

Deployment of an Advanced Electrocardiographic Analysis (A-ECG) to Detect Cardiovascular Risk in Career Firefighters

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INTRODUCTION

Sudden cardiac death is the leading cause of line of duty death among firefighters, accounting for approximately 45% of fatalities annually. Firefighters perform strenuous muscular work while wearing heavy, encapsulating personal protective equipment in high ambient temperatures, under chaotic and emotionally stressful conditions. These factors can precipitate sudden cardiac events like myocardial infarction, serious dysrhythmias, or cerebrovascular accidents in firefighters with underlying cardiovascular disease. Screening for cardiovascular risk factors is recommended but not always followed in this population. PHASER is a project charged with identifying and prioritizing risk factors in emergency responders. We have deployed an advanced ECG (A-ECG) system developed at NASA for improved sensitivity and specificity in the detection of cardiac risk.

METHODS

Forty-four professional firefighters were recruited to perform comprehensive baseline assessments including tests of aerobic performance and laboratory tests for fasting lipid profiles and glucose. Heart rate and conventional 12-lead ECG were obtained at rest and during incremental treadmill exercise testing (XT). In addition, a 5-min resting 12-lead A-ECG was obtained in a subset of firefighters (n=18) and transmitted over a secure networked system to a physician collaborator at NASA for advanced-ECG analysis. This A-ECG system has been proven, using myocardial perfusion and other imaging, to accurately identify a number of cardiac pathologies including coronary artery disease (CAD), left ventricular hypertrophy, hypertrophic cardiomyopathy, non-ischemic cardiomyopathy, and ischemic cardiomyopathy.

RESULTS

Subjects mean (SD) age was 43 (8) years, weight 91 (13) kg, and BMI of 28 (3) kg/m². Maximum oxygen uptake (VO₂max) was 39 (9) ml/kg/min. This compares with the 45th %ile in healthy reference values and a recommended standard of 42 ml/kg/min for firefighters. The metabolic threshold (VO₂θ) above which lactate accumulates was 23 (8) ml/kg/min. The chronotropic index, a measure of cardiovascular strain during XT was 35 (8) /L compared with reference values for men of 40 /L. Total cholesterol, LDL-C and HDL-C were 202 (34), 126 (29), and 55 (15) mg/dl, respectively. Fifty-one percent of subjects had ≥3 cardiovascular risk factors, 2 subjects had resting hypertension (BP≥140/90), and 23 had pre-hypertension (≥120/80 but <140/90). Seven had exaggerated exercise induced hypertension but only one had ST depression on XT ECG, at least one positive A-ECG score for CAD, and documented CAD

based on cardiology referral. While all other subjects, including those with fewer risk factors, higher aerobic fitness, and normal exercise ECGs, were classified as healthy by A-ECG, there was no trend for association between risk factors and any of 20 A-ECG parameters in the grouped data.

CONCLUSIONS

A-ECG screening correctly identified the individual with CAD although there was no trend for A-ECG parameters to distinguish those with elevated BP or multiple risk factors but normal XT ECG. We have demonstrated that a new technology, advanced-ECG, can be introduced for remote firefighter risk assessment. This simple, time and cost-effective approach to risk identification that can be acquired remotely and transmitted securely can detect individuals potentially at risk for line-of-duty death. Additional research is needed to further document its value.

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