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Clinical Case

Surgical treatment for the single ventricle with subaortic obstruction. Clinical case of the Damus-Kaye-Stansel procedure

S.E. Bykov[1] • S.A. Kovalev[1, 2] • D.Yu. Gryaznov[1] • E.I. Korosan[1] • W.M. Novick[3]

Sergey E. Bykov – Cardiac Surgeon, Department of Cardiac Surgery No 1[1]; ORCID: https://orcid.org/0000-0002-7516-0207
✉ 151 Moskovskiy prospekt, Voronezh, 394066, Russian Federation.
E-mail: bykov_s@bk.ru

Sergey A. Kovalev – MD, PhD, Professor, Head of Department of Cardiac Surgery No 2[1]; Chair of Hospital Therapy, Faculty of Medicine[2]; ORCID: https://orcid.org/0000-0001-8200-0351.
E-mail: kovalev@okb.vrn.ru

Denis Yu. Gryaznov – Cardiac Surgeon, Department of Cardiac Surgery No 1[1]; ORCID: https://orcid.org/0000-0002-3224-1680.
E-mail: fuflomycin@gmail.com

Elena I. Korosan – MD, PhD, Pediatric Cardiologist, Department of Cardiac Surgery No 1[1]; ORCID: https://orcid.org/0000-0003-2196-811X.
E-mail: el_ko2004@mail.ru

William M. Novick – MD, Pediatric Cardiac Surgeon[3]; ORCID: https://orcid.org/0000-0002-4506-6113.
E-mail: bill.novick@cardiac-alliance.org

We present a case of hemodynamic correction for the single ventricle combined with subaortic obstruction and coarctation in an infant. The Damus-Kaye-Stansel procedure with modified double-barrel technique was performed. The pulmonary flow was provided with modified Blalock-Taussig shunt. The early postoperative period was characterized by multiple organ failure. Subsequently, the infant underwent the next stages of hemodynamic correction with good long-term results.

Key words: single ventricle, subaortic obstruction, Damus-Kaye-Stansel procedure

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[1] Voronezh Regional Hospital No 1; 151 Moskovskiy prospekt, Voronezh, 394066, Russian Federation

[2] Voronezh State Medical University named after N.N. Burdenko; 10 Studencheskaya ul., Voronezh, 394036, Russian Federation

[3] University of Tennessee Health Science Center; 62 South Dunlap, Memphis, TN 38163, Tennessee, USA

Introduction

The Damus-Kaye-Stansel (DKS) procedure was described independently by P.S. Damus, M.P. Stansel and H.C. Kaye as an end-to-side anastomosis between the ascending aorta and the pulmonary artery and was used as a method for the treatment of transposition of the main arteries with an intact interventricular septum in the 1970s [1]. Today, the procedure is most often used when there is an obstruction to system outflow with a single ventricle, although it was not used in this quality in the original description [2]. The advantages of performing DKS are: the ability to adequately address most cases of obstruction of the systemic blood flow, perform arc reconstruction, and a low risk of developing heart block [3, 4]. Two main methods of DKS are described: creating an anastomosis between the pulmonary artery trunk and the aorta in an "end-to-side" anastomosis and an "end-to-end" anastomosis (modification "double-barrel"). There are also many modifications to the implementation of this procedure [5, 6]. In newborns, pulmonary blood flow is provided by a systemic-pulmonary shunt or conduit from the right ventricle, and in older children, the procedure is accompanied by the imposition of a bidirectional cava-pulmonary anastomosis. The potential disadvantages of DKS include the distortion of the semilunar valves, followed by regurgitation and an increased volume load of the single ventricle, which is more typical for patients undergoing an end-to-side anastomosis, as well as the risk of compression of the left pulmonary arteries or the left main bronchus, especially with non-parallel orientation of the great vessels [7, 8].

The purpose of the message is to present a successful case of hemodynamic correction of a patient with a single ventricle in combination with obstruction of the system outflow.

Description of clinical observation

Patient V., boy. Anamnesis data. A child from 1 pregnancy, proceeding with gestosis 2 halves. Congenital heart disease in the fetus was diagnosed prenatally in the period of 30 weeks – TGA, VSD. Childbirth independent, in the period of 40 weeks. Birth weight 3650 g, height 54 cm. According to the Apgar scale 7/8 points. With a diagnosis of chronic heart disease, a single ventricle was transferred from the maternity hospital to a pediatric hospital where heart failure was treated.

