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Management of Atrial Fibrillation in the Athlete

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Atrial fibrillation (AF) is a recognised arrhythmic risk of endurance sports participation, predominantly affecting middle-aged men who are lifelong athletes. Affected athletes were historically included in the category of lone AF, although specific pathophysiological processes apply to this condition, referred to as exercise-related AF. Younger non-endurance athletes may also present with AF, particularly when associated with co-existing cardiomyopathy or arrhythmia syndrome.

Management of exercise-related AF is largely based on evidence from randomised trials in non-athletes. Cornerstones of treatment are, thus, thromboembolic risk reduction and risk factor modification. Rhythm control is generally preferred over rate control due to frequent presentation with symptomatic AF during the paroxysmal phase.

Many therapies specific to athletes are based on expert consensus alongside observational data in athletic populations. These include: recommendations to detrain; treatment of symptomatic oesophageal reflux; and preferential use of anticholinergic antidysrhythmic agents to address the predominance of ''vagal'' AF in athletes.

Ongoing research involving cardiac ion channel remodelling and systemic inflammation as mediators of AF genesis may provide future novel therapeutic targets for exercise-related AF. Ablative therapy shows promise in the athletic population with AF, although evidence remains limited. International consensus guidance for disqualification from competitive sports exists to guide medical management alongside athletes' preferences to continue to participate.

This review focusses on isolated exercise-related AF and reviews the evidence supporting postulated management recommendations of this unique patient population.

Keywords Atrial fibrillation • Athlete • Endurance sport

Introduction

Q5 Athletes carry around a five-fold increased lifetime risk of atrial fibrillation (AF) over sedentary individuals [1]. This is despite a lower prevalence of conventional risk factors for the development of atrial fibrillation such as hypertension, diabetes, obesity, coronary artery and valvular disease [2]. Athletic training is now recognised as a component of what has traditionally been considered *lone* or *idiopathic* AF, constituting approximately 40% of this previously erroneously-named diagnostic group [3,4]. Risk factors for AF in athletes are [2,3,5–7]: male sex; middle age; endurance sport; tall stature; and total lifetime exercise dose of over 1500–2000 hours. Moreover, the requirement for high lifetime dose dictates that the majority of those affected by exercise-related AF are athletes who participate in endurance sports, such as running, cycling and cross-country skiing [1,4]; the increase in participation in endurance sporting over recent years has the potential to increase the incidence of exercise-related AF over the coming decades.

Q6 Absence of specific randomised trials of AF management in this cohort of patients mandates treatment decision-making on the basis of observational data and expert consensus.

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Therefore, recommendations for management of AF in athletes presented here are founded on evidence in non-athletes, albeit with emphasis on addressing potentially modifiable risk factors for AF in this population alongside consideration of training-related bleeding risk and drug toleration during sporting activity [8]. Hypothesised and evidence-based pathophysiology underlying exercise-related AF is reviewed in brief; potential therapies addressing each proposed mechanism are discussed.

Clinical Assessment of AF in the Athlete

The clinical approach to an athlete with AF begins with a detailed history, with a focus on exercise history and relationship of exercise to AF episodes. Evaluation should include causes and precipitants of AF, both in the general population and specific to the athlete.

Natural History of Atrial Arrhythmias in the Athlete

Sinus bradycardia and silent sinus pauses are known features of physiological adaptation [9] and are associated with AF [10]. Young athletes have a low prevalence (0.2%) of AF, despite echocardiographic evidence of atrial enlargement [11]; surveillance to the age of 40 years in another series also showed no excess AF [12].

Lifelong male endurance cyclists have both demonstrably higher prevalence of sinus pauses and atrial arrhythmias than non-endurance golfers (6% versus 0%) [10]; the epidemiology of AF burden remains undefined in female athletes although emerging evidence suggests a greater lifetime endurance training requirement of around 40 years may portend increased risk [13]. Pacemaker implantation was performed in 3 of 30 (10%) affected athletes over 9 years of an observational study [14], in excess of the 3% requirement in endurance athletes without premature onset atrial arrhythmias [10].

The progression of AF following diagnosis is also poorly understood. Hoogsteen et al. suggest progression from paroxysmal to persistent AF in 18% of 30 athletes over 9 years [14], although a similar proportion (26%) were also rendered asymptomatic over that period. Continued endurance exercise increases occurrence of AF following successful ablation for typical atrial flutter in athletes [15], supporting the premise of ongoing risk with continued endurance sporting participation.

Specific Aetiological Factors

Conventional risk factors for AF should be considered, with inclusion of alcohol history. Even modest alcohol consumption increases risk of AF and increases burden [16]. The roles of illicit substances such as sympathomimetics and performance-enhancing anabolic steroids in AF pathophysiology are unproven. Case reports [17] and mechanistic research suggesting action on atrial electromechanical delay [18] support the premise; these agents should therefore be highlighted as reversible precipitants to affected athletes. Although predominantly strength-trained athletes are not known to be at increased risk of AF, steroid use may be of greater relevance in these individuals. Moreover, steroids are associated with hypertension and its sequelae. Oesophageal reflux remains a putative risk factor for vagal AF seen in athletes [19], although the mechanism is unknown; increasing intensity and duration of exercise induces reflux [20].

Investigations

Athletes are viewed as the healthiest of society; nonetheless, comorbid conditions may remain unidentified until presentation with symptomatic AF in middle age. In fact, endurance cyclists of mean age 66 years had an identical prevalence of hypertension (35%) to matched golfers in an observational study [10]; associated hypertension should thus be considered in athletes with AF. Symptomatic and biochemical evidence of thyroid disease should also be sought.

Echocardiography is also recommended to detect structural or valvular heart conditions associated with AF development. Although infrequent, many highly performing athletes with primary myocardial disorders such as hypertrophic cardiomyopathy have been reported [21].

A resting electrocardiograph (ECG) is required to ensure absence of primary arrhythmia and pre-excitation syndromes, which have a significant impact on management. Diagnosis of AF mandates documentation of the arrhythmia, which may require prolonged monitoring in athletes due to initially infrequent symptoms. Novel single lead wearable ambulatory ''patch'' devices, currently in clinical use in Europe and USA, or short-term smartphone-enabled rhythm recorders [22], may have a role in achieving a diagnosis in this population.

Cycle or treadmill exercise testing can document maximum heart rate and the presence of exercise-induced arrhythmias, which is useful in the context of presentation with exertional palpitations. Paroxysmal arrhythmias may be suggested by documentation of sudden changes in heart rate during exercise on fitness heart rate monitors. Chest-strap monitors used by professional athletes are generally considered more reliable than fitness bands and watches [23]; correlation with activity monitors can identify inappropriate tachycardia episodes although not necessarily the underlying arrhythmia responsible [24]. However, these devices can be unreliable and a diagnosis will ultimately depend on ECG documentation.

Presentation

As with other individuals with AF, affected athletes may have no attributable symptoms. However, in the authors' experience, athletes often present with intrusive effects of AF; patients with lone AF (including exercise-related AF) constitute an excess of symptomatic AF patients [5]. Moreover, athletes universally present when paroxysmal [14].

Approximately 70% of athletes present with ''vagal AF'' that is predominantly resting or nocturnal thereby

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