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Pacemaker Induced Ventricular Tachycardia
Report of a Case with the "Runaway Pacemaker"
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The "runaway pacemaker" is a serious pacing failure resulting from battery exhaustion or malfunction of some of the pulse generator components. Hypotension, rapid rate, dyspnea and palpitations were the main clinical features of one example of this iatrogenic arrhythmia presented here. When diagnosed, this condition must be treated as an emergency by disconnecting the subcutaneous wire electrodes from the unit and attaching them to a new pulse generator. The importance of frequent examinations with electrocardiographic recordings for the early recognition of this complication is emphasized.

The wide use of artificial pacemaker stimulation of the heart in the treatment of Morgagni-Adams-Stokes disease makes it imperative for the practicing physician to become aware of its complications for their prompt diagnosis and correction. Epicardial pacing failures can be classified in three main groups: those resulting from a rise in the myocardial threshold secondary to tissue reaction or sepsis at the electrode site; secondly, those caused by a failure of the impulse delivery system due to a broken wire or electrode; and thirdly, failure of the power pack in generating the appropriate electrical impulse at a safe specified rate and intensity, attributable to battery exhaustion or malfunction of some of the pulse generator components. The "runaway pacemaker" belongs to the last group and represents a serious emergency in the group of iatrogenic arrhythmias, which also includes pacemaker-induced ventricular fibrillation,1,2 reported more frequently in patients with competitive pacemaker rhythms3,4 and ventricular asystole occurring after the sudden interruption of artificial pacing.4 An example of one of the former complications and its treatment is presented.

Case Report
A 61-year-old white male retired truck driver had a five-year history of sinus bradycardia and cerebrovascular insufficiency which was treated by a right carotid artery endarterectomy in 1964. Following this surgery the patient experienced three syncopal episodes, without premonitory symptoms or convulsions, and was involved in an automobile accident. Repeated electrocardiograms at no time demonstrated A-V block. However, there was persistent sinus bradycardia, ranging from 50 to 60 per minute. Also, there was present a right bundle branch block with a wide QRS dura-
Garcia and Arciniegas

tion of 0.16 seconds, and there were recurrent syncopal episodes while under a varied medical program including dilantin, phenobarbital and isoproterenol. So, it was decided to implant an epicardial fixed rate pacemaker* on Sept. 1, 1967. After the surgery the patient had no further syncopal episodes and complained only of mild exertional dyspnea, although ECG revealed competitive action between the artificial pacemaker and the sinus rhythm. During the regular examination two months prior to admission the pulse rate was found to have increased to 84 per minute, but no electrocardiogram was recorded. Eleven months after the pacemaker insertion, the patient was readmitted with shortness of breath associated with generalized weakness, palpitations and chest discomfort of three days' duration.

He appeared in acute distress, with cold clammy skin, was moderately orthopneic, and the blood pressure was 110/0 mm Hg. Heart sounds were very distant with an apical rate of 150 beats per minute, slightly irregular. Neck veins were distended and there were a few rales at both lung bases.

Laboratory investigations disclosed the following values: hemoglobin 16.2 gm/cc, leukocytes 13,700/cu mm, with 72% neutrophils, 13% lymphocytes, 5% monocytes and 5% bands. The blood urea nitrogen was 26 mg/100 ml. The fasting blood sugar was 140 mg/100ml. Urinalysis was normal, and urine culture was negative. Serum sodium was 120 mEq/liter, potassium 3.7 mEq/liter, chlorides 92 mEq/liter, and CO₂ combining power was 18 mEq/liter. Repeat electrolytes were normal. Serum bilirubin was 1.65 mg/100ml total and 0.8 mg/100ml direct.

Chest roentgenogram on admission revealed the heart to be enlarged, and there were congestive changes in both lungs. An x-ray of the powerpack showed no evidence of broken wires and the batteries were believed to be intact.

Following admission the patient became progressively worse, with decrease in blood pressure from 110/0 to 80/0 mm Hg, with a rapid cardiac rate of 150-160/minute. The diagnosis of "runaway pacemaker" was confirmed on the electrocardiogram (Fig. 1) and the electrodes were rapidly disconnected from the powerpack and inserted into a temporary external pacemaker. Subsequently a fixed rate type of pacemaker was used to replace the old unit. At the time of removal of the malfunctioning pacemaker it was noted that the sinus node was not capturing the ventricles; therefore, a new fixed rate unit was implanted. While in the hospital, on the ninth post-operative day, he developed a pulmonary infarction requiring treatment with intravenous Heparin and oral anticoagulants.

Comments

The "runaway pacemaker" is characterized by a rapid increase in the firing rate of the electrical stimuli with concomitant augmentation of the ventricular response, producing a iatrogenic ventricular tachycardia either with 1:1 conduction or with varying degrees of block when the pacemaker rate becomes extremely rapid. In

*MEDTRONIC, Inc.—Chardack-Greatbatch implantable cardiac pulse generator.
untreated patients this malfunction usually terminates in ventricular fibrillation sometimes preceded by the development of congestive heart failure, angina, hypotension and other symptoms related to the low cardiac output. Of the 34 patients with this complication reviewed by Siddons and Sowton,12 died, 5 with ventricular fibrillation.

This complication was seen more frequently in the past when certain pacemaker models included an increase in rate as part of an electronic warning mechanism signaling battery depletion. At present premature failure of some of the unit’s components is the most common cause. When diagnosed, the condition must be treated as an emergency by disconnecting or cutting the subcutaneous wire electrodes from the unit and attaching them to a new powerpack (under sterile conditions). While changing the pulse generator, temporary pacing can be maintained by an external pacemaker, connecting its negative pole to one of the myocardial wires while the positive pole is inserted into the skin with an accessory wire as the ground or indifferent electrode. If time permits, the patient may be supported by the use of a separate intravenous pacemaker prior to removal of the old unit. In urgent situations the application of external skin electrodes or the insertion of chest wall or transthoracic teflon-coated needle or wire electrodes, attached to an external pacemaker, may prove lifesaving while replacing the unit.
Coninuous monitor lead after the replacement of the malfunctioning unit, showing the new fixed rate pacemaker (rate 79/minute) in competition with the sinus node rhythm (rate 77/minute). The faster sinus rate supersedes the artificial stimuli rate on Strip A (arrow). A fusion beat (FB) is shown on Strip A. A iatrogenic ventricular parasystolic focus gives rise to bigeminy on Strip B.

In the case reported, the malfunction occurred relatively early, 11 months after insertion. It is believed to be the result of a defective battery pack, according to the manufacturer's analysis. Because no evidence of A-V conduction was observed at the time of the powerpack replacement, a new fixed rate pacemaker unit was implanted. Several hours later, returning A-V conduction induced a competitive rhythm between the sinus node and the artificial electrical stimuli, — an example of iatrogenic ventricular parasystole (Fig. 2).

During his latest visit to the clinic, the patient continued to be symptom-free. This case stresses the need for frequent electrocardiographic monitoring for early detection of changes in the initial pacemaker rate, decrease in size of the electrical stimuli artefact, inability of the pacemaker to capture the ventricle or the appearance of intercurrent arrhythmias.

REFERENCES