Trends Amongst Implantable Cardioverter Defibrillator Patients in a Tertiary Cardiac Centre in Singapore from 2002 to 2011

Dear Editor,

Implantable cardioverter defibrillators (ICDs) are established therapy for cardiac patients at significant increased risk of sudden cardiac death. The relative risk reduction in mortality range from 23% at 5 years for primary prevention patients in the SCD-HeFT trial[1] to 39% at one year for the secondary prevention patients in the AVID trial.[2]

Current guidelines of all major cardiac societies in North America, Europe and Australia clearly state that ICDs constitute evidence based therapy for improving survival amongst symptomatic heart failure patients with reduced left ventricular ejection fraction (LVEF≤35%), patients with prior ventricular tachycardia/fibrillation and patients with significantly increased personal risk of sudden cardiac arrest (due to various conditions such as high risk hypertrophic cardiomyopathy).

Utilisation of this therapy however to reduce sudden death has historically been low in Singapore.[3] With the publication of guidelines recommending ICDs as a Class I Level A evidence treatment since 2001, we describe the changing trends amongst patients undergoing ICD implantation at the National Heart Centre, Singapore (NHCS). The data derived from our centre provide an indication of the general trends in Singapore due to our centre being a major contributor to the total number of ICDs implanted yearly in our country.

Materials and Methods

We traced the medical records of all patients undergoing implantable cardioverter defibrillator (ICD) or cardiac resynchronisation therapy defibrillator (CRTD) implant at our centre over a 10-year period from 2002 to 2011. Patients were included in the study if they had a new ICD or CRTD implanted, or had an upgrade from a pacemaker to an ICD/CRTD. Patients with ICDs/CRTDs implanted at other centres locally, overseas or outside the study period were excluded. Patients undergoing pulse generator change or device revision for a pre-existing ICD/CRTD were also excluded.

Relevant clinical information was extracted from the medical records including age, ethnicity, gender, indications, LVEF, cardiac conditions, use of electrophysiology study, type of device, complications, duration of follow-up and presence of significant arrhythmias on follow-up.

This study complies with the Declaration of Helsinki, and our research protocol was in agreement with regulations provided by our Institutional Review Board.

Results

A total of 611 patients underwent de novo ICD implantation at NHCS over the 10-year period from 2002 to 2011. The mean age of our population was 59.5 ± 12.0 (SD) years. The ethnic breakdown of our ICD patients was as follows: Chinese 64.5%, Malays 12.1%, Indians 14.6% and Others 8.9%. The large majority of ICD patients were male (82.2%) with the proportion decreasing slightly in recent years.

Total yearly ICD implants have increased from 18 in 2002 to 144 in 2011, with the greatest increase occurring from 2009 to 2010 (Fig. 1). The majority of the increase has been due to primary prevention implants. At the beginning of the study period, primary prevention cases constituted 38.9% of all implants in 2002. By 2011, primary prevention cases reached a high of 88.2% of all ICD implants at NHCS.

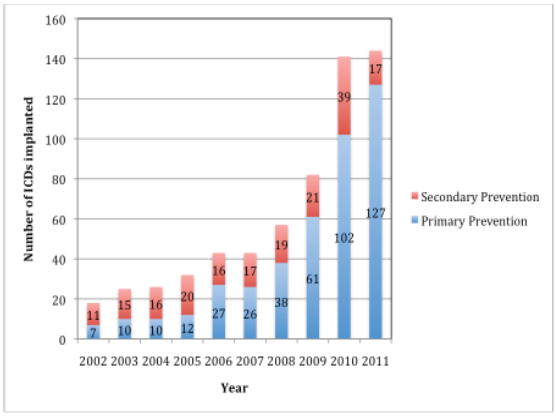

Fig. 1. Number of new implantable cardioverter defibrillator implants by Year (subdivided into Primary and Secondary prevention indications).

The most common cardiac diagnosis in our study population was ischaemic heart disease with reduced ejection fraction or prior ventricular tachycardia or fibrillation (VT/VF) (67.6%). This was followed by non-ischaemic cardiomyopathy (22.4%). Other less common diagnoses include hypertrophic cardiomyopathy, Brugada syndrome, arrhythmogenic right ventricular dysplasia, Long QT syndrome and prior VT/VF in an otherwise normal heart (Fig. 2).

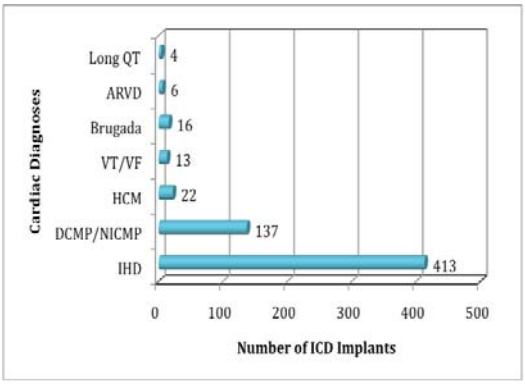

Fig. 2. Cardiac diagnoses of patients undergoing implantable cardioverter defibrillator implantation at National Heart Centre, Singapore.

