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Letter to the Editor

Enhancing positional feedback from real-time wearable sensors during CPR

Rottenberg[1] argues that our system for real-time feedback during cardiopulmonary resuscitation (CPR)[2] is unable to provide feedback on the position of applied sternal force. We agree with his emphasis on the importance of force position but argue that our system generalises compression criteria, including partial information on force position, and can be further enhanced to provide more detailed positional feedback.

Based in part on a study of CPR performed on mannequins,[3] Rottenberg asserts that lack of positional feedback in our system, which uses machine learning from electromyographic and accelerometric signals, would result in about half of CPR interventions being ineffectual, and that in only about one third of cases would the CPR be "maximally effective". He thus implies that about two thirds of CPR interventions would not be maximally effective, and he suggests that this would be due to failure to apply most of the force over the centre of the mid-point of the lower half of the sternum.

With regard to the characterisation of a third of the instances of CPR as "maximally effective", we point out that there is no guarantee that ideal positioning of the applied force will result in maximally effective CPR. Other considerations such compression depth,[4] body position, and rate, cannot be neglected. We suggest reserving the term "maximally effective" for CPR where force position and other variables are optimised, and replacing the term with "optimal force position", as per Fig. 1, when only position of applied force is being referred to.

Our proof-of-concept system, while not specifically designed to identify the force application point, does provide partial classification of hand position, in addition to other features. However, we agree that as the position on the sternum has been shown to be a key element in effective CPR, this warrants further work.

In citing a study dealing with force distribution during CPR,[5] Rottenberg adds that the sternum is relatively fixed cranially, and more mobile caudally. This suggests that the elastic recoil during chest compression will vary with position of the applied force. Our machine learning approach detects this recoil, as the mechanical characteristics feed back to the CPR practitioner, thus modifying the electromyogram and accelerometer signals. To achieve the additional classification suggested by Rottenberg, we could introduce at least one new class viz. "too caudal".

This would require an empirical investigation of the machine learning approach to optimise the classification. It is likely that this real-time feedback approach using our existing system will provide further information on point-of-force application. In so doing, we anticipate that the one third of CPR that Rottenberg terms maximally effective could be further classified to include characteristics such as body position, depth, etc.

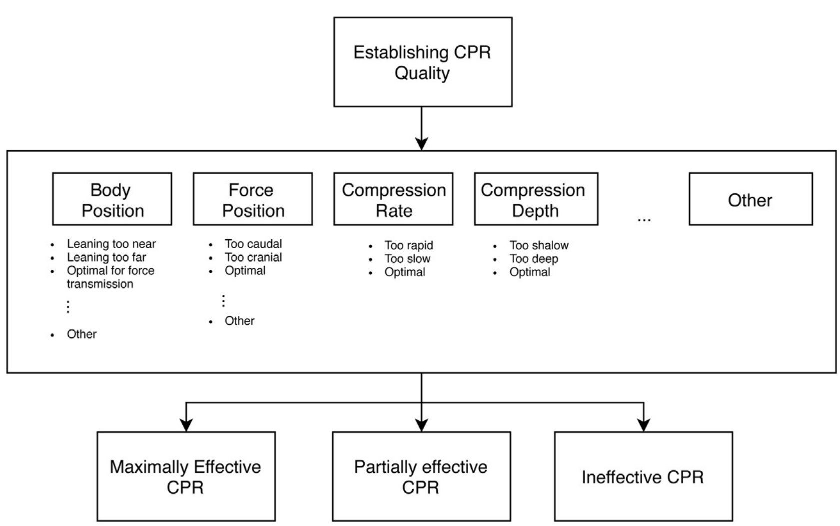

Fig. 1 – Flow chart showing one of a number of possible classification structures which incorporates information on the position of the force applied, depth, rate of compression, and other relevant variables in CPR.

Incorporating additional information from a second sensor worn on the other arm could potentially further enhance the classification.

By expanding on the all-important information relating to the position of the applied force on the sternum, as pointed out by Rottenberg, we believe that it may be possible to further enhance the quality of CPR practice.

Conflict of interest

The authors declare a provisional patent as indicated in the original work[2] and no further conflicts of interest.

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Received 11 April 2019
Accepted 16 April 2019

http://dx.doi.org/10.1016/j.resuscitation.2019.04.031