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## CASE REPORT

# Successful Implantation of Bipolar Epicardial Leads and Dual Chamber Pacemaker in Infant After Postoperative Atrioventricular Heart Block

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### ABSTRACT

Total atrioventricular (AV) block is inconvenient and serious complication of open heart surgery. Permanent total AV block requires the implantation of permanent pacemaker in order to allow normal hemodynamics and patient's survival. In infancy additional challenge is the surgical approach, the selection of electrodes and PM, as well as place of implantation. We are publishing case report of successful double-chamber DDD pacemaker implantation at an infant born with Fallot tetralogy and with low birth weight due to complete AV block after primary surgical correction of these congenital defects.

**Key words:** bipolar epicardial leads, dual chamber pacemaker, infants, postoperative atrioventricular heart block.

## 1. INTRODUCTION

The indication for permanent pacemaker therapy (PM) in neonates and infants is symptomatic bradycardia due to complete atrioventricular block (AV block). AV block may be congenital or acquired after open heart surgery (1, 2). It is important to take into account the particularities of the child's age as PM electrodes sometimes cannot be implanted transvenously due to the small blood vessels diameter and because of the real risk for stenosis or thrombosis (3). Congenital heart malformations with intracardiac shunts or limited access to the heart may exclude transvenous PM implantation. Implantation and follow-up of double-chamber PM in young children is more complex, atrioventricular synchronization with DDD stimulation in children with heart block can correct hemodynamics compared with single-chamber (VVI) PM (4). Long-term prognosis of children with congenital heart defect and AV block may be superior with the DDD PM (5). Implantation of DDD pacemaker in infants with low birth weight is more challenging compared to older children and adults. PM generator is typically large relative to the size of the child's body. The postoperative course may be complicated by the possible necrosis of the skin and subcutaneous tissue above the PM. We would like to report about the first successful implantation of DDD pacemaker to an infant in Bosnia and Herzegovina, born with Fallot tetralogy and with low birth weight due to complete AV block after primary cardiac correction of this birth defect.

## 2. CASE REPORT

A girl, was born with a congenital heart defect in form of Fallot Tetralogy. Her birth weight was 2.5 kg. Parents of a child after the diagnosis left the child in an orphanage. Par-

ents in the documents state that they do not have the ability to care for a sick child, given that this is their 11<sup>th</sup> child in the family. Ultrasound findings showed the typical clinical picture of Fallot tetralogy: a large sub aortal ventricular septal defect, riding aorta and stenosis of the RVOT as well as hypoplastic pulmonary valve. Peripheral saturation of a child was about 90%, with cyanosis when crying. After discussion with cardio surgical board, was set the indication for early surgical repair of congenital heart defect. At the age of 3 months, was made the primary, total correction of the VSD closure and transannular patch. To obtain more problem free early postoperative course was created so called monocuspid pulmonary valve. After declamping aorta during surgery, was registered a total AV block, with a slow pace. Separation from the extracorporeal circulation was duly passed with stable hemodynamics and DDD pacing through temporary epicardial electrodes that was placed on the right atrium and right ventricle. Control TTE show good postoperative results, without re-

