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Dealing with Sudden Cardiac Death: Who Deserves Device Implantation

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ABSTRACT

Sudden cardiac death is one of the leading causes of death in the western industrial nations. Most people are affected by coronary heart disease (coronary heart disease, CHD) or heart muscle (cardiomyopathy). These can lead to life-threatening cardiac arrhythmias. If the heartbeat is too slow due to impulse or conduction disturbances, cardiac pacemakers will be implanted. High-frequency and life-threatening arrhythmias of the ventricles (ventricular tachycardia, flutter or fibrillation) cannot be treated with a pacemaker. In such cases, an implantable cardioverter-defibrillator (ICD) is used, which additionally also provides all functions of a pacemaker. The implantation of a defibrillator is appropriate if a high risk of malignant arrhythmias has been established (primary prevention). If these life-threatening cardiac arrhythmias have occurred before and are not caused by a treatable (reversible) cause, ICD implantation will be used for secondary prevention. The device can stop these life-threatening cardiac arrhythmias by delivering a shock or rapid impulse delivery (antitachycardic pacing) to prevent sudden cardiac death. Another area of application for ICD therapy is advanced heart failure (heart failure), in which both main chambers and / or different wall sections of the left ventricle no longer work synchronously. This form of cardiac insufficiency can be treated by electrical stimulation (cardiac resynchronization therapy, CRT). Since the affected patients are also at increased risk for sudden cardiac death, combination devices are usually implanted, which combine heart failure treatment by resynchronization therapy and the prevention of sudden cardiac death by life-threatening arrhythmia of the heart chambers (CRT-D device). An ICD is implanted subcutaneously or under the pectoral muscle in the area of the left collarbone. Like pacemaker implantation, ICD implantation is a routine, low-complication procedure today.

Introduction

An implantable cardioverter-defibrillator (ICD) has been used as an effective mortality-reducing therapy for the prevention of sudden cardiac death for over 30 years. When choosing an ICD therapy, however, it must also be taken into account that complications (e.g. infections, thromboses, malfunctions) and inadequate shocks that are stressful for the patient may occur, so that careful evaluation of indication is essential.

For the use ICD for protection against sudden cardiac death, two different forms of prevention are generally distinguished:

1. Secondary Prevention, if an ICD is used after a so-called index event, which usually is a tachycardia-related cardiac arrest (or weaker symptoms such as (pre-) syncope or low blood pressure).
2. Primary Prevention, when using an ICD in high-risk patients for sudden

cardiac death without an index event .

The evaluation of the indication for ICD therapy follows the recommendations of the 2015 published guidelines of the European Society of Cardiology (ESC) for the management of patients with ventricular arrhythmias and for the prevention of sudden cardiac death.[1] The following is an overview of the indications for ICD therapy:

- Secondary prevention of ventricular fibrillation or ventricular tachycardia with clinical symptoms
- Secondary prevention after syncope
- Secondary prevention in case of persistent ventricular tachycardia (untreatable)
- Primary prevention in patients with ventricular dysfunction
- Dilated Cardiomyopathy (DCM)
- Hypertrophic cardiomyopathy (HCM)
- Long QT Syndrome (LQTS)
- Short QT syndrome (SQTS)
- Brugada syndrome
- Catecholaminergic polymorphic ventricular tachycardia (CPVT)
- Torsade de pointes tachycardia
- Arrhythmogenic right ventricular cardiomyopathy (ARVC)

Secondary prevention

In three large studies, the survival benefit of ICD use was demonstrated over the sole conservative treatment with antiarrhythmic drugs. While cardiac arrest patients were included in the CASH study (Cardiac Arrest Study, Hamburg),[2] AVID (Antiarrhythmics versus Implantable Defibrillators)[3] and CIDS (Canadian Implantable Defibrillator Study)[4] also included patients with syncope (or other symptoms) and reduced ventricular ejection fractionwhere the arrhythmia for the index event was not documented, but were inducible for ventricular tachyarrhythmias or monomorphic Tachycardias were found to be predictive. A meta-analysis of the 3 studies showed a 28% reduction in the relative risk of death in ICD-treated patients.[5]

There is a Class I indication for documented ventricular fibrillation or hemodynamicallyunstable ventricular tachycardia causing symptoms (cardiovascular arrest, cardiogenic shock, pulmonary edema, syncope, presyncope or very low blood pressure). Care must be taken to ensure that the clinical event causing the indication was not triggered by safely avoidable causes (eg WPW syndrome) or one-time causes (eg heart attack within the last 48 hours). Also ICD implantation is recommended in patients with syncope caused most likely by ventricular tachyarrhythmia associated with a reduced left ventricular ejection fraction (LVEF) or a survived heart attack (with simultaneous inducibility of ventricular tachycardia as part of electrophysiological examination).[1]

