PACEMAKER-INDUCED TACHYCARDIA DURING GENERAL ANAESTHESIA: A CASE REPORT

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During recent years, rate-responsive pacemakers have been introduced in order to improve the patient's circulatory adjustment to situations of stress. The common feature in these pacemakers is an increase in pacing rate in response to an increased demand such as exercise.

In rate-responsive pacemakers, various physiological variables (e.g. rate of ventilation, muscle movement, QT interval, temperature, oxygen saturation or pH in mixed venous blood) are used to adjust pacing rate [1]. However, these may demonstrate unexpected episodes of malfunction in uncommon situations (e.g. general anaesthesia) [2,3]. In this case report we describe the untoward function of a new type of rate-responsive pacemaker (META MV 1202, Telectronics) caused by inadequate knowledge of its mode of action.

CASE HISTORY
A 76-year-old man was admitted to hospital for transurethral resection of the prostate. One month earlier, he had suffered from syncope. ECG showed complete heart block (3° AV block) with a heart rate of 30 beat min⁻¹. He had no previous cardiopulmonary complaints and was not receiving medication. He was in good physical condition, and a rate-responsive pacemaker was implanted to treat the slow heart rate.

The pacemaker was set to pace at 70–115 beat min⁻¹. Within this interval, the pacing rate depended on the pulmonary ventilation, which was calculated by measurement of changes in thoracic impedance using a low energy pulse (1 mA for 15 μs at 20 Hz) between the pacing electrode and the pulse generator. Transthoracic impedance increases with inspiration and decreases with expiration; the amplitude reflects tidal volume. Changes in tidal volume or rate of ventilation which cause a change in ventilatory minute ventilation induce changes in pacing rate [4].

At the first follow-up after the implantation, the patient performed a bicycle ergometer test. At rest, pacing rate was 70 beat min⁻¹ and rate of ventilation was 12 b.p.m. At maximal exercise (80 W) the pacing rate was 115 beat min⁻¹ and the rate of ventilation had increased to 22 b.p.m.

At preoperative physical examination, ECG demonstrated 100% pacing at 70 beat min⁻¹. Serum electrolyte and haemoglobin concentrations were within normal limits. The patient was premedicated with diazepam 10 mg orally 4 h before general anaesthesia. Arterial pressure was 140/95 mm Hg. No particular test or investigation of the pacemaker was performed before the operation.

Anaesthesia was induced with midazolam 2.5 mg and thiopentone 200 mg i.v. After a supplement of midazolam 2.5 mg and fentanyl 0.15 mg i.v., neuromuscular block was achieved with gallamine 20 mg and suxamethonium 100 mg to facilitate tracheal intubation. Assisted manual ventilation of the lungs was given.

SUMMARY
Pacemakers with a rate-responsive function, based on calculation of ventilatory minute volume, may induce tachycardia in patients who undergo hyperventilation during general anaesthesia. If hyperventilation is desired, it is recommended that the pacemaker is reprogrammed in order to avoid tachycardia. If the programming device is not available, a magnet may be placed over the pacemaker site to convert it to fixed-rate pacing.
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with 50% nitrous oxide in oxygen 6 litre min⁻¹, via a modified Mapleson D system (Hafnia D). A few minutes after intubation, an increase was noted in the paced heart rate (Diascope, S&W). The patient showed no clinical signs of inadequate anaesthesia, but the paced heart rate continued to increase to 115 beat min⁻¹, so repeated doses of fentanyl and thiopentone were given. Arterial pressure declined from 170/110 mm Hg immediately after intubation, to 90/50 mm Hg at the maximal heart rate of 115 beat min⁻¹ 35 min after tracheal intubation. There was no accurate measurement of blood loss, but it was thought to be insignificant. However, because of the progressive hypotension, one unit of blood was given. The manual ventilation was reduced incidentally, and there was a slowing of paced heart rate from 110 to 70 beat min⁻¹.

During the remainder of surgery, heart rate was 70 beat min⁻¹, arterial pressure increased steadily from 95/50 mm Hg to 120/70 mm Hg, and no further supplements of i.v. anaesthetics were given. The patient recovered slowly, with inadequate spontaneous breathing, but this improved after naloxone 0.2 mg i.v. After operation the patient's cardiopulmonary condition was stable.

DISCUSSION

There have been several reports of malfunction or unexpected modes of action of pacemakers [2, 3]. The increasing number of advanced pacemakers has made this subject more relevant to anaesthetists [5].

In recent years, pacemakers have been developed to adjust the pacing rate according to the patient's level of activity, in order to obtain a more physiological response to exercise [6]. During exercise, there is an increase in cardiac output, preload and myocardial contractility [7].

Various activity detecting systems have been developed to create a reliable rate-responsive pacemaker (e.g. by monitoring muscle movement, rate of ventilation, temperature, or the QT interval). During periods of rest, most of the rate-responsive pacemakers pace at a pre-set basic rate, usually because these patients have absent or very slow spontaneous heart rate. At operation, the ECG of these patients displays a regular paced heart rate, and most attention is directed towards pacing failure caused by electrocautery, which is the most common cause of disturbance [3, 5].

In this case history an unexpected paced tachycardia occurred. This was interpreted as inadequate anaesthesia, and repeated doses of i.v. anaesthetic were given, without effect on the tachycardia. There was a decrease in arterial pressure, caused presumably by increments of thiopentone and fentanyl [8].

The decision to transfuse blood was accompanied by a slowing of the heart rate and a concomitant reduction in manual ventilation associated with the anaesthetist setting up the i.v. infusion.

This case report illustrates the importance of understanding the principles governing the function of a pacemaker. Patients with rate-responsive pacemakers which respond to changes in ventilation should undergo mechanical ventilation during anaesthesia in order to avoid inadvertent hyperventilation. When deliberate hyperventilation is utilized (e.g. in neurosurgery), it is suggested that the pacemaker be reprogrammed to exclude the rate-responsive function. In many situations it may be difficult to obtain access to the programming device and in this case a magnet may be placed over the pacemaker to obtain a temporary reduction in pacing rate. (The META MV 1202 delivers a pacing rate of 99 beat min⁻¹.)

REFERENCES