OH'S INTENSIVE CARE MANUAL

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NINTH EDITION

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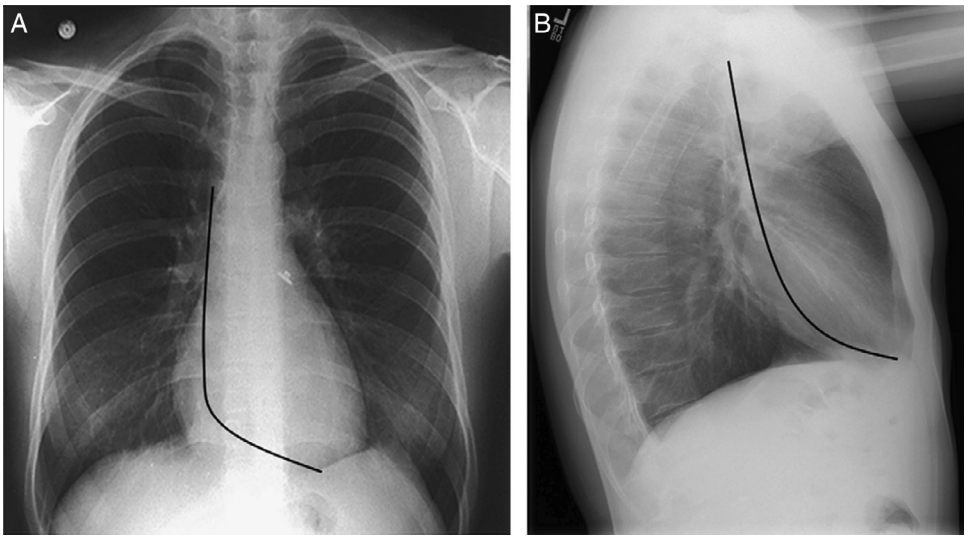

Fig. 32.6 Posteroanterior (A) and lateral (B) chest radiographs, with a line that diagrams the expected course of a right ventricular apical pacemaker lead. *(Reproduced with permission from Belvin D, Hirschl D, Jain VR, et al. Chest radiographs are valuable in demonstrating clinically significant pacemaker complications that require reoperation.* Can Assoc Radiol J. *2011;62(4):290, Figure 1. Copyright Elsevier.)*

that will need long-term temporary transvenous pacing (e.g. due to concomitant infection), an active-fixation lead inserted through the skin and connected to an external pacemaker should be considered (the so-called 'temporary-permanent system' or 'externalised pacemaker')[38] (Fig. 32.7). After a short period of observation, the patient can be mobile and lead displacement and threshold rise are rare, meaning the need for the lead repositioning is also rare. The device can be reprogrammed just like any other permanent pacemaker, and the percentage of time that the patient is pacing, or detection of intermittent arrhythmias, can be recorded so where appropriate, a decision to permanently pace or provide other treatment can be made. If the patient does not need a permanent system, removal of the temporary-permanent system is straightforward.

TESTING THE PACING LEADS

Modern external pacing boxes are available (Fig. 32.8) that will pace in all modes. These units are small, easy to use and can fit into a small pouch suitable for mobile patients. Furthermore, they can perform checks of pacing threshold and sensing.

1. **Pacing threshold:** It is the minimum energy required to be delivered by the pacing system to achieve electrical capture.

- Set the pacemaker rate at least 10 beats per minute (bpm) faster than the intrinsic heart rate, or at 60 bpm if the patient has a profound bradycardia.
- Set the pacing output at 5 V.
- Confirm ventricular capture (pacing spike immediately followed by a broad QRS at the same rate as that set on the box).
- Decrease the output slowly until capture is lost (pacing spike no longer followed by a broad QRS). This is the pacing threshold and ideally should be less than 1 V.
- Set the output to three times the pacing threshold to allow sufficient safety margin, or at least 3 V.

In those with no underlying rhythm or profound bradycardia, loss of capture will lead to asystole – in which case the output should be rapidly increased until capture returns.

2. **Pacing sensitivity/sensing**

Sensitivity, or sensing, refers to the amplitude of the sensed electrograms. Large electrograms are easy to sense and small ones are not and undersensing may occur.

