Initial Experience with the Permanent Implantable Transvenous Pacemaker: 
A Report of 33 Patients

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Thirty-three patients with heart block were treated by implantation of a permanent transvenous pacemaker. There were no deaths and few complications even though 25 of these patients were over 70 years of age. Follow-up examinations, including electrocardiograms, were done in all patients.

The technique of the operation is discussed and the importance of performing it under fluoroscopic guidance in a proper surgical operating suite is emphasized. This arrangement may require the use of a portable image intensifier.

This simple, effective procedure can be performed under local anesthesia and with safety, even in the elderly, frail or debilitated patient. Currently it is the authors' method of choice in the treatment of heart block; thoracotomy is now obsolete unless a synchronous pacemaker is needed or a permanent transvenous pacemaker cannot be inserted.

The implantable cardiac pacemaker has provided dramatic relief of the often disabling symptoms of patients with heart block. The experiences with the development and application of the pacemaker principle in this center has previously been reported. A recent review of our total experience with pacemakers implanted by thoracotomy has shown a mortality of 10%, which is in agreement with figures reported from other centers. This mortality and many of the complications have been related primarily to the risk of thoracotomy in the elderly and often debilitated patient.

The literature shows a high incidence of malfunction and early failure in pacemakers implanted by thoracotomy, and the not infrequent fracture of electrodes sutured directly to the heart have been distressing to the patient, cardiologist and surgeon alike. Many of these failures in the past have necessitated repeat thoracotomies.

It was with this background that we turned to the implantable transvenous pacemaker in November 1965. The initial results have been good, with no mortality and little morbidity.

Nous avons procédé à l'implantation d'un pacemaker transveineux permanent chez 33 malades souffrant d'un bloc auriculo-ventriculaire complet. Il n'y eut aucun décès et nous n'avons observé que peu de complications, bien que 25 de nos malades fussent âgés de plus de 70 ans. Des examens post-thoracotomiques, dont des électrocardiogrammes, ont été effectués chez tous les malades.

Les auteurs exposent la technique de l'opération et soulignent l'importance d'y procéder sous guidage fluoroscopec dans une salle d'opération appropriée. Ce dispositif peut exiger l'emploi d'un amplificateur d'image portatif.

Cette méthode simple et efficace peut être exécutée sous anesthésie locale et en toute sécurité, même sur un patient âgé, frêle ou débile. Dernièrement, nous avons considéré que c'est la méthode de choix pour traiter le bloc auriculo-ventriculaire complet; la thoracotomie est devenue désuète à moins qu'on ne soit obligé d'employer un pacemaker synchrone ou qu'un pacemaker transveineux permanent ne puisse être introduit.

METHODS

We have used two types of transvenous catheters: the Elema-Schönander, Model EM 139, and Medtronic, 5870C and 5816.1 The Elema unit (Fig. 1) has an extremely thin, soft, flexible catheter, with a unipolar platinum electrode, 2.5 mm. in external diameter, at its tip. It is inserted through a short No. 9 Courand catheter which is removed after the electrode has been suitably placed.

The power pack is placed in the subcutaneous tissue of the right upper quadrant of the abdomen along with the indifferent electrode. The Medtronic catheter is bipolar and thus somewhat more bulky. The stainless steel spring conductors terminate in platinum electrodes (Fig.
2). The stiffness required for insertion is provided by two stilettes within the lumen of the coil, which are then removed after satisfactory endocardial contact has been made. The power pack is placed in the subcutaneous tissue of the right upper chest.

![Fig. 2.-Medtronic implantable transvenous pacemaker. The bipolar endocardial electrode is shown with guiding stilettes in place.](image)

Insertion of these catheter electrodes is performed in the operating theatre using aseptic technique. The catheter is introduced into the external jugular vein and passed through the tricuspid valve and wedged in the trabeculae at the apex of the right ventricle, using fluoroscopic guidance. After satisfactory ventricular response to the pacemaker has been demonstrated by temporary connection of the catheter leads to the pulse generator, the catheter is brought through a subcutaneous tunnel and permanently attached to the power pack. Care is taken to form a loop in the neck to prevent dislodgment by shoulder or neck movements.

