Treatment of Congenital and Acquired Heart Block with an Implantable Pacemaker

By Rodman E. Taber, M.D., Ludovico R. Estoye, M.D., Edward R. Green, M.D., and Thomas Gahagan, M.D.

Remarkable progress has been made in the management of complete heart block by pacemaking since the experimental work of Callaghan and Bigelow in 1951 and the first clinical application by Zoll in 1952. Weirich, Gott, and Lillehei helped pioneer this early phase of pacemaker development by successfully applying direct myocardial stimulation to patients with operatively induced heart block. Since then, improvements in equipment and clinical experience with implantable pacemakers have been contributed by Glenn, Chardack, Zoll, and Kantrowitz.

The clinical experience to be reported in this presentation concerns implantation of the Chardack-Greatbatch adjustable rate and current implantable pacemaker in 38 patients (fig. 1).

Surgical Considerations

Since difficulties with bradycardia and arrest may occur during induction of anesthesia and the initial stages of the thoracotomy, it is mandatory that an emergency pacemaking device be in place during this phase of the procedure. Either intravascular or precordial pacemaking electrodes may be used for this purpose. We have found the most satisfactory operative approach to be through a left posterolateral thoracotomy (fig. 2).

Upon discharge, patients are advised to count their pulse once daily and to report a change. The characteristics of the pacemaker are such that an increase in rate warns of the need for battery replacement. A metal identification tag which describes the pacemaker is supplied to be worn around the neck, and patients are advised to carry a description of the unit on their person.

Clinical Experience

Between December 1961 and September 1963 we have used the implantable pacemaker for the management of heart block in 38 patients.

Acquired Heart Block. There were 34 patients in this group and their ages varied from 33 to 85 years. The indications for operation were incapacitating syncopal episodes. The heart block was persistent in 30 patients while the remaining four exhibited intermittent atrioventricular block with a nodal escape mechanism (fig. 3). The type of heart block present...
One 80-year-old patient experienced failure of two pacemakers of a different design that had been implanted elsewhere. She underwent successful installation of a third unit and has been asymptomatic for 12 months. Another unusual patient was believed to have heart block on the basis of metastases to the atrioventricular node from carcinoma of the breast. Successful pacing has continued in this patient for 18 months. Pacemakers were also successfully implanted in three patients who had developed complete block at the time of closing interventricular septal defects.

Pacemaker failure occurred in one patient in this group, a 9-year-old boy who developed complete heart block of unknown etiology 3 months prior to pacemaker implantation. This pacemaker failed owing to breakage of one of the myocardial electrode wires 9 months after implantation and was successfully replaced.

Two patients died in the hospital. One death resulted from postoperative bleeding following aortic commissurotomy and pacemaker implantation. The other death resulted from perforation of a gastric ulcer 7 days after operation for the pacemaker. The remaining 32 patients have done well during follow-up periods varying from 2 to 24 months.

**Congenital Heart Block.** Four patients, ages 1½, 2½, 7, and 18 years, with congenital

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**Figure 2**
The left posterolateral thoracotomy and subcutaneous abdominal wall pouch incisions are shown. The electrodes reach the thoracic cavity through a subcutaneous tunnel connecting the abdominal pouch and the anterior chest wall.

in the latter four patients was detected only by frequent electrocardiographic examinations, which illustrates the necessity of performing repetitive studies in the presence of unexplained syncope if this type of episodic heart block is to be detected.

Two patients, aged 33 and 49 years, had coexisting calcific aortic stenosis. A pacemaker was implanted at the time of aortic commissurotomy in one case and, in the other patient, 5 years after valvular surgery.

