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REVIEW ARTICLE

Atrial fibrillation and cardiac rehabilitation: an overview

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ABSTRACT

Background: Atrial fibrillation (AF) is the most common cardiac arrhythmia, and its frequency will only continue to increase in the future. Despite available drug and electrophysical treatments, death and functional restrictions due to AF are still common. More comprehensive standards of care are therefore needed.

Purpose: After a foreword regarding the link between physical activity and AF, this article aims to give to the clinician an overview of the benefits he may expect or not when including patients suffering from AF in a cardiac rehabilitation programme.

Method: We selected prospective, randomised controlled trials published during the past 10 years and referenced in the PubMed Database evaluating the safety of rehabilitation and/or its impact on AF incidence or tolerance, and tried to summarise them to propose a narrative review.

Conclusion: Cardiac rehabilitation, along with moderate and regular physical activity, has been proven to reduce the time in arrhythmia of patients with paroxysmal and persistent AF. In chronic AF, cardiac rehabilitation may decrease the resting ventricular response rate in patients and therefore improve symptoms linked to arrhythmia. These studies have managed to demonstrate cardiac rehabilitation as a safe and manageable option for AF patients, without serious risk of additional side effects. Its efficiency to limit the occurrence of serious undesirable outcomes, such as mortality and hospitalisation, has not been adequately demonstrated, likely due to the small scale of most studies and lack of long-term follow-up. Large-scale and long-term studies are thus desirable.

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KEYWORDS
Atrial fibrillation; cardiac rehabilitation; cardiac arrythmia; exercice training

Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia. It has an estimated prevalence of 2% of the population in industrialised countries, which markedly rises with increasing age to 15–20% of people over 80 years [1]. Given the increased life expectancy resulting in overall population aging, AF frequency will only continue to increase in the future. AF raises mortality risk by a factor of 1.5 for men and 2 for women [2], while altering quality of life (QOL). Complications are multifaceted and the neurological sequelae of strokes resulting from AF and the increased risk of heart failure both contribute to the development of comorbidities in AF patients. AF also leads to significant health care costs. Direct anticoagulants introduced at the beginning of the decade and their clinical superiority over vitamin K antagonists have contributed to the increased pharmaceutical cost. In Belgium, these costs rose from €1.6 million in 2004 to nearly €100 million in 2015 [3].

Stroke-associated mortality has decreased with the introduction of anticoagulant treatments; however, AF-associated morbidity and mortality have remained problematic. Despite available drug and electrophysical treatments, death and functional restrictions due to dyspnoea, heart failure, and activity reduction are still common. The European Society of Cardiology (ESC) website provides a chart describing major complications (Figure 1) [4]. Furthermore, studies have shown that, despite treatment efficiency, most patients still lack proper instruction, leading to anxiety and increasing the perception of symptoms such as palpitations, dyspnoea, and fatigue [5]. This has led to the continued development of our treatment methodology. More comprehensive standards of care are crucial for the improvement of patient outcomes.

Cardiac rehabilitation seems an achievable aim given the extensively documented benefits across other clinical contexts. After a heart infarction, cardiac rehabilitation decreases mortality, hospitalisation rates,

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Event	Association with AF
Death	Increased mortality, especially cardiovascular mortality due to sudden death, heart failure or stroke.
Stroke	20-30% of all strokes are due to AF. A growing number of patients with stroke are diagnosed with "silent", paroxysmal AF.
Hospitalizations	10-40% of AF patients are hospitalized every year.
Quality of life	Quality of life is impaired in AF patients independent of other cardiovascular conditions.
Left ventricular dysfunction and heart failure	Left ventricular dysfunction is found in 20-30% of all AF patients. AF causes or aggravates LV dysfunction in many AF patients, while others have completely preserved LV function despite long-standing AF.
Cognitive decline and vascular dementia	Cognitive decline and vascular dementia can develop even in anticoagulated AF patients. Brain whit matter lesions are more common in AF patients than in patients without AF.

