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THORACOSCOPIC IMPLANTATION OF AN EPICARDIAL PACEMAKER IN A CHILD WITH COMPLETE ATRIOVENTRICULAR BLOCK

E.B.Polyakova, E.K.Kulbachinskaya, S.A.Termosesov, R.Sh.Garipov, Ya.Yu.Volkova, M.A.Shkolnikova
Veltishchev Clinical Research Institute of Pediatrics, Moscow

A case report describing thoracoscopic approach for implantation of a cardiac pacemaker in a 3.8 years old girl with complete atrioventricular block is presented.

Key words: bradycardia; congenital complete atrioventricular block; epicardial cardiac stimulation; thoracoscopy; thoracotomy; children

Conflict of Interests: nothing to declare

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Corresponding author: Polyakova Ekaterina; E-mail: e_polyakova75@mail.ru

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Complete atrioventricular block (CAVB) is a disturbance of the electrical impulse from the atria to the ventricles due to structural or functional disorders in the conduction system of the heart. CAVB is considered congenital in the case of diagnosis of the disease in perinatal age or early childhood without any connection with another pathology [1].

The first congenital CAVB was described by Morquio L. in 1901 [2]. The prevalence rate of CAVB is approximately 1 per 20 000 live-born infants [3, 4].

There are a number of factors concomitant with the development of CAVB, such as the presence of structural pathology of the heart, autoimmune damage to the conduction system of the heart, which in most cases is associated with the presence of systemic lupus erythematosus in a child or his immediate family [3, 5, 6]. The possibility of a genetic predisposition to the development of the disease has been confirmed in a number of studies [7, 8]. Idiopathic CAVB is diagnosed with the exclusion of known causes of CAVB [1].

The appearance of clinical symptoms of CAVB depends on the etiology of the disease, the presence of concomitant pathology, the age of the child, the severity of bradycardia, and the maximum duration of pause

rhythms [6]. Most often, CAVB is manifested by syncope or pre-syncope conditions, less often - a decrease in tolerance to physical activity, a delay in physical and psy-

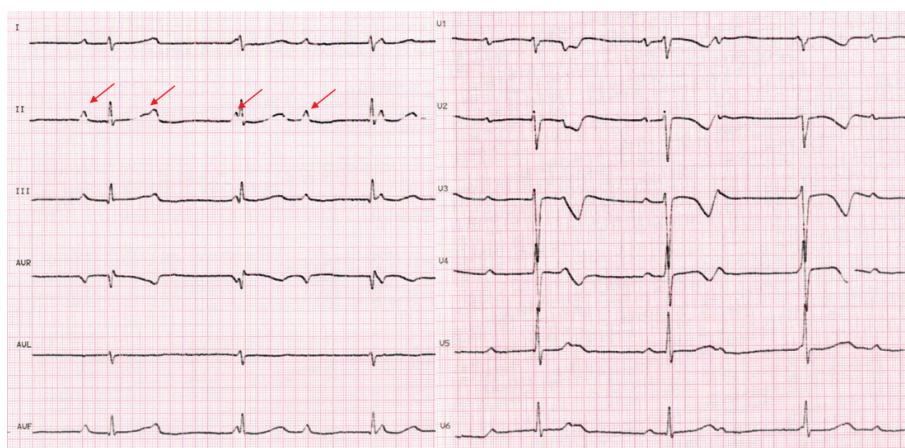


Fig. 1. ECG on admission. CAVB with a rate of atrials 88-109 bpm, and ventricles 57-59 bpm. Vertical position of the electrical axis of the heart. QRS=60 ms, QT=440 ms, QTc=436 ms. P-waves marked by arrows.



Fig. 2. The 24-hour ECG monitor on admission. Complete atrioventricular block was constantly registered. An average heart rate was 59 bpm. Average heart rate was 59 bpm (normal rate is 99-112 bpm), maximum - 98 bpm in the daytime. Average heart rate was 44 bpm (normal rate is 80-89 bpm), minimum - 39 bpm in the night time. An average daily heart rate was 59 bpm (normal rate is 93-105 bpm). The maximum rhythm pause was 2685 ms (normal up to 1300 ms).

chomotor development. Often, CAVB is asymptomatic and becomes an accidental finding on an electrocardiogram (ECG) [9, 10].

Carrying out constant pacemaking (PM) is a recognized method for the treatment of patients with CAVB regardless of the etiology of the disease. It was proved that implantation of PM increases the quality and life expectancy not only in patients with clinical manifestations, but also in asymptomatic patients [4, 9, 11]. According to modern concepts, in children weighing less than 15 kg, the epicardial arrangement of the electrodes is preferable, which allows preserving the possibility of venous access for further implantation of endocardial stimulation systems [9, 12–15]. According to various researchers, the percentage of complications during implantation of PM in children with an epicardial arrangement of electrodes reaches 14% [16, 17].

