Surgical management of ventricular dysrhythmias

Essay

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in

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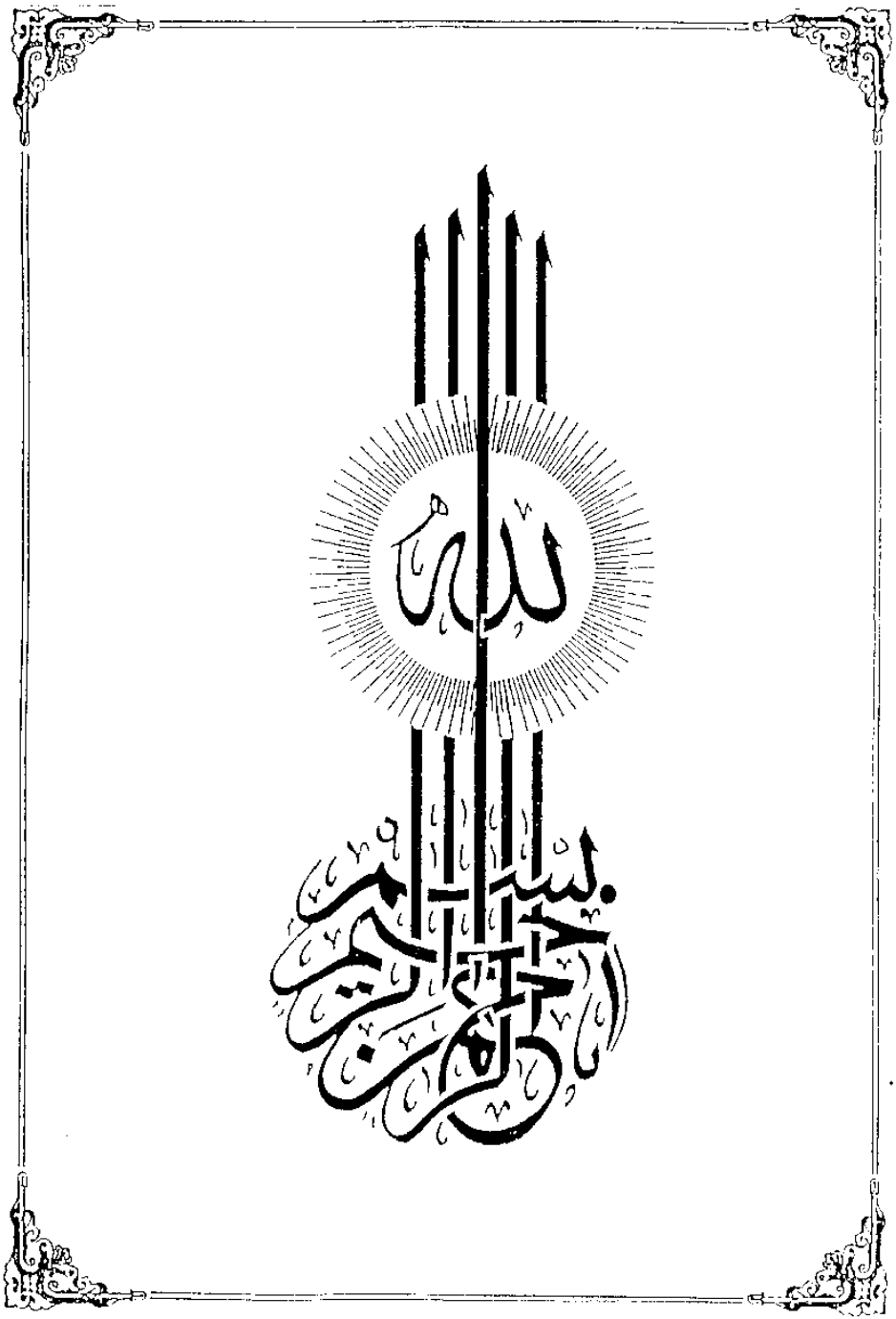

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INTRODUCTION

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Among the most commonly, and certaintly the most lethal of dysrhythmias are those arising in the ventricles. Although medical treatment of ventricular dysrhythmias, especially those associated with ischaemic heart disease, has improved enormously in the past decade, there remains a rather large group of patients in whom ventricular dysrhythmias are refractory to medical treatment. Most of ventricular dysrhythmias unassociated with coronary artery disease was found to be remarkably intractable to medical therapy. As a result, much emphasis has been placed recently on the surgical therapy of these dysrhythmias, **(Gibbon et al., 1986)**.

Patients suffering from incapaciating or life threatening cardiac dysrhythmias may now be cured through a sophisticated combination of electrophysiological mapping and state of the art open heart surgical techniques. The technology currently available provides the clinician with the means to define precisely, locate anatomically, and ablate surgically the source of variety of serious cardiac tachyarrhythmias.

Medical treatment also may be used to control dysrhythmias. When medical therapy is unsuccessful, two basic types of dysrhythmias (supraventricular and ventricular) may be referred to the clinical cardiac surgeon. The various

forms of atrial tachycardia often are symptomatic or incapaciating. Atrial dysrhythmias may result in syncope or sudden death if a very rapid ventricular response to the dysrhythmias occur. Ventricular dysrhythmias, especially ventricular tachycardia or fibrillation are considered ominous **(Cooley et al., 1984)**.

Surgical treatment of cardiac dysrhythmias is presentely in an evolutionary stage and promises to become one of the standard techniques in the surgeon's techniqual armentrum of the future. The cardiologist's skill in electrophysiology is perhaps even more essential to success in the treatment of cardiac dysrhythmias than is any other type of cardiac dysfunction.

