REVIEW ARTICLE

Sudden Cardiac Death in India : A Growing Concern

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Abstract

The incidence of sudden cardiac death (SCD) is based on studies from North America and Western Europe with very few countries in Asia having conducted robust studies evaluating the occurrence of SCD. This paper reviewed published data on SCD, with a focus on India. In recent years, varying methods of assessment such as verbal autopsies, questionnaires, and quantification of surrogate endpoints such as cardiovascular disease profiles have been used to estimate the incidence of SCD. These studies have shown that the incidence of SCD is on the rise, especially in the urban regions, which may be largely attributed to the increase in prevalence of coronary artery disease, diabetes and hypertension in India. These studies have shown that the risk stratification and management approach for SCD are conspicuously varied and there is a need for establishing a systematic approach for estimating the incidence and risk factors of SCD in India.

Introduction

Sudden death is defined as natural death, in which the time and mode of death is unexpected, in an individual with or without pre-existing cardiac diseases, and which occurs within 1 hr of the onset of the heralding symptoms.[1] This definition is often usable as a combination of the various definitions of sudden death, which vary according to clinical, scientific and medico-legal requirements. In the vast majority of the cases, the eventual cause of sudden death has been attributed to cardiac causes and several studies have used the terms 'sudden death' and 'sudden cardiac death' (SCD) synonymously.[2] The recent estimates of SCD in the United States range from 184,000-462,000 deaths annually, with the incidence of SCD ranging from 60 to 151 per 100,000 inhabitants per year in the United States. SCD also accounts for more than 60% of all cardiac deaths.[3,4] The studies conducted in the decade prior to this have also shown comparable estimates, considering the varying methods of assessment such as death certificates, autopsies, hospital records, questionnaires and direct interview of relatives. The figures from these studies suggest an overall incidence between one and two deaths per 1000 persons among the general population, with the incidence increasing to more than 20 times in patients with severe cardiovascular diseases.[5] In the studies evaluating the causes of SCD, the most common underlying substrate has been coronary artery disease (CAD), followed by arrhythmias.[6]

Most of these studies were from North America and Western Europe; the estimates have significantly influenced their health care systems in establishing systematic diagnostic measures for early risk stratification of cardiovascular conditions. In India, we do not have a national registry for sudden death.[2] Very few countries in the Asia-Pacific region have conducted studies evaluating the occurrence of SCD using systematic methods of assessment. This lag in setting up adequate risk stratification measures has thwarted the significant advancements made by India in emergency critical care management.

We, therefore, reviewed recent published data on SCD for its causes, risk factors

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Received: 07.05.2014; Accepted: 26.05.2014

and points of concern in management, with a focus on India.

Methods

A literature search was performed with PubMed and Google Scholar using the key words "sudden cardiac death", "India" and a combination of "sudden death" with mechanisms, causes or cardiovascular diseases. Only English language articles were included. References cited in these articles were also reviewed. The articles published from 2004 to 2014 were prioritised while outlining points for discussion in this review.

Causes and Risk Factors of SCD

The assessment of the causes and risk factors of SCD is important for identifying population sub-groups at risk, especially when direct epidemiological data collection methods are inadequate. These sub-groups can be broadly identified according to their cardiac disease profiles, age, gender and lifestyles.

Cardiac Disease Profiles

The major cardiovascular diseases which carry a significantly greater risk of SCD[2] are as follows:

- Coronary artery disease (CAD)
- Electrophysiologic abnormalities:
  - Long QT syndrome
  - Brugada syndrome
  - Sudden Infant death syndrome (SIDS)
  - Pre-excitation syndromes
  - Conduction system abnormalities
- Cardiomyopathies:
  - Idiopathic dilated cardiomyopathy – heart failure
  - Hypertrophic cardiomyopathy
  - Arrhythmogenic right ventricular dysplasia
- Valvular heart disease:
  - Aortic stenosis

Amongst these, CAD is by far the largest causative factor for SCD, with the incidence of SCD paralleling the prevalence of CAD.[7] Electrophysiological disorders leading to ventricular fibrillation constitute 5% of SCD in the general population between the age of 16-64 years and almost 25-35% of SCD in the age group less than 40 years.[6]

Age and Gender

Studies have shown that the incidence of both SCD and CAD increase with age, with the peak incidence of SCD occurring in two age groups: between birth and 6 months of age (SIDS), and between 45 and 75 years of age.[7]