Our patient underwent thoracoscopic implantation of the epicardial pacing system. The advantages of thoracoscopic surgery have been repeatedly demonstrated in adult patients [18–20], however, there are no references of its use in children with bradyarrhythmias in the literature.

A 3 year-old female child was admitted to Veltishchev Research and Clinical Institute for Pediatrics of the Pirogov Russian National Research Medical University in May 2017. From the anamnesis of life, it is known that the girl was born via normal vaginal delivery, the second pregnancy was a threatened abortion in the third trimester. Birth weight was 3180 g, body length 54 cm, Apgar score 7/8. There are no reliable data about the period of early childhood. According to the parents' opinion, the girl has physical and psychosocial developmental delays compared to peers, as well as insufficient weight gain.

Anamnesis of the disease: for the first time, a rhythm disturbance in the form of CAVB was detected at the age of 2 years, when, after an acute respiratory illness, the first ECG was performed. The child was observed at the place of residence; non-steroidal anti-inflammatory therapy courses were conducted at age-related dosages without effect. There was no family history of heart or autoimmune diseases.

On examination, the patient has evidence of weakness, reduced emotion, the child avoided physical activity. Physical development of the patient was disharmonious due to lack of body weight: body weight was 13 kg, which corresponds to a range of values lying below 3 % according to centile tables [21]. The height of the child fell in the range of 50 %, equaling 101 cm.

An objective examination showed severe bradycardia with the heart rate ranging between 58 bpm (resting) and 62 bpm (orthostasis). According to existing standards obtained during the all-Russian clinical and epidemiological study on ECG screening of children and adolescents, the patient's heart rate was less than 2th percentile for her age (the border is 76 bpm) [22]. During auscultation, heart tones sounded rhythmic, the blood pressure was 100/55 mmHg on both arms. There were no signs of stagnation in the pulmonary and systemic circulations.

A blood count, urine test, biochemical blood test including serum cardiospecific markers were normal. An increased titer of anti-nuclear factor; anti-SSA and anti-SSB antibodies were detected neither in girl nor in parents.

Electrocardiography (Fig. 1) and 24 hours Holter monitoring (Fig. 2) showed CAVB. Echocardiography showed no structural changes in the heart, but there was a mild dilatation of the left chambers of the heart, which was the sign of arrhythmogenic cardiomyopathy. The ejection fraction according to the Teicholz method was 73%,

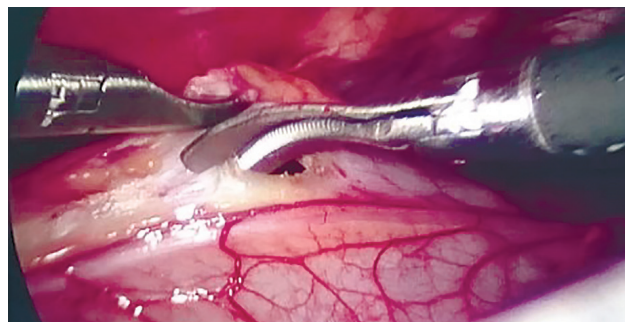


Fig 3. Intraoperative photo from the video camera screen. Dissection of the pericardium by a longitudinal section of 3–4 cm.

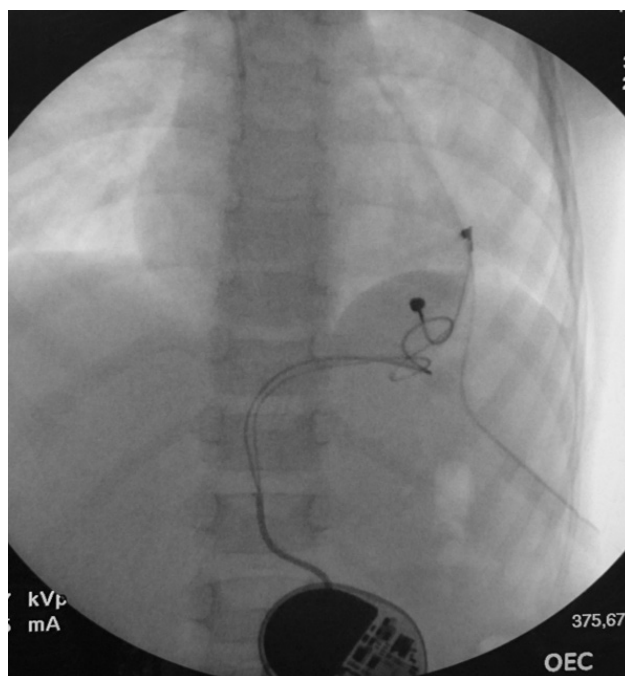


Fig. 4. Postoperative X-ray with the location of the pacemaker in the abdominal cavity and epicardial leads.

