PHOTOPLETHYSMOGRAPHIC DETECTION OF A SPONTANEOUS PULSE DURING CARDIOPULMONARY RESUSCITATION

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ABSTRACT

Detecting return of spontaneous circulation (ROSC) during cardiopulmonary resuscitation (CPR) typically involves pulse checks by manual palpation, which is technically challenging and interrupts the chest compressions [1]. In an experimental automated-CPR study on pigs, retrospective spectral analysis shows photoplethysmography (PPG) as a feasible option to measure a spontaneous pulse during compressions [2].

Here, based on automated-CPR porcine data from Ref. [2], we present an algorithm which removes the compression component from the PPG signal. The time trace of the resulting compression-free PPG signal allows the clinician to directly observe absence or presence of a spontaneous pulse during compressions.

The compression-free PPG signal was obtained by subtraction of the compression component which was modelled by a harmonic series. The algorithm determined the instantaneous compression rate from the trans-thoracic impedance signal. The instantaneous compression rate was used as the fundamental frequency of the harmonic series. The amplitudes of the harmonic components were estimated via a least mean-squares algorithm.

The results obtained from seven animals with ROSC showed that removal of the compression component was feasible. The compression-free PPG signal showed absence of a spontaneous pulse during cardiac arrest, and showed presence of a spontaneous pulse when the heart started beating at a pulse rate different than the compression rate. Detecting absence of a spontaneous pulse may prevent interrupting compressions for futile pulse checks. Detecting presence of a spontaneous pulse may guide stopping compressions to reduce the risk of refibrillation, which is associated with persisting compressions on a beating heart.

We conclude that a compression-free PPG signal can be obtained and can facilitate the clinician in detecting absence or presence of a spontaneous pulse during compressions. This may directly improve survival and neurological outcome by limiting interruptions of compressions. Further research should determine the potential of PPG during CPR in humans and the performance of the compression removal algorithm during manual CPR.

REFERENCES

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