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CASE REPORT

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Sudden cardiac arrest in a marathon runner. A case report

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ABSTRACT

Sudden cardiac death is a rare condition resulting from undetected cardiac abnormalities in athletes and non-athletes. Participant screening, immediate and advanced medical management can probably reduce mortality and ameliorate outcomes. In recent years, extracorporeal membrane oxygenation has emerged as a valuable therapeutic option in patients experiencing refractory cardiac arrest as a bridge to different types of outcome, including recovery, heart transplantation or ventricular assist device and organ donations. In this report we describe a case of a sudden cardiac arrest in a marathon runner treated with extracorporeal membrane oxygenation.

Keywords: *ECLS, refractory cardiac arrest*

INTRODUCTION

Sudden cardiac death (SCD) is described as an event that is non-traumatic, non-violent, unexpected and resulting from sudden cardiac arrest within six hours of previously witnessed normal health (1-3). It is a rare but tragic condition usually precipitated by physical activity which occurs not only in athletes, but in all people.

The growth of long distance running races has been accompanied by studies documenting that prolonged exercise can trigger unheralded ventricular arrhythmias and cardiac arrest in individuals without overt heart disease (4).

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An accurate determination of the incidence of the phenomenon is very difficult to achieve, because of the extreme differences in age, sex, race, athletes and non-athletes (1). Literature data report that in apparently healthy long-distance runners the incidence of sudden cardiac arrest ranges from 1:15000 to 1:150000 per years, while the estimated incidence of sudden deaths in marathon runners is 0.63:100000 (4-6). SCD is more frequent in male and black athletes, and increases significantly with age (7).

The most common cardiovascular conditions predisposing to ventricular tachyarrhythmias, leading to sudden cardiac arrest in athletes, include manifest or latent primary electrical disease and latent structural causes (*Table 1*) (5).

The most common cause of death by sudden cardiac arrest in Italy is arrhytmogenic

Table 1 - *The most common cardiovascular conditions predisposing to ventricular tachyarrhythmias.*

> 35 years of age:	< 35 years of age:
- atherosclerotic coronary artery disease	- hypertrophic cardiomiopathy - arrhytmogenic right-ventricular cardiomyopathy/ dysplasia - congenital anomalies of coronary arteries - myocarditis - aortic rupture (Marfan's syndrome) - valvular disease - pre-excitation syndromes - Brugada syndrome - long/short-QT syndromes

right ventricular cardiomiopathy, while in UK and in USA is hypertrophic cardiomiopathy (2-5).
Survivors require a complete clinical evaluation with an in-depth testing approach.
The diagnosis is very difficult to make as many athletes remain asymptomatic until a cardiac dysfunction takes place.
Moreover, even when each of the known causes of cardiac arrest without overt heart disease has been excluded, the diagnosis remains unexplained in almost half of these patients (7).

CASE REPORT

At the finishing line of a marathon (42 km and 195 m), a 37 y runner with no history of disease collapsed due to a cardiac arrest after 236 minutes of running. The cardiac arrest was witnessed by an advanced cardiac life support (ACLS) team that immediately started advanced cardiopulmonary resuscitation (first return of spontaneous circulation achieved in 18').
Central venous blood gas analysis with manual ventilation was: pH 7,01, PaO_2 23 mmHg, $PaCO_2$ 52 mmHg, Na^+ 145 mEq, K^+ 5.1 mEq, Ca^{++} 1.23 mmol/L, glucose 62 mg/dl, lactate 10.5 mmol/L, HCO^{3-} 13.1 mEq/L, BE -17.9, SvO2 17%. During the treatment of the refractory cardiac arrest the patient developed an impressive pulmonary edema, his body temperature was 39°C.
The patient was admitted to the nearest emergency department and then, taken into consideration the indication to veno-arterial extracorporeal membrane oxygenation (ECMO), he was immediately transferred to a tertiary centre (IRCCS San Raffaele of Milan) to start the extracorporeal life support (ECLS).
Thanks to this procedure, it was possible to perform controlled cooling of the patient till 32°C in consideration of the multi-organ damage to the heat stroke.
Further testing strategy included a coronary angiography that excluded coronary spasm, occlusion and anatomic anomalies, intra-aortic balloon pump positioning, transtoracic ecocardiography revealing normal kinesis.
After five days on veno arterial ECMO, brain death diagnosis was established and multi-organ donation was allowed (kidneys, bones, liver, femoral artery, cardiac valves, corneas). Autopsy revealed a diffuse cerebral edema, acute pulmonary stasis, a focal undermucosal colic hemorrhage and no definite cause of SCD.

DISCUSSION

Nowadays it is evident that SCD is a rare but dreadful event within both athletes and non-athletes.
The outcome of patients victims of sudden cardiac arrest can be largely different depending on different variables including etiology, rapidity of cardiopulmonary resuscitation and defibrillation and age. The outcome can be: survival with recovery (14.6%) (2) as well as organ donation, heart

transplantation or ventricular assist device implantation. Today, these results can be attained with ECLS treatment, by now codified in referral tertiary care hospitals.

Clinicians can use different strategies to prevent SCD:

a) pre-participation screening as accurate anamnesis, medical examination, electrocardiography and echocardiogram can be life-saving and cost effective, even if contrasting results have been demonstrated (5-9);
b) making progress in research to allow early diagnosis of potentially lethal clinically silent cardiovascular abnormalities causing SCD and detect its risk factors;
c) guarantee an on-the-field cardiopulmonary resuscitation and early defibrillation by trained personnel (10);
d) predispose an ECMO assistance on-site in those long-distance races in which the risk of SCD is increased, to provide an immediate and aggressive treatment of cardiac arrest and controlled cooling to ameliorate outcomes (11).

CONCLUSION

Deaths between athletes can be minimized if these conditions will be guaranteed:

a) race organizers plan for comprehensive and advanced emergency cardiac care;
b) the public and the participants are aware of the problem and trained in basic life support;
c) an accurate screening of athletes is performed to detect who meets the criteria for disqualification (10-12);
d) ECLS should be considered without delay in refractory cardiac arrest;
e) ECLS fast-track should be planned not only for large events involving thousands athletes, but also for ordinary management of refractory cardiac arrest in patient who meet criteria for enrollment to extracorporeal treatment (actually, waiting for a consensus conference guidelines, represented by patients characterized by "brain too good to die", receiving high quality cardiopulmonary resuscitation (CPR) and with a short "road-to-pump" time.

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