With persistent (more than 30 seconds) ventricular tachycardias that are hemodynamically tolerated (i.e., "stable"), the study situation is much less clear. If necessary, the data from the AVID register can be used to prove the secondary prophylactic benefit of an ICD in this constellation.[3] However, there is an expert opinion-based indication to consider the implantation of a defibrillator with stable ventricular tachycardia (evidence level C, class IIa according to ESC guidelines).[1]

Primary prevention in patients with ventricular dysfunction

Since most patients do not survive out-of-hospital cardiovascular arrest, the goal of primary prevention is to identify high-risk patients and implant defibrillators. According to current guidelines, patients with ventricular dysfunction LVEF < 35%, an ICD Implantation is recommended.[1]

In patients with ischemic cardiomyopathy or after myocardial infarction, the mortality-reduction benefit has mainly been demonstrated by two prospective studies: the MADIT II study (Multicenter Automatic Defibrillators

Implantion Trial) and the SCD HeFT study (Sudden Cardiac Death in Heart Failure Trial).[6,7] The evidence level of indication for defibrillator implantation in this patient population is A. By contrast, the benefit of ICD therapy is less well demonstrated in patients with non-ischemic cardiomyopathy (DCM); The indication for ICD care is based on a meta-analysis by Desai et al.,[8] which includes several small examinations, the DEFINITE study (Defibrillators in Non-Ischemic Cardiomyopathy Treatment Evaluation), and subgroups of SCD-HFT and COMPANION (Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure).[7-9] The DANISH study published in 2016 following the publication of the ESC guidelines does not find a clear survival advantage of ICD therapy in patients with systolic heart failure caused by coronary heart disease.[10]

In the absence of randomized controlled trials, the authors of the current ESC guidelines do not recommend ICD implantation for primary prevention in NYHA Class I patients and in patients with a LVEF> 35%.[1] Generally, ICD implantation as primary prevention in patients with ventricular dysfunction is indicated only if optimized drug therapy has been performed for at least three months, the life expectancy in good functional status is more than one year and the ICD implantation is not < 40 days after a myocardial infarction.[1]

Cardiomyopathies

The indication for dilated cardiomyopathy (DCM) depends essentially on the conditions for secondary prevention or primary prevention in patients with ventricular dysfunction (see above).The secondary prophylactic indication for hypertrophic cardiomyopathy (HCM) obeys the principles already outlined above. Although there are no prospective randomized studies on ICD therapy in HCM, cohort studies and meta-analyzes show that fatal cardiac arrhythmias are often followed by surviving sudden cardiac arrest or persistent ventricular tachycardia.[11]

Primary prophylactic ICD implantation in HCM is based on the 5-year risk of sudden cardiac death, where a risk of> 6% represents a Class IIa and a risk of between 4% and 6% a Class IIb indication. This risk should be calculated using the HCM Risk SCD calculator, which relies on several risk factors: age, ventricular wall thickness, left atrial diameter, LV outflow gradient, cases of sudden cardiac death from close relatives, non-sustained ventricular tachycardia, and the occurrence of Syncope.[12]

Congenital primary arrhyth-mia syndromes

In patients with long QT syndrome (LQTS) and surviving cardiac arrest or ventricular fibrillation, an implantable defibrillator is indicated as there is a high risk of recurrence.[6] In the primary prevention of patients with LQTS on the other hand, beta-blockers are the main therapy. Since syncope or ventricle tachycardia is associated with an increased risk of subsequent cardiac arrest in beta-blockade,[13,14] ICD implantation may be considered in these cases.[1]

In patients with short QT syndrome (SQTS) who have survived cardiac arrest or ventricular fibrillation, or who have persistent ventricular tachycardia, there is an indication for ICD implantation as there is an increased likelihood of (further) life threatening cardiac events.[15]

If Brugada syndrome is diagnosed, an implantable defibrillator is the only way to effectively reduce the risk of sudden cardiac death. ICD implantation is indicated when ventricular fibrillation, persistent ventricular tachycardia or cardiovascular arrest have been survived, or a spontaneous Brugada type-1 ECG has been identified with otherwise unexplained syncope.[1,16] Although ventricular fibrillation is inducible by electrophysiological

examination, ICD implantation may be considered.[17]

In patients with catecho-laminergic polymorphic ventricular tachycardia (CPVT), ICD implantation is indicated in addition to beta-blocker therapy if cardiac arrest, ventricular fibrillation, ventricular tachycardia, or recurrent syncope have already occurred.[1]

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