

Is the surgical solution to the treatment of tachycardias justified?

For those who suffer from established or paroxysmal tachycardias refractory to medical or pacemaker treatment there is the option of surgical treatment. Although the advent of new and powerful antiarrhythmic drugs and advances in the versatility of pacemakers have, perhaps, reduced the number of patients who may require operative treatment, there are several pressing indications for the surgical approach. The rapid ventricular response to atrial fibrillation in patients with the Wolff-Parkinson-White syndrome (Dreifus *et al*, 1971), the malignant ventricular tachyarrhythmias associated with the long QT syndrome and "floppy" mitral valve (Philips and Ichinose, 1970), and paroxysmal ventricular arrhythmias associated with coronary artery disease (Kimball and Killip, 1968) are potentially life-threatening conditions for which curative surgery is an attractive solution. Other arrhythmias, particularly paroxysmal supraventricular tachycardia may prove impossible to control (Levine and Smith, 1970), and while not representing a threat to life are sufficiently disabling to warrant surgical treatment. When patients need cardiac surgery for unrelated reasons, co-existing tachyarrhythmias amenable to surgical treatment should be tackled at the same operation. Failure to do so may lead to difficulties in postoperative management. Living permanently with an arrhythmia suppressed or partially controlled by antiarrhythmic drugs may prove psychologically debilitating or physically impracticable especially for the young patient, and a once and for all surgical treatment may offer a substantial advantage.

This radical attitude to the treatment of tachycardias is not wholly accepted because the natural history of some of these conditions is imperfectly appreciated, and new and more successful antiarrhythmic drugs may be "just around the corner." Cardiac surgery is associated with a not insignificant morbidity and mortality, and the success of surgical techniques, especially in inexperienced hands, is not assured. The morbidity and mortality of surgical treatment is essentially that of thoracotomy and, when necessary, cardiopulmonary bypass, together with that related to the underlying pathology (Gallagher *et al*, 1977). The

ultimate justification for the surgical approach must be based on the results of such procedures.

In recent years there have been considerable methodological advances that have improved surgical success to almost 100%. The recognition that a large proportion of symptomatic tachycardias may be provoked by electrical stimulation (Wellens, 1978) and the appreciation that signals derived from two closely spaced electrodes represent activity adjacent to those electrodes have allowed the tachycardias to be studied in detail before and during operation (Gallagher *et al*, 1976). The selection of suitable candidates for surgery requires the accurate definition of the tachycardia, its origin and conduction pathway, by detailed preoperative electrophysiological study. At the operation it is often necessary to construct precise epicardial, endocardial, or transmural activation sequences (Roos *et al*, 1968). This may be accomplished by sequentially or simultaneously recording electrograms from several sites, measuring their relative timings, and deriving the sequences of excitation. To facilitate this process on-line computer facilities have been recently developed (Gallagher, 1978; Fontaine *et al*, 1978) and are proving successful for rapid and accurate data acquisition in the operating theatre.

It has long been appreciated that the surgical removal of an aneurysm (Magidson, 1969) or the replacement of an incompetent valve may indirectly solve a tachycardia problem because of the haemodynamic improvement after the procedure. It is increasingly recognised that these indirect benefits are not invariable; for example, paroxysmal ventricular tachycardia associated with a ventricular aneurysm is not necessarily abolished by aneurysmectomy. This realisation, together with the fact that many tachycardias are not related to reversible haemodynamic problems, has led to the development of specific surgical techniques for treating tachycardia. Two principal methods exist: the ablation or isolation of tachycardia foci (Coumel *et al*, 1973) and the interruption of conduction pathways essential to the expression or continuation of the tachycardia. This latter category includes His bundle section for supraventricular arrhythmias (Gianelli *et al*,

1967; Garcia and Arciniegus, 1973), anomalous pathway destruction for atrioventricular arrhythmias associated with overt or concealed Wolff-Parkinson-White syndrome (Cobb *et al*, 1968), and the division of a bundle branch (Spurrell *et al*, 1973) or a specific transmural (Spurrell *et al*, 1975) or encircling ventriculotomy (Guiraudon *et al*, 1978) for ventricular tachycardia.

Until recently the surgeon used ligature, knife, or electrocautery to produce therapeutic damage sufficient to prevent or control the tachycardia. In the past few years hypothermal injury (Harrison *et al*, 1977; Camm *et al*, 1979) has been applied to antiarrhythmic surgery. One outstanding advantage of this technique is that myocardial cell membranes may be reversibly depolarised and inactivated by cooling to 0°C and irreversibly destroyed by freezing to temperatures below -50°C. This allows the surgeon to test the probable success of the proposed intervention before producing permanent damage. Cryosurgery destroys cellular automaticity and conduction capacity without disrupting collagen tissue, impairing fibroblasts, or damaging the larger blood vessels. Thus discrete hypothermal lesions may be produced without threatening structural integrity, jeopardising repair mechanisms, or interrupting an important vascular supply.

Because of the recent developments in arrhythmia investigation, cardiac activation mapping techniques, and specific antiarrhythmic operative procedures, the surgical management of tachyarrhythmias is feasible. The technique is not easy, however, and requires close co-operation between cardiac surgeon, cardiologist, and medical physicist. Surgical success cannot yet be guaranteed in every case, and a small proportion of tachycardias are not amenable to surgical modification. Nonetheless results are encouraging, and the surgical approach to the treatment of tachycardia is justified.

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