**Case Material**

Transvenous catheter electrode pacemakers have been implanted in 33 patients in a seven-month period between November 1965 and June 1966. Twenty-five were over the age of 70. In three other patients the catheter electrode could not be satisfactorily lodged in the right ventricle and the procedure had to be abandoned. These patients are not discussed further in this communication. Twenty-nine patients were in complete heart block and four suffered from intermittent heart block only.

**Indications for Implantation of Pacemakers**

Twenty-two patients suffered from Stokes-Adams episodes. Seven patients presented primarily with fatigue, malaise, congestive cardiac failure and confusion or disorientation, due to a slow ventricular rate. Six patients were admitted because of failure of pacemakers previously implanted by thoracotomy. One patient developed complete heart block as the result of aortic valve replacement by operation. The clinical findings reflect the general status of these elderly patients and are summarized in Table I. Many were too frail or debilitated to withstand implantation of a pacemaker by thoracotomy.

**TABLE I.—Associated Clinical Findings in 33 Patients with Heart Block**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Patients</th>
</tr>
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<tbody>
<tr>
<td>Recent myocardial infarction</td>
<td>3</td>
</tr>
<tr>
<td>Angina pectoris</td>
<td>4</td>
</tr>
<tr>
<td>Cardiomyopathy</td>
<td>2</td>
</tr>
<tr>
<td>Recent aortic valve replacement</td>
<td>1</td>
</tr>
<tr>
<td>Chronic bronchitis and emphysema</td>
<td>5</td>
</tr>
<tr>
<td>Recent pulmonary infarction</td>
<td>1</td>
</tr>
<tr>
<td>Recent stroke</td>
<td>1</td>
</tr>
<tr>
<td>Cerebral blunting</td>
<td>3</td>
</tr>
<tr>
<td>Chronic azotemia</td>
<td>2</td>
</tr>
<tr>
<td>No associated clinical findings</td>
<td>11</td>
</tr>
</tbody>
</table>

**Anesthetic Management**

Local anesthesia was used in 30 patients and general anesthesia in only three. An anesthesiologist was in attendance at all implantations, and all except a few of our early cases were performed in an operating theatre equipped with electrocardiographic monitors, defibrillators and other resuscitative equipment.

The ventricular rate was maintained by temporary transvenous electrode catheters in the three patients undergoing general anesthesia and in nine of those in whom local anesthesia was used. The experience with this technique at this centre will be reported elsewhere. Two patients with previous thoracotomy were protected by connection of their intrathoracic electrodes to an external pacemaker. Nineteen patients have had no artificial stimulation of their hearts during pacemaker insertion, other than an intravenous infusion of isoproterenol (Isuprel).

**Results**

There has been no mortality in this series despite the advanced age and infirmity of many of the patients. The period of follow-up is admittedly brief, being only seven months in our longest case. However, there has been no evidence of late dislocation, or of intracardiac or bloodstream infection. No antibiotic prophylaxis is used. There has been one late perforation
of the heart. The total absence of any thromboembolic complications is noteworthy, as these patients are not placed on any long-term anticoagulant therapy. Electrocardiographic confirmation of continued ventricular capture by the pacemaker after discharge from hospital has been obtained in all cases.

Complications associated with the implantation procedure itself have occurred in only five patients. Two patients had cardiac arrests requiring external massage and a third had recurrent Stokes-Adams seizures during the catheter manipulation. None of these three patients was protected by a temporary catheter electrode during implantation. In a fourth patient the catheter electrode dislodged just as she was being lifted off the operating table and the procedure had to be repeated. The bipolar catheter electrode perforated the myocardium in a fifth patient, with a recent myocardial infarction, in the same area where the temporary catheter had perforated a few days earlier.

Two further cardiac perforations occurred, one at one week and one at three weeks postoperatively. Both patients were still in hospital. In none of the cases of cardiac perforation was there evidence of pericardial effusion, and satisfactory "pacing" could be re-established in all merely by repositioning the catheter under fluoroscopic control.

