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COMPARING OUTCOMES OF CATHETER ABLATION VS. ANTIARRHYTHMIC DRUGS IN ATRIAL FIBRILLATION: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Atrial fibrillation (AF) is a prevalent arrhythmia that leads to an increased risk of stroke, heart failure, and mortality. Traditionally, antiarrhythmic drugs (AADs) have been used to manage AF, but catheter ablation (CA) has emerged as an alternative therapy, offering the potential for more durable results. This randomized controlled trial (RCT) aims to compare the outcomes of CA and AADs in patients with symptomatic, drug-refractory AF. The primary objective was to evaluate the efficacy of CA versus AADs in maintaining sinus rhythm over a 12-month period. Secondary endpoints included hospital readmission rates, quality of life, and adverse events. Our study showed that CA was superior to AADs in maintaining sinus rhythm ($p < 0.01$), with a higher success rate of 85% compared to 55% in the AAD group. Furthermore, patients in the CA group had fewer hospital readmissions ($p = 0.03$) and significantly better quality-of-life scores ($p < 0.001$). The incidence of adverse events was similar between both groups, indicating a comparable safety profile. These findings suggest that CA may offer a more effective long-term solution for AF management compared to AADs. This study contributes to the growing body of evidence supporting CA as a first-line treatment for patients with drug-refractory AF.

Keywords: Atrial Fibrillation, Catheter Ablation, Antiarrhythmic Drugs

Introduction

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia, affecting millions of individuals worldwide. The prevalence of AF is steadily increasing due to the aging population, with estimates indicating that by 2050, nearly 12 million people in the United States alone will be diagnosed with AF. The condition is characterized by an irregular and often rapid heart rate, which can lead to symptoms such as palpitations, shortness of breath, fatigue, and increased risk of stroke. AF is also associated with significant morbidity and mortality, making its management a critical concern in clinical cardiology.[1-4]

The mainstay of AF management has traditionally been pharmacological interventions, particularly antiarrhythmic drugs (AADs). These medications aim to control the heart rate and restore sinus rhythm. However, AADs are often associated with limited efficacy, side effects, and the potential for proarrhythmic effects, particularly in patients with structural heart disease. As a result, the need for alternative treatment strategies has become increasingly evident. Catheter ablation (CA), which involves the targeted destruction of arrhythmogenic tissue in the heart, has emerged as a promising option for patients with symptomatic, drug-refractory AF.[5-7]

Recent studies have demonstrated that CA offers a higher success rate in maintaining sinus rhythm when compared to pharmacological therapy. However, while the short-term benefits of CA are well established, the long-term outcomes and the comparative effectiveness of CA versus AADs remain a subject of ongoing investigation. A growing body of evidence suggests that CA may lead to better outcomes in terms of quality of life, hospital readmissions, and the need for long-term medication, but these findings are not universally consistent.[8-9]

Despite the increasing use of CA, the choice between CA and AADs remains a topic of debate among clinicians. Factors such as patient preference, cost, procedural risks, and underlying comorbidities all influence the decision-making process. Additionally, while CA has shown promise, the procedure itself is complex and carries a risk of complications, such as thromboembolism, cardiac tamponade, and esophageal injury. Therefore, a randomized controlled trial (RCT) comparing the outcomes of CA and AADs is necessary to provide clear guidance on the optimal management of AF.[10-13]

This study aims to evaluate the long-term efficacy and safety of CA compared to AADs in patients with symptomatic, drug-refractory AF. By examining sinus rhythm maintenance, hospital readmission rates, and quality of life, the results will offer valuable insights into the benefits and risks associated with both treatment modalities. Furthermore, this trial will contribute to the growing body of literature supporting CA as a potentially more effective treatment for AF.

Recent evidence highlights the need for personalized treatment approaches in AF management. Studies have shown that factors such as the duration of AF, age, and comorbidities play a significant role in determining the most appropriate therapy. While CA may be more effective in certain patient populations, its suitability for all patients remains uncertain. Therefore, this study will explore how different demographic factors may influence the success of CA and AADs, helping to refine treatment strategies for AF in diverse patient populations.

Methodology

This study was conducted at Civil hospital Quetta over a period of 18 months at a single tertiary care center. The study included adult patients aged 18 to 80 years with symptomatic, drug-refractory AF, defined as failure to respond to at least two antiarrhythmic medications. Participants were randomly assigned to one of two groups: catheter ablation (CA) or antiarrhythmic drugs (AADs). The randomization process was carried out using a computer-generated random number sequence, and both groups were matched for baseline characteristics, including age, gender, comorbidities, and AF duration.

Sample size calculation was performed using Epi Info software (version 7.2.4.0). Assuming an 80% power and a 5% significance level, the required sample size for each group was calculated to be 100 participants. This calculation was based on previous studies reporting a 55% success

rate for AAD therapy and an 85% success rate for CA, with a clinically significant difference set at 30%. The final sample size was adjusted to account for a 10% attrition rate, resulting in 110 participants per group.

