Does patient age and BMI affect temporal changes in depth-force relationship during CPR?

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Introduction: A strong non-linear relationship exists between chest compression (CC) force and depth during cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest events. A decrease in the depth-force (DF) relationship over time and cumulative number of CC has been described for both human and animal subjects. The effect of patient demographics such as age and body mass index (BMI) in the DF relationship during CPR is not as widely explored.

Purpose: The aim of the present study was to analyse the temporal effect of patient demographics (i.e. age and BMI) in the DF relationship during the performance of CPR.

Methods: Data were collected from a first responder group based in Texas, USA. Responders were instructed to use a CPR depth feedback device (Laerdal CPRmeter) and an automated external defibrillator (AED; HeartSine SAM 350P) when attending sudden cardiac arrest events. The AED was configured with a shock protocol separated by 2-minute episodes of CPR and rescuer CC depth and rate were guided by the CPR depth feedback device. Patient demographic data was captured at the cardiac arrest scene.

CC depth and force data were extracted from Laerdal CPRmeter and processed for 171 patient events. The depth-force ratio (DFR) was calculated as mean depth local maxima divided by mean force local maxima (mm/kgf). Data processing and statistical analyses were performed with R version 3.7.3.

Patient age was available for 169 events (median (IQR) = 63 (53–76) years). Age was categorised in two groups: 18–64 (n=87) and 65+ years (n=82). Patient BMI was estimated for 149 patients (median (IQR) = 25.84 (22.58–31.05) kg/m^2). BMI was categorised as: Underweight (gUW, BMI $<$18.5, n=13), Normal (gN, 18.5 $\leq$ BMI $<$25, n=54), Overweight (gOW, 25 $\leq$ BMI $<$30, n=37) and Obese (gOB, BMI $\geq$30, n=45).

Results: No statistically significant differences in mean event duration were found in the age groups (t-test, p=0.368) or the BMI groups (ANOVA, p=0.309).

A multiple linear regression model was applied to the data to assess the effect of time and age or BMI on the DFR. At the beginning of the events, no statistically significant differences were found in DFR between age groups (p=0.092). Time had no effect on the change in DFR for 18–64 age group (p=0.110) but the rate of change between the 18–64 and 65+ age groups was significantly different (p$<$0.010).

For BMI and using gN as reference, there were significant differences in DFR between all BMI groups except gUW at the beginning of the events. Time had a significant effect in DFR during events for gUW, gN and gOB (p$<$0.050), but no common trend in temporal change was identified.

Conclusions: Temporal changes in DFR appear to be significantly affected by patient age. Tailoring CC force or depth to patient demographics during CPR events may be required for some patients.