

The Author's Response:

Response to the Comment: Chest Compression Rate, Rescuer's Fatigue and Patient's Survival

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We understand the arguments on the quality of CPR and confounders including measuring device and different bed/mattress setting. In our study, we made an effort to achieve adequate quality of chest compressions. Certified BLS healthcare providers participated in the study as compressors and they received a 2-hour training course prior to the trial. The compressor was rotated every 2 minutes to avoid rescuer fatigue. As a result, we achieved a relatively high quality of CPR in terms of maintaining optimal compression depth and chest compression fraction (CCF). A very high CCF above 90% was attained by performing continuous chest compressions after endotracheal intubation. We also achieved optimal compression depth deeper than 50 mm as recommended by the Guidelines (1). Participating hospitals used the bed with a backboard on standard foam mattress. Therefore, use of a compression feedback device (Q-CPR[®], Phillips Healthcare, Seattle, WA, USA) in our study may lead to under compression of the chest due to compression of the mattress as Dr. Oh mentioned (2). However, there is no method to measure actual depth of chest compression during CPR in human to date. A compression feedback device is the only way to measure CPR metrics and analyze the quality of chest compressions. Current guidelines for optimal compression depth are based on the study results used a compression feedback device (3-5). Actual compression depth to generate adequate hemodynamic efficacy in human remains to be investigated.

Current guidelines recommend chest compression rate between 100 and 120 CPM (4,5). However, there is a significant inverse relationship between compression rate and depth, and

the most significant deterioration of compression depth occurs between 100 and 120 CPM (6). In this context, CPR with 100 CPM is advantageous over CPR with 120 CPM in maintaining the quality of CPR.

We agree with the argument proposed by Dr. Oh about the limitations of our study. Despite the limitations, our study demonstrates a possibility of applying 100 compressions per minute (CPM) during CPR, which might contribute to maintain the quality of CPR and reduce unnecessarily rapid chest compressions.

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1. Sayre MR, Koster RW, Botha M, Cave DM, Cudnik MT, Handley AJ, Hatanaka T, Hazinski ME, Jacobs I, Monsieurs K, et al. Part 5: adult basic life support: 2010 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Circulation* 2010; 122: S298-324.
2. Perkins GD, Kocierz L, Smith SC, McCulloch RA, Davies RP. Compression feedback devices over estimate chest compression depth when performed on a bed. *Resuscitation* 2009; 80: 79-82.
3. Idris AH, Guffey D, Pepe PE, Brown SP, Brooks SC, Callaway CW, Christenson J, Davis DP, Daya MR, Gray R, et al. Chest compression rates and survival following out-of-hospital cardiac arrest. *Crit Care Med* 2015; 43: 840-8.
4. Kleinman ME, Brennan EE, Goldberger ZD, Swor RA, Terry M, Bobrow BJ, Gazmuri RJ, Travers AH, Rea T. Part 5: adult basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2015; 132: S414-35.
5. Perkins GD, Handley AJ, Koster RW, Castrén M, Smyth MA, Olasveengen T, Monsieurs KG, Raffay V, Gräsner JT, Wenzel V, et al. European Resuscitation Council guidelines for resuscitation 2015: section 2. Adult basic life support and automated external defibrillation. *Resuscitation* 2015; 95: 81-99.
6. Field RA, Soar J, Davies RP, Akhtar N, Perkins GD. The impact of chest compression rates on quality of chest compressions - a manikin study. *Resuscitation* 2012; 83: 360-4.

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