Case reports

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P wave triggered permanent atrial pacing in a case of transient sinus arrest

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P wave triggered permanent atrial pacing has been used to treat either transient sinoatrial block or sinus arrest in patients with normal atrioventricular conduction.

This method requires a normal 'on demand' pacemaker connecting with an atrial electrode only, and limits intervention into the physiological function of the heart.

Atrial pacing has been used for the treatment of patients with supraventricular and ventricular arrhythmias when atrioventricular conduction is normal (Heiman and Helwig, 1966; Moss *et al.*, 1968; Kastor *et al.*, 1967). An intra-ventricular electrode is usually used because of the difficulty in maintaining permanent contact transvenously with the atrium, though successful long-term pacing of this type has been reported (DeSanctis *et al.*, 1968). We report here the application of long-term transvenous atrial demand pacing in a patient with transient sinus arrest.

Case report

A 57-year-old woman was admitted to the 4th Clinic of Internal Diseases, Medical Academy, in Warsaw in January 1970 because of recurrent, abortive MAS attacks caused either by sinus arrest or by sinoatrial block. These attacks had first occurred two years previously, lasted usually several seconds and had been related to physical effort or anginal pain. Electrocardiograms taken between attacks had shown sinus bradycardia with periodic sinus arrest, which the patient had perceived as presyncopal state (Fig. 1). She had been an outpatient of the Institute of Cardiology for a year and had been treated with coronary dilators to no avail.

Just before being admitted to hospital the attacks became more frequent, so that the slightest physical efforts were precluded. There were no signs of circulatory failure and apart from the frequent attacks the patient led a normal, active life. On admission, the patient had a number of short and prolonged MAS attacks due to an inhibition of the sinus node with delayed appearance of a 30/min nodal rhythm. Blood pressure

was 80/60 mmHg, there was peripheral cyanosis, and she complained of acute praecordial pain, radiating to the arm.

After the introduction of a bipolar electrode into the oesophagus, atrial pacing was started (Sadowski and Stopczyk, 1972). Impulses were 100 per cent efficient at 13 volts. The condition rapidly improved, pain and cyanosis subsided, and blood pressure returned to normal. After 90 minutes of pacing a return to sinus rhythm at a rate of 56/min was observed.

During the period in hospital such episodes recurred many times, with periods of a nodal rhythm of up to 60/min between them. Physical examination and laboratory tests performed between attacks showed no abnormal findings. In addition the cardiac silhouette was normal on the chest x-ray.

As pharmacotherapy had proved unsuccessful, artificial pacing seemed indicated. The mode of pacing was chosen according to the rules given above. To assess atrioventricular conduction, the effective atrioventricular nodal refractory period was measured with the use of oesophageal paired atrial pacing and conduction was normal. A unipolar Elema EMT 588 electrode was then introduced through the external carotid vein into the right atrium. This was performed under local anesthesia and fluoroscopic control. A wire loop was left in the atrium so that elasticity of the wire would enhance fixation of the electrode tip.

The electrode was left in a place where P wave voltage was about 5 mV and the threshold for atrial stimulation was 1.8 V, equivalent to 8.1 microjoules.

The patient was immobilized and the electrode wires brought out through the skin of the abdomen and then connected to a Medtronics 5840 demand pacemaker. The patient was in sinus rhythm, with blocking stimuli from the pacemaker with periodic slowing or complete inhibi-

A
FIG. 1 *Electrocardiogram on admission to hospital.*
B

FIG. 2 *P wave triggered atrial pacing (external on demand pacemaker Medtronic-5840). Normal sinus rhythm blocks pacemaker. When the sinus rhythm slows down or sinus arrest occurs the pacemaker delivers its own impulses. A faster sinus rhythm inhibits the pacemaker's impulses through a number of atrial fusion excitations as a product of similar frequency of artificial and cardiogenic rhythm.*

tion giving way to artificial atrial stimulation (Fig. 2).

Between the third and the tenth day of artificial pacing the excitation threshold rose to a maximum of 8 V (24 μ J) and periods of artificial atrial pacing were becoming longer. Later, this threshold fell and stabilized at 2 V (10.5 μ J), while the P wave voltage was about 3 mV.

On the 7th day, after an x-ray control which showed no displacement of the electrode in the atrium, the patient was mobilized. Radioelectrocardiographic examination during physical exercise revealed changing from the artificial pacing to a fast sinus rhythm and back (Stopczyk, Kraszewska, and Żochowski, 1969). These changes were not perceived by the patient and did not produce haemodynamic alterations.

After 14 days a Elema EM 153 ventricular triggered pacemaker was implanted (Fig. 3) and 7 days later the patient was discharged home in a good general condition, with no symptoms of circulatory failure or syncopal attacks.

Discussion

Permanent atrial pacing has seldom been used, because of the rarity of isolated impulse formation and conduction disturbances, occurring at the sinus node level with normal function of the AV node. Furthermore, attempts to pace the atrium with a specially designed electrode employed fixed rhythm stimulation, which curtailed the value of the technique.

Sinus inhibition with normal AV conduction can be handled with conventional ventricular pacing, which unfortunately under certain conditions does not produce good haemodynamic responses. Such conditions exist when normal conduction from the ven-

tricle to the atrium causes retrograde atrial excitation or when nodal rhythm overrides a basic pacing rate of the synchronized pacemaker, and produces retrograde depolarization of the atrium – a situation that occurred in a number of our patients.

In such situations, if normal function of the AV node has been ascertained, permanent atrial pacing eliminates those complications (Furman, 1969; Stopczyk *et al.*, 1969). Fixed rate pacing in patients with periodic malfunction of the sinus node may lead to interference of rhythms, to atrial extrasystoles, and possibly to atrial fibrillation.

FIG. 3 *P wave triggered permanent atrial pacing by means of an implanted 'ventricular triggered pacemaker' (EM 153, Elema). The pacemaker impulses evoke atrial excitation. When the single premature supraventricular beats occur pacemaker impulses are triggered by the potential by the intra-atrial electrode.*

P wave synchronized atrial pacing eliminates any external influences during normal functioning of the sinus node while retaining all the advantages of atrial pacing. It is of prime importance in patients with an unstable sinus node function, and limits to the minimum interference with the physiological function of the heart.

The patient remains well after several months of follow-up with continual normal function of the atrial electrode and the pacemaker.

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