Case Reports

Apparent Pacemaker Failure Caused by Activation of Ventricular Threshold Test by a Magnetic Instrument Mat During General Anaesthesia

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Summary

A patient with a permanent pacemaker underwent radical neck dissection. After induction of anaesthesia, a magnetic surgical instrument mat was placed over the patient's chest. This caused the pacemaker to go into a threshold test which included a 2.5-s period of asystole. Surgery had to be abandoned temporarily. We suggest that magnetic instrument mats should not be used with pacemaker patients; not all pacemakers are converted to a fixed magnetic rate by application of a magnet. The anaesthetist should check to see if the patient has a pacemaker with a threshold test and, if possible, this should be rendered inactive.

Key Words


Case Report

An 82-yr-old man was admitted to hospital for radical right neck dissection of a metastasized carcinoma of the tongue. He had previously had a pacemaker implanted in October 1983 for complete heart block. The pacemaker was changed in April 1987 for a Siemens-Elema 688 which was programmed VVI at a demand rate of 70 beat min⁻¹. He remained asymptomatic, with normal exercise tolerance, without medication. The pacemaker was checked regularly. In March 1991, he presented with a squamous cell carcinoma of the tongue and underwent two uneventful anaesthetics for insertion and removal of irridium wires.

The patient was reviewed before operation by a cardiologist; a recent pacemaker check had shown no abnormality. History and examination were unremarkable. Full blood count, serum urea and electrolyte concentrations, and ECG were within normal limits. Premedication comprised morphine 5 mg and atropine 0.4 mg. 22-Gauge radial arterial and 16-gauge venous cannulae were inserted and ECG, end-tidal carbon dioxide and arterial oxygen saturation monitored (Datex Cardiocap). Anaesthesia was induced with thiopentone 200 mg and morphine 5 mg followed by atracurium 50 mg. The trachea was intubated with a 9.0-mm tracheal tube and the lungs ventilated with a Nuffield Penlon 200 ventilator via a Mapleson D (Bain) breathing system with nitrous oxide and 1% isoflurane in oxygen. Unknown to the anaesthetist, a magnetic surgical instrument mat (Applied Research Ltd) was placed over the patient's left chest. Before surgery could begin, an abnormal rhythm appeared on the ECG (fig. 1). From a paced rhythm of 70 beat min⁻¹ the pacemaker increased to 99 beat min⁻¹ for 16 beats and then to 119 beat min⁻¹ for 11 beats, became asystolic for 2.5 s and then repeated the cycle. During the asystolic period, there was no cardiac output evident from the arterial pressure recording. Several episodes of bradycardia were noted also. The sudden onset of this rhythm caused the anaesthetist to abandon surgery; the patient was de-towelled and normal paced rhythm returned. At this time, the magnetic mat was brought to the attention of the anaesthetist. A cardiologist was consulted and he rechecked pacemaker function. Surgery then proceeded uneventfully without the mat in place.

Discussion

The dangers of using magnetic instrument mats on patients with a pacemaker have not been reported previously.

The application of a magnet to permanent pacemakers does not always result in the pacemaker going into a fixed rate, as is commonly thought [1]. As noted previously [2–4], it is essential that anaesthetists understand exactly what type of pacemaker a patient has and what pacing modes they may expect.

Usually, a programmer is needed to test the stimulation threshold of most programmable pacemakers. In order to determine the stimulation threshold that captures the myocardium, the output voltage is reduced gradually until capture is lost. This threshold is a test of the integrity of the pacing lead and the electrode–myocardial interface and it may be influenced by cellular factors, such as serum

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FIG. 1. ECG leads 1, 2 and 3. The 16 pulses of the threshold test start from ▲. There is loss of capture at pulse 4. After the O-V pulse, the rhythm returns to 16 pulses at the magnetic rate of 99 beat min⁻¹.

potassium concentration [5, 6], oxygen partial pressure [7], acid-base status [8], antiarrhythmic agents [9] and physical factors such as lead and insulation fracture in addition to oedema and tissue growth around the electrode which can be modified by defibrillation [10, 11], surgical diathermy [12] and myocardial infarction. However, in all Siemens programmable pacemakers and in the older versions of Telecronic pacemakers (Optima MP and MPT), the threshold function mode may be activated by a normal magnet unless this function has been programmed to be inactive. The reason for this is to allow the pacemaker threshold to be checked in the absence of a programmer, as may be the case in less sophisticated clinics.

When a magnet is placed near the pacemaker of a Siemens model, the “Vario” cyclic test sequence occurs (Siemens–Elema 688 Manual). This comprises a battery test phase (as seen in all other pacemakers) and a threshold test phase, and this sequence is repeated for as long as the magnet is present. The battery phase consists of 16 pulses with constant amplitude at 99 beat min⁻¹, followed immediately by the threshold test in which the amplitude of the pulses is reduced gradually in 15 steps from the maximal programmed amplitude to zero. The rate is 119 beat min⁻¹ and the test is terminated by the O-V pulse. The programmed amplitudes can be 10, 5 or 2.5 V, with the smallest voltage giving the longest battery life of up to 18 yr.

Unfortunately, no ECG recordings were made during operation, therefore the patient was rechallenged with the magnet in the pacemaker clinic (fig. 1). The stimulation threshold was calculated at 1.33 V (the maximal amplitude was 5 V), which is obviously fairly small, but if the stimulation threshold had been substantially greater, the period of asystole would have been prolonged and may have led to significant cerebral ischaemia.

The episodes of bradycardia noted in our patient are more difficult to explain and could not be reproduced on rechallenging. However, it has been described that waving of a magnet over some VVI pacemakers can cause prolonged inhibition as a result of changing magnetic fields which are sensed, with consequent inhibition of pacemaker output [13].

REFERENCES