Seasonal Distribution of Pacemaker Implantation for Symptomatic Bradycardia

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SUMMARY

Permanent cardiac-pacemaker therapy is widely recognized as beneficial in the treatment of various types of symptomatic bradycardia. However, the seasonal distribution of pacemaker implantation has never been discussed. The purpose of this study was to investigate the seasonal distribution of pacemaker implantation in a large population of patients with symptomatic bradycardia. The study population consisted of 904 patients who underwent implantation of a new permanent pacemaker between January 1999 and December 2001 and were registered in the database of CPI Company in Taiwan. The number of pacemaker implantations in each month was analyzed to investigate the seasonal distribution of pacemaker implantations in a year. The number of patients who underwent pacemaker implantation between October and December was significantly higher than that of other seasons ($P < 0.007$). The results indicate that there is a tendency for bradyarrhythmic patients to have symptoms between October and December. (Jpn Heart J 2003; 44: 379-384)

Key words: Bradycardia, Pacemaker, Season

PERMANENT cardiac-pacemaker therapy is widely recognized as beneficial in the treatment of various types of symptomatic bradycardia. Over 70 percent of pacemaker recipients are at least 70 years old. In symptomatic sinus node disease and atrioventricular block, syncopal attacks and other cerebral manifestations of bradycardia can occur unexpectedly and pacemaker placement leads to dramatic improvements in health-related quality of life. No previous study has discussed the seasonal distribution of pacemaker implantation. Therefore, the purpose of this study was to investigate the seasonal distribution of pacemaker implantation in a large population of patients with symptomatic bradycardia. This study should provide important information in terms of which season brad-
yarrhythmic patients are predisposed to having symptoms, especially in the elderly.

**METHODS**

**Patient population:** The study population consisted of 904 patients who underwent implantation of a new permanent pacemaker between January 1999 and December 2001 and were registered in the database of CPI Company in Taiwan. Patients who had pacemaker replacement were excluded from this study. There were 432 men and 472 women, ranging in age from 16 to 99 years (mean, 71 ± 11 years). Six hundred and ninety patients underwent dual chamber pacemaker implantation and the remaining 214 patients single chamber pacemaker implantation. Four hundred and forty-two patients received pacemaker implantation for sick sinus syndrome, 440 patients for symptomatic atrioventricular block, and 22 patients for concomitant sick sinus syndrome and atrioventricular block. The number of pacemaker implantations in each month was analyzed to investigate the seasonal distribution of pacemaker implantations in a year.

**Statistical analysis:** Data are expressed as the number of patients. Categorical variables were compared using the chi-square or Fisher’s exact test. In order to avoid the potential influence of a festival or holiday on data analysis, we compared the seasonal (3 months) distribution of pacemaker implantation instead of the monthly distribution. Statistical analysis was performed using the computer software program SAS for Windows, version 6.12 (SAS institute, Cary, NC). A probability value < 0.05 was considered statistically significant.

**RESULTS**

**Seasonal distribution of pacemaker implantation in the whole population group:** A trend towards a higher number of pacemaker implantations in November and December in the whole population was observed (Figure 1). The number of patients who received pacemaker implantation between October and December was significantly higher than that of other seasons in the whole population ($P < 0.007$) (Figure 2). There was also a trend towards a higher number of pacemaker implantations between October and December than other seasons in each year.

**Seasonal distribution of pacemaker implantation in sick sinus syndrome:** There was a trend towards a higher number of pacemaker implantations between October and December compared to other seasons for each year, although the difference did not reach statistical significance ($P = 0.16$, 0.152, and 0.675, respectively in 1999, 2000, and 2001; $P = 0.078$ as a whole) (Figure 3).
Figure 1. Monthly distribution of pacemaker implantation in the entire study population.

Figure 2. Seasonal distribution of pacemaker implantation in the entire study population. Numbers in the columns represent the number of patients. \(P^* < 0.007\).

Figure 3. Seasonal distribution of pacemaker implantation in the sick sinus syndrome patients.
Seasonal distribution of pacemaker implantation in atrioventricular block: There was a trend towards a higher number of pacemaker implantations between October and December compared to other seasons for each year, except in 1999 ($P = 0.0027, 0.255, \text{ and } 0.157, \text{ respectively in } 1999, 2000, \text{ and } 2001; P = 0.07 \text{ as a whole}$) (Figure 4).

**DISCUSSION**

This is the first study to investigate the seasonal distribution of pacemaker implantation for symptomatic bradycardia. Our study demonstrates that the number of pacemaker implantations between October and December was significantly higher than that of other seasons. The reason for the predominance is unknown. However, the study does provide important information in terms of which season predisposes bradyarrhythmic patients to have symptoms.

**Mechanism of predominance of pacemaker implantation between October and December:** There was one putative mechanism. Myocarditis is an insidious disease that is usually asymptomatic. There is a consensus that viruses are an important cause of myocarditis. It has been generally assumed that the majority of cases of viral myocarditis are due to enterovirus infection. Virus infections have been demonstrated to occur predominantly in the winter season in Asia. An association between virus infection and bradycardia, such as atrioventricular block and sick sinus syndrome, has been reported. More recent studies in animals have enhanced our understanding of the complex interactions between direct viral injury and the immune response of the host. The mechanisms of virus-induced bradycardia include direct lytic damage or an immunologically
mediated killing of myocytes and the cardiac conduction system.\textsuperscript{6,10,11} Maisch and colleagues demonstrated that the incidence of anti-sinus node antibodies is high in patients with former myocarditis and sick sinus syndrome.\textsuperscript{10} Therefore, myocarditis may be the triggering process for sick sinus syndrome or bradyarrhythmia in later life.

Socioeconomic issues should not be a cause of this discrepancy since the National Medical Insurance Bureau of Taiwan provides coverage for pacemaker implantation in our country. The influences of festivals or physician vacations on the discrepancy were minimal because physician vacations are usually less than 2 weeks in Taiwan. All of the indications for pacemaker implantation in our country are strictly based on the ACC/AHA guidelines\textsuperscript{12} and the National Medical Insurance Bureau strictly monitors pacemaker implantation. This should exclude the possibility of the existence of a quota CPI.

\textbf{Study limitations:} There are several limitations in this study. First, we analyzed a registered database on CPI pacemaker implantations in Taiwan and therefore, we could not provide information regarding the impact of underlying cardiac diseases on the seasonal distribution of pacemaker implantation. Second, there tended to be a higher number of pacemaker implantations between October and December in both the sick sinus patients and atrioventricular block patients. The reason we were unable to demonstrate statistical significance for the predominance of pacemaker implantation between October and December in the sick sinus patients or atrioventricular block patients could be due to a type-2 error. Finally, whether our observations can be applied to other countries, especially non-Asian countries, needs to be further investigated.

\textbf{Conclusion:} Pacemaker implantation in bradyarrhythmic patients occurred predominantly between October and December in Taiwan.

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\section*{REFERENCES}