

Pacemaker Implantation in Singapore in 1997

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ABSTRACT

Introduction: Previous reports on pacemaker implantation in Singapore have been from a single institution and hence may not accurately reflect the practice in Singapore. As part of the World survey on pacemaker implantation, a survey of all pacemaker implantations in Singapore in 1997 was performed.

Method: Information was obtained from the pacemaker manufacturers and a survey form was sent to all doctors involved in pacemaker implantation.

Result: In 1997, 206 pacemakers were implanted or replaced in Singapore. This gives a pacemaker rate of 69 per million. For new implants only, there were 61 implants per million. More detailed information regarding the patient and implantation was obtained in 160 (78%) patients. The mean age of the patients was 68.5 ± 14.4 years (range 2 – 97 years). There were 142 (89%) new implants and 18 (11%) replacements. 62.5% of the patients were females. Seventy-nine percent of the patients were older than 60 years old and 17.5% were older than 80 years. Seventy-five percent of the pacemakers were single chamber pacemakers. Twenty-five percent were dual chamber pacemakers. Only 1.4 % of the pacemakers used epi-myocardial leads and all these were in children. Heart block was the most common indication for pacing and consisted of 52.8% of the patients while 43.0% of patients were implanted for the sick sinus syndrome.

Conclusion: Pacemaker implantation in Singapore in 1997 was 69 per million. Heart block remains the most common indication for implant and single chamber pacing is still the most commonly used mode of pacing. The majority of the implants were in persons older than 60 years. With an increasing ageing population in Singapore, the implant rate for pacemakers will be expected to increase significantly.

Keywords: pacemaker implant, permanent pacing, heart block, sick sinus syndrome

INTRODUCTION

Permanent pacing has become the established treatment for patients with symptomatic bradyarrhythmias since it was first introduced in 1958⁽¹⁾. Drugs are no longer recommended, as they

have significant side effects and cannot be used long term. The indications for permanent pacing have been clearly established and guidelines have been published⁽²⁻⁴⁾. The most common indications for pacing is complete heart block and the sick sinus syndrome⁽⁵⁾ and studies have clearly established that pacemakers improve survival in patients with symptomatic complete heart block^(6,7).

A previous report on pacemaker implantation in Singapore⁽⁸⁾ has been from a single institution and hence may not accurately reflect the practice in Singapore. As part of the World survey on pacemaker implantation, a survey of all pacemaker implantations in Singapore in 1997 was performed. This report summarises the findings of this nationwide survey, providing us with an idea of the practice of pacemaker implantation in Singapore.

METHODS

Information was obtained from the pacemaker manufacturers and a detailed survey form was sent to all doctors involved in pacemaker implantation. The total number of pacemakers implanted or replaced were estimated from the manufacturer's information. There were only 3 pacemaker companies supplying pacemakers in Singapore in 1997 and hence detailed information about the total number of pacemakers implanted in Singapore could be obtained. The survey form was sent to all cardiologists and cardiothoracic surgeons in Singapore who implant pacemakers, to obtain detailed information on the age, sex, primary symptoms for initial implants, indication for initial implant, pacing mode at implant, mean post-implantation hospital stay, type of pacing lead, lead polarity, method of lead fixation, steroid or non-steroidal eluting lead and method of lead insertion.

DEFINITIONS

Pacemakers are classified according to standard pacemaker codes that have been developed to define the operational function of the pacemakers. These were first adopted by the Inter-Society Commission on Heart Disease (ICHD) in 1974 as a 3-letter pacemaker code and subsequently revised to a 5-letter code in 1981^(9,10). In 1987, the North American Society of Pacing and Electrophysiology together with

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the British Pacing and Electrophysiology Group⁽¹¹⁾ modified the pacemaker code but the most commonly used code is still the 3-letter code with the fourth letter depicting the presence or absence of rate response. The first letter of the code denotes the chamber paced, while the second letter denotes chamber sensed and the third letter indicates the response to sensing. The most common codes used are thus:

- VVI Ventricular demand pacemaker, inhibited by sensing in the ventricle
- AAI Atrial demand pacemaker, inhibited by sensing in the atrium
- VVIR Ventricular demand pacemaker, inhibited by sensing in the ventricle and with rate response to activity
- VDD Ventricular pacing triggered by sensing in the atrium inhibited by sensing in the ventricle
- DDD Dual chamber pacemaker with atrial pacing inhibited by atrial sensing in the atrium or ventricle; ventricular pacing triggered by sensing in atrium, inhibited by sensing in ventricle
- DDDR Dual chamber pacemaker with features of DDD but has additional rate response to activity

