

Healthcare After Implantable Cardioverter-Defibrillator Shocks Underuse and Overuse

Ryan T. Borne, MD; Pamela N. Peterson, MD

Implantable cardioverter-defibrillators (ICDs) have become an important therapy for both primary and secondary prevention of sudden cardiac death among a large number of patients at high risk. ICD shocks are life saving when appropriate for ventricular arrhythmias. However, both appropriate and inappropriate shocks are associated with morbidity, including anxiety, depression, and impaired quality of life, as well as increased mortality.^{1,2} Thus, after receipt of a shock, it is logical that patients should be evaluated to determine the appropriateness of shock, the patient's clinical condition, and whether any programming changes should be made to the device. However, best practices are not well defined. The extent to which patients are evaluated, in what setting, and what other testing or procedures are performed after ICD shock has not previously been defined.

See Article by Turakhia et al

In this issue of *Circulation: Cardiovascular Quality and Outcomes*, Turakhia et al³ present data on health care received after shock and the associated expenditures in a real-world population. Patients undergoing de novo ICD implantation between 2008 and 2010 were identified in a manufacturer database that includes information on device implant and remote monitoring. A deterministic matching algorithm was then used to link to commercial and Medicare supplemental claims databases to determine healthcare utilization. Patients were followed up through 2011 for shocks. All shock episodes were adjudicated to determine whether they were appropriate (ventricular tachycardia/ventricular fibrillation) or inappropriate (eg, supraventricular tachycardia, atrial fibrillation, or lead noise). Among all patients with linked outcomes data, 9% had at least one shock event, of which 43% had only appropriate, 42% had only inappropriate, 12% had both, and 6% could not be classified. Shock-related health care was defined as an inpatient hospitalization or outpatient service within 7 days after shock with a shock-related diagnosis. Shock-related

diagnoses were prespecified by the investigators to conservatively only consider visits that were likely directly related to the shock and included cardiac dysrhythmia, syncope, dizziness, palpitations, tachycardia, and mechanical complication of cardiac device. Among all shock episodes, 54% had no shock-related health care, 14% were hospitalized, and 32% were seen in the outpatient setting or emergency department. Although a minority of patients were hospitalized after shock, testing and invasive procedures were frequently performed among those hospitalized. Of note, cardiac catheterization was performed in 76% of these patients, yet percutaneous coronary intervention occurred in only a small proportion of those patients (5%–6.5%). Expenditures for patients hospitalized were substantially higher than that for patients with outpatient care but were similar for appropriate and inappropriate shocks in the inpatient and outpatient settings.

This study provides several important insights. First, it should be noted that over half of patients with a shock had no shock-related health care within 7 days. A few limitations of the study may be responsible for this. First, the authors defined the postshock period at 1 week, and there may be times with which a patient is unable to be seen in this period. Additionally, shocks can frequently go unnoticed, for example, during sleep or if a patient was to have syncope and then a shock. Second, healthcare utilization may be underestimated based on the author's conservative definition of a shock-related diagnosis. Diagnoses such as heart failure and myocardial infarction may have been the final discharge diagnoses even if the initial presentation was for a shock. Recommendations from the European Society of Cardiology state that patients with a single ICD shock in the absence of symptoms (including chest pain, shortness of breath, palpitations, and distress) should be contacted within the next working day to initiate device interrogation (in office or remote), whereas those with symptoms or have experienced 2 shocks should be evaluated on a more urgent/emergent basis.⁴ This is an opportune time to mitigate the risk of further ICD shocks by changing programming, initiating medical therapy, or considering catheter ablation. The proportion of patients in the study by Turakhia et al with no inpatient or outpatient visit within 7 days after shock may be an overestimation, but clearly a substantial proportion of patients are not receiving appropriate and timely evaluation. Thus, future studies should evaluate processes of care and interventions to improve appropriate follow-up.

Second, use of invasive procedures after shock, particularly coronary angiography, should be carefully considered. It is remarkable that cardiac catheterization occurred in 76% of hospitalized patients, including half of patients with

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From the Division of Cardiology, University of Colorado Anschutz Medical Campus, Denver (R.T.B., P.N.P); and Division of Cardiology, Denver Health and Hospital Authority, CO (P.N.P).

Correspondence to Ryan Borne, MD, Division of Cardiology, University of Colorado Anschutz Medical Campus, 12631 E 17th Ave, Campus Box B130, Aurora, CO 80045. E-mail ryan.borne@ucdenver.edu (*Circ Cardiovasc Qual Outcomes*. 2017;10:e003528. DOI: 10.1161/CIRCOUTCOMES.117.003528.)

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inappropriate shock, yet only a minority of patients underwent percutaneous coronary intervention (6.6%). The low rate of percutaneous coronary intervention suggests that many of the cardiac catheterizations may not have been clinically necessary. Yet, patients were exposed to the potential complications of this invasive procedure. Noninvasive testing, including echocardiography and stress tests, was also common. What is not known from this study is what, if any, impact these diagnostic tests and invasive procedures had on patient outcomes. It is important to understand whether outcomes are improved or whether substantial testing is being done without benefit, increasing costs but adding no value.

Finally, this study suggests that strategies to reduce the rate of ICD shocks could result in substantially less resource utilization. ICD shocks occurred in 9% of the cohort, with \approx 40% of all shocks being inappropriate. Comparison to historical or contemporary cohorts is difficult because the indications for ICD implant (ie, primary versus secondary prevention) and degree of left ventricular systolic dysfunction were not characterized. However, this is a high proportion of ICD shocks, which may reflect the time frame during which the outcomes were assessed (between 2008 and 2011). Since that time, considerable advances in ICD programming have occurred. The MADIT-RIT (Reduction in Inappropriate Therapy and Mortality Through ICD Programming) trial, published in 2012, demonstrated the effectiveness of (1) high detection rates and (2) delayed time to therapy in reducing rates of inappropriate shock compared with conventional programming.⁵ Additionally, lower all-cause mortality was observed with these programming enhancements. Current ICD programming guidelines provide class I recommendations for long detection periods and high detection rates as well as use of supraventricular tachycardia discriminators.⁶ Current conventional programming should use these recommended settings to minimize ICD shocks.

This study identifies possible areas of both underuse and potential overuse of care. Thus, there is a need and an opportunity to improve health for patients receiving ICD shocks and to increase value. As technology advances, understanding the downstream use of health care and the effects of that health care on outcomes is an important aspect of providing high-value quality care. To date, few studies have evaluated the impact of ICD shocks on contemporary populations. In the current study, the finding that less than half of patients with a shock had a healthcare encounter within 7 days demonstrates a need for future studies to evaluate processes of care and interventions to ensure that those who have an ICD shock receive appropriate and timely evaluation. Furthermore,

although the current study demonstrates that ICD shocks, both appropriate and inappropriate, can result in a cascade of health care, further studies are needed to define whether this care and the costs incurred improve outcomes. Finally, studies need to evaluate whether ICDs are being programmed to minimize ICD shocks in contemporary practice. Observational studies of real-world clinical practice can provide important insights to these questions. It is only by understanding the patterns of care for patients who undergo ICD implantation and those who receive shocks that we can establish processes of care that maximize outcomes for patients while minimizing risk and expense.

Disclosures

None.

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