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Return to professional football after ICD implantation in athlete with apical hypertrophic cardiomyopathy

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SUMMARY

The risk of sports participation in elite athletes with cardiac disease with an indication for implantable cardioverter-defibrillator (ICD) therapy is largely unknown. Currently, international guidelines provide restrictive sports advice for such athletes. This case report presents a professional football player who after an episode of syncope and diagnosis of apical hypertrophic cardiomyopathy expressed a strong wish to explore the feasibility of returning to elite-level sports. After a shared decision-making and monitored stepwise graduated rehabilitation, the athlete made a full return to professional football. Our case indicates that individualised sports advice in elite athletes with cardiac disease and an ICD may be warranted.

BACKGROUND

The diagnosis of a cardiovascular disorder in an athlete often leads to discussion whether the condition is compatible with sports. In this process, central considerations include potential interaction with the underlying disease/cardiac substrate, and the risk of exercise-induced ventricular arrhythmias (VAs), and potentially, sudden cardiac arrest/death (SCA/D). This discussion can be further complicated if there is an indication for an implantable cardioverter-defibrillator (ICD).

Until recently, global international guidelines have recommended highly restrictive sports advice for athletes with an ICD wishing to return to competitive sports, except for those engaging in sports with low cardiovascular demands, such as golf, billiard or bowling.[1] Elite sports career-ending advice due to cardiac conditions constitutes a central, multifaceted challenge for healthcare professionals involved in athlete care, and includes medical, ethical and legal dimensions. Furthermore, the athletes can also be faced with psychosocial and economic adverse consequences. Finally, the athletes themselves may be highly motivated to explore the feasibility to continue their sport, which places considerable demands both on the athlete and the athlete's medical team.[2]

We describe the rehabilitation of a professional football player who after an episode of syncope underwent subsequent evaluation revealing the presence of an apical hypertrophic cardiomyopathy with fibrosis and fatty infiltration of the apex. After a shared decision-making (SDM) (figure 1) process, the athlete received a subcutaneous ICD (S-ICD) and enrolled in a highly monitored, stepwise graduated rehabilitation programme, leading up to a full return to prior levels of professional sports.

CASE PRESENTATION

A male professional football player in his 30s was hospitalised after a syncopal episode during a training session. The athlete had a medical history of asthma diagnosed at 16 years of age after pulmonary complaints during training and used budesonide/formoterol and salbutamol regularly. He had pneumothorax in his 30s but no other major injuries.

At the age of 18 years, the athlete underwent his first cardiac screening, which identified an abnormal ECG with T-wave inversions in the inferior leads. An echocardiogram was performed, where no signs of cardiac disease were found; no cardiac MRI was conducted. The findings were interpreted as 'athlete's heart', and the treating physicians performed follow-up with regular (annual) ECGs and echocardiography for the next 15 years. His medical file thereafter made no further mentions of any signs of progression of ECG abnormalities or new echocardiographic findings (figure 2). The athlete never reported any clear cardiac symptoms. There was a family history of 'blood clots' but no other cardiac diseases. The athlete was a non-smoker and used a minimal amount of alcohol.

Before hospitalisation, during a resting period between two sessions of field training, the athlete experienced a sudden episode of fast and irregular heart rhythm followed by a short syncopal episode during which he fell to the ground. The athlete awoke spontaneously and was immediately transported by ambulance to the nearby university hospital.

