

Exploring the essential aspects of the hybrid approach for atrial fibrillation

Citation for published version (APA):

van der Heijden, C. A. J. (2024). *Exploring the essential aspects of the hybrid approach for atrial fibrillation*. [Doctoral Thesis, Maastricht University]. Maastricht University. <https://doi.org/10.26481/dis.20240202ch>

Document status and date:

Published: 01/01/2024

DOI:

[10.26481/dis.20240202ch](https://doi.org/10.26481/dis.20240202ch)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
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CHAPTER 10

Summary

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Background information

Atrial fibrillation (AF) is the most prevalent cardiac arrhythmia in adults and is characterized by a chaotic contraction of the atria. This often leads to symptoms including palpitations or dyspnea. Since during AF the atria often contract rapidly and irregularly, they are in fact dysfunctional. As a result, the normal blood flow from the atria to the ventricles is impaired. Consequently, the cardiac function may be impaired and blood clots can develop, thereby increasing the risk for heart failure and stroke respectively. As such, AF is associated with a reduced quality of life and an increased risk of morbidity and mortality.

Atrial fibrillation may terminate spontaneously, but if AF persists, several AF-induced mechanisms aggravate the complexity of the arrhythmia even further. Consequently, the atria become progressively enlarged, stretched and stiff, leading to a substrate that is more refractory for intervention.

Anti-arrhythmic therapies for atrial fibrillation

For many patients, anti-arrhythmic treatment using drugs and/or a catheter ablation procedure offer a good solution to treat the arrhythmia. During a catheter ablation procedure, the cardiologist inserts the ablation instruments into a vein in the groin towards the inside of the heart, where the ablation takes place (scarring of the tissue). For many patients, a catheter ablation offers successful results. Unfortunately, for patients with more persistent forms of AF and severely diseased atria, a catheter ablation procedure often has unsatisfactory results. As such, adequate treatment of AF in this patient category remains a real challenge. For such patients, a minimally invasive surgical ablation via the ribs may offer a solution. Back in the days, a surgical ablation procedure required a sternotomy and the use of cardiopulmonary bypass. Meanwhile, surgical AF ablation can be performed without opening the chest and on the beating heart. An important difference with catheter ablation is that during surgical ablation, the ablation lines are created on the outside of the atrium and different ablation instruments are used.

Catheter versus minimally invasive surgical ablation

An important advantage of a catheter ablation, besides the natural less invasive character of the procedure, is that it allows the cardiologist to create a detailed electro-anatomical map of the atria by testing for signals. On such a map it is possible to validate the

completeness of the ablated lesions. In case of incompleteness, immediate touch-up ablation to fulfil the lesion set can be performed. On the other hand, a surgical ablation offers the opportunity to exclude the left atrial appendage and considerably lower the risk of stroke. In addition, the use of certain instruments during a surgical ablation via the outside of the heart has shown to be more effective in creating lesions over the full length of the atrial myocardium than the instruments that are used during a catheter ablation procedure. Therefore, the surgical approach may be more successful in terminating the arrhythmia than a catheter ablation procedure. However, the cardiac surgeon does not dispose of such detailed information about the underlying tissue and arrhythmia compared to the cardiologist during a catheter ablation procedure.

Hybrid ablation procedure

In Maastricht, the cardiologist and cardiac surgeon have bundled their skills to further improve the current anti-arrhythmic treatment options for patients with advanced and complex AF. As such, the first thoracoscopic hybrid procedure was performed in 2010 in the MUMC+. During this procedure, the surgical ablation is combined with the endovascular procedure executed by the cardiologist. During the latter step, the cardiologist is able to validate the previously surgically created scars by testing for signals. If necessary, an extra ablation lesion can directly be created to complete the lesion set and improve rhythm outcomes.

This thesis

The aim of this thesis is to evaluate the beneficial aspects of a surgical (including hybrid) ablation procedure. In the **first chapter**, the general introduction describes underlying pathophysiological mechanisms of AF, current anti-arrhythmic therapies and other important outcome measures. Then, in the following **chapter 2**, the CT-scan analysis of a certain type of fatty tissue surrounding the left atrium and its relation to the occurrence of AF after cardiac surgery is described. Although this type of fatty tissue seems important in the early development of AF, there does not seem to be an association between this type of fat and the occurrence of AF in the postoperative setting. Hence, for this type of AF, other factors such as inflammation seem to play a more important role.

Thereafter, the following chapters focus on the outcomes after a surgical (including hybrid) ablation procedure. Although hybrid ablation yields promising outcomes, the

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procedure has never been compared to a catheter procedure alone. Therefore, **chapter 3** compares the efficacy and safety of a hybrid procedure with a catheter ablation procedure. Although this systematic review and meta-analysis shows that hybrid ablation is more effective than catheter ablation for people with persistent AF, the risk of complications was also higher.

To further validate our results in **chapter 4**, both techniques were directly compared with each other in a randomized study: the HARTCAP-AF trial. Again, the hybrid procedure was more effective than the catheter procedure. Interestingly, the hybrid procedure was as safe as a catheter procedure, since the risk of complications was comparable between both interventions. A possible explanation is that in this trial, all procedures were performed by an experienced team that had already overcome the effect of the learning curve.

Moreover, over the past few years surgical techniques have evaluated into a variety of less invasive keyhole alternatives. Currently, the thoracoscopic part of a hybrid procedure can also be performed from only one side instead of two. As such, **chapter 5** shows that a thoracoscopic hybrid procedure performed via only the left-side of the thorax is feasible, efficacious and safe. Importantly, sparing of the contralateral side of the thorax has the potential to reduce procedure related complications, thereby improving recovery time and subsequently quality of life.

In the category of minimally invasive procedures, we then describe the combination of two minimally invasive surgical procedures in one in **chapter 6**. For patients undergoing a robot-assisted bypass operation for treating their coronary artery disease, and who at the same time apply for a surgical treatment of AF, this combined all-in-one minimally invasive procedure performed in the MUMC+ should be considered. It turned out that the combined procedure was not only technically feasible, but also safe with satisfactory rhythm outcomes until 1 year. An additional analysis using cardiac echocardiography even showed a significant improvement in the left atrial function following the procedure. The latter finding triggered our curiosity and led to the idea of analyzing the left atrial function and contractility after the hybrid approach as well and if an association was present with successful rhythm outcome. In **chapter 7** we found that in general, the left atrial function improves and the left atrial size decreases after a hybrid procedure. The effect was mostly present in people with persistent AF due to rhythm restoration, but the procedure itself also resulted in reduced left atrial size. These are important findings, as

they implicate that the progressive disease remodeling processes during AF are at least partially reversible when performing a hybrid procedure.

Besides rhythm or echocardiographic outcomes, patient reported outcomes such as quality of life are becoming increasingly important. After all, the goal of an ablation is symptom reduction and quality of life improvement. For this reason, we investigated in **chapter 8** the patient reported quality of life after a surgical AF ablation procedure, whether or not combined with another cardiac surgery procedure. The study was based on worldwide data and described in a systematic review and statistical meta-analysis. Quality of life improved for all patients undergoing surgical AF ablation and the improvement was even greater in patients where the arrhythmia could be treated successfully without the occurrence of recurrences.