



Editorial

Health Economic Analysis of Catheter Ablation for Ventricular Tachycardia: Breaking Even With Medical Therapy?

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See article by Porta-Sánchez et al., pages 169–177 of this issue.

The management of recurrent ventricular tachycardia (VT) in patients with structural heart disease poses a significant challenge to clinicians. In this setting, VT is often secondary to scar-related macroreentrant circuits involving infarcted or damaged myocardium.¹ Implantable cardioverter defibrillators (ICDs) are indicated for patients with VT, or at high risk for ventricular arrhythmias (VAs). Their widespread use has resulted in lower risk of sudden cardiac death in patients with cardiomyopathy, with most surviving episodes of VA. Anti-arrhythmic drug therapy options are scarce, often associated with limited efficacy and a significant risk of side effects requiring discontinuation of therapy.²

Percutaneous catheter ablation for complex cardiac arrhythmias has evolved over the past 2 decades, with higher resolution nonfluoroscopic electroanatomic mapping systems and advances in catheter design and technology. Percutaneous catheter ablation for VT was developed to eliminate reentrant circuits responsible for arrhythmogenesis. Catheter ablation has been shown to effectively reduce the risk of VT recurrence in the setting of ischemic cardiomyopathy. During ablation, steerable catheters are placed in the heart to enable detailed mapping of the ventricular myocardium. Bipolar voltage mapping is used to detect areas of abnormal myocardium and scar secondary to ischemic or nonischemic cardiomyopathy. Reentrant circuits often involve diseased myocardium harboring slow conduction that promotes VT. After detailed mapping is completed, catheter ablation is delivered to regions harboring critical arrhythmia circuits and adjacent areas of unhealthy myocardium. The safety and efficacy of catheter ablation for VT has improved over the past 2 decades, allowing more patients to benefit from this therapy. However, the procedure is complex, requires a high level of expertise, is available exclusively in specialized tertiary care

centres, and is associated with significant health care resource utilization. Hence, the time has come for well conducted health economic analyses to assess the cost-effectiveness of this highly specialized, resource-intensive treatment strategy.

In this issue of the *Canadian Journal of Cardiology*, Porta-Sánchez et al.³ present a propensity score-matched study in which they evaluated health care utilization after VT catheter ablation. The authors diligently analyzed health care utilization of 100 patients treated with catheter ablation and compared it with 100 matched controls treated with medical therapy. The medical therapy group was selected from a cohort of approximately 7000 patients in the ICD database that prospectively collects data from 10 ICD-implanting centres in Ontario, Canada.⁴ Inclusion criteria included the following: (1) patients with left ventricular ejection fraction < 40% and ICD; (2) at least 1 appropriate shock; and (3) at least 1 subsequent hospitalization for VA. Propensity score matching was used to align variables known to affect survival in ICD patients. Patients treated with catheter ablation had had a higher rate of unplanned hospitalizations for VA in the 1 year preceding ablation than patients who were medically treated. In the 2 years after the ablation, the authors showed a significant reduction in the number of unplanned hospital admissions and emergency department (ED) visits because of VA, hence supporting the effectiveness of the intervention. After the initiation of treatment for recurrent VT and ICD shocks, the rate of cardiovascular-related hospitalizations was similar between patients who were medically treated and those treated with ablation. Health care costs were not increased in patients treated with ablation compared with medical therapy. This study provides contemporary comparative data on real-world health care resource utilization between medical therapy and catheter ablation for management of patients with VT. The authors must be commended for their comprehensive health economic analysis.

The first study to report the cost effectiveness of catheter ablation for VT was published in 2000,⁵ and used a model-based analysis. It showed that ablation was more costly than amiodarone but led to greater quality-adjusted life-years (QALYs). The ensuing cost-effectiveness ratio for ablation vs

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amiodarone in patients with frequent VT episodes was USD\$20,923 per QALY. It was not until recently that more data became available to guide clinicians. In a retrospective study, Winterfield et al.⁶ showed that catheter ablation for VT in the setting of structural heart disease reduced hospitalization and health care utilization in patients with ICD. In this study, a total of 523 patients from US centres were evaluated. The median reduction in arrhythmia-related expenses was USD\$5408. Healthcare resource utilization in the 1 year preceding and 1 year after ablation was evaluated. Cardiac rhythm-related total medical expenditures decreased from a median of USD\$7318 before ablation to USD\$1910 after ablation (74% reduction; $P < 0.0001$), mainly related to a reduction in the number of ED visits and arrhythmia-related hospitalizations. The percentage of patients with at least 1 VT-related ED visit or hospitalization was reduced from 41% and 53% to 26% and 28%, respectively. A cumulative increase in health care utilization in the year preceding ablation was also observed. This was followed by a reduction in hospital visits post procedure. The absence of a control group precluded comparative analyses. The study by Porta-Sánchez et al.³ expands the body of literature by providing real-world comparative data on medical vs catheter ablation therapy in the setting of recurrent VT.