INVESTIGATIONS

At admission, the ECG showed normal sinus rhythm 53 bpm with increased QRS amplitudes and pronounced ST-T changes with ST segment elevation and T-wave inversion in the chest leads, more than could be explained by so-called athlete's heart or early repolarisation (figure 2). Serial high-sensitive troponin I measurements were normal (T_0 17 T3 52 T6 50 ng/L, reference value 99th percentile: 53 ng/L for men and 34 ng/L for women), interpreted as no acute myocardial tissue damage. Echocardiography demonstrated maximal left ventricular (LV) sepal thickness of 13 mm, LV ejection fraction >55% and a small aneurysm-like recess at the apex of the left ventricle (online supplemental video 1). Cardiac MRI showed a hypertrophic

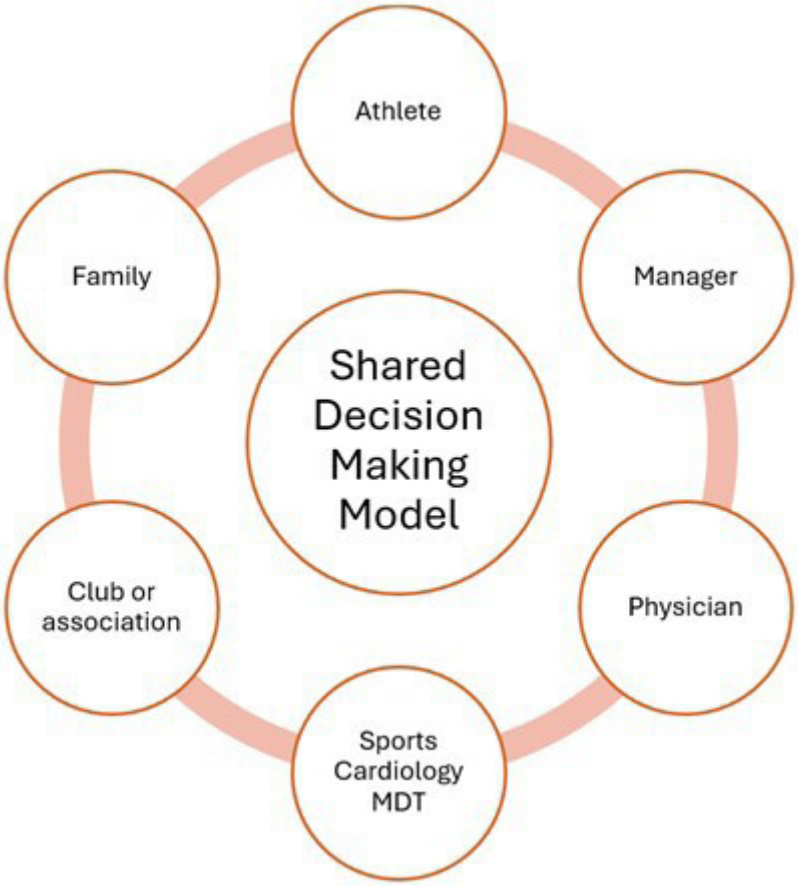

Figure 1 Shared decision-making (SDM) model, illustrated by the authors. Before initiating the programme, an SDM was used. This means that the athlete was given all the information, both risks and benefits, regarding return to professional football. Figure illustrated by Amanda Lahti.

LV apex (11–12 mm) with an apical aneurysm and apical late gadolinium enhancement (LGE) and fatty infiltration. (figure 3). A positron emission tomography (PET) scan demonstrated no cardiac inflammation. 3 months after the hospitalisation, the results of the DNA panel for known mutations for channelopathies and cardiomyopathies were found negative.

DIFFERENTIAL DIAGNOSIS

The athlete was diagnosed with gene-elusive apical hypertrophic cardiomyopathy (HCM) with LV apical aneurysm and fibrosis with fatty infiltration.

Ventricular arrhythmia

The underlying heart disease and the apical fibrosis/fatty infiltration in the apex were hypothesised as possible substrates for a malignant VA that could have caused the syncopal episode. However, as no malignant VAs were observed during hospitalisation, this hypothesis could neither be verified nor excluded.

Atrial fibrillation

Atrial fibrillation is commonly seen in master athletes but seldom causes syncope. Hypothetically, rapid conversion from atrial fibrillation to sinus bradycardia with a sinus arrest could have caused the syncopal episode, but this is unlikely to lead to syncope in an athlete at rest.