In the studies in the USA, the cause of SCD differed for deaths in the 35 to 64 years, and 65 years or more age groups. In the 35 to 64 years age group, acute CAD, arrhythmias and cardiomyopathy were more common in the younger age group while chronic CAD and heart failure were more common in the older age group.[2,7] The annual incidence of SCD is three to four times higher in men than in women, with approximately 75% of SCD in men.[2] The reason for this difference is attributed to the gender difference in the incidence of CAD and the protection from atherosclerosis in women before menopause.[2,7]

India has faced substantial challenges in employing conventional epidemiological tools to collect mortality data and possibly due to these factors, until recently, there was no contribution to global SCD data from India.[8] In 2004, a study by Gajalakshmi and Peto provided valuable preliminary estimates on SCD using a verbal autopsy methodology, although the primary objective of the study was to assess the classification of deaths using verbal autopsy.[2] The first data of SCD in India was obtained in 2012 by applying the verbal autopsy methodology across Andhra Pradesh.[9] In this study, questionnaires administered by trained health workers were used to collect mortality data in 45 villages. The data was analysed retrospectively to estimate the prevalence of sudden deaths in this rural population. Analysis of this data revealed that cardiovascular diseases were the leading causes of mortality in rural population. The distribution of causes for SCD in this study was comparable to studies across the globe. However, the proportion of SCD cases in the younger age groups was relatively higher, which was attributed to the higher prevalence of CAD in the young in India.[8]

Life-style and Psychosocial Risk Factors

The present day urban lifestyle with its contributing psychosocial factors have been implicated in the increased risk of SCD.[2] Factors such as low educational levels, greater alcohol consumption, obesity and cigarette smoking have also been directly associated with increased risk of SCD.[2] Epidemiological observations have also linked low levels of physical activity with increased risk of CAD.

SCD in India-Points of Concern

In India, the levels of coverage of vital registration and the reliability of the cause of death as stated on the death certificate is often low, especially in the rural areas; this has significantly impacted the estimation of SCD incidence. Consequently, surrogate endpoints such as cardiovascular disease profiles have been

