Assessment of endocardial leads for permanent cardiac pacing

D. S. WRIGHT AND G. P. McNEILL

From the Department of Cardiology, Ninewells Hospital, Dundee

SUMMARY Catheter tip dislocation is the main complication of permanent pacemaker implantation using the subclavian vein. In this study of 50 patients we compared the incidence of complications using two endocardial electrodes specially designed to prevent tip dislocation. One catheter had a helical endocardial electrode and the other had retractable nylon barbs. The helical electrode was superior in every respect and we recommend its use for pacing through the subclavian vein.

A high incidence of catheter tip displacement has been described using the Devices LC 62 pacing electrode inserted through the subclavian vein (McNeill and Taylor, 1978). This has been ascribed to the obligatory use of narrow-gauge catheters required to negotiate the limited space between clavicle and first rib.

In this study we compare the efficacy of two endocardial electrodes specially designed to minimise the risk of catheter dislocation when the subclavian vein is used for implantation. Catheter tip dislocation is the main complication of pacemaker insertion and in 1976 Sowton reported that it occurred after 10 per cent of implantations in Britain.

Patients and methods

Between March 1978 and January 1979, 50 patients aged between 35 and 90 years (mean 72 years), with symptomatic heart block were given initial pacemaker implants by the subclavian route.

Before implantation the patients were randomly divided into two equally sized groups. One group received 'Vitatron Helifix 23' endocardial pacing catheters (Fig. 1) and the other 'Vitatron MIP 2000' endocardial catheters (Fig. 2a and b).

The procedure has been previously described in detail (McNeill and Taylor, 1978), the catheter being inserted percutaneously under the clavicle using an introducer (Fig. 3). In that description an Argyle Medicut needle was used to gain entry to the subclavian vein. Recently we have found it easier to use the needle accompanying the 'Vygon Desilet-Hoffman FG09 dilator and introducer' set.

This introducer is particularly suitable for insertion of the Helifix catheter. The tip of the 'MIP 2000' catheter, however, precludes its use and a special introducer, supplied by the manufacturer, is required.

In all cases the electrode was positioned in the right ventricle at a site where the pacing threshold was under 1 volt. Using the Helifix catheter this often involved waiting a few minutes for the initially high threshold voltage to fall to acceptable limits. Each catheter was attached to a 'Vitalith 6121' pacemaker sited over the right pectoral muscle.

The patients have been followed-up for between 1 and 13 months (mean 7.2 months) after implantation. Both groups of patients were similar in terms of age and duration of heart block and the same physicians implanted an equal proportion of pacemakers within each group.

Fig. 1 Helifix endocardial electrode.

Fig. 2 MIP 2000 electrode; (a) barbs retracted; (b) barbs projected.

Fig. 3 Subclavian subclavian venepuncture.

Results

The incidence of catheter tip dislocation and pacing failure caused by rising threshold of stimulation are shown in the Table. The Helifix catheter, though occasionally catching the anterior wall of the right atrium, was invariably easier to implant. Insertion of the larger 'MIP 2000' catheter, because of its bulbous electrode tip, frequently led to oozing of blood for a few minutes from the venepuncture site making subsequent catheter manipulation more difficult.

Although 4 patients with 'Helifix' catheters died during the study, death could not be attributed to pacing failure. When necropsies were carried out in 3 of these patients, it was impossible to dislodge the catheter from the right ventricle by traction, the catheters finally breaking just proximal to their distal electrode tips. Unfortunately, when 1 patient in the 'MIP 2000' group died of a myocardial infarction, permission for necropsy was not obtained.

Table Complications of pacing

Catheter	Number of patients	Catheter dislocation	Rising threshold
'Helifix'	25	0	0
'MIP 2000'	25	3	4

Discussion

The subclavian vein is a useful portal of entry to the heart for permanent cardiac pacing because it may be used repeatedly and it is constantly sited (Keeri-Szanto, 1956). However, though movement of the arm and neck is not liable to exert traction on a catheter in the subclavian vein, the small space between the clavicle and first rib precludes the use of a very large catheter which would be unlikely to displace from the right ventricle. Though this problem can be overcome by using the supraclavicular approach to the vein this may result in damage to the subclavian artery and phrenic nerve which lie posteriorly to the vein (Epstein *et al.*, 1976).

A possible method of overcoming the problem involves the use of catheters with electrode tips specifically designed to resist displacement after implantation. Endocardial fixation may be by traumatic or non-traumatic means depending on whether or not the endocardium is perforated. The Vitatron Helifix catheter with its helical unipolar electrode achieves non-traumatic fixation by entanglement in the trabeculae carneae. In contrast the MIP 2000 catheter tip traumatically fixes to

the endocardial surface by means of projecting nylon barbs deployed by pressure with a guide wire. These are retracted by traction on a nylon wire occupying part of the lumen of the catheter.

Examples of other electrode tip designs range from simple 'shouldering' of the distal end of the catheter gaining a very limited degree of non-traumatic fixation, to more invasive traumatic fixation by means of screw-like helices (Biomedix) or terminal projections (Schaldach, Irnich).

Apart from occasional inadvertent subclavian arterial puncture and two pneumothoraces, none of the various complications associated with subclavian venepuncture has occurred in over 500 subclavicular venepunctures performed in our department. We have found the 'Vitatron Helifix 23' endocardial pacing catheter superior to the 'MIP 2000' pacing catheter in all respects. The Helifix catheter is easily inserted into the subclavian vein and through the tricuspid valve. The helical electrode anchors the catheter firmly in the right ventricle and, in our experience, pacing failure caused by a rising threshold of stimulation has not been a problem.

After implanting pacemakers through the

cephalic, axillary, and subclavian veins we have found that implantation by the subclavicular subclavian route using a 'Vitatron Helifix 23' endocardial lead to be the most reliable and easily performed method of permanent cardiac pacing.

We are indebted to Dr Hamish Watson for advice.

References

- Epstein, E. J., Quereshi, M. S. A., and Wright, J. S. (1976). Diaphragmatic paralysis after supraclavicular puncture of subclavian vein. *British Medical Journal*, **1**, 693-694.
- Keeri-Szanto, M. (1956). The subclavian vein. A constant and convenient intravenous injection site. *Archives of Surgery*, **72**, 179-181.
- McNeill, G. P., and Taylor, N. C. (1978). Use of subclavian vein for permanent cardiac pacing. *British Heart Journal*, **40**, 114-116.
- Sowton, E. (1976). Use of cardiac pacemakers in Britain. *British Medical Journal*, **2**, 1182-1184.

Requests for reprints to Dr G. P. McNeill, Department of Cardiology, Ninewells Hospital, Ninewells, Dundee DD1 9SY.