AF — Atrial Fibrillation; LV — left ventricular

Figure 1. Frequent complications linked to atrial fibrillation.

and depression, resulting in improved QOL. Patients suffering from heart failure with systolic dysfunction exhibit the same improvements to overall health and QOL with cardiac rehabilitation [6]. The benefits of cardiac rehabilitation in AF patients have not been comprehensively characterised, however. The addition of exercise has the potential to be detrimental by raising the risks of AF, another arrhythmia, or of ischaemic heart events.

Methods

This article aims to review the recent studies investigating the safety and efficacy of cardiac rehabilitation in patients suffering from AF, after a foreword regarding the link between physical activity and AF. We searched for publications from the previous 10 years (from January 2008 to June 2018) in the PubMed database, using the keywords *atrial fibrillation and cardiac rehabilitation*. We only selected prospective, randomised controlled trials evaluating the safety of rehabilitation and/or its impact on AF incidence or tolerance, and tried to summarise them.

Physical activity and AF

An established correlation exists between athletic conditioning and AF. It has long been demonstrated that practicing high-intensity endurance sports increases the risk of AF, presumably due to heart tissue remodelling seen in athletes [7]. Endurance training-driven remodelling can be characterised by increased left atrial volume and left ventricular hypertrophy coupled with alterations to the autonomic nervous system.

Alternatively, suggesting therapeutic moderate physical activity for AF, given the known improvements to blood pressure homeostasis, may lead to decreased left ventricular hypertrophy and reduction of left atrial dilatation. Further, moderate activity may facilitate weight loss, therefore reducing the occurrence of AF as shown by the LEGACY study [8]. An observational study published in 2008 by Mozaffarian et al. confirmed moderate physical activity, amounting to an energy use of about 600 kcal per week, could reduce risk of AF occurrence in patients aged over 65 (average age 73 years) by 28% on average when compared to those reporting no physical activity at all [9]. In 2015, another observational study, published by Azarbal et al., reviewed a group of more than 90,000 women with an average age of 63 years. Their weekly exercise rate was assessed with a newly created index that multiplied the intensity of the physical activity, in metabolic equivalents (MET), by the time spent practicing. The women who reported a weekly physical activity superior or equal to 15 MET.hour showed significantly fewer episodes of AF than those who failed to reach 1 MET.hour a week over a follow-up period of 11.5 years, on average, with a 0.91 odds ratio (95% CI: 0.85–0.97) [10].

The question of how cardiac physical capacity evolves in patients suffering from AF is also interesting. "Atrial fibrillation and declining physical performance in older adults: the health, aging, and body composition study" was published by Magnani et al. in 2016 and demonstrated people aged 70 years or older ($n = 2753$) with AF suffered an overall faster physical decline when compared to their peers without AF [11]. Throughout the study, their physical performances were assessed every 4 years through *The health ABC physical performance battery*, a series of tests commonly used to assess the psychomotor abilities of elderly people such as measuring the time needed to sit in and get up from a chair five times, the ability to stand on one foot for 30 s, a grip

strength measurement, the distance walked in 2 min, or the time needed to walk 400 m. These assessments demonstrated that patients with AF suffered from physical decline at a significantly faster rate ($p < .05$).

Cardiac rehabilitation and AF recurrence

Since moderate physical activity can reduce the risk of developing an AF, some have wondered if the same could be said for cardiac rehabilitation. In 2016, Vegard Malmo published a Norwegian prospective and randomised study [12]. The study included 51 patients suffering from non-permanent AF divided into two groups, a control group and a group following a cardiac rehabilitation programme. The programme consisted of three sessions per week for a 12-week duration. Methodology followed a traditional protocol of 10 min of warm-up at 60–70% of the predicted maximum heart rate (HR_{max}), more intensive exercises at 85–95% of HR_{max} for 4 min, a 3-min cooling down period between activities at 60–70% of HR_{max}, and a progressive decrease of effort cool down for 5 min at activity completion. The primary endpoint of the study was duration of AF, measured with an implanted loop recorder, starting 4 weeks before and up to 4 weeks after the cardiac rehabilitation.

