Sport practice and the risk of lone atrial fibrillation: A case–control study

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Abstract

Background: Lone atrial fibrillation (LAF) is characterized by the presence of atrial fibrillation in the absence of structural heart disease or other identifiable cause of arrhythmia. In a recent study, we reported sport practice to be more frequent in LAF patients than in the general population. The aim of the study was to determine the association between sport practice and the prevalence of LAF in men.

Methods: An age-matched case–control study was designed. Cases were identified from consecutive patients who attended an outpatient clinic; 51 men with LAF were included, 20 of them with vagal characteristics. Controls were selected from the general population (n = 109). A questionnaire to assess former and current sport practice and the number of lifetime hours of sport practice was administered. Conditional logistic regression was used for statistical analysis.

Results: The proportion of patients with LAF who reported current sport practice (31%) was higher than that observed in controls (14%). In the logistic regression, current practice of sport was associated with a higher prevalence of LAF (OR = 3.13; 95% CI: 1.39–7.05). The practice of more than 1500 lifetime hours of sport appears to be the threshold for the observed association. Current practice of sport with a lifetime practice greater than 1500 h was associated with LAF (OR = 2.87; 95% CI: 1.20–6.91).

Conclusion: In men, the combination of current and prolonged lifetime sport practice is associated with higher risk of LAF.

Keywords: Atrial fibrillation; Exercise; Men

1. Introduction

Lone atrial fibrillation (LAF) is characterized by the presence of atrial fibrillation in the absence of structural heart disease or other identifiable cause of arrhythmia, such as hyperthyroidism or alcohol abuse. Although uncommon causes for this arrhythmia have been described in recent years [1–3], the aetiology of this condition remains unknown. It has been suggested that a disorder of autonomic tone may play an important role in this type of arrhythmia [4], and an “atrial arrhythmia syndrome of vagal origin” characterized by recurrent paroxysmal atrial arrhythmia, present in middle aged males with no underlying structural heart disease and triggered by vagal overactivity, has been described [5].

In a recent study, we reported sport practice to be more frequent in LAF patients than in the general population of the same age in northern Spain [6]. This association has also been observed in a study of Finnish orienteers [7]. Although LAF could be considered a benign condition [8], it is generally associated with symptoms [8], causes a significant impairment of quality of life [9], and has been associated with increased mortality [10,11].

The aim of this population-based study was to confirm and determine the magnitude of the association between sport practice and LAF in men.
2. Materials and methods

2.1. Design

The study was an age-matched prospective population-based case–control study.

2.2. Subjects

A total of 70 patients younger than 65 years of age with LAF were identified from the hospital records of 1160 consecutive patients seen at the outpatient arrhythmia clinic between October 1997 and March 1999. Of these, 51 were men.

LAF was defined as atrial fibrillation in the absence of structural heart disease or other identifiable cause of arrhythmia, such as hyperthyroidism or alcohol abuse. Patients with mild hypertension, controlled with only one drug, were included in the study. Individuals showing minor dilatation or mild hypertrophy of the left ventricle or atrium were also included because these changes might be related to the athlete’s heart.

Two age-matched controls for each case were selected from the general population of Girona, using data from the REGICOR (Registre Gironí del Cor) Study [12]. This is a cross-sectional study designed to establish the prevalence of cardiovascular risk factors in the province of Girona. Both cases and controls were taken from the same population (Catalonia, northern Spain). Written informed consent was obtained from all the participants.

2.3. Atrial fibrillation

Episodes of atrial fibrillation were classified according to the definition of persistent, paroxysmal, and permanent atrial fibrillation proposed by Gallagher and Camm [13] and adopted by the international cardiologic societies [14]. Moreover, although there is no consensus definition of vagal LAF, those patients for whom most of their episodes occurred during the nocturnal or postprandial period were considered to present LAF related to or triggered by vagal overactivity. This group of patients with vagal LAF was considered for a subgroup analysis.