A recent substudy of the **Ventricular Tachycardia Ablation or Escalated Antiarrhythmic Drugs in Ischemic Heart Disease (VANISH)** trial evaluated the cost effectiveness of catheter ablation compared with escalation of antiarrhythmic drug therapy in drug-resistant patients with ischemic cardiomyopathy and VT over 3 years.⁷ Overall, ablation led to greater QALYs than antiarrhythmic drug therapy and higher cost (\$65,126 vs \$60,269; difference: \$4857), mainly related to the upfront cost of ablation. This was offset by the costs of subsequent ablations and adverse outcomes in the medical therapy group. The analysis of patients with recurrent VT despite therapy with amiodarone is of particular interest: VT ablation was less costly and associated with greater QALYs (\$67,614 vs \$68,383; difference: \$769). This arm accounted for 75% of the 259 patients enrolled in the trial. For those with sotalol-refractory VT, ablation resulted in similar QALYs and higher costs (mean difference: \$15,422) compared with escalated antiarrhythmic drug therapy.⁷ This aligns with findings from the main trial. Patients with recurrent VT despite amiodarone treatment had a higher risk of VA and mortality than those with sotalol-refractory VT, and thereby were more likely to derive greater benefit from catheter ablation.⁸ This study showed that on the basis of a willingness-to-pay threshold of \$50,000 per QALY, there is a 75% probability that ablation is cost-effective in patients with amiodarone-refractory VT. The probability was substantially lower (24%) in patients with sotalol-refractory VT. These findings are not surprising, because selection for drug-refractory patients produces a bias against drug therapy and selection for amiodarone-resistant patients produces a particularly strong negative bias because amiodarone is the most effective drug therapy available.

Porta-Sánchez et al.³ also analyzed the effect of preprocedural antiarrhythmic drug (sotalol or amiodarone) use. When 66 pairs of patients were matched to antiarrhythmic drug use and number of VA-related admissions in the preceding 12 months, VT ablation was found to be linked to a decreased

number of ED visits for VA during 2-year follow-up (hazard ratio, 0.53; 95% confidence interval, 0.28-0.97). However, the authors did not evaluate outcomes related to baseline treatment with sotalol or amiodarone alone. The VANISH trial strongly suggested that the cost effectiveness of VT ablation is limited to patients with amiodarone-refractory VT.⁹ This is expected in light of the results of the trial, which showed comparable rates of the composite end point of death, VT storm, or ICD shock between sotalol-refractory patients treated with ablation or escalation of antiarrhythmic drug therapy. The 2017 American Heart Association/Heart Rhythm Society guidelines for the management of VT¹⁰ endorsed catheter ablation as a class I recommendation for patients “with prior myocardial infarction and recurrent episodes of symptomatic sustained VT, or who present with VT or ventricular fibrillation storm and have failed or are intolerant of amiodarone or other antiarrhythmic medications.” Data from the health economic analysis performed as part of the VANISH trial suggested that this approach provides good value in health economic terms, particularly in patients with amiodarone-refractory VA.

Porta-Sánchez et al.³ contribute contemporary comparative data revealing a reduction in VA-related hospitalizations in patients with recurrent VT treated 2 years after catheter ablation, whereas hospitalization rates for patients treated with medical therapy were unchanged. Importantly, hospitalization rates were similar whether patients were treated with medical therapy or catheter ablation. In contrast to previous data showing an increase in health care costs with ablation,⁶ Porta-Sánchez and colleagues showed no increase in the downstream health care costs following VT ablation.³ This suggests that from a health economic standpoint, catheter ablation is a reasonable treatment, particularly in patients with VA leading to ED visits or hospitalizations in the preceding year.

Certain limitations must be acknowledged. First, despite efforts to mitigate the effect of confounders via propensity score-matching, the retrospective, single-centre design leaves potential for bias. Second, health care utilization outcomes were retrieved using administrative databases. Third, most (65%) patients had ischemic heart disease, limiting findings to this patient population. Because most VT ablation procedures are performed to treat VT secondary to ischemic cardiomyopathy, this simply reflects real-world data.

Despite these recent publications on the health economic effect of catheter ablation for VT, uncertainties remain regarding its cost-effectiveness in specific populations. Most patients included in these studies had ischemic cardiomyopathy. The study by Porta-Sánchez and colleagues³ is no exception, because one-third of patients had nonischemic cardiomyopathy. This is relevant from an effectiveness standpoint, because patients with recurrent VT secondary to previous myocardial infarction are more likely to benefit from ablation compared with patients with recurrent VT from nonischemic causes.¹⁰⁻¹² Therefore, healthcare utilization outcomes resulting from catheter ablation in patients with nonischemic cardiomyopathy should be interpreted with caution. Furthermore, there are limited data on the cost-effectiveness of ablation in patients with sotalol-refractory VT and those who are naive to antiarrhythmic drug therapy. Finally, these results cannot be extended to patients with VA resulting from cardiac diseases that were not well

represented in the published studies (eg, cardiac sarcoidosis). Therefore, well designed prospective trials are required to provide further insight into the health economic effect of catheter ablation in patients with nonischemic cardiomyopathy, and in those with recurrent VA not yet treated with antiarrhythmic drug therapy.

Favourable health economic analyses now add to the established safety and efficacy of catheter ablation for patients with ischemic cardiomyopathy and amiodarone-refractory VA. Thanks to the contribution by Porta-Sánchez et al.,³ real-world data support the cost-effectiveness of catheter ablation in patients with high-burden VT in the Canadian context. The cost-effectiveness of catheter ablation for VA in specific populations such as patients with nonischemic cardiomyopathy and those naïve to antiarrhythmic therapy warrants further investigation. However, cost is but one consideration in the appraisal of available therapies, which should not deter clinicians from using clinical expertise to appropriately select patients who might benefit from catheter ablation. Decisions regarding the use of catheter ablation should be guided by thoughtful patient selection, on the basis of best available evidence, sound clinical judgement, and patient preferences.

Disclosures

The authors have no conflicts of interest to disclose.

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