COST ANALYSIS OF ELECTROCARDIOGRAPHIC SCREENING IN A POPULATION OF NON-COMPETITIVE ATHLETES

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ABSTRACT

To quantify the costs for each situation at risk of sudden death identified by ECG screening using a Telecardiology system.

ECGs received at the Telecardiology Center (Telemedico Srl, Genoa) for non-competitive sports, in the September-November 2018 period were analyzed.

A total of 4360 non- competive athletes (2113 women, 48.5%) were evaluated between the ages of 3 and 40 years (mean ± SD: 17.3 ± 10.6). The average cost per ECG was € 9.2.

An ECG pattern at risk of sudden death has been identified in 319 (7.3%) subjects, respectively 259 (5.9%) at low risk and 60 (1.4%) at medium-high risk. The cost of ECG screening to identify a risk situation was € 125.74 and rose to € 668.53 in the identification of a medium-high risk situation of sudden death.

The low costs of the ECG performed by Telecardiology justifies its use in the screening of heart disease at risk of sudden death even in subjects practicing non-competitive sports.

Keywords: athlete; electrocardiogram; pre-participation screening; sudden cardiac death

1. INTRODUCTION

It's known that medical evaluation of athletic populations before competition offers the potential to identify asymptomatic athletes with potentially lethal cardiovascular abnormalities and to prevent sudden death through disqualification from competitive sports.

Since 2012, also the practice of a non-competitive sport requires, in Italy, the execution of at least one electrocardiogram (ECG) in order to identify situations at risk of sudden cardiac death.

Telemedicine allows health care professionals to evaluate, diagnose and treat patients at a distance using telecommunications technology. Furthermore its applications are increasingly important in many areas of health education and training.

Among the wide range of medical specialties in which telemedicine has been successfully applied, cardiology can be considered as one of the most important fields of application. Through the transmission of clinical data and the electrocardiogram, telecardiology allows access to a real-time assessment (teleconsultation) without any need to travel for both patient and cardiologist. Telecardiology has three different settings of application. Pre-hospital telecardiology has proved to be useful either in the clinical management of remote patients with acute coronary syndrome or in supporting the decision-making process of general practitioners. In the setting of in-hospital telecardiology, most of the applications refer to real-time echocardiography transmissions between rural small hospitals and tertiary care centres, particularly for the diagnosis or exclusion of congenital heart disease in newborns. Finally, many trials show that post-hospital telecardiology improves outcomes and reduces re-admissions or outpatient contacts in patients with heart failure, arrhythmias or implantable devices.

Recently, telecardiology has been used as a preparticipation screening method for the evaluation of sport subjects.

Purpose of this study was to quantify the costs for each situation at risk of sudden death identified by ECG screening using a Telecardiology system.

2. METHODS

ECGs received at the Telecardiology Center (Telemedico Srl, Genoa) for non-competitive sports, in the September-November 2018 period were analyzed.

2.1. ECG recording and transmission

For each athlete, a 12-lead ECG was recorded using Cardiette Microtel 1 or Cardiette Microtel 2 electrocardiographs at a sampling rate of 500sps and with a frequency response range of 0.05-150Hz. ECGs were recorded by general practitioners, pediatricians, sport physicians, nurses or pharmacists practising all over the Italian territory, trained to correctly using the devices. ECG signals were transmitted in real time over the internet (Cardiette Microtel 1) or by phone (Cardiette Microtel 2) to the Telecardiology Center, where one or more cardiologists are on duty 24 hours a day, as previously reported [1-4].

2.2. ECG measurements

The digitally stored ECGs were processed and analysed using a well-validated ECG computer program (Cardioline Record, IT Medical Devices SpA).

2.3. Exclusion criteria

Pre-existing heart disease and / or intake of any pharmacological substance in the previous 48 hours.

Based on the ECG report, the following conditions were considered:
• subjects at medium-high risk: presenting expressive or suspected ECG patterns for genetically determined ion channelopathies, congenital cardiac conduction abnormalities, idiopathic disease of the ventricular myocardium, acquired cardiomyopathies;
• subjects at low risk: minor conduction disorders, 1st or 2nd degree atrio-ventricular blocks, supraventricular or ventricular extrasystoles;
• normal subjects: no ECG abnormalities outside the normal juvenile pattern.