In the control group, average AF duration increased from 10.4% to 14.6%, but decreased from 8.1% to 4.6% in the rehabilitation group ($p < .01$). According to the study, cardiac rehabilitation also reduced the frequency ($p < .01$) and severity ($p < .01$) of symptoms due to AF. Additional peripheral factors were significantly improved during the study. Maximum oxygen uptake (VO_{2max}), left ventricular systolic function, QOL, and blood lipid profile were all improved. The rehabilitation group also reported a trend towards decreased frequency of hospitalisation and reported no serious side effects. Together, these data confirm the potential antiarrhythmic effect of heart rehabilitation and general value of cardiac rehabilitation. While this study is very promising, it is limited by the small number of subjects.

In patients with permanent AF

In attempt to ascertain whether or not patients with permanent AF would benefit from rehabilitation in terms of symptom management, QOL, cardiac output, and levels of natriuretic peptides, a prospective randomised study published by Osbak et al. in the *American Heart Journal* in 2011 divided 49 patients suffering from permanent AF into cardiac rehabilitation and control groups [13]. The study targeted the maximum power developed during a stress test, distance walked during a six-minute walking test (6-MWT), cardiac output measured by echocardiography, QOL, and levels of natriuretic peptides. Rehabilitation lasted for 12 weeks with 1-h sessions three times a week and consisted of a warm-up followed by higher intensity exercises, Borg scale 14–16, and a few minutes of cooling down exercises. Subjects in the rehabilitation group were also encouraged to maintain regular physical activity at home after programme completion.

The results showed significant improvements for the rehabilitation group in maximal power during the stress test and 6-MWT ($p < .01$) and a significant decrease in the resting heart rate ($p = .04$). The QOL, assessed through the MLHF-Q score, also improved in the rehabilitation group ($p = .03$) (Figure 2). Cardiac output and natriuretic peptide levels remained unchanged. None of the patients in the rehabilitation group presented any serious side effects.

Post-ablation rehabilitation

AF ablation is known to be a marginally effective procedure; arrhythmia will resume, after a single procedure, in 20–30% of the patients. Thus, effectively combating risk factors for AF recurrence, among ablated patients, are crucial. The ARREST-AF study, published in 2014 by Pathak et al., aimed to examine this recurrence [14]. Subjects, who had recently undergone an AF ablation, were randomised into comprehensive management and control groups ($n = 149$). Comprehensive management focussed on apparent risk factors identified as: lack of exercise, hypertension, excessive weight, glucose intolerance, sleep apnea–hypopnea, smoking, and excess alcohol consumption. Targeted treatment of risk factors markedly reduced the risk of AF recurrence and the intervention group exhibited a 16% rate of recurrence, whereas the control group had a 42% rate of recurrence over a 2-year follow-up period ($p < .01$). Subjects enrolled in the intervention group were initially prescribed moderate exercise three times a week for 20 min, then progressing up to 1 h. This prescribed risk factor targeted intervention was very similar to cardiac rehabilitation standards. Together these data suggest a comprehensive cardiac rehabilitation, for patients who had undergone AF ablation, may potentially lead to better AF control and improved overall patient QOL.

The CopenHeartRFA study was published by Risom et al. in the *American Heart Journal* in 2016 [15]. It enrolled 210 patients with an average age of 59 years,

The following questions ask how much your heart failure (heart condition) affected your life during the past month (4 weeks). After each question, circle the 0, 1, 2, 3, 4 or 5 to show how much your life was affected. If a question does not apply to you, circle the 0 after that question.

