Case report - Congenital

Intra-diaphragmatic pacemaker implantation in very low weight premature neonate

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Abstract

Implantation of a pacemaker (PM) in very low weight premature neonates can be a challenging procedure because of the actual dimension of generators. Ideal placement of the PM is still controversial. We describe a technique of intra-diaphragmatic PM implantation in a 1.3 kg neonate.

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1. Introduction

Early pacing strategy is mandatory in congenital complete heart block (CCHB) when prenatal hydrops, low ventricular rate (<45 beats/min), low birth weight retardation or ventricular dysfunction is present [1].

Implantation of a pacemaker (PM) in very low weight premature neonates can be a challenging procedure because of the actual dimension of generators. Ideal placement of the PM is still controversial. We describe a technique of intra-diaphragmatic PM implantation.

2. Case report

CCHB was diagnosed prenatally at gestational age of 24 weeks. There was no clinical sign of maternal connective tissue disease but anti-Ro/SS-A and anti-La/SS-B were positive. Oral corticosteroid therapy was given until delivery without improvement of heart rate.

Elective caesarean was performed at 32 weeks of gestation for moderate foetal hydrops and low ventricular rate. Birth weight was 1300 g. The neonate had mild hydrops and mild skin oedema. Mean ventricular rate was 40–50 beats/min. Echocardiography showed normal intracardiac anatomy, moderate left ventricular dysfunction and a small circumferential pericardial effusion.

There was no significant increase in heart rate in response to either atropine or isoproterenol; the mild ventricular dysfunction and the presence of alarming signs of low output syndrome indicated the necessity of ventricular pacing. The patient was taken to the operating room on day 2 for a single-chamber VVI PM implantation.

A 25 cm bipolar steroid-eluting epicardial pacing lead (CapSure Epi 4968; Medtronic, Minneapolis, Minnesota) was placed on the right ventricular free wall through a median sternotomy. The PM (Microny II SR+; St Jude Medical, Sylmar, California) was placed in an intradiaphragmatic pocket within the diaphragm layers, between the parietal pericardium and the diaphragmatic muscle (Fig. 1).

The lead was fixed using the sleeve with non-absorbable sutures to the upper part of the diaphragm in order to fix the device and to avoid any mobilisation which could compromise the IVC flow. The lead was then looped in the right pleural cavity, which was intentionally opened, in order to avoid any coronary compression. The PM rate was programmed at 120 bpm.

Mechanical ventilation was required until the 5th day of life. There was no perioperative complications related to PM implantation. Especially, there were no mechanical respiratory problems and no phrenic nerve paralysis. The chest X-ray after extubation was normal.

Values of ventricular lead impedances, as well as sensing and pacing thresholds were obtained and stable at the implantation time and at six months postoperatively.

3. Comment

When an early pacing strategy is mandatory in very small neonate, a staged pacing strategy can be an alternative. Temporary epicardial pacing wires are used during 1–3 months, until the body weight reaches 2 kg for PM implantation. However, increasing threshold before sufficient growth, pericardial adhesions and risk of sepsis of the transcutaneous leads can be a matter of concern [1].
On the other hand, various sites have been reported for implantation of a primary permanent PM in children. Historically, the ventricular epicardial electrodes were inserted through a left thoracotomy or sternotomy and a second incision was used to place the PM. Generators placed beneath both rectus muscles required a large abdominal incision [2]. In case of preperitoneal implantation, ileus, hernia, wound dehiscence and infections have been reported [3]. When the devices were placed intraperitoneally in the abdominal cavity, the risk of dislocation and gut injury have been also reported [4]. Disadvantage of the retroperitoneal approach was the difficulty to resuscitate these small neonates in any cardiac arrest situation due to lateral decubitus position. Extraperitoneal technique has the advantages of a unique incision for lead and generator implantation, and has been used in neonates with a body weight as low as 1.8 kg [3]. The only restriction of this technique is the possible impairment of respiratory function in very low body weight. Recently, defibrillators have been positioned within the diaphragm layers in a horizontal position underneath the heart to optimize the electrical pathway [5]. Results were satisfactory for children over three years old.

According to our experience, the intra-diaphragmatic approach has the advantages of unique incision for lead and device implantation, allowing good protection of the device from traumatic injury. It avoids wound complications. Care must be taken not to implant the PM too close to the inferior vena cava (IVC) in order to avoid any compression. Bipolar steroid-eluting epicardial pacing leads have been chosen because they show stable long-term pacing and sensing characteristics [6]. Dual-chamber pacing (DDD mode) allows sinus node responsiveness and maintains physiologic atrioventricular synchrony but requires a larger device and two epicardial leads (atrial and ventricular). Concern about technical difficulties was anticipated in such a small premature neonate and VVI pacing with this 12.8 g device was favoured. Up to now, there has been no need to change the device, however if needed, it would be easy and safe to access the device through a subxiphoid approach.

4. Conclusion

We believe that this technique is easily applicable even in very low birth weight neonates and can avoid many complications that have been already reported with other PM implantation techniques.

References


eComment: Re: Intra-diaphragmatic pacemaker implantation in very low weight premature neonate

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The article is dedicated to intra-diaphragmatic pacemaker (PM) implantation in a very low weight premature neonate [1]. The leads were implanted epicardially. In the literature there are no analogue PM implantation in such a low weight premature neonate.

As from our experience neonate without co-existing pathology and rhythm > 80 beats/min are doing well up to five years. But low weight premature neonate, especially with rhythm < 50 beats/min or with co-existing heart pathology are suffering from such a low rhythm. The same is true for the neonates after congenital heart surgery when complete heart block is a surgical complication. PM implantation in such group of neonates has no strong recommendations for leads implantation (epicardial or endocardial placement). In particular Cohen et al. [2] had successfully implanted 60 epicardial leads and PMs to children with congenital complete heart block.

Subsequent improvements of PMs and leads did not change the appearance of the surgical technique.

We have implanted 15 PMs in neonates, including 75% of dual-chamber PM in neonates with different co-existing pathologies. We have used classical implantation technique of the device in the abdominal wall even in neonates of < 2000 g.

Bakhitiary et al. [3] described their experience of 21 implanted PMs; 15 of them were dual-chamber and neonates (average weight was 3120 ± 230 g). All PMs were implanted in the abdominal wall.

Antretter et al. [4] described the successful single-chamber PM implantation in a neonate with endocardial lead via the left subclavian vein. The PM was implanted under m. pectoralis major. Operation and postoperative period were without complication. PM pocket was performed intramuscularly or under the muscle (depending on implantation place).
The surgical technique described in this article has a particular interest as it is new and non-standard.

References


