Manuscript submitted to JACC: Cardiovascular Imaging

Title: Left atrium size in former elite athletes

Short title: exercise and left atrium

Authors:

Fabian Sanchis-Gomar, MD, PhD,[a] Nuria Garatachea, PhD,[a,b] Pilar Catalán, MD,[c] Marta López, MD,[d] Alejandro Lucia, MD, PhD,[a,e] Enrique Serrano-Ostáriz, MD, PhD,[f]

[a]Research Institute of Hospital 12 de Octubre ("i+12"), Madrid, Spain.
[b]Faculty of Health and Sport Science, University of Zaragoza, Huesca, Spain.
[c]Hospital Universitario Miguel Servet, Zaragoza, Spain.
[d]Cardiology Service, Hospital Universitario Miguel Servet, Zaragoza, Spain.
[e]European University of Madrid, Madrid, Spain.
[f]Faculty of Medicine, Physical Education and Sports Section, University of Zaragoza, Zaragoza, Spain.

Article Type: Letter to the Editor

Author for correspondence:
Fabian Sanchis-Gomar MD, PhD
Department of Physiology.
Faculty of Medicine.
University of Valencia.
Av. Blasco Ibañez, 15, Valencia
46010 Spain
Phone: (34) 96 386 46 50
Fax: (34) 96 386 46 42
Email: fabian.sanchis@uv.es

A recent meta-analysis by Iskandar et al. nicely showed that endurance athletes have larger left atrial (LA) diameters compared with controls (1). Yet only nine of the 54 studies included in their analysis reported LA volume values corrected for body surface area (BSA). In fact, few studies have determined LA volume in young athletes and to the best of our knowledge no study has reported this variable in older athletes. This is an important question given the growing debate about the potential deleterious effects of long-term strenuous endurance exercise on the human heart, notably higher risk of atrial fibrillation (AF), a condition for which both atrial dilatation and the normal ageing process are thought to be potential causative mechanisms (2). Thus, we aimed to assess the long-term consequences of endurance exercise on LA volume in athletes who were highly competitive at younger ages and are still active. To this end, we compared BSA-corrected LA volumes determined with late gadolinium enhancement magnetic resonance imaging (LGE-MRI), among former elite endurance athletes and sedentary controls.

After IRB approval, five healthy individuals (controls) and 10 former elite endurance athletes [all men; aged (mean±SD) 57.0±4.3 and 52.4±6.3yrs; body mass index of 25.8±2.7 and 22.6±1.3kg·m^{-2}] provided written informed consent and were studied. Control subjects had never participated in regular exercise whereas the athletes' group included former professional road cyclists (n=6) and runners (n=4, one of them being a two-time marathon world champion). Their mean experience in professional sports competition (including for some of them participation in the Olympic Games) was 14.3±4.2yrs. All of them except one are still training and competing regularly in Master categories. The only non-active athlete had been retired from competition for 24yrs.

Evaluations were performed with a Signa HDx 3.0T instrument (GE Healthcare, Buckinghamshire, UK). Approximately 10-15min after injection of 0.2mmol/kg gadolinium-chelate contrast, high-resolution LGE images of the LA were acquired in the three cardiac planes. LA volumes were evaluated using the software Report Card 4.3 (General Electric) by a blinded, single experienced researcher.

The values of LA volumes corrected for BSA followed a normal distribution and were significantly higher in athletes compared with controls (58±14 *vs* 39±14ml/m^2, respectively, p=0.026). In the former, the lowest LA volume was found in the only inactive subject (individual values shown in **Figure 1**).

