medicina *intensiva*

SCIENTIFIC LETTERS

Assessment of the reliability of the accelerometers feedback devices depending on the surface on which cardiopulmonary resuscitation is performed☆

Evaluación de la fiabilidad de los dispositivos acelerómetros de retroalimentación inmediata en función de la superficie en la que se realice la reanimación cardiopulmonar

Dear Sir,

The current guides of the European Resuscitation Council 2015[1] recommend that whenever possible, cardiopulmonary resuscitation (CPR) should be performed on a hard surface. If this is not possible, a hard spinal board is considered to be acceptable,[1] taking care to minimize CPR interruption and the inadvertent removal of the intravenous accesses and advanced airway management devices.

In relation to CPR feedback devices, the current guides[1] consider that their use should only be contemplated as part of a broader patient care system. Despite the lack of evidence of any significant improvement in patient survival at hospital discharge, the studies in this field have reported significant improvement in percentage recovery of spontaneous circulation in the context of in-hospital CPR when the use of such devices is combined with an improvement system based on training and debriefing sessions.

Although several studies on elastic surfaces and their influence upon compression depth[3–5] alert to the negative impact of accelerometer feedback devices when used on elastic surfaces commonly found in hospitals, the utilization of such systems has become widespread among out-hospital emergency care teams, and such devices presently contribute to data recording in both in- and out-hospital CPR studies,[6,7] which have generated new information on the relationship between compression depth and patient survival in CPR.

In order to investigate whether the CPR guiding distortion effect of hospital bed elastic surfaces also occurs with ambulance stretchers, a study was carried out with the specific aim of determining the reliability of the Philips accelerometer feedback device HeartStart Mrx Q-CPR™ (Q-CPR) when used as CPR guiding element on a mannequin by the staff of an emergency care team on three different surfaces: floor, bed and ambulance stretcher.

Sixteen volunteers (11 men [68.75%] and 5 women [31.25%]) comprising physicians, nurses and emergency care technicians of the SEM FPUS 061 (Lugo, Spain), participated in the study. The Skill Reporter mannequin (Leardal) was used for the simulations, with a gyroscopic control device following feedback from the Q-CPR during two continuous chest compressions on a standard hospital bed with mattress (190 cm in length, 90 cm in width and 19 cm in thickness); a Promeba 6107 ambulance transfer stretcher raised to a height of 57 cm, with mattress (190 cm × 48 cm × 9 cm); and on a non-elastic surface (floor). The primary outcome variable was the difference in compression depth (difference between the parameters recorded by the Q-CPR and the Skill Reporter mannequin accelerometer) on each of the three surfaces.

The statistical analyses were performed using the SPSS version 20 statistical package for MS Windows. The Kolmogorov–Smirnov test was used to assess normal distribution of the data. The differences in means among the different surfaces were explored by single-factor analysis of variance (ANOVA), with Bonferroni post hoc testing.

The mean compression depth recorded with the Q-CPR accelerometer versus the gyroscopic recording was 51.68 mm (standard deviation [SD] 6.11) (range 43–62 mm) vs 56.06 mm (SD 5.05) (range 46–63 mm) on the floor; 54.93 mm (SD 7.88) (range 43–69 mm) vs 45.12 mm (SD 4.88) (range 35–54 mm) on the ambulance stretcher; and 57.18 mm (SD 10.79) (range 40–78 mm) vs 31.12 mm (SD 4.16) (range 24–42 mm) on the hospital bed. The differences in mean depth (in mm) between the two recording methods on the three surfaces were: $M_{Floor} = -4.41$ (SD 7.34); $M_{Stretcher} = 9.81$ (SD 5.92) $M_{Bed} = 26.06$ (SD 9.39). These differences were considered to be statistically significant on all three surfaces ($F_{(2,45)} = 62.38$ ($p < 0.001$), $Eta^2 = 0.7349$).

The participants repeatedly failed to follow the indications of the device. These were health professionals used to performing cardiac compression on real-life victims: the subjective impression of performing compressions of little depth caused them to stop monitoring the device, and this

tendency was seen to increase with the thickness of the elastic surface on which compression was performed.

The accelerometer proved adequate as a compression quality guide when used on a hard surface (floor), but not so on the elastic surfaces, since the device suggested that cardiac compression depth was correct, when in fact the depth fell short of the limit recommended by the CPR guides.[1] This effect was attributable to the inertia of the low resistance of the elastic surface, and was related to the thickness of the latter–depth error increasing with the thickness of the elastic surface.

Despite the small sample size, which precludes generalization of the findings, this study obtained results similar to those of previous publications involving accelerometers on elastic surfaces commonly used in hospital. The findings are consistent with those of other authors[3] and are less concordant with those of studies involving prior calibration.[4,5]

Recent studies offer encouraging data on new feedback devices not affected by elastic resistance, such as gyroscopic systems[4] and flexible pressure sensors (Shinnosekuken),[8,9] and on the potential advantages of using mechanical cardiac compression devices[10] versus the human operator, especially on elastic surfaces. However, for the time being, it is probably advisable to strengthen the recommendation of the European Resuscitation Council[1] to perform chest compression on a hard surface whenever possible, and to develop specific protocols for the use of these new and promising devices in the case of those Departments which because of their special characteristics are unable to maintain high quality compression[1]–such practice in all cases forming part of an integral patient management system.[2]

In sum, the Q-CPR accelerometer offered reliable guidance feedback when used on hard surfaces, though not so on surfaces with a degree of elasticity, such as hospital beds or ambulance stretchers, where the use of such devices should be avoided.

Authorship/collaborators

All the authors have participated in this study and in preparation of the article (study conception and design, data acquisition, analysis and interpretation of the data, drafting of the manuscript, critical review of the intellectual content, and definitive approval of the paper).

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