OPINION

Sudden cardiac arrest risk factors due to hypertrophic cardiomyopathy

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ABSTRACT

One of the most common causes of Sudden Cardiac Death (SCD) in young people and athletes is Hypertrophic Cardiomyopathy (HCM). Finding the SCD risk factors in people with HCM is essential. The risk factors for SCD in patients with HCM will be the main topic of this review, which is based on recent systematic literature investigations. New risk markers have appeared as a result of more studies exploring the factors that may increase the risk of SCD in individuals with HCM. Additionally, more precise approaches for categorization and estimate of SCD risk have been suggested and are being developed. The discovery of independent risk factors for SCD caused by HCM would probably aid in risk categorization. SCD occurs annually in about 1% of adult patients with HCM, therefore it is challenging to forecast with full confidence. A family history of SCD, unexplained syncope, and other new risk factors are discussed in the review along with the existing risk factors. The results of this analysis show that SCD risk classification in HCM patients is still a clinical problem and that more research is required on specific risk variables.

Key Words: *Sudden cardiac death; Hypertrophic cardiomyopathy; Fibrinolysis*

INTRODUCTION

A hereditary cardiomyopathy with asymmetric aberrant enlargement of the left ventricular muscle and a non-dilated left ventricle is known as Hypertrophic Cardiomyopathy (HCM) (LV). The estimated frequency of HCM in the general population is at least 1 in 500, and SCD might be the condition's initial symptom in asymptomatic or younger patients. HCM is also one of the primary causes of SCD in young people and sports. The annual incidence of SCD in adults with HCM is about 1%, but it is much greater in children with HCM. In order to inform prevention initiatives, it is crucial to identify the risk factors for SCD and rule out possible HCM patients who are at a high risk of developing the disease. Age, left atrial diameter, and Left Ventricular Outflow Track Obstruction (LVOTO) were added as new risk factors. As new clinical risk factors for SCD in HCM patients, the 2020 AHA/ACCF guidelines have added HCM with left ventricular systolic dysfunction, Left Ventricular Apical Aneurysm (LVAA), and substantial Late Gadolinium Enhancement (LGE). The B-type natriuretic peptide level, atrial fibrillation, and New York Heart Association functional class are a few other risk factors that have been documented in pertinent research as being linked to SCD risk. In order to provide a reference for clinical therapeutic decision-making, the aim of this study was to conduct a comprehensive literature review of publications on clinical risk factors for SCD in patients with HCM in recent years. One or more first-degree relatives under the age of 40 or 50 who incidentally passed away within one hour (if witnessed) or twenty-four hours (if seen in an asymptomatic state) of the symptom's onset are considered to have a family history of SCD. There is agreement that SCD episodes in first-degree relatives raise a person's risk of developing SCD, notwithstanding definitional differences. Patients with a family history of SCD had a 20% higher risk of developing the condition compared to HCM patients without a clear family history. A family history of SCD is a Class IIa recommendation for ICD inclusion in the ACCF/AHA recommendations and is included in the HCM Risk-SCD Calculator due to the familial clustering of risk (ESC website).

Unexplained syncope

A single incident of an unexplained loss of consciousness within the last six months is considered one episode of unexplained syncope. In one of every four HCM patients, syncope is common, but it can have a variety of reasons, including supraventricular arrhythmia, sinus node dysfunction, and full heart block. Unaccounted for syncope has

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been linked to a higher risk of SCD, according to a number of studies. Unexplained syncope is taken into consideration when making ICD decisions by both the ACCF/AHA recommendations (Class IIa) and the ESC guidelines. Spirito showed that the relative risk of SCD was five times higher in patients with recent, unexplained syncope (within six months) compared in patients without syncope. The risk of SCD was not higher in older patients who had isolated syncopal episodes.

NSVT

Three or more consecutive ventricular beats that occur at a rate of at least 120 beats per minute and last for less than 30 s are referred to be NSVT. With a high incidence rate of 20%–30% in HCM patients over the age of 40, NSVT is quite prevalent in this condition. According to a study, NSVT is only indicative of SCD when it happens frequently or is accompanied by symptoms. A further study found that HCM patients with NSVT had a higher risk of developing SCD, but only if they were under 30 years old, and that the frequency, duration, and rate of the NSVT had no prognostic significance.