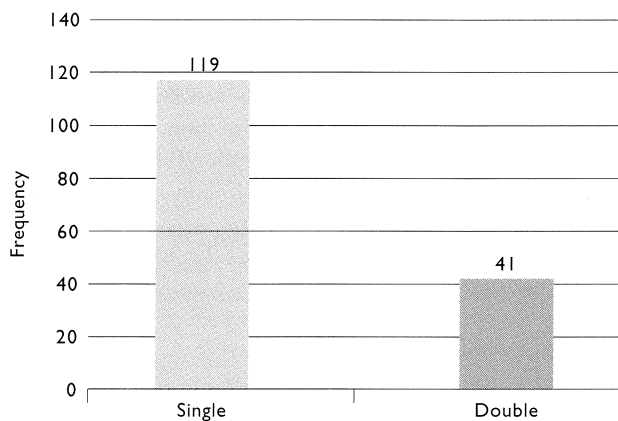


Fig 1 – Single chamber versus dual chamber pacemaker implantations.

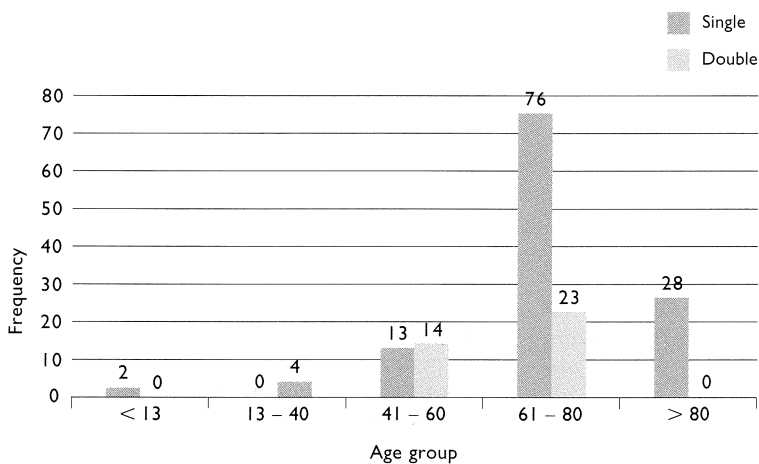


Fig 2 – Age distribution of single and dual chamber pacemaker patients.

Automatic mode switching is a special feature in the pacemaker that automatically switches from an atrial tracking mode to a non-tracking mode during episodes of atrial tachyarrhythmias, to avoid ventricular pacing at unwanted high rates. When the atrial rhythm meets the criteria for a physiologic rhythm, the mode switches back to an atrial tracking mode.

RESULTS

In 1997, 206 pacemakers were implanted or replaced in Singapore. With an estimated population of 3 million in Singapore, this gives an overall pacemaker rate of 69 per million. There were 184 new implants and 22 replacements. Considering only the initial implants, the number of new implants per million was 61. The implants were performed by cardiologists in 97% and only 3% were implanted by cardiothoracic surgeons. The pacemakers were implanted in 6 hospitals in Singapore.

More detailed information regarding the patient and implantation was obtained in 160 (78%) of the patients surveyed. This report details the information obtained from the survey. The mean age of the patients was 68.5 ± 14.4 years (range 2 – 97 years). There were 142 (89%) new implants and 18 (11%) replacements. Females predominated and comprised 62.5%, of the patients. The pacemakers were implanted in older patients with 79% of the patients older than 60 years and 17.5% older than 80 years. As shown in Fig 1, 75% of the pacemakers were single chamber pacemakers (VVI, VVIR or VDD pacemakers) while 25% were dual chamber pacemakers (DDD or DDDR pacemakers). The age distribution of single and dual chamber pacemaker patients is illustrated in Fig 2. Only 1.4% of the pacemakers used epi-myocardial leads and all these were in children.