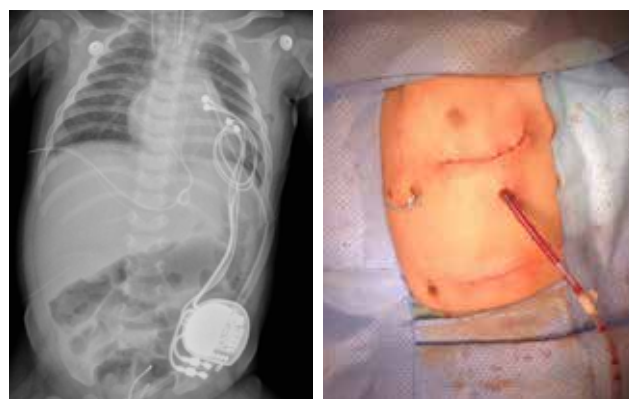


Figure 1. PM generator was implanted under skin left to the umbilicus

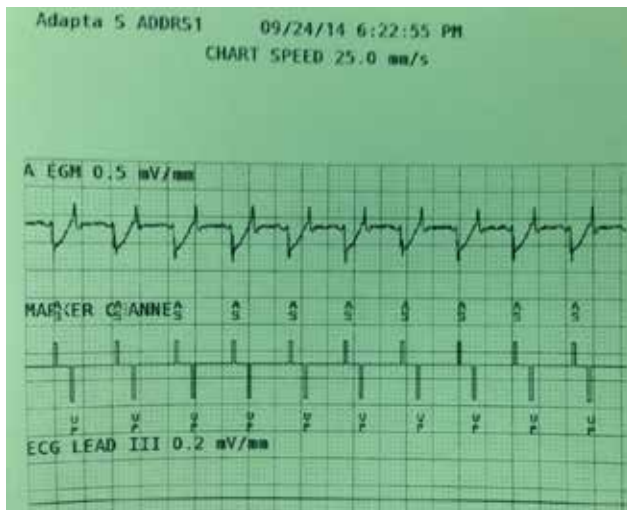


Figure 2. EGM from PM implantation  
sidual VSD and no signs of obstruction of the right ventricle outflow tract. The postoperative course was without complications, but with still present AV block that did not show signs of improvement. After 14 days of surgery was set the indication for permanent PM. The implantation of permanent PM was done 14 days after the surgery. On the day of PM implantation child's body weight was 4.3 kg.

### 2.1. Implantation procedure

Surgery was performed under general anesthesia. Surgical access was left anterolateral thoracotomy, through 4th intercostal space. The pericardium were incised vertically anterior to the phrenic nerve, two pacing leads were separately attached to left atrial appendage and left ventricular lateral wall. After all the parameters were detected to be satisfactory, a pouch was made at left side of abdomen under costal margin. PM was connected with epicardial steroid-eluting atrial and ventricular leads (Medtronic CapSure Epi 4986) through subcutaneous tunnels. PM generator was implanted under skin left to the umbilicus (Figure 1). Dual chamber pacemaker, Metronic Adapta S (Medtronic, Inc, Minneapolis, MN) was selected because of small size and low body weight of the infant. Atrial sensing was 3.1mV, and the atrial lead pacing threshold was 0.250V@0.40ms, with lead impedance 755  $\Omega$ , ventricular sensing was 8mV with ventricular lead pacing threshold 0.350mV@0.40ms and ventricular lead impedance 735 $\Omega$ . After the first day of implantation the infant was hemodynamic unstable with acute heart failure, and it was necessary to correct medical therapy and the PM parameters. Postoperatively, there were no problems with wound healing or skin necrosis. After that infant had an uneventful postoperative recovery and the PM function was monitored twice weekly and the implanted lead remained stable (Figure 2). After six months of follow up period the infant was in clinically good condition, body weight was 6,2 kg, with stabile rhythm and following PM parameters (DDD AS-VP, P-wave sensing was 4mV, atrial lead impedance 524 $\Omega$  and ventricular lead pacing threshold 0.350mV@0.40ms, ventricular lead impedance 649 $\Omega$  and estimated PM generator life time of 6,5 years.

### 3. DISCUSSION

Surgical procedures on the open heart which require the closure of the ventricular septal defect (VSD) have a signifi-

cant risk of postoperative AV block due to iatrogenic injury of the conduction system. Because of the great advances in surgical technique, during time incidence of AV block was reduced from 10% to 1-3% in the modern era in large surgical centers. If not treated with the implantation of PM, permanent heart block is responsible for 28-100% deaths ii. The efficiency and benefit from implantation of permanent PM is well known, as well as surgical techniques, but there are more problems associated with PM implantation PM in infants. Traditionally, transvenous electrodes with the subsequent RV pacing were the preferred mode of stimulation, not only for adults but also for children ii. However, this approach in young children and infants, who require lifelong pacing, is potentially very dangerous due to probable extraction of the electrode in the future, their replacement as well as possible vena cava thrombosis and obstruction.

The new type of electrode (Medtronic CapSure Epi 4986) with steroidal type of electrodes maintains a stable pacing and sensing in these patients. We chose Capsure EPI electrodes for the infant due to ability to maintain a low threshold voltage and stable resistances. Careful placing of epicardial electrodes and a sufficient length of the electrodes are essential in infants due to their rapid growth as compared to adults. The excess length of the electrodes enables their proportional retraction and adjustment during the growth of the child. Evidence suggests the emergence of dilated cardiomyopathy in infants associated with dual chamber pacemakers and electrodes on the right heart, which is repaired after the implantation of electrodes in the left heart. Left atrium and left ventricle are recommended as the first choice and localization for routine epicardial electrodes in infants for the better hemodynamics and prevention of dyschrony, ventricular remodeling and cardiac dysfunction (6-8).

**CONFLICT OF INTERESTS: NONE DECLARED.**

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