Vasovagal syncope

Vasovagal syncope is common in athletes after intense training, with or without extensive loss of fluid in warm conditions, but was considered unlikely in this case due to the reported tachycardia before the episode.

TREATMENT

Subcutaneous ICD

After both national and international multidisciplinary meetings,[3] the final consideration was that a VA could not be ruled out as a cause of the syncopal episode, that there were major SCD risk factors present (apical aneurysm, LGE, syncope suspect for a VA), and that implantation of an S-ICD was warranted for prevention of arrhythmia-related SCA/D.

Sports advice and return to sport

After discharge and recovery from S-ICD implantation, the athlete expressed a wish to explore the feasibility of returning to elite-level sports. A comprehensive SDM process followed, wherein the patient was provided extensive information about both the risks and benefits of return to sports and about the lack of evidence and large studies investigating elite sports in his specific situation. In short, potential risks included new syncopal episodes, VAs or cardiac arrest, appropriate and inappropriate ICD-shocks and progression of the underlying disease. Benefits included respect for the athlete's autonomy and the overall benefits of a physically active lifestyle. In addition, a return to sport could possibly reduce the risks of depression, anxiety

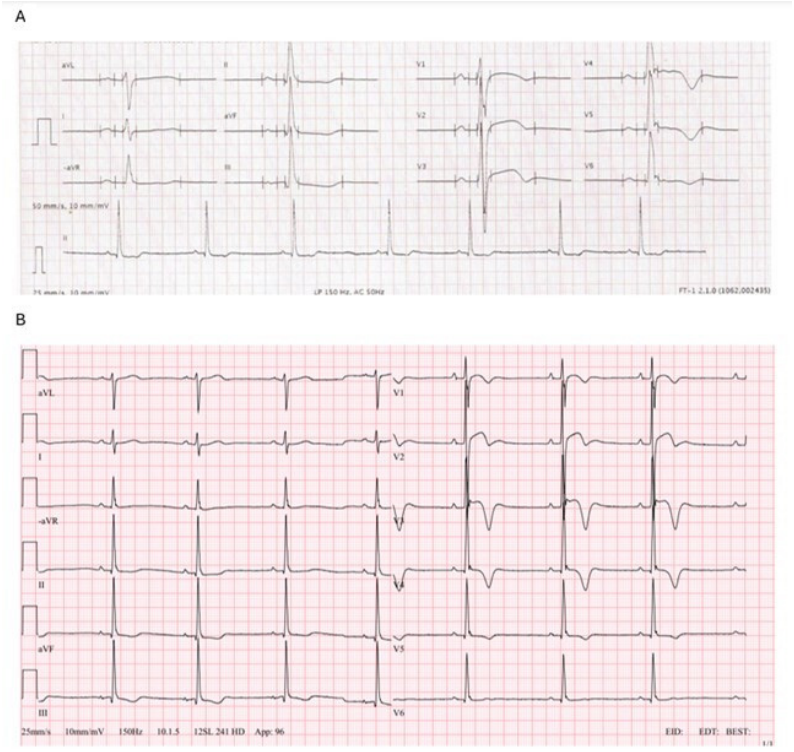

Figure 2 (A) The athlete's ECG at his annual examination in the football club 1 year before the syncope and (B) ECG during hospitalisation in association with the syncope episode.

and identity loss that are the conditions associated with involuntary sport transition due to injury or disease.[4] The athlete confirmed that he accepted the risks, in both written and oral form. After multiple sports cardiology panel meetings,[3] a stepwise graduated, encapsulated (ie, with a permanent core team in a regulated environment) rehabilitation programme was proposed. The programme was based on 'the Amsterdam Encapsulated Approach' (online supplemental appendix 1). The encapsulated approach constitutes individual training supervision in an isolated setting, with decision-making and monitoring performed by a core expert team. Before the start of the programme, the expert panel defined a number of red flags (box 1), which would prompt immediate (re-)evaluation of current sport advice, and potentially lead to a negative sport advice. The athlete was informed about all the red flags and potential consequences.