- Set the pacemaker rate at least 10 bpm slower than the intrinsic heart rate (not possible if extremely slow underlying rhythm or asystole).
- Set the pacing sensitivity at 1mV and the pacing output to the lowest to avoid pacing on the T wave.
- Confirm ventricular sensing (flashing light on the pacing box and no spikes should be seen).
- Increase the sensitivity number (>1 mV) until you see a pacing spike/failure of sensing. This represents the sensitivity threshold of the sensed electrograms.

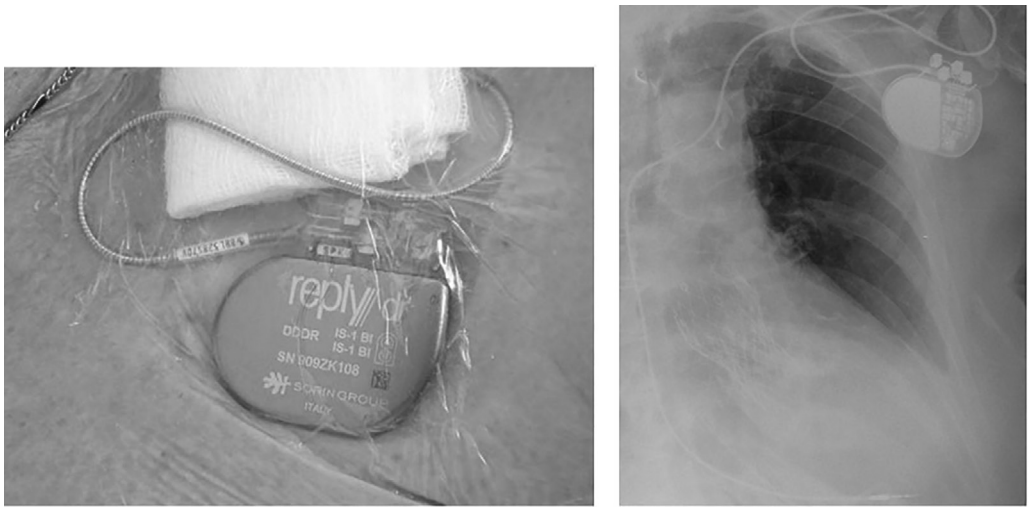

Fig. 32.7 Active-fixation lead is connected to a reusable generator secured to the skin with a large occlusive dressing to maintain sterility (A). Chest radiography showing the position of the pacing lead. The active-fixation screw mechanism and the CoreValve are visible (B). *(Reproduced with permission from Cuisset T, Quilici J. Subclavicular screwed wire transient pacing to increase safety of transcatheter aortic valve implantation with the CoreValve system.* J Cardiol Cases. *2011;3(3):e168, Figures 1 and 2.)*

Fig. 32.8 Temporary pacing systems. Medtronic, Inc. (i) Model 5388 (dual-chamber); (ii) model 5348 (single-chamber).

- Set the sensitivity to a half to a third of the sensitivity threshold, to allow continuous sensing of all intrinsic signals (e.g. if it senses at 8 mV, set it at 4 mV or less).
- Do not forget to increase the pacing output.

PACEMAKER PROGRAMMING

Multiple parameters can be programmed on temporary and permanent pacing systems. All pacing practitioners, and this includes physicians who implant temporary systems, should be familiar with programming the mode, rate, pacing output and sensitivity of a pacing system. In addition, they should also be able to diagnose and troubleshoot basic pacing problems like undersensing and oversensing. If dual-chamber pacing systems are used, programming the AV delay should be performed to optimise cardiac output and cardiac function (using echocardiographic guidance). Programming permanent pacing systems is more complicated than for temporary systems and should be performed only by individuals qualified to do so.

TROUBLESHOOTING

The incidence of pacing system malfunction is difficult to determine due to inconsistent definitions and the lack of any comprehensive reporting mechanism or registry.[39] The malfunctions discussed here will be limited to those that are manifest on an electrocardiogram rhythm strip.

1. Pacing stimuli present with loss of capture

Loss of capture is the failure of the pacemaker stimulus to produce electrical activation of the heart and a subsequent cardiac contraction. The diagnosis of loss of capture is based upon the presence of a pacing stimulus, without a subsequent P wave or QRS complex (Fig. 32.9). The result can be asystole or bradycardia, depending on the patient's underlying rhythm.

Causes: increase in pacing threshold above programmed value; lead dislodgement or malposition;

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