



Ablation Procedures for Rhythm Control in Patients with Atrial Fibrillation: Clinical and Cost-Effectiveness Analyses

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Introduction

Atrial fibrillation (AF), which is the most common form of cardiac arrhythmia, is associated with high morbidity and mortality.^{1,2} Patients with AF are at a higher risk of clot formation and subsequent adverse hemodynamic events (such as stroke) because of the loss of atrial contractility, irregular ventricular rate of activity, and the loss of atrial appendage contractility and emptying.³ AF increases the risk of stroke four- to five-fold in all age groups and leads to 10% to 15% of all ischemic strokes.⁴ This arrhythmia, which is the most common cause of stroke among elderly people, causes approximately 25% of strokes in patients aged 80 years or older.⁵

AF affects approximately 250,000 Canadians.⁶ The prevalence increases with age (ranging from 0.1% of the population younger than 55 years of age to 9% among individuals aged 80 years or older).¹

The first-line medical therapy for AF is antiarrhythmic drugs (AADs),^{7,8} which have the advantage of being non-invasive and available but may require chronic administration. Ablation of AF may prevent long-term use of AADs. However, there remains uncertainty about the health impact of using ablation, and its place in therapy.

Objective

The objectives of this report were to compare the clinical and cost-effectiveness of minimally invasive ablation procedures for AF with those of other modalities for converting AF to normal sinus rhythm (NSR), and to evaluate the health services impact of funding AF ablation procedures.

There were eight research questions in this report:

- In adults with AF, what is the comparative clinical effectiveness of the minimally invasive ablation procedures for AF?
- In adults with AF, what is the comparative cost-effectiveness of the minimally invasive ablation procedures for AF?
- In adults with AF, what is the comparative clinical effectiveness of the minimally invasive ablation procedures versus alternative interventions (pharmacological or electrical cardioversion, or surgical procedures)?
- In adults with AF, what is the comparative cost-effectiveness of minimally invasive ablation procedures versus alternative interventions (pharmacological or electrical cardioversion, or surgical procedures)?
- What recommendations on the use of minimally invasive ablation procedures are included in Canadian and international guidelines for AF?
- What is the level and strength of the evidence supporting the recommendations on the use of invasive ablation procedures that are included in Canadian and international guidelines for AF?
- What is the expected budget impact on the Canadian provinces and territories with the provision of minimally invasive ablation procedures for AF to adults?
- What are the expected planning issues (for example, quality measures on the volume of ablation procedures) in the Canadian provinces and territories with the provision of minimally invasive ablation procedures for AF to adults?

Methods

Clinical Assessment

Systematic literature searches were undertaken to identify relevant clinical and economic evaluations of ablation procedures for AF. One additional search was conducted to identify the latest Canadian and international guidelines on the use of minimally invasive ablation procedures for AF. Relevant controlled clinical trials (randomized and non-randomized) of any duration mainly designed to evaluate clinical efficacy, effectiveness, or safety of ablation procedures in adult patients with AF were identified. Decisions about eligibility and methodological quality of studies were made by two independent reviewers. Any discrepancies were solved by consensus. When two or more comparable studies were identified, a pooled estimate of effect was obtained in a meta-analysis. For the studies that were not comparable in population, interventions, or outcome measures, narrative descriptions are provided.

Economic Assessment

A peer-reviewed literature search was performed to identify relevant economic analyses assessing the cost-effectiveness of catheter ablation for AF. Findings from this search were summarized in a review of economic studies. As no Canadian economic studies were retrieved, a primary Canada-specific cost-utility analysis was conducted using a Markov model for patients with AF.

Health Services Impact Assessment

Two key components of this assessment included determining the population impact and the budget impact for the provision of AF ablation procedures in Canada.

Results

Clinical Effectiveness

a) Literature search

Of the 2,648 potential citations that were identified during the systematic search, 2,362 and 256 citations were excluded during the title and abstract and the full text reviews,

respectively. Thirty citations reporting 23 randomized and six non-randomized controlled trials met the inclusion criteria of this review.

b) Catheter ablation versus medical treatment

The systematic review of clinical evidence indicated that the use of catheter ablation was superior to treatment with AADs, in patients with AF, for the maintenance of sinus rhythm up to a year (relative risk [RR] 2.82, 95% CI 2.13 to 3.74). There was insufficient evidence comparing catheter ablation as a first-line treatment with medical therapy in patients for whom a rhythm control strategy was appropriate. Based on the subgroup analyses, the use of ablation techniques led to better results in patients with paroxysmal AF (RR 3.80, 95% CI 2.92 to 4.96) compared with the pooled results for all AF types (RR 2.82, 95% CI 2.13 to 3.74).