The main purpose of the programme is risk stratification through comprehensive monitoring during a significant time period, to exclude the recurrence of symptoms and occurrence of red flags and to establish feasibility and safety of returning to professional football. In this case, the total duration of the rehabilitation was 7 months. For the athlete, additional potential benefits included psychological support, overcoming exercise-related anxiety, empowerment of self-management of the ICD as well as improving fitness levels and sport-specific demands. As the number of professional football players with ICD is limited, the programme also enabled the club, including coaches, staff members, medical team, managers and teammates to acclimatise to an athlete playing with an ICD.

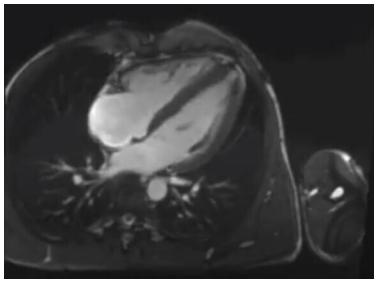

Figure 3 Cardiac MRI showing a hypertrophic left ventricular apex (11–12 mm) with an apical aneurysm and apical LGE and fatty infiltration. LGE, late gadolinium enhancement.

Cardiac monitoring

An S-ICD was chosen instead of a transvenous ICD due to a lower risk of lead-related complications but with comparable efficacy and safety. The S-ICD may also be beneficial compared with the transvenous ICD regarding long-term device-related complications.[5] Before the initiation of the rehabilitation programme, the athlete was provided with an implantable cardiac monitor (ICM). An ICM is a device that is placed just under the skin of the chest with minor surgery and records the heart rhythm continuously and can communicate with the hospital through an application installed in the athlete's mobile phone. The athlete was monitored 24 hours per

Box 1 Red flags prompting direct evaluation of current sports advice

- Cardiac signs or symptoms.
- Signs of increase in arrhythmic burden, both exercise- and non-exercise-related.
- Syncopal events, sudden cardiac arrest and implantable cardioverter-defibrillator shocks.
- Signs of progression of underlying cardiac disease, that is, gross morphological changes, or detrimental changes in systolic or diastolic function.
- Detrimental changes in athlete's mental or psychosocial status.

Figure 4 Subcutaneous ICD in the athlete. The player uses a vest including padding of the S-ICD during football training and matches. Even though the effectiveness of these protection systems has never been proved and the device itself should tolerate potential trauma associated with football, it provides a mentally calming effect. ICD, implantable cardioverter-defibrillator; S-ICD, subcutaneous ICD.

day by this device. In case of any arrhythmia, an alarm was sent from the implantable loop recorder to two electrophysiologists involved in the rehabilitation programme. The physicians made manual examinations of the registered heart rhythm data from the devices one time per week. The athlete was informed to report the symptoms to the physicians so that extra manual examinations of the heart rhythm could be done immediately in the occurrence of a symptomatic event or signal from the loop recorder. In addition, a one-lead ECG ambulatory monitoring device was used during exercise, in addition to the monitoring capacity of the S-ICD.

OUTCOME AND FOLLOW-UP

During the rehabilitation programme, the athlete remained asymptomatic, and no 'red flag' events occurred. Echocardiography and cardiopulmonary exercise tests showed no detrimental changes or arrhythmias. The athlete experienced no inappropriate or appropriate S-ICD shocks. After the programme, the athlete returned to the prior level of professional football as before the S-ICD implantation, that is, the premier football league, with approximately 10–15 hours per week of training, including high-intensity training with and without body contact and matches. He uses padding of the ICD implantation site during football training and matches (figure 4).

The athlete will continue to undergo annual cardiac and health examinations as warranted by his football club and cardiac pathology. In addition, he will undergo annual MRI examinations, echocardiography and cardiopulmonary exercise tests during his entire football career. The athlete will continue to have an S-ICD and to be monitored with an ICM as the risks associated with the underlying disease continue to be present, also after the termination of his professional career. After the end of the career, the athlete will be followed as any other patient with an ICD and HCM.

