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REVIEW

State of the Art Review: Atrial Fibrillation in Athletes

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Exercise has substantial health benefits with pleomorphic vascular, metabolic, psychological and anti-neoplastic actions resulting in improved quality of life and longevity. Despite these many benefits, numerous studies have shown that endurance athletes are more likely to develop atrial fibrillation (AF) than non-athletes.

The type, intensity and amount of sport appears to influence the risk of developing AF. Several endurance sport activities have been shown to increase the risk of developing AF but an excess in AF has not been shown in non-endurance sports. Furthermore, lifetime hours of participation appear to increase the risk of developing AF. Intriguingly, women appear relatively protected and an association between endurance sport and AF has not been clearly demonstrated amongst female endurance athletes.

The mechanisms by which endurance sport promotes the development of AF are unclear. There are, however, a number of pathophysiological mechanisms which are known to increase the risk of AF in non-athletes which have correlates in athletes. These include structural remodelling of the left atrium, elevated left atrial pressure, inflammation, myocardial fibrosis, vagal tone, sinus bradycardia and genetic predisposition. In this article, we explore how some of these mechanisms may contribute to the development of AF in endurance athletes.

Keywords Atrial fibrillation • Athlete • Endurance sport

Introduction

Atrial fibrillation (AF) is the most common, sustained arrhythmia in the general population [1]. Atrial fibrillation is associated with a number of adverse outcomes including stroke, heart failure and death [2]. The monetary cost alone to society is substantial and predicted to increase in coming years [3,4].

The relationship between exercise and AF is complex. Low and moderate intensity exercise has been associated with a lower risk of AF [5,6], in both obese and non-obese patients [5,7]. In contrast, high intensity endurance training has been associated with an increased risk of AF [8–14]. This results in the classic J shaped curve with increased exposure correlating with higher risk beyond a certain point [15] (Figure 1).

A meta-analysis by Abdulla et al. calculated that endurance athletes were 5.3 times more likely to develop AF than controls [16]. This would seem substantial given that hypertension, which is the most common underlying risk factor for AF, confers a relatively modest 1.42-fold increase in AF risk [17,18].

Participation in endurance sport has increased quite dramatically over the past decades, raising the possibility of an increase in the clinical burden of sport-associated AF [19–22].

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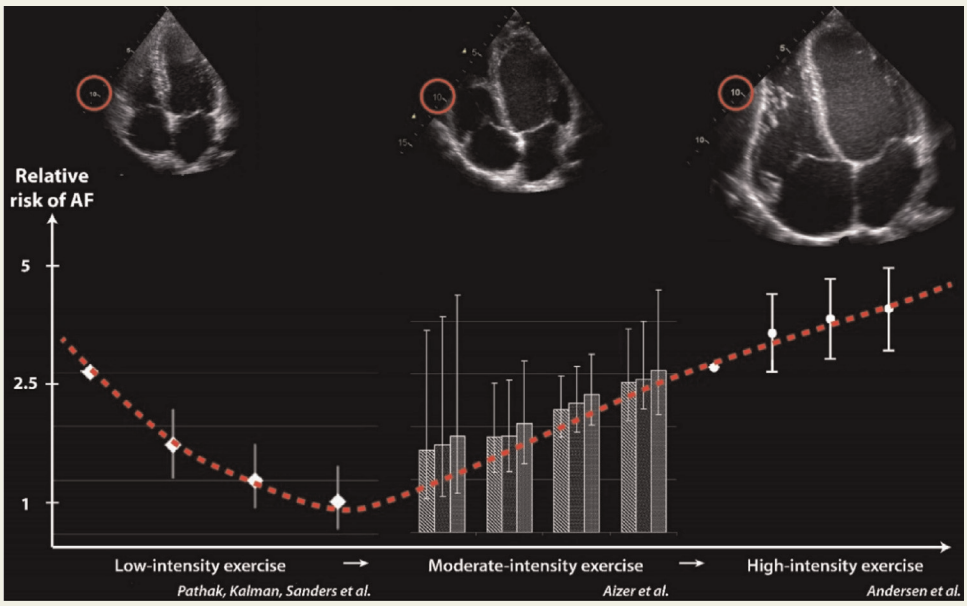

Figure 1 J-shaped relationship between exercise dose and the relative risk of developing AF. The echocardiograms are represented at relative scale (10 cm marker highlighted) demonstrating the increase in heart and atrial size with training (Reproduced with permission. La Gerche et al. Eur Heart J 2013).

Despite this, the benefits of endurance sport participation far outweigh the risks. This is supported by the fact that endurance athletes on average are healthier and live longer than non-athletes [23].

A Critical Appraisal of the Epidemiology

There are several studies linking endurance sport to increased risk of AF but most are retrospective cohort or case control studies of modest size [8–13,24,25]. Adequately powered prospective cohort studies with careful quantification of exercise exposure and identification of incident AF are yet to be performed. Furthermore, a randomised trial comparing endurance exercise with more moderate exercise is unlikely to be feasible, given that subjects are unlikely to be willing to dramatically increase or decrease habitual exercise for a research project.

Nevertheless, the overall body of evidence supporting an association between endurance exercise and AF is compelling. Several large Norwegian trials have utilised prospectively collected health data to measure exercise exposure and the corresponding risk of AF. A cohort of over 20,000 men and women in Tromsø was followed, on average, for 20 years [24]. The study included intermittent surveillance of physical activity. This data was linked to hospital records to detect incident cases of AF. This study demonstrated a clear correlation of increased exercise exposure leading to a greater incidence of AF.

An even larger Norwegian study, involving over 300,000 participants in a Norwegian health screening program, utilised the Norwegian Prescription Database to link exercise exposure to cases of incident AF [25]. The information collected included self-reported physical activity. By linking the data of the participants without a prior history of cardiac disease to prescriptions of flecainide and sotalol, which are usually prescribed for AF, the investigators were able to identify cases of probable AF. Using this method, the investigators found that physically active men were much more likely to be prescribed flecainide than sedentary men, suggesting exercise increases the risk of developing AF.

Gender Differences

There is a paucity of data on the risk of AF in female athletes. The vast majority (93%) of subjects in the cohort and case-control studies combined in a recent meta-analysis were men [16]. Thus, these data are not useful for determining any association between AF and endurance exercise in women.

In the aforementioned Tromsø study, 49.7% of the population was female and a reduction in AF with moderate exercise but increased risk of AF with higher intensity exercise was observed over 20 years' of follow-up in both genders [24]. The incidence of AF was similar amongst women and men but the relatively small number of participants reporting high levels of physical activity meant that the apparent increased risk of AF in female athletes was not statistically significant.

Studies explicitly investigating female athletes' risk of AF are rare. Several studies in women have not shown an increased risk of AF but, rather, a decreased risk [26–28]. The level of exercise reported in these studies is variable. Drca et al. reported a reduction in risk of AF with greater than