EDITORIAL

Sports cardiology: lessons from the past and perspectives for the future [version 1; peer review: not peer reviewed]

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Abstract
The possibility of myocardial damage as a result of endurance sport has been known about since ancient times. According to a legend, a soldier named Pheidippides (more likely Philippides) dropped dead after running from war-torn Marathon to Athens with the news of victory. Millennia later, we do not know whether he was a soldier or a courier, or whether he really ran the entire 240 km from Athens to Sparta and then back from Marathon to Athens. What is clear however, is that his death went down in history as the first documented exercise-related death and provides a tangible starting-point for the discipline of sport cardiology.

Sports cardiology today covers a broad range of areas; from patients with cardiomyopathies, coronary disease and metabolic syndrome through to fitness fans, high-performance athletes and those with physically demanding professions.

The following editorial introduces the primary topics for discussion to be included in the *F1000Research* channel Sports cardiology with the hope that this will evoke open, controversial and broad discourse in the form of reviews and original research papers in this important field.

Keywords
Cardiac Health, Negative remodelling, Sports screening, ECG, Myocardial Hypertrophy

This article is included in the Sports cardiology collection.
Editorial

Sport is of great social and medical significance. Accordingly, prevention of sudden cardiac sport-related deaths (SCD), prevention of negative cardiac remodelling or arrhythmias and training recommendations or rules for patients are extremely important to ensure wide-spread participation and the health benefits that this provides. The present collection of papers focusing on sport cardiology should stimulate lively, controversial, fair and future-oriented discussions.

Structural changes in the athlete’s heart

Changes in the cardiac structures may occur as a consequence of repeated vigorous exercise. This adaptation of the heart to allow the accommodation of greater activity loads is a well-known phenomenon and was first mentioned by Henschen, a Finnish physician, at the end of the 19th century. One of the physiological modifications of the heart in response to sustained exercise is a ‘harmonious increase in size’ (also known as “healthy” myocardial hypertrophy). The influencing factors on the degree of hypertrophy include the kind of physical activity, individual genetic predisposition and environmental effects. Morganroth et al. described in simplified terms that athletes who took part in endurance-based exercise would often present with eccentric hypertrophy as a result of prolonged and repeated volume overload. Conversely, the Morganroth hypothesis purported that athletes who underwent strength training were more likely to present with concentric hypertrophy. Today, it is recognised that there are more than two different types of athletic heart, the Morganroth hypothesis is not immediately applicable to all types of sports and that more research is required into the extent and type of myocardial hypertrophy that can result from exercise.

Sudden cardiac sports-related deaths (SCD), negative cardiac remodelling and the question of sport ‘dosage’. The prevalence of sudden death in connection with sporting activity is about 4.6 people out of 10,000,000 per year in an average population. About 6% of this cohort comprises young athletes. Young competitive athletes have a 5-fold higher risk of sudden death than non-competitive athletes and men have a 20-fold higher risk than women. It is arguably more important however to pay attention to the variety of causes rather than to the absolute figures, which vary widely over the years and among studies.

Exercise-induced “cardiac fatigue” is a broadly discussed issue, but one that still holds unanswered questions. Numerous investigations regarding the increase in biomarkers of left ventricular injury in endurance exercise/marathon and triathlon competitors have been conducted. Negative cardiac remodelling due by sporting activity can lead to arrhythmias and atrial fibrillation. In this area the contribution of genetics must also be considered. The role of exercise-induced right ventricular injury is controversial and remains under discussion.

Generally, endurance athletes and joggers live longer compared to the general population. The question of the intensity of physical activity and use of different methods of training in patients and athletes are potential themes of future studies. In the last 20 years many high-intensity interval training (HIT)-studies have been initiated, but as with any new exercise regime, the risks, advantages and exact definitions of a healthy ‘dose’ for different groups of patients and athletes must be carefully defined through prospective investigation.

Cardiac screening in sports

The discussion about the extent and methods of screening in young/middle aged and old athletes/patients has been ongoing for years. The debate about screening examinations should consider not only SCD, but the possible cardiac structural changes caused by sport activities and implications for complications in long-term follow-up of athletes. Even in countries without sufficient public health systems, the costs for screening-examinations should be regarded as negligible given the high expenditures for preparation and participation in marathon and triathlon competitions and intensive costs in professional football and other team sports. Inequalities in sports cardiology screening should not be a cause for natural selection or contribute to the possibility of later complications of aortic/atrial enlargement and arrhythmias. These complications can be seen in treatment centers as a major problem in long-term care with long-term follow-up. A discussion about global prices for sport screening should be initiated because of the importance of this examination for public health.

Summary

There are a number of recurrent and salient topics in the field of sports cardiology: SCD in connection with sporting activity; cardiac “fatigue” and cardiac injury caused by endurance sports; structural changes in an athlete’s heart; screening methods for SCD or cardiac remodelling; the right ‘dose’ of sport and types of training methods. These have been briefly introduced in this Editorial, in the hope of stimulating research and discourse in these important areas, for which the channel ‘Sports cardiology’ will be a lively forum.

Competing interests

No competing interests were disclosed.

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References

1. Fiuza-Luces C, Garatachea N, Berger NA, et al.: Exercise is the real polypill. Physiology (Bethesda) 2013; 28(5): 330–358. PubMed Abstract | Publisher Full Text

2. George KP, Wolfe LA, Burgraff GW: The ‘athletic heart syndrome’. A critical review. Sports Med. 1991; 11(5): 300–330. PubMed Abstract

3. Hansch S: Skilauf und Skiwettlauf. Eine medizinische Sportstudie. Mitt Med Klin Upsala. 1899; 2: 74.

4. Dickhuth H, Hipp A, Niess A, et al.: Differentialdiagnostik der physiologischen Herzhytrophie (Sportherz). Deutsche Zeitschrift für Sportmedizin. 2001; 52(6): 205–210.