DISCUSSION

This case indicates that it is possible to return to professional football with hypertrophic cardiomyopathy (HCM) and an S-ICD and that a stepwise rehabilitation programme with close cardiac monitoring during a significant time period may be a successful method to stratify risk and investigate the feasibility and safety of return to professional football, next to acclimatising the athlete, the football club and the medical team to an athlete with an ICD.

Emerging data from retrospective studies and a large prospective cohort study have demonstrated the relative safety of athletes participating in more vigorous and competitive sport, which challenges previous guidelines.[6–8] The same trend is found among paediatric athletes with cardiac disease and ICD where the SDM also can be used,[9] even though it should be empathised that the experiences from this current case are limited to an adult athlete. The American Heart Association and American College of Cardiology scientific statement in 2015 has therefore begun to liberalise the recommendations regarding return to sport in athletes with an ICD.[10] In addition, a recent prospective study of 1660 participants with hypertrophic cardiomyopathy found no higher rates of death or life-threatening arrhythmias in those exercising vigorously compared with those exercising moderately or being sedentary.[11]

However, there are still countries and physicians that ban athletes with an ICD from competitive sports, except in those disciplines with low cardiovascular demand, aiming to prevent exercise-induced cardiac incidents. For example, a Danish football player who survived a cardiac arrest during the European Championship in 2020 had an ICD implanted and is now allowed to play in England, Netherlands and Denmark but not in Italy.[12] The Italian Cardiologist Guidelines (COCIS) complement recent European and American guidelines but highlight a key difference.[13] While those guidelines offer recommendations for physical activity across all levels, the COCIS guidelines focus specifically on competitive athletes, particularly in high cardiovascular stress sports. This focus explains why Italian guidelines are more restrictive than their European and American counterparts.

Ideally, the final decision regarding return to sport should be acceptable to the athlete, the club, the athlete's family and other relevant parties. However, patient autonomy regarding sports participation is not absolute, and the discussion model should not be oversimplified as a process where the athlete simply makes the decision. In answer to such challenges, our case demonstrates that it is possible to return to elite football after ICD implantation and supports the view that systematically prohibiting all athletes with an ICD from participating in high-intensity, competitive sports may not be reasonable. Instead, a broader and individualised evaluation is warranted, and a shared decision model may be an effective method for return to play for ICD athletes.

Patient's perspective

"For me, it was important to be a part of the decision regarding whether to return to sport or not. Through a shared decision making, my autonomy was respected. I felt that I got a fair chance to try to return to my sport. The gradual increase of training intensity during the program made me feel safe and mentally calm during the rehabilitation. I want everyone, not only professional athletes but also people in the general population, to have the same structured and controlled rehabilitation after ICD implantation as I had. What works for athletes may also work for regular workers. I wish that the opportunity for a rehabilitation program after ICD implantation will be democratised in the future, reaching out not only to professional athletes but also to the general population in society. I am currently enjoying playing football at the same level as before the ICD implantation."

Learning points

- A stepwise graduated rehabilitation programme can be used to assess the risk, safety and feasibility of returning to elite-level sports in cases where the interaction between sports, arrhythmias and underlying disease is uncertain, in this case in an athlete with a subcutaneous implantable cardioverter-defibrillator (ICD) and apical hypertrophic cardiomyopathy with high-risk morphological features.
- Shared decision-making is essential when developing and running such a rehabilitation programme.
- 'Red flags' should be identified before the initiation of the programme.
- Instead of systematically prohibiting all high-intensity competitive sport in ICD athletes, a broader and individualised evaluation may be warranted.

Correction notice This article has been corrected after publication. The figure 1 has been updated.

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Contributors The following authors were responsible for drafting of the text, sourcing and editing of clinical images, investigation results, drawing original diagrams and algorithms, and critical revision for important intellectual content: AL, EL, DM, ES and HJ. The following authors gave final approval of the manuscript: AL, EL, DM and HJ.

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