HISTORICAL REVIEW

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The philosophy of dealing with ventricular tachyarrhythmias has evolved through the years. Originally proposed operations were directed towards altering the electrophysiologic milleu that predisposes to the arrhythmias. These include thoracic **sympathectomy** and revascularisation of ischaemic myocardium. Insertion of pacemakers for management of ventricular bradyarrhythmias has a very long history which extends to the past century.

Historical note about pacemakers :

It has long known that the heart is capable of responding to external electrical stimulation. As long ago as 1804, Aldini successfully stimulated systole in the hearts of decapitated criminals. Apparently it was known in the late 1800 s that direct punctures of the heart with or without the instillation of drugs would occasionally produce effective cardiac contraction. It is said by Mord that Lidwill, in Australia, in 1929 successfully paced the heart of a stillborn infant for a time by direct ventricular puncture. In 1932, Hyman atrially paced several patients with what he termed an artificial pacemaker, and Bigelow and callaghan, in Toronto, paced canine hearts by esophageal and precordial electrodes in 1950.

In 1952, Zoll, in Boston, reported the successful pacing, with external cutaneous electrodes and a large and relatively nonmobile pulse generator, of the hearts of the patients with complete heart block. This method was the only one available when open cardiac surgery came into existence in the mid 1950s, and although the stimulation of each heart beat was accompanished by skeletal muscle contractions and the skin under the electrodes quickly became excoriated, this method kept some cardiac surgical patients alive until sinus rhythm returned. However, as the days passed in patients in whom sinus rhythm did not return, the agony of skeletal muscle contractions and skin excoriations increased

The change began when Lillehie, in Minneapolis, Minnesota, enlisted the help of a television engineer named Earl Bakken (later founder of the Meditronic corporation) in developing a small portable pacemaker. More important, he devised the techniques of leaving at operation a wire attached to the ventricular epicardium and broughout externally and used it and external electrode to pace heart with minimal discomfort of the patient. Later, Thevenet, Hodges and Lillehie devised a method of inserting the wire into the pericardium through a needle passed through the skin of the precordium without an operation. These systems used the small portable pacemaker system devised by Bakken.

In 1959, Elmquist and Senning, in Stockholm, reported the placement of the first totally implantable pacemaker system, using epicardial electrodes. This development was made possible by the development of the transistors in the 1950s. In 1960, Chardack, Gage, and Greatbatch described a self-contained, mercury cell battery-driven implantable pulse generator for use with implanted epicardial leads.

In the previous year, Furman and Robinson, had reported the use of endocardial electrodes introduced transvenously rather than epicardial electrodes placed at thoracotomy. their paper reported data supporting the idea that endocardial and epicardial electrodes perform in an entirely similar manner. These developments lead to the widespread availability of both transvenously inserted endocardial electrodes and epicardial electrodes inserted by thoracotomy, by 1961. These early pacemakers paced at a factory-set rate only and did not sense. They were crude by present standards but did make the difference between less than 50% 1 year survival and 85% 1-year survival for patients harving Adams-stokes episodes.

Rapid development followed, and pulse generators that sensed the QRS and fired only when no spontaneous QRS occurred within the specific time period became available in the mid 1960s. Much work in the late 1960s, and early 1970s, to improve the cells (batteries), made by Greatbatch, resulted

in the commercial availability of lethium-cell-powered pulse generators in the early 1970s. The lithium cells were much more reliable, and with hydrogen gas no longer being liberated in the pulse generator, hermetic sealing of the entire device became possible. To allow programming of rate and stimulus duration and to to allow better QRS sensing, more complicated electronic circuits were developed, with an evolution of transistorised circuits with a few components to hybrid circuits with more components to integrated circuits and finally to implantable pulse generators containing microprocessors.

Further improvement have permitted atrial sensing and pacing as well as ventricular sensing and pacing (i.e. universal pacing) and ventricular pacing synchronized with the patient's atrial contraction as well as sequential atrioventricular pacing. Finally, the combination of multiprogrammability with diagnostic radiotransmission has permitted precise evaluation of the pacemaker function and improved treatment.

Improvements in the wires and electrodes have also been made through the years, in the form of improved allays, antifracture characteristics, electrode pacing threshold properties and lead insulation. These improvement have diminished the incidence of high pacing thresholds and lead fractures **(Mond GH and Sloman GJ; 1986)**.

Historical note about sympathectomy, aneurysmectomy and other surgical procedures :

Estes and Iziar in 1961, were the first to report success in the treatment of tachycardias in human with cardiac sympathectomy **(Harken A and Josephson M. 1982)**.

It was demonstrated later on that cardiac sympathectomy permitted the medical control of ventricular tachycardia previously refractory to propranolol **(Lioydet et al., 1974)**.

In 1938, Parkinson and colleaguges apparently first noticed the association between ventricular aneurysm and intractable ventricular tachycardia. However, the problem seemed to be known to sir Thomas Lewis, who stated in 1909 the need for understanding the condition by a controlled method of inducing tachycrdia.

As early as 1959, Cough reported that removal of aneurysmal left ventricle scar eleminated a patient paroxysmal tachycardia **(Mason et al., 1982)**.

Fontaine, Frank, and Guirdon reported surgical epicardial mapping as an adjacent to arrhythmia surgery in 1974, and Ghallagher and colleaguges reported the successful use of ventricular aneurysm resection guided by electrophysiologic mapping in 1975. In 1978, Guirdon and colleagues introduced encircling endocardial ventriculotomy, as a method of directly

treating life threatening ventricular tachycardia in patients with ischaemic heart disease. Harken and colleaguges reported electrophysiologically directed endocardial resection as a method of treatment in 1980.

Delivery of the high energy direct current shocks through electrodes catheters for treatment of patients with cardiac arrhythmias was first introduced in 1981. In 1987, this experimental technique has become established as a therapeutic tool for selected patients.