of treatment and a decrease in the quality of life of the patient;

– the risks of minimally invasive surgery include damage to surrounding tissues, the possibility of heart failure, infection, bleeding and other complications;

– the risks of endovascular surgery include the possibility of infection, bleeding, damage to surrounding tissues, as well as the risks associated with the use of catheters and other instruments;

– the risks of hybrid surgery include risks associated with open and minimally invasive surgery [14].

It is important to note that risk adjustment is an important component of preparation for surgical treatment of heart defects in children, and should be carried out comprehensively, taking into account all factors that may affect the success of the operation and the postoperative period. This is the only way to achieve maximum efficiency and minimize possible complications.

A review of the literature shows that the choice of the optimal surgical technique depends on many factors, including the type of heart defect, the age and general condition of the patient, the experience of the surgeon and the availability of the necessary equipment. It is important to take these risks into account when choosing the optimal surgical technique and developing strategies to minimize risks and ensure patient safety. Accordingly, the choice of a specific method of treating heart defects in children should be based on the individual characteristics of the patient and a carefully established diagnosis.

The definition of such a method, as well as its implementation and monitoring of the general condition of a child patient is carried out according to certain algorithms for the management of such patients in the perioperative period.

Discussion

The preparatory period before the operation of children with degenerative heart disease is a critical stage in perioperative management and should be carefully thought out and performed. It includes an assessment of medical history, physical examination, assessment of cardiological status, as well as additional examinations, if necessary.

Assessment of medical history includes collecting information about the presence of other diseases and possible risk factors, such as genetic abnormalities or previous surgical interventions. Physical examination includes an assessment of the condition of the skin and mucous membranes, the presence of edema, pulse, respiration, auscultation of the heart and lungs.

Assessment of the cardiological status may include electrocardiography (ECG), echocardiography (ultrasound of the heart), hemodynamic studies (for example, cardiac catheterization), as well as other specialized tests, if necessary. These studies help to assess the degree of heart disease and give an idea of its characteristics, such as size, location and degree of stenosis or insufficiency [15].

Depending on the results of the assessment of medical history, physical examination and cardiological status, decisions may be made on additional examinations and treatment, such as correction of iron deficiency anemia or preparation for surgery with the help of drug therapy.

In general, the preparatory period should be individualized for each child, taking into account its
characteristics and the requirements of the surgical procedure. It may also include consultations with other specialists, such as a pediatrician, anesthesiologist, pulmonologist, etc. All this makes it possible to minimize the risks and ensure the maximum possible success of surgery in children with congenital heart disease [16].

Diagnostic methods of preparing children for heart defect surgery include the following stages:

1. Anamnesis study – the doctor collects information about the health of the child and his close relatives, medical history, symptoms experienced by the child, features of his development.

2. General clinical examination – the doctor assesses the general physical condition of the child, as well as assessess the state of his cardiovascular system. During the examination, the doctor pays attention to signs such as pulse, breathing, skin color, swelling of veins on the neck, as well as the presence of edema and other symptoms indicating the presence of a heart defect.

3. Electrocardiography (ECG) is a research method in which electrical impulses transmitted by the heart are recorded using electrodes. This allows you to evaluate the work of the heart and identify the presence of abnormalities in its work.

4. Echocardiography (ultrasound of the heart) is a method in which an image of the heart is produced using ultrasound waves. This allows you to determine the size, shape and structure of the heart, as well as to identify the presence of defects and assess their severity.

5. Radiography is a method in which an X-ray examination of the chest is performed. This allows you to assess the size and shape of the heart, as well as to identify the presence of other diseases of the lungs and chest organs.

6. Computed tomography (CT) and magnetic resonance imaging (MRI) are more modern research methods that produce more accurate images of internal organs, including the heart. However, these methods can be prescribed only in cases when other methods do not allow obtaining enough information about the state of the heart.

Depending on the condition of the child and the nature of the heart defect, other studies may be prescribed, for example, cardiac catheterization, which is carried out during a special procedure in which a catheter is inserted through a vein and reaches the heart in order to conduct a more detailed and accurate study of its work.

In addition, an important part of preparing a child with a heart defect for surgery is to assess his general health and the presence of other diseases. For this purpose, additional studies may be prescribed, such as a general blood and urine test, biochemical analyzes, coagulogram, analysis for the presence of infections, and others [17].

In general, the diagnostic process of preparing a child for surgery for a heart defect can be quite complicated and require a lot of research. However, this is necessary in order to assess the condition of the heart and choose the most appropriate treatment strategy. In addition, carrying out all the necessary studies helps to reduce the risks of complications during the operation and ensure the most favorable outcome for the child.

During the preoperative assessment of children with heart disease, various types of risks can be identified. They can be related both to the operation itself and to the state of the child's health.

Operational risks may include:

– the risk of anesthesia. Some children may be more susceptible to anesthesia, which may increase the risk of complications during surgery;

– risk of bleeding. Heart surgery is often associated with the risk of bleeding due to a violation of the integrity of blood vessels;

– risk of infection. The possibility of infection is one of the main risks of any surgical operation, including on the heart;

– risks associated with the child's health, which may include: circulatory disorders (a child with a heart defect may have circulatory disorders, which may increase the risk of complications during surgery); the presence of other diseases (diseases such as diabetes, lung or kidney diseases, may increase the risk of complications during surgery and after her) [18].