Maximum left ventricular wall thickness

The largest end-diastolic dimension inside the chamber is the thickness of the left ventricular wall. The maximum wall thickness is thought to be the thickest measurement made at any point along the LV. Studies have demonstrated that having a left ventricular wall thickness of at least 30 mm is independently related with SCD, and the ACCF/AHA guidelines classify this as a Class IIa recommendation for ICD implantation. A binary cutoff for decision-making, however, ignores the gradationally increased risk of left ventricular hypertrophy. The HCM Risk-SCD Calculator's use of left ventricular thickness as a continuous variable probably results in a more thorough evaluation of risk in this area.

Abnormal exercise blood pressure response

Failure of an SBP increase of more than 20 mmHg or an SBP decrease of 10 mmHg during exercise is considered an abnormal blood pressure response. More than one in three HCM patients experience an irregular blood pressure response to physical activity. The majority of research demonstrate that abnormal blood pressure response increases the risk of SCD in HCM patients who are younger (under 40 years old), and it is unknown what significance abnormal blood pressure response has for patients who are older (over 40 years).

Hypertrophic cardiomyopathy risk-sudden cardiac death tool

The ESC model contains age, outflow tract gradient, and LAD in addition to those characteristics that are shared with the ACCF/AHA approach. Patients are assigned to one of three 5-year SCD risk groups based on the results of the HCM Risk-SCD tool: less than 4%, 4%–6%, or more than 6%. ICDs should not be considered for the lower-risk group, but they may be for the intermediate-risk group and higher-risk group. The ESC model exhibited a superior discriminative C-statistic than the current "risk factor" method, according to statistical validation in two retrospective cohorts. However, only 20%of the 1629 AHA risk-stratified patients in a real-world cohort who used the HCM risk-SCD algorithm had experienced SCD.

Late gadolinium enhancement on cardiac magnetic resonance imaging

A sign of myocardial fibrosis in HCM is LGE-CMR. Numerous investigations have demonstrated that a high risk of SCD is independently linked to widespread LGE. In a cohort of 1293 HCM patients, data from Chan et al. showed that LGE was more effective than individual risk factors in predicting SCD. A quantitation of at least 15% LGE showed a two-fold increase in SCD, and a meta-analysis showed that the risk of SCD was significantly correlated with the degree of LGE, increasing by 36% for every 10% increase in LGE. Regarding whether LGE offers additional information to conventional risk variables in HCM, there is still considerable debate. While past studies reported that the degree of LGE was not a reliable predictor of SCD in HCM, recent research demonstrated a substantial relationship between the risk of SCD in patients with HCM and the extent of LGE. Three groundbreaking studies found a connection between the location of LGE and severe arrhythmia and SCD in HCM patients. There was a significantly higher incidence of SCD in patients with LGE outside the interventricular septum than there was in patients with LGE only in the interventricular septum in our cohort study of 557 HCM patients with a mean follow-up time of 83.0 months, showing that the location of LGE plays as important a predictive role as the presence of LGE.

Left atrial diameter or left atrial volume

The most precise approach for determining left atrial size, according to recent echocardiographic standards, is the left atrial volume (LAV). A persistent increase in left atrial pressure, which is the result of impaired diastolic function, mitral regurgitation, and atrial arrhythmias, is measured by left atrial enlargement. A substantial difference in SCD risk between patients with and without an expanded LAD was not observed among those with confirmed atrial fibrillation, despite the fact that enlarged LAD was an independent predictor of SCD risk among patients without atrial fibrillation. These findings imply that the presence or absence of atrial fibrillation in HCM patients affects the connection between LAD and SCD. Other risk factors have been described in addition to the above stated risk factors for SCD in HCM patients. According to studies, a rise in BNP levels is associated with the development of SCD and/or malignant ventricular arrhythmia. Atrial fibrillation has been linked in several studies to a significant risk of cardiovascular death. Additionally, Sorajja et al. discovered that among individuals with HCM, the sole risk factor for SCD was persistent atrial fibrillation. A few researchers have also suggested that the NYHA functional class may be a risk factor for the development of SCD.

CONCLUSION

In patients with HCM, there are numerous risk factors for SCD. Finding SCD individuals at high risk, however, is still difficult. To identify and confirm the various risk factors for SCD in individuals with HCM in larger HCM patient cohorts, more research is needed. By combining genetic information and machine learning analytics with LGE in CMR, more accurate risk predictions may be possible. However, there will always be tradeoffs in determining how to strike a balance between the number of lives saved and the chances of consequences from ICD implantation, regardless of how accurate the risk estimations become.