This is the first attempt to evaluate LA volumes with LGE-MRI in former elite athletes. Although our results are preliminary and more research is needed with larger cohorts, in accordance with Iskandar et al (1), our data suggest that long-term participation in regular endurance exercise increases LA volume. Interestingly, LA dimensions are also larger in former highly trained athletes compared with their younger peers (as shown in Figure 2 of the Iskandar's paper), probably due to the combined effects of long-term strenuous endurance exercise together with age-related physiological changes. It seems, however, that LA enlargement in endurance trained athletes is an overall benign adaptation coupled with the left ventricle (LV) enlargement and volume overload induced by chronic exercise (3,4): indeed, endurance training preserves ventricular compliance, thereby preventing heart failure in later life whereas sedentary aging is associated with decreased LV compliance and diastolic performance. Further, LA enlargement associated with sedentary aging is due to LV dilation owing to (i) increased LV mass and eccentric hypertrophy (*eg*, caused by obesity) and/or (ii) concentric increase of LV mass (*eg*, caused by essential hypertension), and eventually leads to impaired ventricular filling and diastolic dysfunction (5). On the other hand,

although the association between increased LA diameter/volume and higher risk of AF is well documented, no athlete studied here has ever being diagnosed with persistent or paroxysmal AF.

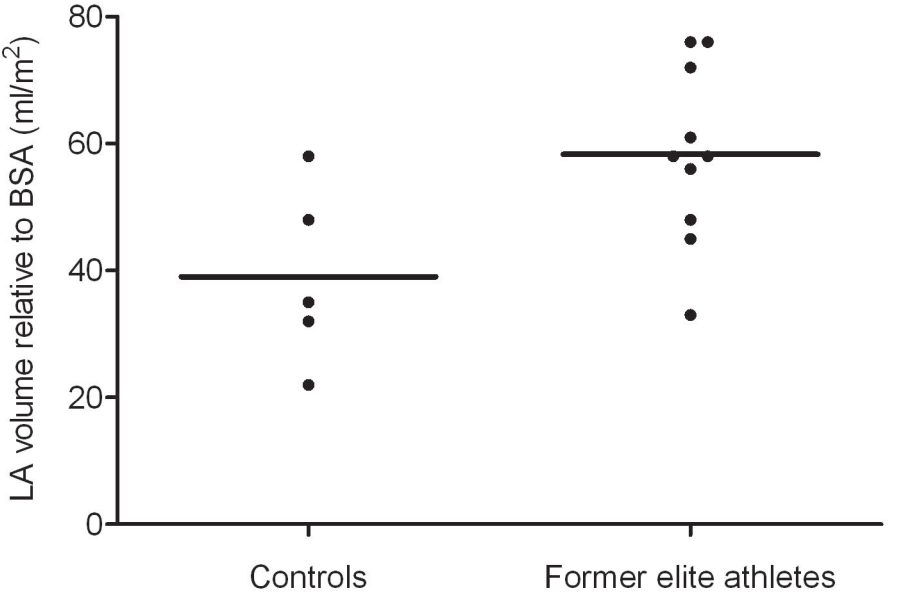
In conclusion, clinicians should be aware of the fact that highly trained endurance athletes usually show larger LA diameters compared to the general population, a phenomenon especially remarkable in veteran athletes. Future research might elucidate the clinical implications (if existing) of such morphological changes.

References

1. Iskandar A, Mujtaba MT, Thompson PD. Left Atrium Size in Elite Athletes. JACC Cardiovasc Imaging 2015;8:753-62.
2. Schotten U, Verheule S, Kirchhof P, Goette A. Pathophysiological mechanisms of atrial fibrillation: a translational appraisal. Physiol Rev 2011;91:265-325.
3. Maron BJ, Pelliccia A. The heart of trained athletes: cardiac remodeling and the risks of sports, including sudden death. Circulation 2006;114:1633-44.
4. Pelliccia A, Maron BJ, Di Paolo FM, et al. Prevalence and clinical significance of left atrial remodeling in competitive athletes. J Am Coll Cardiol 2005;46:690-6.
5. Stritzke J, Markus MR, Duderstadt S, et al. The aging process of the heart: obesity is the main risk factor for left atrial enlargement during aging the MONICA/KORA (monitoring of trends and determinations in cardiovascular disease/cooperative research in the region of Augsburg) study. J Am Coll Cardiol 2009;54:1982-9.

Figure legend

Individual data in both groups. Horizontal black lines represent the mean value. Abbreviation: LA, left atrial.


80
60
40
20
0
LA volume relative to BSA (ml/m2)
Controls
Former elite athletes