3. RESULTS

A total of 4360 non- competive athletes (2113 women, 48.5%) were evaluated between the ages of 3 and 40 years (mean ± SD: 17.3 ± 10.6).
An ECG pattern at risk of sudden death has been identified in 319 (7.3%) subjects, respectively 259 (5.9%) at low risk and 60 (1.4%) at medium-high risk. Abnormal ECG patterns are listed in table I. Among subjects with ECG abnormalities at low risk of sudden death, three presenting right bundle branch block resulted affected by arrhythmogenic right ventricle cardiomyopathy and 2 subjects with left bundle branch block by dilated cardiomyopathy. Ionic channel diseases such as Brugada Syndrome or long/short QT syndrome have been found very rarely in our population (only in 0.3% of subject) while the finding of Wolff-Parkinson-White Syndome has been more frequent either in the persistent (Figure 1) or intermittent pattern (Figure 2).
The total cost of the screening was € 40.112. The average cost per ECG was € 9.2±0.9 .
The cost of ECG screening to identify a risk situation was € 125.74 and rose to € 668.53 in the identification of a medium-high risk situation of sudden death.

4. DISCUSSION

A nationwide systematic preparticipation athletic screening was introduced in Italy in 1982. The impact of such a program on prevention of sudden cardiovascular death in competitive athletes was positive and in the following years the mortality trend significantly decreased while remained unchanged the mortality in non-competitive athletes. On this bases a new program regarding non-competitive athletes (the so-called decreto Balduzzi) was applied since 2012.Our study refers to this kind of athlete subjected to ECG screening by means of a Telecardiology system. As expected the most athletes (92.7%) showed a normal ECG pattern. Sixty non-competitive athletes (1.4%) were stopped because of a clear ECG pattern of cardiac disorder with high risk of sudden death, i.e. ECG abnormalities suggestive for ischemic heart disease, Wolff-Parkinson-White Syndome, Brugada Syndrome,

Long or Short QT Syndrome. In the remain 5.9% of cases further investigations, such as echocardiography, stress test, magnetic resonance imaging, were necessary to reach a final decision.

Many authors have previously reported that telecardiology is more cost effective than routinary care in different cardiology settings, nevertheless at the state of art does not exist a study about costs of an ECG screening.

The major limitation of this study is that we do not have a control with the cost of ECG performed in a hospital environment. However, we know the patient's participation in health care costs to perform an ECG that is about € 20.

On this basis we suggest ECG screening using a Telecardiology   system.

5. CONCLUSIONS

The low costs of the ECG performed by Telecardiology justifies its use in the screening of heart disease at risk of sudden death even in subjects practicing non-competitive sports.

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TABLES

Table 1

Abnormal ECG pattern in 319/4360 Subjects	
Subjects at low risk of S.D., n (%)	**259 (5,9)**
Incomplete/complete RBB, n (%)	123 (2,82)
Incomplete/Complete LBB, n (%)	25 (0,57)
Negative T waves*, n (%)	93 (2.13)
Hypertrophic Cardiomyopathy,n (%)	7 (0.16)
I/II degree AV Block, n (%)	11 (0.25)
Subjects at medium-high risk of S.D., n (%)	**60 (1.4)**
QT interval exceeding age corrected normal limits, n (%)	6 (0,14)
QT interval shorter than age corrected normal limits, n (%)	4 (0,09)
Type I or II Brugada pattern, n (%)	3 (0,07)
Wolf Parkinson White pattern, n (%)	35 (0,80)
Ischemic changes, n (%)	12 (0,28)

S.D.= Sudden Death
* in peripheral leads other than V1 to V3.
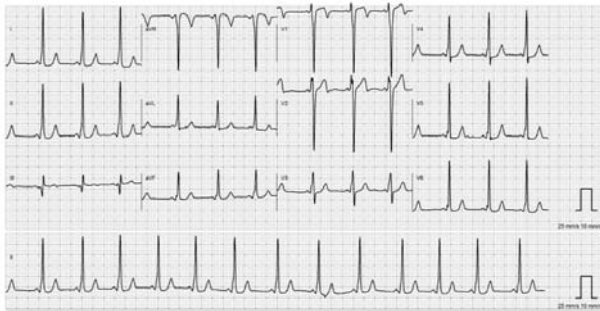
FIGURES

Figure 1: Typical ECG persistent pattern of Wolff-Parkinson-White Syndrome in a 22 years-old subject
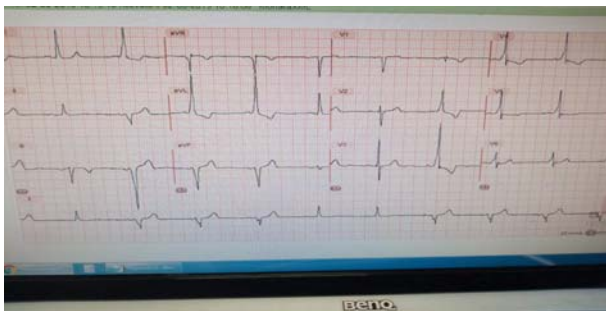

Figure 2: ECG intermittent pattern of Wolff-Parkinson-White Syndrome in a 13 years-old subject