THE 1-YEAR MORTALITY of paced patients is at present of the order of 10 to 15% and the morbidity associated with this form of treatment is continuously falling as apparatus is improved and greater skill is acquired in its use. Unfortunately arrangements for the follow-up of paced patients have seldom kept pace with technical and surgical advances so that responsibility for the after-care of the patient is often ill-defined. One solution to this problem is for patients to attend regularly at a pacemaker clinic after discharge from the hospital. Several such clinics are now in existence in Europe and the United States which provide facilities for dealing with paced patients that cannot be achieved at less specialized centers. At each visit the response of the patient to treatment can be assessed, any drug therapy reconsidered, and an evaluation of pacemaker function carried out.

The frequency with which patients should attend such a clinic varies with the clinical state and with the results of the previous pacemaker tests, but in the absence of any apparent abnormality an initial visit 1 month after discharge from the hospital and subsequent visits at 3 monthly intervals have proved satisfactory. The establishment of such clinics at strategic centers throughout the country also allows malfunctioning pacing systems to be dealt with rapidly and avoids the necessity for patients to travel long distances to the hospital where their pacemaker was originally implanted.

Experience gained from a pacemaker clinic may be of great value to the clinician who is faced with the decision as to when an implanted pacemaker should be changed. Although isolated examples of pacemakers functioning for over 4 years have been reported, it is generally accepted that elective replacement of implanted units has greatly reduced the incidence of pacing failure. The time for pacemaker replacement should ideally be based upon past experience of actual failures with identical generators, but with many types of pacemaker this is not possible since even minor alterations in design may greatly influence long-term reliability. With several types of pacemaker it is therefore necessary for decisions to be based upon manufacturers' estimates of pacemaker lifetime; the accuracy of these estimates is unknown, particularly in the case of newer types of pacemakers such as ventricular synchronized or standby generators.

A further complication is that an unknown proportion of failed pacemakers are not returned to the manufacturer and may even be buried with the patient. Pacemakers which have failed when implanted not infrequently appear normal when subsequently tested by the manufacturer, perhaps because of loss of fluid after removal from the body. Even if
these uncertainties could be removed, a small proportion of patients would experience failure of pacing from random causes before elective replacement, and it is the aim of a pacemaker clinic to detect as many as possible of the faulty units before clinical symptoms appear. Problems associated with installation failure due to faulty technique will often be dealt with before the patient leaves the hospital, since failure to pace due to causes such as badly positioned electrodes or poor electrical contacts made between electrodes and pulse generator usually occurs early. The development of techniques for evaluating implanted pacemakers has been proceeding for some years, and tests applicable to most types of generators are now available. Generator failure may occur suddenly, but experience during the past 4 years at the pacemaker clinic of the National Heart Hospital in London has shown that some changes develop slowly over many weeks.

The single most useful test of fixed-rate pacemakers is a simple measurement of discharge rate; an accurate count must be made over a full minute since variations of up to 10% occur in paper transport speed of many electrocardiographic machines. Any pacemaker which has altered in rate by 5 impulses/min should certainly be changed, and lesser variations may be considered as indications for replacement of certain models. Patients are taught to check their own pulse daily and to notify the hospital if a change is noted, but this procedure has been beyond the capabilities of an appreciable proportion of subjects, and changes have only been found at routine clinic attendances.

Additional information can be obtained for all types of implanted pacemaker by analysis of the stimulating impulse, which is detected by skin electrodes and displayed upon the screen of a calibrated oscilloscope. Most of the available information from this method of testing has been obtained in Europe and relates particularly to the Dutch Vitatron and the British Devices pacemakers, but the technique has also been used on patients with Medtronic and Cordis generators.

Measurements of impulse duration can be made directly and conclusions can be drawn about the state of the pacemaker batteries and the electrode system. The interpretation of results is still in an early stage, but faults such as fractured insulation and early battery depletion have been successfully diagnosed before clinical failure of pacing occurred. X-rays of implanted pacemakers have been used to estimate the remaining battery life, but this method can be utilized only for pacemakers in which axial views of the mercury cells can be obtained, such as the Medtronic. Procedures such as these are not confined to fixed-rate pacemakers and can be applied to atrial triggered, ventricular synchronized, or demand units.

Pacing failure due to a rising cardiac threshold can also be forecast in certain patients who are treated with implanted pacemakers in which the output energy can be temporarily suppressed until pacing ceases by the use of specialized external apparatus. At present this facility is available only for Vitatron and General Electric pacemakers.

Methods such as these of testing implanted pacemakers cannot be expected to detect all failures before clinical symptoms appear and in particular will not prevent emergencies due to sudden component failure. Fortunately, such sudden failures are now rare, and a system of follow-up visits by a pacemaker clinic results in early detection of malfunction in a significant number of patients who would otherwise experience clinical pacing failure.

Edgar Sowton

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Within but a few years the instruments of precision have so multiplied that a well-trained consultant may be called on to know and handle as many tools as a mechanic. Their use, the exactness they teach and demand, the increasing refinement in drugs, and our ability to give them in condensed forms, all tend towards making the physician more accurate, and by overtaxing him, owing to the time all such methodical studies require, have made his work such that only the patient and the dutiful can do it justice.—S. Weir Mitchell: Doctor and Patient, ed. 4. Philadelphia and London, J. B. Lippincott Company, 1904, p. 36.
Follow-up Care for Patients with Cardiac Pacemakers
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