# Shock Avoidance and the Newer Tachycardia Therapy Algorithms

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**KEYWORDS**

• Inappropriate shocks • Avoidable shocks • Antitachycardia pacing (ATP) • ICD programming

**KEY POINTS**

- Patients who receive shock therapy have an associated reduction in the mortality benefit from implantable cardioverter defibrillators (ICDs).
- Prolonging the time to therapy and restricting therapy to faster tachycardias can significantly reduce shocks overall, with an associated mortality benefit.
- The decision on single-chamber versus dual-chamber defibrillator implantation needs to be individualized.
- Remote monitoring facilitates earlier recognition of patient-related and device-related issues, reducing the risk of inappropriate therapy.
- Medical therapy and catheter ablation are effective adjunctive strategies in patients with ICD shocks to reduce or eliminate future events.

## INTRODUCTION

Implantable cardioverter defibrillator (ICD) therapy has been proven in several large-scale clinical trials to reduce mortality in patients with primary and secondary indications.[1–4] There is evidence to suggest that receiving shocks may reduce the mortality benefit; however, more recent study has suggested that this maybe due to the arrhythmia or comorbidities rather than the shock itself.[5,6] Shock therapy, despite the benefits, is also associated with significant psychological issues, including anxiety, depression, and posttraumatic stress.[7–9] Therefore, reducing both appropriate and inappropriate shocks, without compromising patient safety, is desirable. This can be achieved with a multifaceted approach with medical therapy, improved device-based programming, and ablation strategies. This article discusses these strategies.

## BACKGROUND

The first ICD was implanted in 1980, and was revolutionary in the approach to cardiac arrhythmias and sudden cardiac death.[10] It is now well established that ICD therapy improves mortality and is generally considered to be cost-effective.[2,3,11] Over many years, large randomized trials have identified patients with greatest potential benefit

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from ICD placement and therapy, and this is reflected in current guidelines.[12]

ICD implantation has become a cornerstone of therapy for many patient groups, including those with inherited or acquired cardiomyopathies and channelopathies. Although sudden cardiac death (SCD) is a leading cause of death in the United States and Europe, identification of those at higher risk of death than the general population has been critical in reducing mortality in select groups. Although there are inherent risks associated with ICD implantation (infection or lung, vascular, or cardiac injury), in these populations the benefits of prophylaxis outweigh the risks.

Despite these benefits, ICD shocks can have a profound effect on patients when a shock is delivered, such as physical and psychological trauma, as well as impairment of their quality of life and general health.[7–9,13–15] As a result, reduction in shock exposure is an ideal strategy, and various methods have been developed to avoid both appropriate and inappropriate shocks. In this pursuit, it is important to understand the types of shocks that patients are exposed to (**Box 1**).

It has been reported that among patients with an ICD who have received a shock from the device, about one-third were inappropriate.[3] There are conflicting data regarding the effect of ICD shocks on survival. Some studies have indicated that mortality is increased among patients with an ICD who receive shock for any reason compared with receiving no shock.[5,16] An analysis of 2135 patients from 4 trials of antitachycardia pacing (ATP) therapy to reduce shock therapy revealed that shocked ventricular arrhythmic events were associated with increased mortality risk compared with ATP-terminated tachycardia.[17] This was attributed to the substantially higher ventricular arrhythmia burden among these patients and a poorer survival compared with ATP-only treated patients. A recent study supported this finding that the increased mortality is due to the underlying arrhythmia, and not the physical effect of the shock itself, as those who receive shock for inappropriate reasons did not have increased mortality compared with those without any shock.[6]

In the United States, more than 250,000 ICD implantations occurred in 2011, with most (>70%) for primary prevention indications.[18] Inevitably, clinicians will be faced with increasingly complex management issues pertaining to shock therapy, both appropriate and inappropriate. Knowledge in strategies to reduce shock therapy is vital, as it is associated with significant beneficial implications to the patient, as well as the health care system (**Box 2**).

**Box 1**
**Classifications of shock therapy**

1. Appropriate shocks: triggered by life-threatening ventricular arrhythmias, which can be further classified as follows:
   a. Necessary shocks: shock delivered due to failure of antitachycardia pacing (ATP) therapy/other means
   b. Avoidable shocks: as a result of underutilization of other termination methods
2. Inappropriate shocks: shocks triggered from incorrect detection

### *Management Options to Minimize Shock Therapy*

1. Medical therapy
2. Catheter ablation
3. Advanced device programming

General measures, such as electrolyte replacement and avoidance of aggravating factors like sleep deprivation, caffeine, alcohol, over-the-counter medications, herbal remedies (eg, gingko, ephedra, ginseng, guarana, and yohimbine), and cardiac stimulants (eg, theophylline, cocaine, and amphetamines), should be used. Patients with underlying heart disease should be on optimal medical therapy (eg, aspirin, angiotensin-converting enzyme inhibitor/angiotensin receptor blocker, beta-blockers, aldosterone antagonists, statins). Treatment of other underlying structural or ischemic heart disease should be considered, as these are associated with proarrhythmia.

## MEDICAL THERAPY

Beta-blocker therapy can be beneficial in reducing shocks of any type, as they can suppress supraventricular tachycardias, as well as ventricular ectopy and arrhythmias. Recently, analysis of the

**Box 2**
**Benefits of shock-avoidance techniques**

1. Improved survival
2. Better quality of life
3. Reduced hospitalizations
4. Increased ICD battery life
5. Lower health care expenditure
6. Less need for post-shock care
7. Greater acceptance of ICD therapy