2.4. Sport practice and physical activity assessment

An interviewer administered a questionnaire about current and former sport practice to cases and controls. The following questions were included: a) “Have you ever practiced a sport regularly?” All participants who reported a practice of more than or two sessions per week totalling more than 2 h per week were considered as regular sport practitioners; b) “Which sports have you practiced?” Sports were classified as mainly aerobic or non-aerobic. Those sports that use a large muscle mass, are rhythmic, continuous and usually sustained for a long period of time were considered as mainly aerobic. Examples of this type of sports are swimming, cycling, soccer, etc.; c) Please indicate the age of beginning and ending the practice of each sport, and average number of hours of practice per week. According to the number of years of sport practice and the number of hours of practice per week, the lifetime number of hours of sport practice was calculated. Among those reporting sport practice, those practicing sport at the time of the study were considered current practitioners and the rest former practitioners.

2.5. Other variables

Hypertension was defined as a systolic blood pressure higher than 140 mmHg or diastolic blood pressure higher than 90 mmHg or receiving treatment with antihypertensive drugs.

An echocardiogram was performed on all the patients with atrial fibrillation to determine the absence of any structural heart disease using standardized and recommended criteria [15]. We have previously reported the echocardiographic finding and parameters of these group of

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Characteristics of the control group and the group of patients with lone atrial fibrillation and vagal lone atrial fibrillation at the time of the study</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Controls</td>
</tr>
<tr>
<td>Age (years)</td>
<td>43.9 (11.4)</td>
</tr>
<tr>
<td>Paroxistic atrial fibrillation (%)</td>
<td>–</td>
</tr>
<tr>
<td>Persistent atrial fibrillation (%)</td>
<td>–</td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>45.0</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>31.2</td>
</tr>
<tr>
<td>Current–Former sport practice (%)</td>
<td>65.1</td>
</tr>
<tr>
<td>Aerobic (%)</td>
<td>91.5</td>
</tr>
<tr>
<td>Years of practice</td>
<td>12 (6–18)</td>
</tr>
<tr>
<td>Years from withdrawal</td>
<td>15 (5–23)</td>
</tr>
<tr>
<td>Lifetime hours of practice</td>
<td>3744 (1248–6760)</td>
</tr>
<tr>
<td>Current sport practice (%)</td>
<td>13.8</td>
</tr>
</tbody>
</table>

a Mean (Standard Deviation).

b Median (Range).
patients [6] [among the 32 patients with LAF who were practicing or had practiced sports 5 presented with a left atrium diameter >45 mm, ranging from 46 to 48 mm. The five of them had been practicing cycling for more than 10 years and we considered these diameters as normal in the context of this sport practice level]. Other identifiable causes for the arrhythmia such as hyperthyroidism or alcohol abuse were also ruled out.

2.6. Statistical analysis

The Chi square test was used to compare proportions between groups. Student t or Mann–Whitney U tests were used to compare continuous variables between the two groups. Conditional logistic regression was used to determine the association between sport practice and LAF. A secondary subgroup analysis was carried out considering the group of patients with vagal LAF.

A p value lower than 0.05 was considered as statistically significant.

3. Results

The characteristics of the 109 control men and the 51 male patients included in this study are presented in Table 1. No statistically significant differences were observed in age, smoking status, and hypertension prevalence between cases and controls. No significant differences were observed in the proportion of subjects reporting current or former sport practice, the years of practice, the years since cessation, and the number of lifetime hours of sport practice among groups. The only statistically significant difference between the controls and the cases was the proportion of current practice of sport, which was higher in the patients with LAF or vagal LAF than in the control group.

In the logistic regression, no association was observed between the presence of LAF and the former or current sport practice considered as a dichotomous variable (yes or no) (Table 2). However, current sport practice was associated with a three times greater risk of presenting with LAF. Current sport practice was also associated with higher risk of vagal LAF (Table 2).

When considering the tertiles of the lifetime number of hours of sport practice, a statistically significant association was observed between the practice of 1561 to 5668 h of sport and vagal LAF. The practice of more than 5668 h of sports was marginally non-significantly associated with this type of arrhythmia. On the other hand, the magnitude of the association between atrial fibrillation and hours of lifetime sport practice was similar for both groups (1561–5668 h and >5668 h), suggesting an association with a threshold point and a posterior plateau. In fact, the cut-off-point for the lifetime number of hours of sport practice that maximized the likelihood of the logistic model was 1500 h.