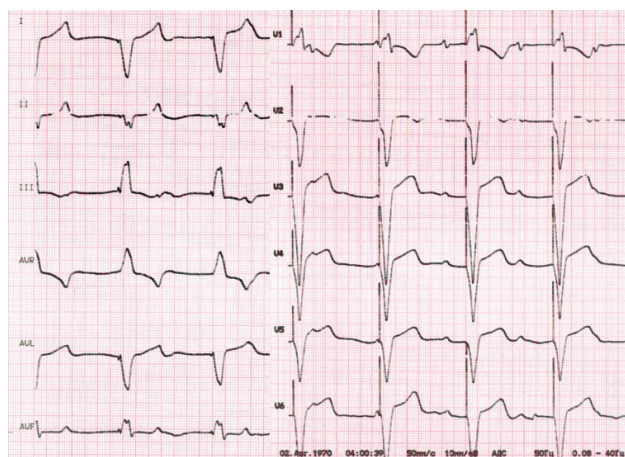


Fig.5. ECG after surgery. The rhythm from pacemaker VVIR with basic rate 70 imp/min.

according to the Simpson method - 64%. A final diagnosis was made based on life history, medical case history, and diagnostic findings: «Complete atrioventricular block. Arrhythmogenic cardiomyopathy». CAVB, identified at an early age in a child with a lag in physical and psychomotor development, was highly likely congenital. Due to the lack of structural abnormalities in the development of the heart and data for the autoimmune nature of arrhythmia, the idiopathic genesis of the development of CAVB was suggested.

According to existing recommendations for the management of patients with congenital CAVB, systolic left ventricular dysfunction and heart ventricular rate of 50 bpm or slower in this patient were standard criteria for pacing implantation [23]. Video-assisted thoracoscopic of epicardial pacing was chosen due to the low weight of the child and high trauma rate of open surgery.

Technique for surgical intervention

The procedure was performed using complex intra-tracheal anesthesia. Applying intravenous and inhalation anesthetics allows for achieving adequate anesthesia simultaneously and minimizing adverse effects of drugs. The patient was intubated with a single lumen endotracheal tube, which was sufficient to ensure adequate ventilation of the patient by capnography for a collapsed left lung. Three incisions were made: the first and the second at the anterior axillary line in the fourth and in the ninth intercostal space and in the 6th intercostal space at the medium axillary line, toracoports were installed through it, one of which serves for holding a video camera, and the rest for holding tools. The lung collapsed due to CO₂ insufflation. For visualization and access to the heart, pressure in the left pleural cavity was supported at the level of 10 mmHg. The pericardium was dissected longitudinally for 4 cm toward the front of n. phrenicus (Fig. 3). An epicardial bipolar lead (CapSure Epi 4968-25cm) was promoted via thoracoport. Polar of the lead was fixed in the nonvascular area of the anterior and anterolateral walls of the left ventricle with rare loop sutures. Pacing threshold was 0.5V at 0.4 ms, R-wave was 15mV, impedance was 1478 Ohm. The incision in the epicardial area was made. Connector part of leads was positioned in the epicardial area in approximately 1 cm below the xiphoid appendix. The pericardi-

um was sutured with rare loop sutures and thoracoscopic incisions - with single loop sutures. The tissue bed in the left rectus abdominis was formed for implantation of pacemaker Adapta ADSR01 with VVIR mode and basic rate 70 imp/min (Fig. 4). The postoperative period was without any complication. The patient discharged home on the 9th post-procedure day.

On ECG after surgery the rhythm from pacemaker VVIR with basic rate 70 imp/min was registered (Fig. 5). The 24-hour ambulatory ECG monitor reported an average heart rate of 84 bpm (minimum 70 bpm and maximum 142 bpm) in the daytime and an average heart rate of 71 bpm (minimum 70 bpm and maximum 91 bpm) in the night time, respectively. An average daily heart rate was 74 bpm.

During systematic pacemaker monitoring, the stable function of the device was noted: amplitude and resistance indicators were without negative dynamics, the battery charge was sufficient.

During the 1.8 year follow-up period of the child, indicators of the heart rate became normal, weight gain was sufficient, as of January 15, 2019 the weight and height of the girl was 108 cm and 18 kg, respectively. The child's physical activity increased, and there was an interest in outdoor games. Parents noted the improvement of the girl's psychoemotional status.

CONCLUSION

Minimally invasive thoracoscopic implantation of the epicardial pacemaker has several advantages compared with traditional method, such as shorter procedure time, reduced risk of blood loss, less postoperative pain, as well as better cosmetic effect. It can be assumed that the accumulation of experience of thoracoscopic implantation of the epicardial pacing in children, and collection of long-term follow-up data lead to a greater dissemination of this technique. In the future, the widespread use of the method will reduce the number of days spent in the hospital, which makes it economically feasible to prefer minimally invasive intervention to the traditional one with transthoracic access. This clinical case report demonstrates that thoracoscopic implantation of the pacemaker is the effective low-traumatic method of surgical correction of CAVB in children.

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