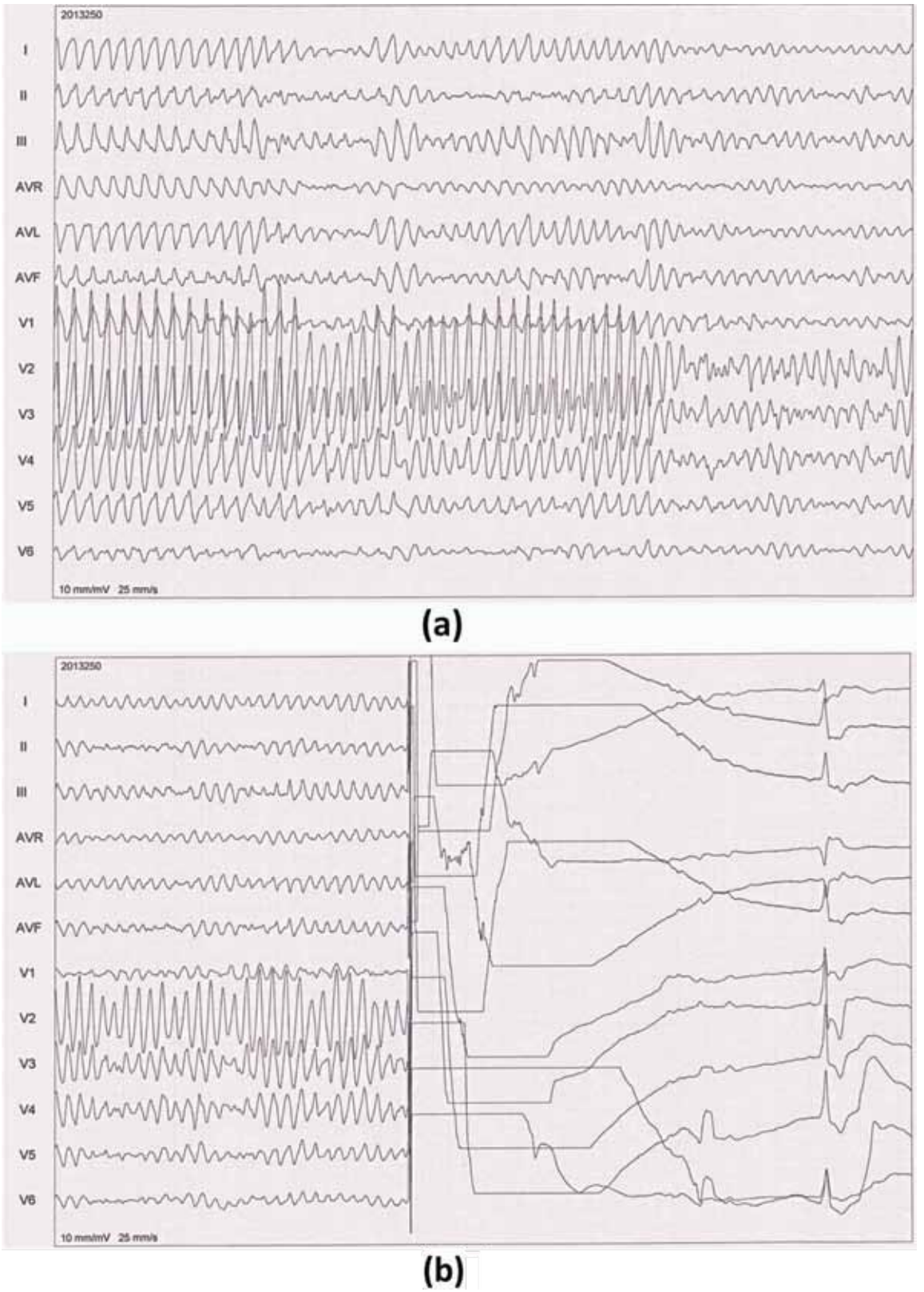

Fig. 1 : (a) ECG showing ventricular fibrillation induced during electrophysiology study in a 72 year old man with an old myocardial infarction, frequent PVCs and a history of syncope; (b) Prompt defibrillation restored sinus rhythm after a pause. The patient subsequently underwent an ICD (implantable cardioverter-defibrillator) implantation

extrapolated to estimate the incidence of SCD. In recent years, India has shown an increase in the rates of CAD and a corresponding increase in SCD incidence. This trend was similar to the increase in prevalence of the major cardiovascular diseases in the other South Asian countries like China, Thailand, Pakistan etc.[2]

The first study evaluating SCD as an endpoint using verbal autopsy by Rao et al in 2012 showed that SCD contributed to 10.3% of overall mortality.[9] The mean age of SCD cases was significantly lower (60 years) in this study as compared to studies in the United States and Europe (75 years), with 21% of the deaths in people below 50 years of age. In this study, one-third of the SCD cases had old myocardial infarction (MI) and 80 per cent of them had risk factors (hypertension, diabetes, and smoking) associated with CAD.[9] In a similar study, acute MI preceded about half the cases of SCD and involved a younger population.[8] The data from this study on extrapolation to national mortality figures places the annual incidence of SCD at about 7 lakhs in India. This study also showed a difference in the SCD cohort from India, compared to previous studies. This emphasises the importance of establishing an optimal, structured and systematic diagnostic work-up for risk stratification of SCD in India.

Diagnostic Work-up for Assessing Risk of SCD

The usual goal for an individual patient being assessed for risk of SCD is to determine the appropriateness of implanting an ICD versus choosing the medical therapy versus providing the patient with information regarding his or her prognosis. Presently, in India, there is no consensus regarding the level of risk that justifies an intervention, based on either the level of benefit or cost associated with the intervention.

The majority of SCD cases will occur in the general population who are not known to have heart disease.[7] Unfortunately, there is no universally applicable test for assessing SCD risk in this population. The ECG may be the only test which could be undertaken for our adult population. However, it has a poor sensitivity in identifying SCD risk.

Based on an approximation of the current scenario for risk-stratification of SCD and the measures available for managing the risk of SCD in India, the following measures are outlined. A routine 12-lead ECG may be used to identify a prior MI by showing typical Q-wave infarct pattern, or it may show increased R-wave voltage, suggesting primary or secondary ventricular hypertrophy. Non-specific ST/T wave changes with intra-ventricular conduction delay may suggest the presence of a possible cardiomyopathy. These ECG abnormalities raise the clinical suspicion of structural heart disease. Similarly, the QT interval is an evident marker for SCD in patients with the long-QT syndrome. However, further data is needed to assert the use of QT interval, QT dispersion, or QT-interval variability for risk stratification for SCD in patients without the long-QT syndrome.