ARVD: Arrhythmogenic right ventricular dysplasia; Brugada: Brugada syndrome; VT/VF: Ventricular tachycardia or fibrillation (in a structurally normal heart); HCM: Hypertrophic cardiomyopathy; DCMP/NICMP: Dilated cardiomyopathy/non-ischaemic cardiomyopathy; IHD: ischaemic heart disease

Utilisation of electrophysiology study (EPS) prior to ICD implantation has dropped dramatically over the 10-year period studied. From 40% of patients prior to ICD implants in 2002/2003, EPS usage has declined to 1.4% in 2010/2011. The greatest decline occurred from 2005 to 2006.

CRTD implants as a percentage of total ICD implants have increased from 0% in 2002 to 19.4% in 2011 (Fig. 3).

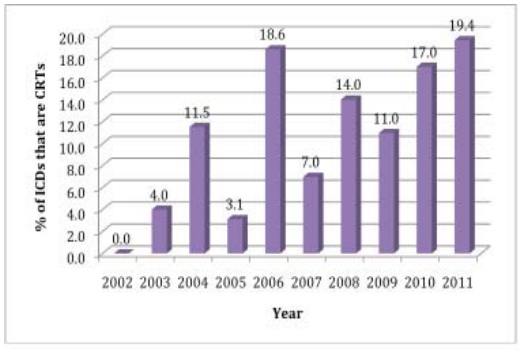

Fig. 3. Cardiac resynchronisation therapy defibrillators as a percentage of total implantable cardioverter defibrillator implants by year.

Short-term (<6 month) complication rates directly arising from ICD implant as tracked by the Singapore Cardiac DataBank remained low. There was no intra-procedural or immediate post procedural mortality at our centre over the period studied. Most common complications identified include lead dislodgement (1.3%), infection (0.8%) and major pocket haematoma (0.5%).

Discussion

The obvious trend across 10 years of ICD implants at NHCS is a major increase in new ICDs implanted, especially amongst primary prevention patients. The number of primary prevention implants has increased 18 fold from 7 in 2002 to 127 in 2011. Secondary prevention implants have increased as well, but less consistently and at a slower pace. The major increase in 2010 at NHCS occurred 8 years after the publication of MADIT II study[4] and 5 years after SCD-HeFT study[1]—the 2 major primary prevention clinical trials which demonstrated significant mortality reduction in the ICD arm. This contrasts with the United States, which had major increases in ICD implants from 2002 onwards.[5] When compared with other developed countries, new ICD implant rates in Singapore remain low at 32 per million population based on the 2009 World Survey of Pacemakers and ICDs.[6] In Australia it was 160 per million, United Kingdom 97 per million, Germany 290 per million, Norway 102 per million, Israel 167 per million and USA 434 per million. Nonetheless, in Asia, Singapore was one of the leading implanters and only Japan had a higher rate at 42 per million. With increasing numbers of ICD implants at NHCS and other local hospitals, it is likely Singapore's ICD implant rate will rise at the next World Survey.

The patients' mean age of 60 years and 82% of them were males are a reflection of the underlying population for which ICD is indicated. However, at 60 years, the mean age is lower than that in the US,[5] suggesting that ICDs are less likely to be implanted amongst elderly patients in Singapore compared to the US.

The dramatic decline in electrophysiology study (EPS) usage prior to implant was expected. Prior to 2002, primary prevention patients had to undergo EPS before being classified eligible for ICD implant. It was only after the MADIT II[4] and SCD-HeFT[1] studies that EPS was no longer required for primary prevention patients. Cardiac resynchronisation therapy defibrillator (CRTD) implants as a proportion of total ICD implants has increased but less consistently. In recent years, the proportion of CRTD implants has approached about 20% of all ICDs implanted at NHCS. The actual number of CRTD implants remain low relative to the rates in North America and Europe.

Complication rates associated with device implants have remained low in our centre. Overall rates of lead dislodgement and infections have remained acceptable despite a major increase in ICD implants. In the US, there has been a major increase in device related infections[7] over recent years attributed to the increasingly ill patients with multiple comorbidities undergoing device implants. Although we have not seen such a trend locally or at our centre, this will be an area for close monitoring in the coming years as our implant numbers increase and the types of patients requiring ICDs become increasingly complex.

Conclusion

The number of ICD implants at NHCS has increased significantly over the 10-year period from 2002 to 2011. Majority of this increase was driven by implants for primary prevention. Despite the increase in ICD implants, the complication rates have remained low with no short-term mortality arising directly from the implantation procedure.

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