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Defibrillation Testing of Cardioverter in Clinical Setting

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Introduction

The homicide detectives of the nordic ICD trial conclude that defibrillation testing of Implantable Cardioverter Defibrillators (ICDs) does not improve outcomes when compared to device implantation without testing. As a result, they suggest that defibrillation testing during first ICD implantation should no longer be recommended for routine left-sided ICD implantation. Defibrillation testing involves producing ventricular fibrillation to evaluate if a newly implanted ICD correctly detects and ends it. However, it has not been demonstrated that changing the system after the first test fails improves survival. Furthermore, testing can increase fluoroscopy exposure by 40% and raise the risk of adverse outcomes by 30 minutes. As a result, the Nordic ICD study was designed to see if skipping defibrillation testing was non-inferior to doing so. A total of 1,077 patients were given an ICD with or without defibrillation testing at random. During the study's follow-up period (median 22.8 months), 8.6% of patients who had defibrillation testing experienced an arrhythmic episode with at least one suitable shock, compared to 8.8% of patients who did not have defibrillation testing. The average first shock efficacy for all true episodes of ventricular tachycardia or fibrillation (the primary end point) was 96.7% in patients who had defibrillation testing and 100% in patients who did not have defibrillation testing, meeting the predetermined non-inferiority threshold. There were no significant differences in procedure-related major adverse events or death across the groups. The trial's principal author, Dietmar Bänsch, recommends thatICDs should no longer be examined during normal implantations." This simplifies the procedure and makes it more similar to pacemaker implantations. There will be fewer complications during implantations, and less technical assistance will be required.

Subcutaneous Implantable Cardioverter-Defibrillator

A pulse generator is attached to a lead with a single high-voltage, low-impedance shock coil and two sensing electrodes in the subcutaneous ICD system. The device senses from one of three vectors: Primary (proximal ring to generator); Secondary (distal tip electrode to generator) and third (distal tip to proximal ring electrode) (alternate). The initial generation of the device had a volume of 69 mL and a mass of 145 g. With a volume of 59.5 mL and a mass of 130 g, the second generation is slightly smaller. Beginning in 2001, preliminary short-term experiments were conducted to determine the most effective electrode site for the Subcutaneous ICD (S-ICD) based on anatomical landmarks. The most successful electrode site was a left lateral pulse generator with an 8 cm coil electrode positioned to the left of the sternum, which was tested four times. Pre-implant ECGs should be performed on patients who are candidates for S-ICD implantation to check for QRS-T wave morphology, which can lead to multiple counting of T-waves and improper defibrillations. To confirm patient compatibility with one of the three vectors used with the S-ICD device, an ECG test is required. Patients had to pass the screening in at least one vector in both the supine and standing positions in the largest registry to date. In 1622 of the 1637 individuals studied, full data on all three vectors was available for review. In 93.8% and 51.4% of patients, respectively, ECG vector screening was satisfactory in two and all three vectors. Patients with a lower BMI or a higher Left Ventricular Ejection Fraction (LVEF) were more likely to pass one vector.

The generator is attached to the electrode, which is tunneled 1 cm to 2 cm to the left of and parallel to the sternum, between the mid-axillary and anterior axillary lines. The lead was tunneled through an inferior and superior parasternal incision in early implantations (three-incision technique). However, in a recent study, the majority of implantations were done using the two-incision approach, which only required an inferior sternal incision. In a study of 69 patients implanted with an S-ICD at three German centers. The use of general anesthesia has varied substantially across trials, with rates ranging from 47% to 100%. General anesthesia was used in 64.1% of implantations in the recently released US S-ICD post-market approval study (S-ICD PAS). At the end of the process, arrhythmia termination is usually tested with 65 J shocks. The device's output is a non-programmable 80 J shock once implanted. If the first attempt fails, the mechanism automatically reverses the polarity of the shock. Five defibrillations are required for maximum therapy. The device has no anti-bradycardic or anti-tachycardia features save from 30 seconds of post-shock a systole demand pacing. The 2017 American Heart Association (AHA) guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death recommend S-ICD implantations in patients who meet the following criteria have insufficient vascular access or an unacceptable risk of infection pacing for bradycardia, termination of ventricular tachycardia, or CR (Class IIa, LOE B-NR). In patients who require or anticipate pacing for bradycardia, ATP, or CRT, S-ICD implantation is not indicated (Class III, LOE B-NR).

New Technologies

Subcutaneous Implantable Cardioverter Defibrillators

The requirement for an endovascular lead is one of the major limitations of current ICD technology. As previously stated, ICD lead failure is not insignificant, and if ICD lead removal is required for infection management or is considered for the removal of superfluous hardware, it is associated with morbidity and mortality. S-ICDs (completely subcutaneous ICDs) are now accessible for implantation all around the world. A specific lead is attached to an ICD in the anterior axillary region after being put vertically parallel to the sternum and horizontally across the anterior chest. A distal sensing electrode at the lead tip, a proximal sensing electrode near the typhoid process, and an intervening shocking electrode between the two sensing electrodes make up the three electrodes on the lead. Between the shocking electrode and the ICD container, defibrillation energy is delivered. A reduction in the necessity for fluoroscopy during implantation and the elimination of an endovascular lead are two

major advantages. The lowest rate of improper discharges of any ICD has been seen in S-ICDs. Despite its many advantages, S-ICDs have certain disadvantages. Current S-ICDs lack programming choices for long-term pacing or ATP for ventricular arrhythmias, however future generations of ICDs will almost certainly have leadless pacing technology, which will solve this problem.

The device must generate higher energy discharges due to the distance between the leads and the heart; therefore the current generation of S-ICD cans is 30% larger than their trans venous predecessors. This issue will most likely be solved with further advances in battery chemistry and electronics design. Even without these technological breakthroughs, some patients find the current generation of S-ICDs very appealing. An S-ICD, for example, is a fascinating possibility for hemodialysis patients with limited intravascular choices. An S-ICD may be the best option for this patient population because younger people are more likely to have lead failure or require lead extraction over their lifespan. The S-ICD may also be effective in individuals with congenital cardiac disease who are unable to implant an endovascular lead in the ventricle due to anatomical constraints. Although these patient populations are potentially beneficial, supporting data is restricted to case reports or small case series.

Percutaneous implantable cardioverter defibrillators

Intravascular defibrillators that are fully functional have been tested in canine models and may be a feasible replacement for ICDs in the future. These defibrillators are attached to the sub clavian vein and descend through the right atrium to the vena cava. The SVC and inferior vena cava have electrodes, while the right ventricle has a single-coil lead. The percutaneous ICD's efficacy has yet to be proven, and various obstacles such as generator exchange and explanation are expected. Magnetic resonance imaging-compatible implantable cardioverter defibrillators in a variety of situations magnetic resonance imaging is frequently indicated for optimal imaging. Magnetic resonance imaging is generally not suggested in patients with ICDs, while it can be done if clinically essential in some cases. All of the manufacturers have ICDs in various levels of research and approval that are designed to work in the magnetic resonance imaging setting. Several manufacturers ICDs have earned the Conformity Europeans Mark and can be implanted in Europe, despite the fact that none of these ICDs are approved for use in the United States.