Did your heart failure prevent you from living as you wanted during the past month (4 weeks) by -	No	Very Little				Very Much
1. causing swelling in your ankles or legs?	0	1	2	3	4	5
2. making you sit or lie down to rest during the day?	0	1	2	3	4	5
3. making your walking about or climbing stairs difficult?	0	1	2	3	4	5
4. making your working around the house or yard difficult?	0	1	2	3	4	5
5. making your going places away from home difficult?	0	1	2	3	4	5
6. making your sleeping well at night difficult?	0	1	2	3	4	5
7. making your relating to or doing things with your friends or family difficult?	0	1	2	3	4	5
8. making your working to earn a living difficult?	0	1	2	3	4	5
9. making your recreational pastimes, sports or hobbies difficult?	0	1	2	3	4	5
10. making your sexual activities difficult?	0	1	2	3	4	5
11. making you eat less of the foods you like?	0	1	2	3	4	5
12. making you short of breath?	0	1	2	3	4	5
13. making you tired, fatigued, or low on energy?	0	1	2	3	4	5
14. making you stay in a hospital?	0	1	2	3	4	5
15. costing you money for medical care?	0	1	2	3	4	5
16. giving you side effects from treatments?	0	1	2	3	4	5
17. making you feel you are a burden to your family or friends?	0	1	2	3	4	5
18. making you feel a loss of self-control in your life?	0	1	2	3	4	5
19. making you worry?	0	1	2	3	4	5
20. making it difficult for you to concentrate or remember things?	0	1	2	3	4	5
21. making you feel depressed?	0	1	2	3	4	5

Figure 2. Minnesota living with heart failure® questionnaire.

of which 74% were men. Patients were then stratified according to the paroxysmal (72%) or persistent nature of AF and gender. Once stratified, patients were randomised into a group subjected to cardiac rehabilitation, four psycho-educational sessions, and routine care or a control group only receiving routine care. The rehabilitation was initiated 1-month post-ablation, in order to avoid any complications due to procedural-associated femoral vein puncture. The primary outcome was VO_{2max} following 4-month rehabilitation and the secondary outcome was mood, as assessed by the Short Form 36.

After 4 months, the rehabilitation group showed significant improvement of VO_{2max} (24.3 ml/kg min as compared to 20.7 ml/kg min, $p < .01$). In contrast, no variation in mood was detected between groups. Both groups reported one death, unrelated to the rehabilitation, and one subject was hospitalised due to an AF episode during rehabilitation. Subjects in the rehabilitation group complained of more minor side effects, especially of the musculoskeletal sort, than did patients in the control group.

Conclusions

The relevance of cardiac rehabilitation for patients with AF has yet to be firmly established and its efficiency to limit the occurrence of serious undesirable outcomes, such as mortality and hospitalisation, has not been adequately demonstrated, likely due to the

small scale of most studies and lack of long-term follow-up. Questions still remain surrounding the reduced tendency towards heart failure in rehabilitated patients. Large-scale and long-term studies are thus desirable to determine the merit of a cardiac rehabilitation standard of care for AF patients. Overall, cardiac rehabilitation, along with moderate and regular physical activity, has been proven to reduce the time in arrhythmia of patients with paroxysmal and persistent AF, thus identifying it as a suitable complement to antiarrhythmic therapies.

In permanent AF, decreasing the resting ventricular response rate in patients, for whom the drug treatments are not enough or for whom it would be desirable to reduce the bradycardia therapies like digitalis, is a necessity. Decreasing the resting ventricular response rate contributes to improved symptoms linked to arrhythmia, physical ability, distance travelled with a 6-MWT, and QOL. Improvements to measurements of rehabilitation correlate with overall improved patient well-being and are crucial endpoints when treating patients with diagnosed AF.

Together these studies have managed to demonstrate cardiac rehabilitation as a safe and manageable option for AF patients, without serious risk of additional side effects. Thus, AF should not be identified as an exclusion criterion for rehabilitation programmes.

Disclosure statement

The authors have nothing to declare.

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