c) Catheter ablation versus electrical cardioversion

The non-randomized controlled trial comparing the efficacy of using catheter ablation to that of using electrical cardioversion showed a higher success rate in patients undergoing ablation procedures (82%) compared with patients in the electrical cardioversion group (40%).

d) Catheter ablation versus surgical procedures

No studies evaluated the effectiveness of using catheter ablation procedures compared with open heart surgery for the treatment of AF.

e) Pulmonary vein isolation (PVI) versus PVI plus adjunctive atrial ablations

The results of the CADTH meta-analyses showed that, at 12 months, patients with AF who underwent PVI plus adjunctive atrial ablations (PVI+) had an 8% higher chance of maintaining sinus rhythm compared with those who underwent PVI (RR 0.92, 95% CI 0.86 to 0.99). The overall estimate of the effect size is interpreted with caution because of between-study variations in patient populations (AF types) and heterogeneity of the ablation techniques that were used. The meta-analysis suggested that PVI plus linear ablations of left atrial sites had a 15% higher success rate than PVI (RR 0.85, 95% CI 0.76 to 0.95). There was

insufficient evidence to reliably estimate the effects of additional ablation lines in the right atrium, adjunctive ablation of ectopic triggers of AF, or other approaches such as stepwise and tailored ablation techniques. The results of subgroup analysis indicate that patients with persistent AF could benefit more from PVI+ strategies than from PVI alone (RR 0.59, 95% CI 0.39 to 0.91).

Economic Analysis

The primary economic analysis found the incremental cost-effectiveness of AF ablation compared with AADs to be \$59,194 per quality-adjusted life-year (QALY) in patients with a CHADS₂ risk score of two, and for whom at least one AAD had failed. Therefore, if society's willingness to pay for each QALY is \$59,194 or greater, AF ablation would be cost-effective in this population. Otherwise, AADs would be the cost-effective strategy. The probability of AF ablation being cost-effective at willingness-to-pay thresholds for a QALY of \$25,000, \$50,000, \$100,000, and \$150,000 was estimated to be 0.03, 0.30, 0.89, and 0.98, respectively. When no difference in utility is assumed between normal sinus rhythm (NSR) and AF health states, the cost per QALY of AF ablation becomes \$221,839. If it is assumed that restoring NSR has no impact on stroke, the cost per QALY of AF ablation compared with AADs is \$86,129. Such findings may be inconsistent with the clinical motivation for AF treatment, which may be stroke prevention instead of improving quality of life in the absence of stroke.

Health Services Impact

In 2008, an estimated 2,030 minimally invasive AF ablation procedures were performed in Canada. The Quebec data are not included in the databases that are used to identify the number of procedures. Most ablations occurred in Ontario (910), British Columbia (851), Alberta (119), and Nova Scotia (98). The in-patient and physician costs are estimated to be \$19,467,400. Based on trends over the past five years, the projected expenditures on these procedures are estimated to reach \$40,888,821 by 2013.

Limitations

The CADTH review failed to evaluate the long-term consequences of AF ablation procedures. In the clinical review, few trials were found on the efficacy of catheter ablation as a first-line therapy.

The studies did not address the effectiveness of AF ablation in patients with congestive heart failure, the comparative effectiveness of catheter ablation and surgical procedures, and the effectiveness of repeated ablations. There were insufficient data on adverse events following the use of ablation techniques and comparators. The primary economic evaluation had a number of limitations. Among these, indirect costs were not considered in the analysis, and the clinical data input on NSR for AF ablation and AAD treatment were based on short-term data. The model also assumed a lower risk of ischemic stroke associated with AF ablation compared with AAD.

Conclusions

The evidence in this systematic review indicates that the use of catheter ablation increases the rate of maintenance of sinus rhythm compared with treatment with AADs in patients for whom the use of one or two drugs failed. The studies are of insufficient size and duration to evaluate the impact on stroke, heart failure, and mortality. Ablation techniques were shown to lead to better results in patients with paroxysmal AF. Limited data suggest that catheter ablation may be an effective first-line rhythm control strategy in patients with AF. More trials are needed to confirm these findings. Our review suggests that patients with persistent AF may benefit more from PVI+ strategies than from PVI alone.

The primary economic evaluation using a five-year time horizon found the incremental cost per QALY of AF ablation compared with AAD to be \$59,194. These findings were similar to those of other published economic evaluations. The cost-effectiveness of AF ablation was found to be more favourable when longer time horizons were used.

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Canadian Agency for Drugs and Technologies in Health (CADTH)
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Tel.: 613-226-2553
Fax: 613-226-5392
Website: www.cadth.ca

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