When considering only the 142 initial implants, the primary symptom for initial implants was dizzy spells in 42% and syncope in 32%. Heart block was the most common indication for pacing and consisted of 52.1% of the patients, while 42.9% were implanted for the sick sinus syndrome. Other indications included history of torsade de pointes in 1.4% and post-radiofrequency catheter ablation of the AV node in 2.8% (Table I). The initial pacing mode at implant

Table I – Indications for pacing

Indications	Percentage of patients
Complete heart block	52.8%
Sick sinus syndrome	42%
Post radiofrequency ablation	2.8%
History of torsade de pointes	1.4%

was VVI or VVIR in 61.2%. No AAI/AAIR was implanted in 1997. 9.9% of the initial implants were single pass VDD pacemakers and 28.9% of the pacemakers were DDD or DDDR pacemakers. Importantly, 16.9% of the pacemakers had automatic mode switch capabilities. The mean hospital stay was

3.6 days. 98.6% of the pacemaker leads were implanted transvenously and only 1.4% of new implants were implanted epicardially via thoracotomy. The leads were bipolar in 80.7% and unipolar in the rest. When atrial leads were implanted, 82.5% of the leads were implanted by active fixation via screw-in leads and 17.5% were passively fixed by tines on the distal end of the atrial J leads. For the ventricular leads, 94.9% of the leads were passively fixed via tines and only 5.1% of the leads were actively fixed via screw-in leads. All atrial leads and 96.3% of ventricular leads had steroid elution. The main technique of lead cannulation was via a subclavian puncture and an introducer which was performed in 80% of atrial leads and 87.6% in ventricular leads. There were no lead extractions done in Singapore in 1997.

DISCUSSION

This survey of pacemaker implantation is a very comprehensive survey as previous published surveys are usually only a small sample of cases in the country^(5,12). We were also able to obtain complete details of the pacemaker implantation in the country because of the small number of pacemaker companies and limited number of centres implanting pacemakers in Singapore. The survey showed that pacemaker implantation in Singapore is still relatively low. The number of new implants per million is only 61. This is very low compared to the estimated 434 per million new implants in the United States of America in 1993⁽⁵⁾. This number of implants in the US may however be too high when compared with the rest of the world. In the United Kingdom, cardiac pacing increased from 148 implants per million in 1989 to 202 per million in 1992⁽¹³⁾. The British Cardiac Society estimated from the current indications for pacing that about 300 per million population would receive a permanent pacemaker each year⁽¹⁴⁾. The low number of implants per million in Singapore is likely to be due to our relatively young population at present. As can be seen, the majority of pacemakers are needed in the elderly patients, as demonstrated by the mean age of patients being 68.5 ± 14.4 years, with 79% of the patients older than 60 years and 17.5% older than 80 years. In view of our rapidly ageing population in Singapore, we can expect a rapid increase in the number of pacemakers implanted in the future. Surveys in the United States in the 1990s have shown an increase of as much as 6% per year⁽⁵⁾.

In this study, heart block was the most common indication for pacing and accounted for 52.1% of the patients. The second most common indication was the sick sinus syndrome which was the indication in 42.9% patients. This pattern is similar to that in Europe but different from that of the US where sick sinus syndrome has become the most common indication for pacing, accounting for 53% of the indications for pacing^(5,15). It is likely that with increasing age, sick sinus syndrome will become more prevalent as an indication for permanent pacing. Also more frequent use of investigations especially Holter

ambulatory ECGs and occasionally electrophysiological studies will help to unmask patients with the sick sinus syndrome.

The survey also shows that more sophisticated pacemakers are being implanted, with about 10% being VDD and almost 30% being dual chamber pacemakers. The age distribution versus type of pacemakers suggest a lower implant rate of the more physiological dual chamber pacemakers in the older patients. Bipolar steroid eluting leads were also the leads of choice and the majority are implanted transvenously. Transvenous leads are preferred because of their improved chronic thresholds and decreased incidence of lead fracture while bipolar leads have the advantage of better sensing of spontaneous electrical events and less susceptibility to myopotential signals and electromagnetic interference. Our data is very similar to that reported in the survey published in 1992 by Bernstein et al, where the "typical" implanter used bipolar electrode systems in 90% of cases and single-chamber pacemakers in 70%⁽¹⁶⁾. The number of dual chamber implants in subsequent surveys however showed an increased use of dual-chamber pacemakers. Dual chamber pacemakers increased from 32% to 68% of the total, and adaptive-rate systems from 29% to 48%⁽⁵⁾ and it will be interesting to have subsequent surveys in Singapore to see if there is an increasing trend in the use of dual chamber pacemakers.

In conclusion, total pacemaker implantation in Singapore in 1997 was 69 per million and for new implants, 61 per million. Heart block remains the most common indication for implant and single chamber pacing is still the most commonly used mode of pacing. The majority of the implants were in persons older than 60 years, and hence with a rapidly ageing population in Singapore, the implant rate for pacemakers is expected to increase significantly.

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