Most patients were eating regular meals the evening of operation and were ambulant the following day. Many were discharged within a week. There were no hospital deaths. Owing to dislocation, reposition of the catheter electrode was required on five occasions in four patients. These occurred within the first 48 hours in three instances and within three weeks in the remaining two.

With further experience we have learned to avoid many of these complications.

Discussion

Our current belief is that all patients with established or symptomatic heart block should have a permanent pacemaker implanted and that the transvenous catheter pacemaker is the instrument of choice in most instances. However, in the younger, more active patients, or in the elderly patient with only intermittent heart block who is a suitable candidate for thoracotomy, synchronized pacemaking may be considered. In many of these cases the extra hazard of thoracotomy may be justified in order to implant a p-wave synchronized pacemaker. Fortunately, recent information from Sweden indicates that it may be possible to achieve synchronized pacing without thoracotomy.8

The implantation of the transvenous catheter electrode pacemaker appears to be an extremely safe and effective procedure. We have had no mortality in the current series of 33 cases. Chardack9 has reported one late death due to electrode perforation of the myocardium four and one-half months after implantation. But with technical modifications in the procedure which have since been made, this complication should be infrequent or non-existent. Lagergren et al.10, 11 have reported the largest series of permanent transvenous pacemakers, having combined the experiences of five European centres in the treatment of 305 cases. There were no electrode fractures and the incidence of other complications was low. The complete absence of thromboembolic complications in the present series as well as in those of Chardack and Lagergren is gratifying. It is of some interest that no cardiac perforations occurred in Lagergren's series and that no perforation in the present series has occurred using the Swedish pacemaker.

The prognosis of untreated heart block is poor and medical management is often unreliable and only temporarily effective. A recent study of 193 patients with complete heart block who were not treated surgically showed that 62 died within four weeks and 97 within one year.12 The almost routine use of the implantable transvenous pacemaker for the treatment of complete heart block would therefore seem justified even in the very frail or elderly. We have been particularly impressed with the use of the transvenous catheter electrode in two special instances: (1) the failed pacemaker previously implanted by thoracotomy or (2) where infection has occurred. Intrathoracic electrode fracture has been a not uncommon event and heretofore repeat thoracotomy was necessary for the management of this complication. The transvenous pacemaker has made repeat thoracotomy for failed pacemakers unnecessary. The infected pacemaker has been an almost insoluble problem because of the two conflicting aims in therapy of eliminating all foreign material (i.e. pacemaker and electrodes) and yet maintaining continued electrical stimulation of the heart. We have successfully treated one case of infected pacemaker by completely removing the previous unit and implantation of a transvenous unit through a new separate, clean field.

It is highly desirable that implantation of transvenous pacemakers be carried out in a proper operating room suite under aseptic technique and with complete anesthetic facilities. A portable image intensifier* suitable for operating

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*Siemens "Siremobil" S 50/179.
room use has been especially helpful in this regard. Early experience led us to believe that this operation cannot be performed properly in the cardiac catheterization laboratory or in the x-ray department. It is certainly not an office procedure. Because of the tendency of patients with complete heart block to develop cardiac asystole on the induction of general anesthesia, we have preferred to perform most of our implantations under local anesthesia. If for some reason general anesthesia is required it is mandatory that a temporary transvenous catheter be placed prior to induction.

**SUMMARY**

The initial experience in 33 patients with heart block treated by the implantation of a permanent transvenous electrode pacemaker has been presented. There has been no operative mortality and few complications occurred.

We now consider this the treatment of choice in the management of complete heart block. The indications for operation have been discussed.

In young patients, or in elderly patients who have only intermittent complete heart block and who are satisfactory risks for thoracotomy, implantation of a p-wave synchronized pacemaker can be considered. Further technological advances may render thoracotomy obsolete for this group as well.

The permanent transvenous pacemaker is a simple, safe and effective method of treatment associated with a short and usually uncomplicated convalescence. It should be carried out in a proper operating room suite on an in-patient basis for best results.

**REFERENCES**


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**THE CANADIAN JOURNAL OF SURGERY**

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