In some cases, additional procedures may be required to ensure a successful outcome of the operation.

Assessment of all these risks is an important step before surgery for a heart defect in children. Based on this assessment, the most appropriate action plan will be determined to ensure the safety and success of the operation.

After surgery for a heart defect in children, careful monitoring should be carried out to assess and maintain their health. Here are some of the monitoring aspects that are commonly applied:
1. Monitoring of cardiovascular function. It includes monitoring of heart rate, blood pressure, oxygen saturation and other parameters that may indicate circulatory disorders.

2. Breath control. Children who have undergone heart surgery may need support for respiratory function. Monitoring includes monitoring the respiratory rate, the volume of inhalation and exhalation, the level of carbon dioxide in the blood and other parameters.

3. Pain control. Heart surgery can be painful and children may need pain relief. Monitoring includes an assessment of the level of pain and the effectiveness of painkillers.

4. Control of the presence of infection. Surgical monitoring also includes the search for signs of infection, such as elevated body temperature, rapid breathing, changes in laboratory blood counts and other symptoms.

5. Nutrition and hydration control. After heart surgery, children may need to temporarily restrict nutrition and fluids. Monitoring includes assessment of the input and output of fluids, nutritional status and other indicators.

Surgical monitoring after heart surgery in children should be carried out by experienced medical professionals with the necessary knowledge and experience. The frequency of monitoring and duration depend on the condition of the child and the type of surgery performed.

A special role in the postoperative period is assigned to the monitoring of cardiovascular function in children after surgery for a heart defect. The methods, methods and types of this monitoring are widely studied in the literature. Thus, one of the literature reviews includes information about the types of monitoring, how to evaluate monitoring results and potential complications [19]. In addition, there are comparative studies that compare three methods of continuous monitoring of cardiac output in children after heart surgery. The authors believe that all three methods can be effective, but their choice should be based on the individual needs of the patient [20].

In general, monitoring of cardiovascular function in children after heart surgery is an important component of care and should be carried out by experienced specialists based on the individual needs of the patient.

It is noted in the literature that various methods are used to monitor cardiovascular function in children after heart surgery, including:

- electrocardiogram (ECG) – a test that records the electrical activity of the heart and can show the presence of arrhythmias or other cardiac arrhythmias;
- the use of an intravenous catheter – this method allows you to monitor various parameters of blood circulation, such as central venous pressure (CVP), pulmonary artery pressure (PAP), cardiovascular index (CVI) and others;
- continuous monitoring of blood pressure is a method that allows you to examine blood pressure for a long period of time and detect changes that may indicate problems in blood circulation;
- transthoroidal echocardiography (TEho) is a test that uses ultrasound waves to create an image of the heart and can show the presence of abnormalities in the structure of the heart, changes in the size and function of the heart;
- pulse oximetry is a monitoring method that allows you to measure the level of oxygen saturation in the blood by using a sensor mounted on your finger or ear;
- cardiac monitors (heart rate monitors) are portable devices that allow you to monitor your heart rate in real time and detect arrhythmias or other cardiac arrhythmias [21].

Depending on the condition of the child and the type of heart surgery, one or more of these methods of monitoring cardiovascular function may be used.

Medical monitoring of children’s recovery after surgery to eliminate heart disease is very important for their health and further well-being. These procedures help doctors monitor the progress of recovery, identify possible problems and take appropriate measures to prevent their occurrence.

After surgery to eliminate a heart defect, children usually undergo a rehabilitation program, which includes regular examinations, prescribing medications, physical therapy and lifestyle changes. In the first few days after surgery, patients are under the supervision of doctors and medical staff to make sure that they are recovering normally and there are no complications.
Monthly visits to a cardiologist and, if necessary, to a cardiac surgeon are also planned and carried out to monitor the state of the heart and monitor blood pressure, pulse and other important health indicators. In addition, children may be prescribed echocardiograms, electrocardiograms and other medical tests to assess the condition of the heart and identify possible problems.

It is important that children and their parents follow all doctors’ prescriptions and follow recommendations for lifestyle changes, such as proper nutrition, moderate physical activity, etc. Monitoring recovery after surgery to eliminate heart disease is an integral part of treatment and helps to ensure the maximum well-being of children in the future.

Conclusions

Surgical treatment of heart defects in children is a complex and sometimes risky process that can be accompanied by a number of problems and complications. Some of the main problems associated with surgical treatment of heart defects in children include: complications after surgery: various complications may occur after surgery, such as infections, bleeding, cardiac arrhythmia or pneumothorax; high risk during surgery: some heart defects can be very complex and require highly qualified and experienced surgeons, what can increase the risk for a child; long rehabilitation period: after surgery, children may need a long period of rehabilitation and medical supervision, which may be difficult for both the child and his parents; the possibility of repeated operations: in some cases, heart defects may require several operations to achieve complete treatment, which may lead to increased risk and additional stress on the child’s body; the need for constant medical supervision: children who have undergone surgical treatment of heart defects should be constantly monitored by a cardiologist and perform a number of procedures and tests to check the work of the heart and identify possible complications.

Despite these problems, surgical treatment of heart defects in children can significantly improve their quality of life and prolong it. At the same time, the perioperative management of pediatric patients with congenital heart disease should be organized in accordance with medical protocols and be individualized in accordance with the severity of the patient's health condition.

References