### Table 2

<table>
<thead>
<tr>
<th></th>
<th>Lone atrial fibrillation</th>
<th></th>
<th>Vagal lone atrial fibrillation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number cases–controls</td>
<td>OR (95% CI)</td>
<td>p</td>
<td>Number cases–controls</td>
</tr>
<tr>
<td>Former or current sport practice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No practice</td>
<td>19–38</td>
<td>1</td>
<td></td>
<td>3–38</td>
</tr>
<tr>
<td>Former or current practice</td>
<td>32–71</td>
<td>0.75 (0.36–1.57)</td>
<td>0.441</td>
<td>17–71</td>
</tr>
<tr>
<td>Current practice of sport</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No practice</td>
<td>35–94</td>
<td>1</td>
<td></td>
<td>14–94</td>
</tr>
<tr>
<td>Current practice</td>
<td>16–15</td>
<td>3.13 (1.39–7.05)</td>
<td>0.006</td>
<td>6–15</td>
</tr>
<tr>
<td>Lifetime number of hours of sport practice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No practice</td>
<td>19–38</td>
<td>1</td>
<td></td>
<td>3–38</td>
</tr>
<tr>
<td>100–1560 h/life</td>
<td>7–29</td>
<td>0.48 (0.18–1.30)</td>
<td>0.150</td>
<td>3–29</td>
</tr>
<tr>
<td>1561–5668 h/life</td>
<td>15–19</td>
<td>1.58 (0.66–3.78)</td>
<td>0.305</td>
<td>7–19</td>
</tr>
<tr>
<td>&gt;5668 h/life</td>
<td>10–23</td>
<td>0.87 (0.34–2.19)</td>
<td>0.767</td>
<td>7–23</td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th></th>
<th>Lone atrial fibrillation</th>
<th></th>
<th>Vagal lone atrial fibrillation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number cases–controls</td>
<td>OR (95% CI)</td>
<td>p</td>
<td>Number cases–controls</td>
</tr>
<tr>
<td>No sport practice/Former sport practice &lt;1500 h/life</td>
<td>22–59</td>
<td>1</td>
<td></td>
<td>5–59</td>
</tr>
<tr>
<td>Former sport practice &gt;1500 h/life</td>
<td>13–35</td>
<td>1.00 (0.45–2.22)</td>
<td>0.992</td>
<td>9–35</td>
</tr>
<tr>
<td>Current sport practice &lt;1500 h/life</td>
<td>1–1</td>
<td>–</td>
<td>–</td>
<td>0–1</td>
</tr>
<tr>
<td>Current sport practice &gt;1500 h/life</td>
<td>15–14</td>
<td>2.87 (1.20–6.91)</td>
<td>0.018</td>
<td>6–14</td>
</tr>
</tbody>
</table>
In order to assess this association more accurately, four groups were defined: a) no sport practice or former sport practice totalling fewer than 1500 lifetime hours; b) former sport practice totalling more than 1500 lifetime hours; c) current sport practice with fewer than 1500 h of lifetime practice; and d) current sport practice with more than 1500 h of lifetime practice. Current practice of sport totalling more than 1500 h of lifetime practice was associated with a higher risk of LAF (Table 3), and particularly vagal LAF (Table 3). Former practice of sport totalling more than 1500 lifetime hours was also marginally non-significantly associated with vagal LAF. The results for the group reporting current sport practice and fewer than 1500 h of lifetime practice were not valid because there were too few individuals in this group.

All these multivariate analyses were adjusted for hypertension and matched for age. Hypertension was not associated with LAF prevalence.

4. Discussion

In this study we have documented that current and prolonged sport practice was associated with a three times higher prevalence of LAF, and with five times higher prevalence of vagal LAF.

These results are similar to those observed by Karjalainen et al. [7], who reported a higher risk of LAF in vigorously exercising middle aged men (orienteers) than in the general Finnish population. In that study the prevalence of LAF was 5.3% and 0.9% in the orienteers and the control population, respectively. The odds ratio for LAF associated with vigorous exercise was 5.5 (95% confidence interval: 1.3–24.4), which is very similar to that observed in our study for vagal LAF (5.1, 95% CI: 1.4–19.0). We also reported recently that the proportion of male patients with LAF who practiced sport regularly (63%) was higher than that observed in the general population (15%), suggesting that sport practice could contribute to the development of LAF in men [6].