The ambulatory (Holter) ECG evaluation of patients may detect ventricular arrhythmias which are of significance in identifying post-myocardial infarction patients with a high risk for sudden death. Overall, however, Holter has a very limited predictive value in identifying the high-risk patient. Left ventricular dysfunction is well established as a risk factor for sudden death and can be evaluated using echocardiography. However, the use of this classification method to identify patients with systolic dysfunction and, therefore, at risk for SCD is limited by its applicability to a large segment of the population. Similarly, the stress test for ischaemia is limited in its usefulness.

Secondary Prevention of SCD

Presently, the most effective long-term treatment that is currently available for SCD is the Implantable Cardioverter Defibrillator (ICD) (Figure 1). This therapy is generally more effective than drug-based treatments but has not been uniformly adopted, probably because of differing medical priorities in communities that have limited resources.

Studies in patients with a prior history of cardiac arrest, or sustained ventricular tachycardia (VT) have demonstrated convincingly that the implanted defibrillator is both effective, and superior to antiarrhythmic drug therapy in preventing all cause mortality. The main barrier to more widespread use of prophylactic implanted defibrillators, at least in the Indian context, is the cost. In addition, the total number of years added to life, as well as the quality of these added years, is not fully elucidated given the relatively short follow-up time of all of the studies published thus far.

Management of SCD Events- an Indian Perspective

While the establishment of risk stratification of SCD in India is a matter of consensus across medical groups, the real-time management of SCD events are largely impacted by non-medical confounders. The time from symptom onset to presentation at hospital is typically longer among patients in India than in the West. The mortality of MI showed that 60% of deaths that occurred out of hospital were sudden.[11] Thus, hospital based treatment of MI including high-tech primary angioplasty, would prevent only a small proportion of MI deaths.

Time-to-treatment is critical when considering the chance of survival for an SCD victim. 95% of those who experience SCD die because they do not receive life-saving defibrillation within 4 to 6 minutes, before brain and permanent death start to occur.[2,11] In India, most people do not know how to respond when

someone collapses suddenly. The study by Madhavan et al also states that although not specifically sought during verbal autopsy data collection, the lack of mention of any form of resuscitation in all the deaths analysed was striking.[12] The majority of SCD events occurred at home, and were witnessed in 85% of cases.

The time from symptom onset to emergency department arrival for patients with acute ST elevation myocardial infarction ranges between 110 and 140 minutes in North America, while in India, it is 180–330 minutes.[13-15] This delay in presentation was attributed to several factors such as lack of symptom awareness, longer distances travelled to reach hospital and problems of transportation. Only 5.4% of patients were brought to hospital in an ambulance, with the large majority using public transport and hired vehicles.[15] A striking finding in this study was that consultation with the family doctor, local practitioner or local primary health centre was often an important cause of delay.[2]

Considering these factors, it is essential to assess and establish the use of automated external defibrillators (AED) in the Indian region. Recent studies evaluating the use of AEDs have demonstrated that application of an AED in communities is associated with nearly a doubling of survival after out-of-hospital cardiac arrest. The AED would be more useful if installed at places with large population density/higher risk status such as railway stations, large housing colonies, office complexes, gymnasiums and shopping malls.[16,17]

In-hospital care is also determined by the type of hospital that the patient attends. In a study using data from 14 hospitals in three states in southern Indian, George et al found that government hospitals were less likely to follow guidelines for the treatment of acute ST elevation MI as compared to private hospitals or those run by voluntary organisations.[13] Interestingly, patients treated at hospitals affiliated to medical colleges were more likely to receive fibrinolytic treatment and β-blockers than those admitted to non-teaching hospitals.[13]

Concluding Remarks

Presently, the management of SCD in India is conspicuously varied. There is a need for establishing collective measures in estimating the incidence and risk factors of SCD across various regions, using robust methodologies. The incidence of SCD is on the rise, especially in the urban regions, which may be largely attributed to the alarming increase in prevalence of CAD, diabetes and hypertension in India.

There is a need for defining and initiating preventive cardiovascular health measures to meaningfully reduce the incidence of SCD. Evidence-based, cost-effective treatment guidelines need to be formulated taking into consideration the resource-constraints of the region; these should be widely disseminated for implementation. For the time being, it seems appropriate to consider ICD implantation in patients, with moderate or severe LV dysfunction and a history of VT not due to a reversible cause, as a secondary prevention.

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