Inclusion criteria included patients with symptomatic, persistent AF who had failed at least two different antiarrhythmic drugs. Exclusion criteria included patients with contraindications to either treatment modality, such as significant structural heart disease, previous AF ablation, or life-threatening comorbidities such as severe heart failure, active cancer, or recent stroke. All participants provided written informed consent prior to enrollment.

The primary endpoint of the study was the maintenance of sinus rhythm, defined as the absence of AF episodes lasting longer than 30 seconds over a 12-month period. Secondary endpoints included hospital readmission rates, quality of life as assessed by the SF-36 questionnaire, and adverse events related to the interventions. Statistical analysis was performed using SPSS (version 25), and p-values of less than 0.05 were considered statistically significant.

Results

Table 1: Comparison of Sinus Rhythm Maintenance

Group	Success Rate (%)	Mean Duration of Follow-up (months)	p-value
Catheter Ablation	85	12	< 0.01
Antiarrhythmic Drugs	55	12	

Explanation: This table demonstrates the superior efficacy of catheter ablation (CA) in maintaining sinus rhythm compared to antiarrhythmic drugs (AADs). The statistically significant difference ($p < 0.01$) underscores the greater success rate of CA.

Table 2: Hospital Readmission Rates

Group	Readmission Rate (%)	p-value
Catheter Ablation	15	0.03
Antiarrhythmic Drugs	30	

Explanation: CA resulted in fewer hospital readmissions ($p = 0.03$), suggesting that it provides more durable symptom control compared to AADs.

Table 3: Quality of Life (SF-36 Scores)

Group	Mean SF-36 Score	p-value
Catheter Ablation	75	< 0.001
Antiarrhythmic Drugs	60	

Explanation: The quality of life, measured by the SF-36 score, was significantly better in the CA group ($p < 0.001$), indicating the broader benefits of ablation in symptom relief and functional status.

Discussion

The results of this randomized controlled trial provide compelling evidence that catheter ablation (CA) is superior to antiarrhythmic drugs (AADs) in the management of symptomatic, drug-refractory atrial fibrillation (AF). The findings align with recent studies that have highlighted the long-term benefits of CA in maintaining sinus rhythm, improving quality of life, and reducing hospital readmissions. While AADs have been the cornerstone of AF management for decades, their limited efficacy and potential for adverse effects underscore the need for more effective alternatives. The statistically significant difference in sinus rhythm maintenance observed in our study ($p < 0.01$) further supports the growing body of evidence favoring CA as a first-line treatment option for AF patients.[14-16]

Our study also demonstrated a significant reduction in hospital readmission rates in the CA group ($p = 0.03$). This is consistent with previous studies that have shown that CA leads to fewer AF-related hospitalizations, likely due to the more durable nature of the rhythm control achieved through ablation. This result has important implications for healthcare systems, as it suggests that CA may be more cost-effective in the long term, despite the higher upfront procedural costs.

The improvement in quality of life, as assessed by the SF-36 score, was also significantly greater in the CA group ($p < 0.001$). This finding aligns with prior research indicating that patients undergoing CA experience greater relief from AF-related symptoms and improved functional status. This is particularly important, as AF is a highly symptomatic condition that significantly impairs patients' quality of life. The improvement in quality of life seen in the CA group provides further justification for its use as a first-line treatment.[17-18]

In terms of safety, the incidence of adverse events was similar between both groups, which is consistent with the results of other studies comparing CA and AADs. This suggests that, while CA is a more invasive procedure, its safety profile is comparable to that of pharmacological therapy. However, it is important to note that CA carries procedural risks, such as bleeding, infection, and tamponade, which should be carefully considered in patient selection.[19-20]

The results of this study are consistent with several recent trials that have compared CA and AADs. For instance, a large-scale meta-analysis published in 2023 found that CA was associated with significantly higher rates of sinus rhythm maintenance compared to AADs, and this was accompanied by improved quality of life and reduced hospitalizations. Our study further adds to this evidence by demonstrating these benefits in a well-powered, randomized trial. Additionally, our findings support the increasing use of CA as a first-line therapy in patients with symptomatic, drug-refractory AF.

One of the strengths of this study is the rigorous methodology, including the use of randomized assignment, long-term follow-up, and comprehensive outcome measures. The sample size was appropriately calculated, and the inclusion and exclusion criteria ensured that the results are generalizable to a wide range of AF patients. Furthermore, the statistical significance of our findings strengthens the validity of the results and supports the clinical utility of CA over AADs in the treatment of AF.

While our study provides strong evidence in favor of CA, several limitations must be acknowledged. First, the single-center design may limit the generalizability of the results. Second,

while the study had a sufficient sample size to detect significant differences in primary and secondary outcomes, the relatively short follow-up period of 12 months may not capture the long-term risks and benefits of each treatment. Future studies with extended follow-up are warranted to assess the durability of the outcomes over several years.

Conclusion

This randomized controlled trial confirms that catheter ablation is more effective than antiarrhythmic drugs in maintaining sinus rhythm, reducing hospital readmissions, and improving quality of life in patients with symptomatic, drug-refractory atrial fibrillation. The findings highlight the potential of CA as a first-line therapy for AF, although careful patient selection is necessary. Future research should focus on long-term outcomes and refine patient selection criteria to optimize treatment strategies for AF.

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