In our study, only current sport practice was associated with LAF, whereas former sport practice was not associated with this arrhythmia. Furlanello et al. reported that LAF was a common arrhythmia, present in 25% of athletes visited because they reported palpitations [16]. These authors also observed that most of the athletes improved clinically upon cessation of competitive sport [16]. These observations suggest that only current sport is associated with LAF. However, their study refers to young competitive athletes in the active phase of their career. In contrast, our patients are middle aged men, and not high-level athletes.

Noteworthy, the association of current sport practice with LAF was observed when the number of hours of lifetime sport practice was greater than 1500 suggesting the existence of a threshold point. This result should be interpreted with caution and probably points out the pattern of the association, a threshold in the number of hours of sport practice and a posterior plateau, rather than the exact point where the threshold is. The precise estimation of this threshold point at which the LAF risk increases is difficult to determine and probably should be assessed with a prospective study where the quantity of sport practice could be accurately measured and monitored. Therefore we think that this threshold point, 1500 h of lifetime sport practice, should be confirmed in prospective studies and should not be taken as a point to establish recommendations toward athletes’ lifetime training.

Although there is not a consensus about the definition of vagal LAF, the association between sport practice and atrial fibrillation was mainly related to what we defined as vagal LAF. This fact may identify one of the mechanisms inducing atrial fibrillation in sport practitioners. It is well established that regular sport practice increases the vagal tone [17]. In 1978, Coumel et al. defined “the atrial arrhythmia syndrome of vagal origin” [5], although they did not relate this syndrome with sport practice. It is difficult to prove the role of the vagal mechanism in initiating this arrhythmia because this would require monitoring heart rate in the minutes/hours preceding arrhythmia to demonstrate the relationship between the attack and decrease in heart rate (a marker of vagal predominance) [18]. Nevertheless, it is well known that a significant proportion of patients with paroxysmal atrial fibrillation do not present underlying heart disease [8,19], and in these cases the onset of the arrhythmia is predominantly mediated through variations in the autonomic tone [20]. In experimental animal models, it is also well established that: a) atrial fibrillation can be induced by perfusion acetylcholine [21], and b) increasing vagal tone produces a shortening of the atrial refractory period; this, combined with atrial stimulation, allows the induction of atrial fibrillation, which persists as long as vagal tone is enhanced [22,23].

A second plausible mechanism to explain the association between sport and LAF could be related to the slight dilatation of the heart cavities secondary to sport practice [24]. It is well established that slight atrial dilatation is a factor that induces atrial fibrillation. In fact, in our previous study we observed that this group of patients with LAF had a larger mean left atrium size (39 mm) than a group of healthy controls (35 mm) [6].

One of the limitations of this study is that only men were included. More studies are needed to determine if the reported association is modulated by sex, and only observed in men.

On the other hand, the small sample size of the study raises the possibility that a false positive association between sport practice and LAF could explain the results. Nevertheless, this study was designed to test this hypothesis, based on a previous reported observation [6], and our results are consistent with the only previous study analysing this association [7]. For these reasons we consider the possibility of a false positive result to be low.
Another limitation of our study is that we are including as cases those patients who report symptomatic atrial fibrillation. We cannot disregard the possibility that those currently exercising had atrial fibrillation episodes usually asymptomatic as opposed to those not exercising who could usually present asymptomatic atrial fibrillation episodes.

Finally, another limitation of this study refers to the validity of the estimation of the total number of hours of sport lifetime. To our knowledge there is not a valid instrument to measure lifetime sport practice although some of them have been shown to be reliable [25]. As mentioned before, a prospective study in which the quantity of sport practice could be accurately measured and monitored should be designed.

A final consideration is that although the practice of sport could increase the risk of acute cardiovascular events [26–28] or lone atrial fibrillation [18], we also must take into account the overall benefits of sport and physical activity in cardiovascular health [29], even as an antiarrhythmic factor [17].

5. Conclusion

In men, the combination of accumulated lifetime and current sport practice is associated with a three fold higher risk of LAF. Future studies are warranted to confirm these results and investigate the mechanisms underlying this association.

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