Endocardial pacing electrode design and rate of displacement

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In a series of 184 patients with a permanent endocardial pacing system the rate of electrode displacement was 3.0 per cent using the Devices L120 SR electrode, and 23.1 per cent using the Devices S120 electrode. The technique and pacing team were unchanged during the period of study. It is suggested that the design and mechanical characteristics of the electrodes were responsible.

The safety and convenience of the transvenous approach to long-term endocardial pacing are well established, but its principal drawback is electrode displacement (Goldstein *et al.*, 1970). The reported incidence of this complication varies from 0 to 44 per cent (Parsonnet, 1970; Morse *et al.*, 1973; Bette *et al.*, 1975; Fiandra *et al.*, 1976) and is highest in the early post-implantation period before endocardial fixation of the electrode tip. The Inter-Society Commission for Heart Disease Resources report on pacemakers (Parsonnet *et al.*, 1974) suggests that a rate of early displacement greater than 5 per cent calls for a critical review of results. Variations in displacement rate may accompany changes in the technique of electrode insertion (Simmons *et al.*, 1970) and in the experience of the operators involved (Goldstein *et al.*, 1970). In the present series a sharp increase in displacement rate accompanied a change in the type of electrode used. The same experienced operators used a standard technique throughout the period of study.

Subjects and methods

PATIENTS

From July 1974 to April 1976, 184 patients were equipped with permanent endocardial pacing systems. In 132 patients the Devices L120 SR electrode was used, and in 52 patients the Devices S120 electrode.

PROCEDURE

Electrodes were inserted by the infraclavicular subclavian approach and manipulated into the apex of

the right ventricle under fluoroscopic control. The suitability of the position was confirmed by attaining an endocardial potential of 5 millivolts or more, and a pacing threshold of less than 1 volt. The electrode was anchored by a silk or linen tie at the point of entry, and a loop made using silicone rubber twin tubing. The electrode was secured in the distal limb of the tubing, and the latter anchored to the deep fascia. The generator was implanted in the pectoral region and the patient was kept in hospital for 4 days.

ELECTRODES

From July 1974 to October 1975, the Devices L120 SR electrode was used. This comprises a quadruple helical wound lead wire insulated by polythene with a short silicone rubber sleeve just proximal to the electrode tip. From November 1975 to April 1976 the Devices S120 electrode was substituted. The lead wire is wound as a single helix and is insulated with silicone rubber. There is no sleeve at the tip.

Results

The incidence of electrode displacement is shown in the Table. Early displacement is defined as within the first month after insertion, and late displacement as that occurring later than one month.

Table Incidence of electrode displacement

	L120 SR	S120
No. of patients	132	52
No. of displacements	<div> <div>Early</div> <div>Late</div> </div>	<div> <div>0</div> <div>4</div> </div>
Overall percentage displacement	3.0	23.1

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Discussion

Electrode durability is becoming an increasingly important factor in long-term pacing. In this department the decision to change to S120 electrodes was taken because silicone rubber insulation is possibly more resistant to mechanical stress and to the action of body fluids than the polythene insulation of the L120 SR. However, the change in policy was attended by an eightfold increase in electrode displacement, all other factors remaining constant.

There are two possible causes, both related to electrode design. Firstly, the polythene insulated quadruple wound L120 SR electrode is stiffer and more damped and consequently has greater resistance to lateral movement. The silicone rubber insulated S120 electrode is more flexible and, therefore, tends to spring back to a straight position more readily if deviated to one side or the other. Secondly, the L120 SR electrode has a short segment of sleeving over the insulation near the electrode tip which helps to trap the tip among the ventricular trabeculae; the S120 electrode is without this feature. It is suggested that these factors may account for the higher displacement rate of the S120 electrode, 9 of which occurred in the first 6 weeks after insertion before effective anchoring to the endocardium by fibrosis (Goldstein *et al.*, 1970).

The technique for electrode placement in the right ventricle was unchanged in this series. With the stiffer L120 SR electrode a satisfactory electrical position in the right ventricle is relatively easily obtained, and though an effort was made in all cases to place the electrode as peripherally as possible in the right ventricle, a less peripheral position was sometimes accepted provided that the other parameters were satisfactory.

It may be argued that in using a less stiff electrode such as the S120, greater care needs to be exercised in its placement and that better stability may be achieved by ensuring that it is lodged more peripherally in the right ventricle. Though this is

not entirely discounted by our experience, we do not think that this factor played an important part in our high displacement rate. In the majority of our patients, including those who experienced displacement, the electrode as gauged from anteroposterior and lateral radiological projections was wedged peripherally in the apex of the right ventricle, in a position that was entirely acceptable.

An unacceptably high displacement rate with the S120 electrode has been encountered by at least one other cardiac department using an implantation technique similar to ours (E. B. Raftery, 1976, personal communication).

It is concluded that a relatively damped wire, and a barbed or flanged electrode tip are desirable features of an electrode lead system for permanent endocardial pacing.

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