Continuous Heart Rate Monitoring for Automatic Detection of Life-Threatening Arrhythmias with Novel Bio-Sensing Technology

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Background. The chain of survival refers to a series of actions that, when put into motion, reduce the mortality associated with cardiac arrest, particularly in view of the availability of the automatic external defibrillator (AED). A continuous heart-rate monitoring device, comfortable enough to be worn continuously and reliable enough to detect potentially life threatening arrhythmias like ventricular tachycardia (VT) and ventricular fibrillation (VF), could trigger the alarm that would start the chain of survival.

Methods. We studied a new custom-made portable photo-plethysmograph (PPG) wrist-watch sensor, designed for continuous heartrate monitoring and incorporating contact and motion noise-filters, and tested its ability to automatically detect VT, VF and asystole.

Results. Twenty-five patients undergoing electrophysiologic studies, defibrillator implantation (with VT or VF induction) or adenosine injection (with transient ventricular asystole provocation) were studied with simultaneous PPG and electrocardiogram (ECG) recordings. Cardiac arrest was defined as PPG-based heart rate >200 beats/min or <30beats/min. A >50% decrease in PPG signal amplitude during tachycardia was accepted as evidence of hemodynamic decompensation. Contact and movement sensors were used to exclude noise-related artifacts. All tests were conducted with the patients at rest. All episodes of VT, VF and adenosine-induced ventricular asystole were reliably detected as "cardiac arrest" by the PPG-based automatic algorithm (Figure).

Conclusions. This PPG-based wrist-watch sensor reliably detected cardiac arrest. VF and adenosine-induced ventricular asystole were recognized by the PPG monitor as "asystole" that could trigger alarms to prompt the chain of survival culminating in AED use.