Effects of the Myo-monitor on cardiac pacemakers

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Interference of Myo-monitor stimulus on normal function of cardiac pacemakers depends on the sensitivity of the pacemaker and the amplitude setting of the stimulator. Because of electrical isolation of the fixed-rate pacemaker, it is resistant to interference and is unaffected by the Myo-monitor.

Transcutaneous electrical neural stimulation has long been used in various areas of medicine for neurologic diagnosis, for neuromuscular relaxation, and more recently for relief of pain. The modality has currently been adapted to the needs of dentistry and is widely used in the United States, Japan, and Europe (Fig 1). The stimulator (Myo-monitor) is designed specifically to accomplish transcutaneous electrical neural stimulations through the fifth and seventh nerves[1] to relax the masticatory and facial muscles and to precisely control their contraction during clinical treatment of the temporomandibular joint, problems of occlusion, and prosthodontic procedures. Because bilateral stimulation through the fifth and seventh nerves is a new procedure, this study evaluates the effects of Myo-monitor stimulation on patients with pacemakers and determines whether such stimulation causes alteration of the normal function of the pacemaker.

Currently, there are more than a half million patients with cardiac pacemakers implanted for control of various cardiac arrhythmias. Because this is a relatively large group of persons, it is probable that dental clinics will treat some of these patients with use of Myo-monitor stimulation.

Pacemakers may be classified either as fixed-rate (asynchronous) or as demand (synchronous). Fixed-rate

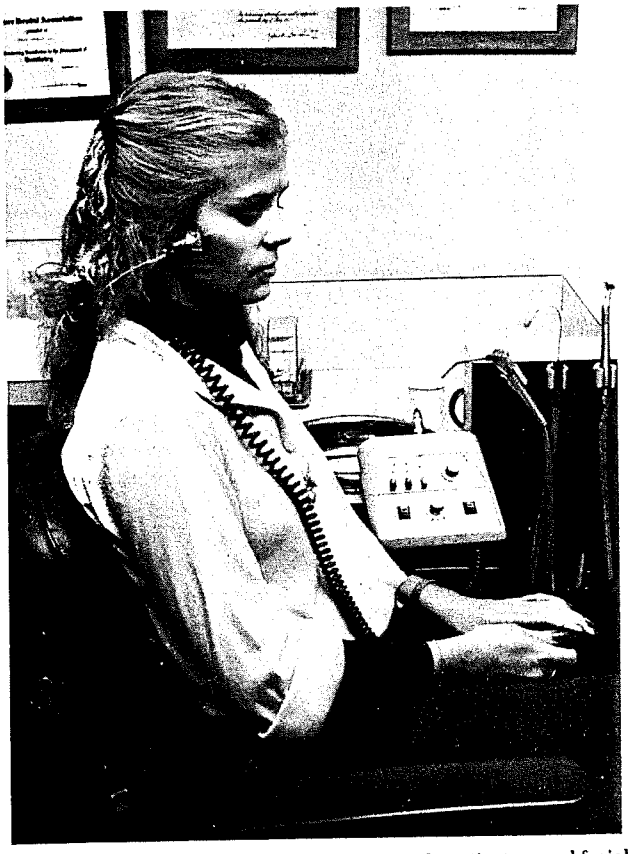


Fig 1 ■ J-3 Myo-monitor is used for relaxation of masticatory and facial muscles.

pacemakers provide a fixed, preset rate of electrical stimuli to the ventricles; they are independent of the electrical or mechanical activity of the heart. Demand pacemakers sense the electrical signals produced by the heart muscles, and, if these signals do not indicate normal heart activity, the pacemaker will send its own signal in the form of an electrical stimulus to ensure normal cardiac function. Several studies[2-10] have reported the effects of interference caused by external sources on the pacemakers. These studies have mostly concentrated on electromagnetic interference that is caused by external sources but is monitored by the pacemaker's sensing circuitry. The Myo-monitor, however, sends small electrical pulses directly to the facial nerves, in contrast to external electrical sources that act as antennae emitting electromagnetic waveforms.

