Intraoperative pacemaker failure in an infant

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Pacemakers in children can present clinical challenges during surgery. We present a case report of an infant whose pacemaker reverted to a backup mode when electrocautery was used during surgery. The resulting bradycardia did not respond either to a magnet placed over the generator or to iv atropine. The circulation was supported by isoproterenol until the pacemaker was re-programmed by the manufacturer. Such devices require care and understanding if problems during surgery are to be avoided.

De graves problèmes peuvent survenir chez un enfant porteur d'un stimulateur cardiaque pendant une intervention chirurgicale. Nous avons vu un de ces stimulateurs se convertir en mode lent lors de l'usage de l'électro-cautère. La bradycardie qui s'ensuivit persista malgré l'injection d'atropine et l'utilisation d'un aimant au dessus du stimulateur. Nous avons dû temporiser avec de l'isoprotérénol en attendant que le fabricant reprogramme l'appareil. Si on veut s'éviter de graves problèmes, mieux vaut bien connaître et bien traiter les stimulateurs cardiaques.

We report a type of pacemaker failure occurring in an infant undergoing major abdominal and thoracic surgical procedures. The combination of a relatively slow back-up mode, use of monopolar electrocautery and a lack of familiarity with this pacemaker led to a need for isoproterenol support while awaiting reprogramming.

Case report

The patient was a 9-mo-old, 4 kg infant who had previously undergone repair of oesophageal atresia with tracheoesophageal fistula shortly after birth and repair of VSD at two months of age. She had an oesophageal stricture and gastroesophageal reflux which lead to transfer to our institution for operative repair. The VSD

repair had resulted in complete heart block which required a unipolar pacemaker (Intermedics Nova II, Model 281-05, Charlotte, North Carolina). She had also suffered a severe scalp IV infiltration with skin necrosis. Her initial operation at our centre was for placement of a Broviac catheter and debridement of the scalp wound. A standard monopolar electrocautery was used without incident.

Two weeks later, she returned to the operating room for Nissen fundoplication and gastrostomy. Noninvasive blood pressure, lead II ECG, and pulse oximetry were placed prior to induction of anaesthesia. The ECG documented appropriate pacemaker function with all paced beats at a rate of 125 bpm. The blood pressure was 110/50. Following rapid sequence induction of anaesthesia and relaxation with tracheal intubation, anaesthesia was maintained with isoflurane and relaxation with pancuronium. Because blood loss with this procedure was not anticipated to be very great, electrocautery was not used in order to avoid pacemaker complications. The operative procedure was initially uneventful, but passage of the dilator produced an oesophageal perforation. The patient remained haemodynamically stable during completion of the abdominal procedure.

In preparation for the oesophageal repair, an arterial line was placed, and the patient was turned to the lateral decubitus position with the grounding pad for the electrocautery on the patient's lower back. As the electrocautery had been used without incident for scalp debridement, it was used again during the thoracotomy to repair the perforation. Initially, pacemaker function was inhibited by bursts of cautery, but function returned after its discontinuation. Following one prolonged burst, pacemaker function returned at a rate of 75 bpm. A magnet was applied over the generator but without effect. Atropine also had no effect. Blood pressure and urine output remained adequate during the remainder of the procedure in spite of the relative bradycardia.

Following surgery, the patient was taken to the paediatric intensive care unit. A representative of Intermedics was called to reprogram the pacemaker. Isoproterenol was used while awaiting reprogramming, as capillary refill became prolonged and urine output fell in spite of fluid boluses shortly after arrival in the intensive care unit. Maximal heart rate achieved with isoproterenol was 99 bpm. Once the pacemaker was reprogrammed to 125 bpm, the patient's haemodynamic status stabilized, and isoproterenol was discontinued.

Key words

ANAESTHESIA: paediatric;

HEART: pacemakers, artificial.

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Discussion

Intraoperative pacemaker complications associated with surgical electrocautery have been recognized for many years,¹⁻⁶ but remain a source of confusion for anaesthetists and surgeons. It is recognized that the use of electrocautery can temporarily inhibit the pulse generator or cause the generator to revert briefly to asynchronous pacing. When the surgeon stops using the electrocautery, the generator should return to normal function. This is what we observed with the initial use of the electrocautery in short bursts, and it was well-tolerated by the patient.

Some pacemakers have sensing circuits that can detect defects with the primary program and activate a default or back-up mechanism. The back-up system is designed to protect the circuitry from damage due to exposure to electrocautery, defibrillation, or component failure. The Intermedics Nova II pulse generator reverts to its back-up rate of 75 bpm if pacing and sensing events are absent for 2½ secs.* Except in the case of component failure, the pulse generator can only be returned to normal function by reprogramming. Placing a magnet over the generator will not alter the rate. This has previously been reported as a complication in an adult patient undergoing surgery.⁵

The very small infant is more dependent than an adult on a high heart rate to maintain adequate cardiac output, and the default rate may be inadequate. In our patient, a rate of 75 bpm maintained adequate perfusion for 90 min but was not well-tolerated after that. Because our institution did not routinely use the Intermedics® pacemakers, the programmer was not readily available. Isoproterenol was used to temporize but was unable to raise the heart rate above 100 bpm. Other alternatives considered were the use of a transcutaneous pacemaker or a transvenous pacemaker. Both would have allowed an increase in heart rate above that generated by the isoproterenol if perfusion and cardiac output had not been sufficient.

When electrocautery is needed in a patient with a pacemaker, the bipolar type is generally preferable. These minimize the ambient field around the probe, which decreases the risk of interference with the pacing system.⁶ Unfortunately, bipolar electrocautery is not as effective as unipolar electrocautery for haemostatic division of muscle in situations such as the infant thoracotomy. As the previous use of unipolar cautery was uneventful in this infant, it was decided to use it again to decrease blood loss and operative time. Had the peculiarities of this particular pacemaker been known, cautery burst times could have been limited to less than the 2½-sec threshold. When unipolar cautery is necessary, special care should be taken in positioning the grounding pad. It should be placed as far from the generator as possible such that the electrical

pathway between the cautery probe and the grounding pad is directed away from the pacemaker.^{6,7} The grounding pad was placed on the back of this patient while the generator was in the lower abdomen. In the small infant, distances between the generator, grounding pad, and incision may be very short, which increases the possibility of interference.

In the present case, selection of the pacemaker had been made previously. However, a pacemaker which reverts to a back-up mode with cautery may not be the best choice in an infant with multiple problems who is likely to need further operative therapy. Furthermore, a back-up rate of 75 bpm may be insufficient to maintain adequate perfusion in such a small infant.

Patients or parents of paediatric patients should carry information regarding their type of pacemaker. Anaesthetists and surgeons should understand the particular model before surgery. The most reliable and accurate source of information may be the company representatives who are normally available 24 hr a day to answer questions. Anticipation of intraoperative problems and availability of alternative methods of pacing may avert a serious problem.

Summary

We present an infant in whom surgical electrocautery caused a permanent pacemaker to revert to a back-up rate of 75 bpm. This slow rate was insufficient to maintain an adequate cardiac output. A knowledge of the effects of electrocautery on this model of pacemaker might have averted a potentially dangerous complication.

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*Nova 11, Model 281-05, Intermedics Cardiac Pulse Generator Physician's Manual.