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**Figure 3**
Electrocardiogram before and after pacemaker implantation. The patient experienced syncope due to asystole from heart block which was followed by a nodal escape mechanism. Pacemaker at 60 beats per minute has prevented further symptoms.
heart block underwent pacemaker implantation. Two of them had experienced syncopal episodes and the remaining two exhibited progressive cardiomegaly and easy fatigue. Heart block in the 1½-year-old child was diagnosed during gestation. The size of the pacemaker did not present a problem in this small patient (fig. 4). The 7-year-old child had a pacemaker implanted for coexisting congenital heart block at the time of closing an interventricular septal defect. The 18-year-old patient exhibited progressive cardiomegaly on the basis of corrected transposition of the great vessels and a common ventricle in addition to congenital heart block. A pacemaker was implanted at the time of inserting a prosthetic ventricular septum in this patient. This pacemaker subsequently failed because of electrode breakage and was replaced, but the patient died 3 months after the second pacemaker implantation from complications of the intracardiac surgery. A second mortality occurred in this group of patients when the 2½-year-old child suddenly died 12 months postoperatively. An internal electrical failure of this pacemaker was demonstrated, which represents the single breakdown of this type in our experience. The remaining two patients have been symptom-free for periods of 10 and 14 months.

**Discussion**

Since satisfactory pacemakers are now available that can be implanted with minimal risk to the patient, discussion can be focused on the problem of patient selection. The symptomatic patient who is experiencing syncopal episodes presents a straightforward indication for pacemaking. Death due to asystole occurring in the presence of heart block can only be prevented with certainty by this approach. The life span of patients protected in this manner will then be determined by the course of their underlying cardiac disease. It is less clear to what extent use of the pacemaker should be recommended for the patient with heart block that is not accompanied by syncope. Two of our patients with congenital heart block presented this finding. Pacemaking was established in both instances because of progressive cardiomegaly.

The management of surgically induced heart block accompanying intracardiac surgery is best performed by pacing through temporary myocardial electrodes implanted at the completion of open-heart surgery. Since some of these patients convert to a sinus mechanism in from a few hours to a few weeks following open-heart surgery, implantation of a permanent unit should be withheld until the reversibility of the dissociation is apparent. A few patients undergoing open-heart surgery for intracardiac lesions have pre-existing heart block. We have encountered this combination as congenital heart block accompanying ventricular septal defects and as acquired block in the presence of calcific aortic stenosis. The likelihood of recovery following open-heart surgical repair of these lesions would seem greater if a more normal heart rate is insured during the postoperative period by simultaneous pacemaker implantation.

**Summary**

The Chardack-Greatbatch implantable pacemaker has proved a worthwhile device for the management of both congenital and acquired heart block. The procedure used for implantation in 38 patients is described. The most frequent indication for use of the pacemaker is syncope due to heart block. Progres-
sive cardiac enlargement was also an indication for pacemaker implantation in two of four children with congenital heart block. The pacemaker has also been useful in the management of surgically induced heart block and coexisting heart block that accompanies intracardiac lesions, such as aortic stenosis, which require open-heart surgery.

Pacemaker failure due to electrode breakage occurred in two patients. In both instances, a replacement unit was successfully used. Three of the 38 patients have subsequently died from causes unrelated to pacemaking while one death resulted from pacemaker failure 12 months after implantation. The remaining 34 patients have remained free from cardiac symptoms during observation periods of 2 to 24 months.

References


Auscultation

Auscultation though in practice and in our minds dating from Laennec and the invention of the stethoscope was not an absolutely new idea in 1819. The Hippocratic School applied the ear to the chest and were familiar with pleuritic friction and succussion. Harvey listened to the sounds of the heart, Robert Boyle (1627-91) is said also to have done so, and a little later Robert Hooke (1605-1703), as told in his posthumous works published in 1705 by Richard Waller, listened to the heart and realized, but did not pursue, the possibilities of this method of obtaining information about the movements of the viscera. Laennec believed that G. L. Bayle (1774-1816), Corvisart's assistant when he worked under him, was the first of the moderns to practise the immediate or Hippocratic auscultation by putting his ear on the chest, and stated that Corvisart listened to the heart sounds with his ear very close to but not actually in contact with the chest wall.—Sir Humphry Davy Rolleston. The Harveian Oration. Great Britain, Cambridge University Press, 1928, p. 74.
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Circulation. 1964;29:182-185
doi: 10.1161/01.CIR.29.2.182

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