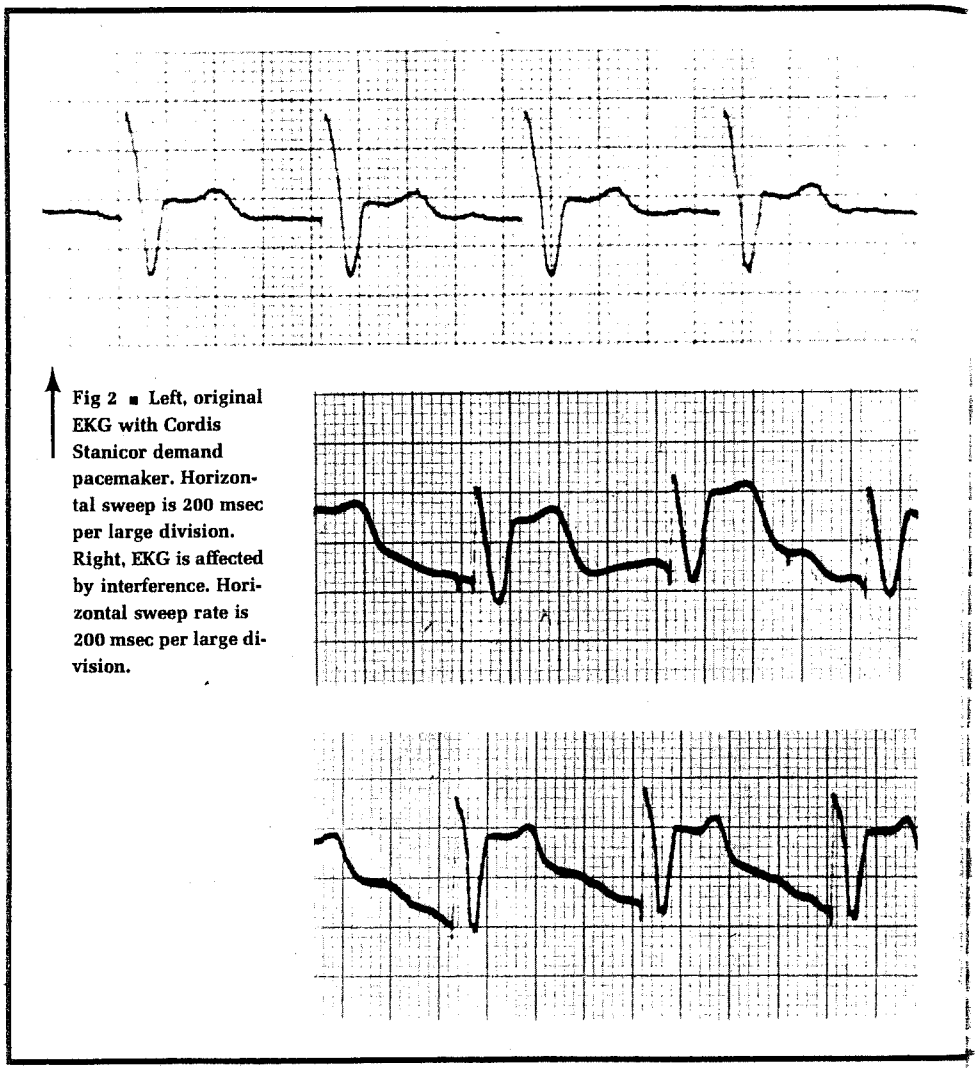


Fig 2 ■ Left, original EKG with Cordis Stanicor demand pacemaker. Horizontal sweep is 200 msec per large division. Right, EKG is affected by interference. Horizontal sweep rate is 200 msec per large division.

Methods and materials

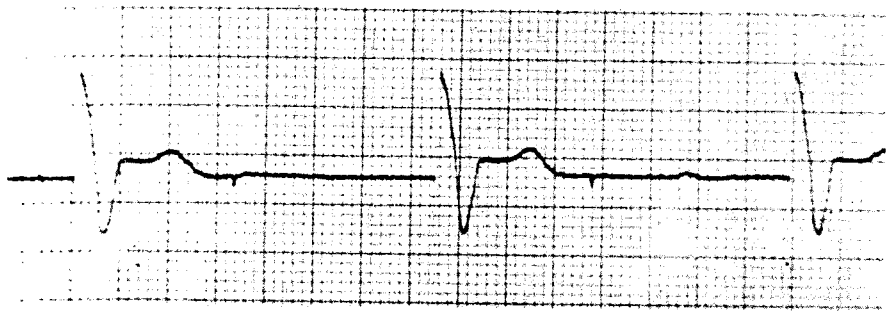
For this study, three patients with the most commonly used types of currently marketed pacemakers were selected. The Myo-monitor's active electrodes are placed on the upper part of each cheek anterior to the tragus, and the common electrode is placed on the back of the neck below the hairline (the Myo-monitor is powered by batteries so no ground is used). Patient A with a Cordis Stanicor demand pacemaker was monitored by an electrocardiograph that registered a pulse rate of 71 (Fig 2, left). With the Myo-monitor turned on, the amplitude was gradually increased to 1.5 (amplitude setting can be varied from zero to ten as each increment supplies 2.2 mA of current that is independent of the patient's electrical resistance) when the electrical interference with the pacemaker was observed. The cardiac rate was approximately 40 (the same as the Myo-monitor pulse rate); it decreased by a factor of 1.8 (Fig 2, right). To supply an adequate stimulus to cause contraction of a mandibular muscle in patient A, the amplitude had to be turned up to 5.5; however, the same electrocardiogram (EKG) was observed as with lower amplitudes. The Myo-monitor was regularly recycling the pacemaker.