5. Morganroth J, Maron BJ, Henry WL, et al.: Comparative left ventricular dimensions in trained athletes. Ann Intern Med. 1975; 82(4): 521–524. PubMed Abstract | Publisher Full Text

6. Marjon E, Tallett M, Catenzrger DS, et al.: Sports-related sudden death in the general population. Circulation. 2011; 124(6): 672–681. PubMed Abstract | Publisher Full Text

7. Leischik R, Demnak B, Forshag P, et al.: Pre-Participation and Follow-Up Screening of Athletes for Endurance Sport. J Clin Med Res. 2015; 7(9): 385–392. PubMed Abstract | Publisher Full Text

8. Oxtonbro D, Birch K, Shave R, et al.: “Exercise-induced cardiac fatigue”–a review of the echocardiographic literature. Echocardiography. 2010; 27(9): 1130–1140. PubMed Abstract | Publisher Full Text

9. La Gerche A, Bums AT, Mooney DJ, et al.: Exercise-induced right ventricular dysfunction and structural remodeling in endurance athletes. Eur Heart J. 2012; 33(8): 998–1006. PubMed Abstract | Publisher Full Text

10. Leischik R: Endurance sport and cardiac injury. Kardiol Pol. 2014; 72(7): 587–597. PubMed Abstract | Publisher Full Text

11. Shave R, Oxtonbro D: Exercise-induced cardiac injury: evidence from novel imaging techniques and highly sensitive cardiac troponin assays. Prog Cardiovasc Dis. 2012; 54(5): 407–415. PubMed Abstract | Publisher Full Text

12. Andersen K, Farambhnd B, AhbNom A, et al.: Risk of arrhythmias in 52 755 long-distance cross-country skiers: a cohort study. Eur Heart J. 2013; 34(47): 3624–3631. PubMed Abstract | Publisher Full Text

13. Calvo N, Brugada J, Sitges M, et al.: Atrial fibrillation and atrial flutter in athletes. Br J Sports Med. 2012; 46(Suppl 1): i37–43. PubMed Abstract | Publisher Full Text

14. Kass RS: The channelopathies: novel insights into molecular and genetic mechanisms of human disease. J Clin Invest. 2005; 115(8): 1986–1989. PubMed Abstract | Publisher Full Text | Free Full Text

15. Prior D, La Gerche A: Exercise-Induced Right Heart Disease in Athletes. The Right Ventricle in Health and Disease: Springer. 2013; 315–335.

16. Leischik R: Myths of exercise induced right ventricular injury: the bright side of the moon. Br J Sports Med. 2014. PubMed Abstract | Publisher Full Text

17. Schnohr P, O'Keefe JH, Marott JL, et al.: Dose of jogging and long-term mortality: the Copenhagen City Heart Study. J Am Coll Cardiol. 2015; 65(5): 411–419. PubMed Abstract | Publisher Full Text

18. Garatachea N, Santos-Lozano A, Sanchis-Gomar F, et al.: Elite Athletes Live Longer Than the General Population: A Meta-Analysis. Mayo Clin Proc. 2014; 89(9): 1155–200. PubMed Abstract | Publisher Full Text

19. Wisloff U, Stoylen A, Lotensche JP, et al.: Superior cardiovascular effect of aerobic interval training versus moderate continuous training in heart failure patients: a randomized study. Circulation. 2007; 116(24): 3086–3094. PubMed Abstract | Publisher Full Text

20. Gibala MJ, Little JP, Macdonald MJ, et al.: Physiological adaptations to low-volume, high-intensity interval training in health and disease. J Physiol. 2012; 590(Pt 5): 1077–1084. PubMed Abstract | Publisher Full Text | Free Full Text

21. Sharma S, Merghani A, Gati S: Cardiac screening of young athletes prior to participation in sports: Difficulties in detecting the fatally flawed among the fabulously fit. JAMA Intern Med. 2015; 175(1): 125–7. PubMed Abstract | Publisher Full Text

22. Grazzini G, Menino B, Montserrat S, et al.: Usefulness of Echocardiography in Preparticipation Screening of Competitive Athletes. Rev Esp Cardiol (Engl Ed). 2014; 67(5): 701–5. PubMed Abstract | Publisher Full Text

23. Leischik R, Spelsberg N, Niggemann H, et al.: Exercise-induced arterial hypertension - an independent factor for hypertrophy and a ticking clock for cardiac fatigue or atrial fibrillation in athletes? [v1; ref status: indexed, http://f1000res.es/3b5], F1000Res. 2014; 3: 105. PubMed Abstract | Publisher Full Text | Free Full Text

24. La Gerche A, Baggish AL, Knuth J, et al.: Cardiac imaging and stress testing asymptomatic athletes to identify those at risk of sudden cardiac death. JACC Cardiovasc Imaging. 2013; 6(9): 993–1007. PubMed Abstract | Publisher Full Text

25. FoxBusiness: The True Costs of Training for Triathlons. 2013. Reference Source

26. Lee DC, Lavie CJ, Vedanthan R: Optimal dose of running for longevity: is more better or worse? J Am Coll Cardiol. 2015; 65(5): 420–422. PubMed Abstract | Publisher Full Text
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