IMPLANTED ARTIFICIAL CARDIAC PACEMAKER IN A MAN-MACHINE COMPLEX SYSTEM

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CURRENT STATUS OF LONG-TERM CARDIAC PACING IN JAPAN

Since 1963 when the first cardiac pacemaker was implanted in a patient with complete atrioventricular block, in Japan total number of new implants was approximately 1,000 until recently. Although, of these late years, new implants have been increasing very rapidly year after year, comparing with the nation's population of over one hundred million, 1,000 are extraordinary few.

They say that there live 50 thousand people with cardiac pacemakers implanted in the United States, from which 25 thousand must exist in Japan. Of course, this will be a similar phenomenon to that in other acquired cardiac diseases probably due to some racial, dietary and other differences between the two countries. Even so, according to a crude statistic, the incidence of heart block with bradycardia in Japan will be 15 and more or less per a million population each year, all of which will be the subjects of pacemaker implantation. Compared with this number, total 500 new implants of 1971 were less than one third of required.

Most of the recently-implanted pacemakers were imported: 95% from the United States, 5% from England and few from other and our own countries.

The reasons of this Japanese current status must be further analyzed and discussed.

PROBLEMS IN INDICATION OF PACEMAKER IMPLANTATION

Not only for bradyarrhythmias complicated with Adams-Stokes syndrome due to advanced atrioventricular block, sinoatrial block or sinus node dysfunction, but also for right bundle branch block with left axis deviation, trifascicular bundle branch block, paroxysmal supraventricular or ventricular tachycardia and other rhythm disorders, the cardiac pacemakers tend to be indicated for chronic implantation as absolute, relative or preventive indications. The fact per se that indication and application have been becoming wider and more common is welcomed without any doubt.

At the same time, however, when a pacemaker is implanted, the patient has to be burdened with psychological, economical and social stresses, whereas he will be able to recover from physical distress. Moreover, he has to be put on a continuous aftercare throughout his life.

According to the statistics of 1969, there were 94 new implants per one million population in Sweden, 30 in the United Kingdom, 40 in the United States and 1.6 in Japan. Even as the country of social security and with her domestic pacemaker manufacturing and many investigators in this field, Sweden had to be criticized for too wide indication of implantation.

PROBLEMS IN SELECTION OF PACEMAKER AND IMPLANTATION PROCEDURE

In Japan, over 70% of the currently-implanted pacemakers were demand-type generators, endocardial electrodes and the combination. In fact, this has made the cardiac pacing safer and the implantation easier and more common. On the other hand, application of this combination should be avoided if done without due consideration or done only from a physician's private favour. As the fact, the endocardial electrode used to cause various complications more frequently than the myocardial one. The most suitable pacemaker, implantation procedure and site should be selected for the patient considering his cardiac condition and life before and after implantation.

Although there are some theoretical advantages in the inductive pacemaker, the choice of that system requires some consideration on psychological disadvantages, those of danger in displacement of the transmitting and receiving coils and those in human engineering.

PROBLEMS OF "PACEMAKER SYNDROME"

When setting the new heart rate, namely pacing rate, of the patient, if the physician is careless of the patient's optimal heart rate and of the generator's set-rate before implantation, the patient is apt to suffer from a new complication of "pacemaker syndrome" after the pacing commenced, which complaints are shortness of breath, exertional dyspnea, flushing face, palpitation and sometimes anginal pain.

The "pacemaker syndrome" may be due to discrepancy between the patient's optimal heart rate and pacemaker rate. Sudden and very effective change of his heart rate and of resulted internal milieu will sometimes result in this type of maladaptation syndrome.

This syndrome is rather often seen in the elderly patients with coronary sclerosis or in those who are psychologically unstable.

Even if a given pacing rate might be thought optimal, it could not be so unless the patient could feel comfortable and optimal by himself. In the same meaning, the pacemaker could not be "taken" with mental and psychological burden, even if there was theoretically much physical benefit for the patient.

PROBLEMS IN AFTERCARE OF THE IMPLANTED PACEMAKER

Treatment does not finish but does begin at the time of patient's discharge from hospital.

Pacemaker as a machine with limited longevity of life requires a new unit, the pacemaker clinic, with engineering facilities in the hospital and a continuing human relationship between the patient and physicians and engineers. Special technology is also required for aftercare of the implanted pacemaker.

In case that the regular and periodical check-up is not sufficient in, for example, emergency pacing failure, the pacemaker clinic via telephone transmission and 24-hour services using computer will be needed and realized in the near future.

For the practical convenience and necessity of aftercare, the generator circuit should be designed to have a simple, accurate and reliable correlation between battery and/or component failure and signs and changes of parameters to be checked.

PROBLEMS IN REHABILITATION AND RETURN TO WORK AND COMMUNITY OF THE PATIENT

The ultimate purpose of pacemaker treatment is to realize to let the patient to return to his work and community. In most of the patients it used to be realized, but not in all.

Because the cardiac pacing does not cure the original heart diseases but is only a symptomatic treatment, an indication of rehabilitation to the patient should be the most adequate to his status based on an over-all evaluation of cardiac reserve function at his given heart rate.

Suspension of car-driver's license of the people with pacemaker in London was a procedure of con-

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tradictions from the view points of safety and social welfare. "The remedy is worse than the evil."

TECHNOLOGY ASSESSMENT OF ARTIFICIAL CARDIAC PACEMAKER

It is doubtless that progress of pacemaker technology must be always promoted without interruption. Even if the pacemaker is the most modern model, it must always have many things to be improved in circuit, battery, electrode and moulding as well as in principle and theory.

In many aspects, such as medical, technological, socioeconomical, political and ecological, uncontrolled implantation of the nuclear (plutonium-238 and others) pacemakers must be a subject of strict criticism.

The artificial cardiac pacemaker cannot exist only upon technology but also upon its assessment.