The patient was admitted to the Department of Cardiac Surgery at the age of 60 days. Upon admission, the condition is assessed as severe due to heart failure, pulmonary hypertension. Weight 4.7 kg. Height 60 cm, BSA = 0.27 m^2. Diffuse cyanosis when crying. 50% saturation in air. With auscultation of the heart systolic murmur of medium intensity over the entire region of the heart. According to the ECHO: anatomy of a single left ventricle, the ascending aorta departs from the rudimentary right ventricle, atresia of the left atrio-ventricular valve, VSD 9 mm (ratio VSD / AO ring = 0.6), PFO 3 mm (gradient 5 mm Hg). Conclusion according to the comprehensive examination (ECHO, CT-angiography) – single ventricle. L-TGA, mitral valve atresia, VSD, coarctation of the aorta. PDA. Restrictive PFO. Pulmonary hypertension.

The patient underwent the DKS procedure in a modification used cardiopulmonary bypass and circulatory arrest. The "end-to-end" anastomosis between the aorta and the pulmonary artery was formed using a xenopericardium patch on the anterior surface; ligation of the open arterial duct. BP time was 320 minutes, aortic clamping was 53 minutes, circulatory arrest was 28 minutes. Custodiol cardioplegia. The operation is completed by prolonged sternotomy and setting up a catheter for peritoneal dialysis.

The postoperative period on the background of cardiac, multiple organ failure, hemorrhagic syndrome, nosocamial ventilator-associated pneumonia. Delayed closure of the sternum on the 6th day. Inotropic support for 8 days, extubated for 8 days. Discharged from the hospital on the 25th day after surgical correction in a satisfactory condition, prescribed therapy for heart failure (captopril, veroshpiron), acetylsalicylic acid.

The next stage of surgical correction, the bidirectional cavapulmonary anastomosis, was performed at the age of 10 months. The third stage of surgical correction was carried out at the age of 2 years and 8 months. The right cath was performed before. According to the study, no significant veno-venous collaterals were detected, the diameter of the right branch of the pulmonary artery was 12 mm, the left branch of the pulmonary artery was 13 mm, the average pressure in the pulmonary artery was 14 mm Hg, and there was no gradient on the cavapulmonary anastomosis. The child underwent a Fontaine operation in a modification of extracardiac conduit. In both cases, the postoperative period was uneventful.

Outpatient observation for 3 years after surgical correction showed that the child belongs to the first functional class. The boy is active, tolerates physical activity, attends kindergarten. Blood oxygen saturation was 97–98%. According to the ECHO, a good contractile function of a single ventricle was noted, the ejection fraction was 68%, the deficiency in the semilunar valves was 0–1 st. There was no gradient on the aortic valve, the gradient on the pulmonary artery valve was 13–15 mm Hg, aorta, 7–9 mm Hg. Applied therapy: acetylsalicylic acid 3–5 mg/kg per day.

Discussion

In choosing the tactics of surgical correction of a single ventricle with subaortic obstruction, many authors

adhere to initially performing a narrowing of the pulmonary artery, followed by the creation of a double exit from a single ventricle in combination with a bidirectional cava-pulmonary anastomosis [9, 10]. This path of hemodynamic correction is effective and is associated with relatively low postoperative mortality. According to the authors, the overall survival rate is 85% and 83% at 1 month and 5 years after correction, respectively [11].

The primary DKS procedure in conjunction with a systemic-pulmonary shunt is performed primarily in young patients. The separation of the aorta from the rudimentary right ventricle in combination with mitral atresia, restrictive VSD and coarctation were the factors determining indications for this type of correction in our case. The results of the primary surgery are high-risk, according to different authors, mortality can reach 30% depending on the age and timing of the procedure [12].

In the absence of complications characteristic of the DKS procedure, further hemodynamic correction is assessed as successful [9, 12, 13].

Conclusion

Damus-Kaye-Stansel procedure and further hemodynamic correction to a patient with a single ventricle and subaortic obstruction against the background of severe heart failure and pulmonary hypertension showed the effectiveness of the surgical treatment method used.

Additional information

Informed consent statement

Parents of the patient have given informed, written consent for publication of clinical details.

Conflict of interests

The authors declare that they have no conflict of interests.

Authors' contributions

S.E. Bykov, the concept and study design, surgical procedure, data collection and management, data analysis, text writing; S.A. Kovalev, editing and final approval of the manuscript; D.Yu. Gryaznov, literature search and analysis, surgical procedure, analysis and interpretation of the results; E.I. Korosan, follow-up of the patient, comprehensive assessments, data management and collection; W.M. Novick, the concept and study design, clinical case management, editing of the final manuscript version. All authors have contributed significantly to the study conduct and preparation of the paper, have read and approved its final version before the publication.

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