Patient B with a Medtronic demand pacemaker was similarly pulsed with the Myo-monitor and the amplitude was turned up to a level in which contraction of a mandibular muscle could be observed. The resulting setting of 6.3 did not cause change in the original EKG waveform (Fig 3, left). However, at an amplitude of 9.2, the Myo-monitor supplied enough current to the electrodes to cause interference with the pacemaker (Fig 3, right).

Patient C with a Cordis Ventricor asynchronous (fixed-rate) pacemaker was similarly tested and the Myo-monitor stimulus did not affect the pacemaker (Fig 4).

Results and discussion

Electrical isolation of the fixed-rate pacemaker makes it resistant to interferences, and therefore it should not be affected by the Myo-monitor. The demand pacemaker, however, does monitor the electrical activity of the heart and often can not differentiate between these signals and waveforms induced by other sources (that is, Myo-monitor stimulus). The nature of the interference may cause the pacemaker to synchronize with the Myo-monitor stimulus and have the same pulse rate (that is, 40 pulses/min). The degree to which the Myo-monitor stimulus interferes with the normal function of the pacemaker depends on the sensitivity of the pacemaker and the amplitude setting of the Myo-monitor. Patients with demand pacemakers can be supplied with a sensing circuit deactivating magnet that can switch the demand pacemaker to a fixed-rate mode. Thus, electrical interference can be eliminated by placing the magnet directly over the pacemaker. Using the magnet while pulsing the patient with the Myo-



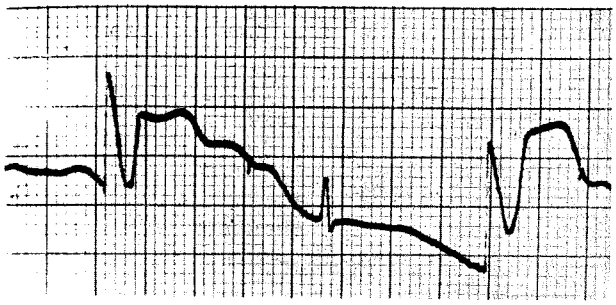


Fig 3 ■ Left, original EKG with Medtronic demand pacemaker. Right, EKG is affected by interference. Notice intrinsic cardiac beat caused by prolongation of pacer rate.

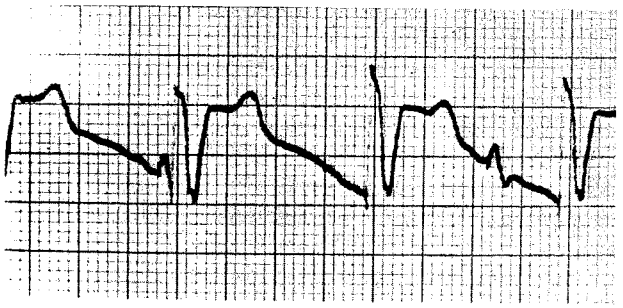


Fig 4 ■ Left, original EKG with Cordis Ventricor fixed-rate pacemaker. Right, EKG is unaffected by interference.

monitor seems to possibly solve the problem of interference. However, opinions differ as to whether the pacemaker should be placed in the fixed-rate mode; some physicians are concerned about the potential adverse effects caused by a competitive rhythm; others claim that a pacemaker temporarily functioning in a fixed-rate mode is essentially safe and that chances of cardiac problems are remote.

Summary

Effects of the Myo-monitor stimulus on the function of a pacemaker were studied. The fixed rate pacemaker would not show alteration of function because of the stimulus. However, the more widely used demand pacemakers seem to be affected by such electrical interference. The degree of susceptibility depends on the sensitivity of the demand pacemaker and the amplitude of the Myo-monitor stimulus. The effect is characterized by a synchronization of the pacemaker to the Myo-monitor (that is, it slows to the pulse rate of the Myo-monitor).

From our study, it can be concluded that potential interference caused by operation of the Myo-monitor does not distort the EKG waveform; it only alters the frequency. It should be noticed that the Myo-monitor stimulus does not directly affect the heart. Any effect on the heart results through its effect on the pacemaker.

It is apparent from this study that the physician responsible for the patient with a pacemaker should be consulted before treatment with the Myo-monitor stimulus. The dentist is advised to discuss with the physician the method by which the potential conflict may be managed if it proves to be necessary.

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