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SIMGHOSTS

Posture improvement method for insufficient chest compression depth in CPR

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Introduction and Aim

Basic life support (BLS)'s purpose is to respond to sudden cardiac arrest victims and resuscitate without sequelae, regardless of time and place, and thus, requires high-quality cardiopulmonary resuscitation (CPR). Chest compression is important, and a good posture is a must for CPR. The recommended posture for chest compression is pushing from the top so that the weight to the victim's sternum is applied vertically without bending the rescuer's elbow. However, according to previous research, chest compression performed by slender women is often superficial despite good posture. In many cases, the first to discover a sudden change in a patient's condition at the hospital are nurses, many of whom are women. Additionally, Japanese women are petite. Herein, we examined how to improve posture when there is decreased chest compression depth due to the rescuer's physique.

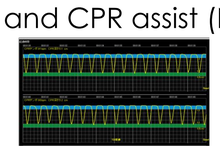
Subject and Method

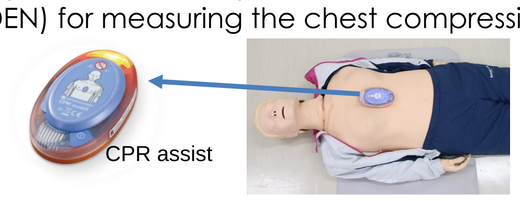
Subject

The study consisted of 25 subjects (male 5, female 20) with BLS training or teaching experience (aged 20–40 years). They included 2 doctors, 19 nurses, 1 paramedic, and 3 students from Shimane University School of Medicine. Moreover, 7 of 25 people weighed <45 kg and were all women.

Method

Resusci Anne QCPR Manikin (Laerdal Medical) was used for chest compression, and CPR assist (NIHON KOHDEN) for measuring the chest compression depth.



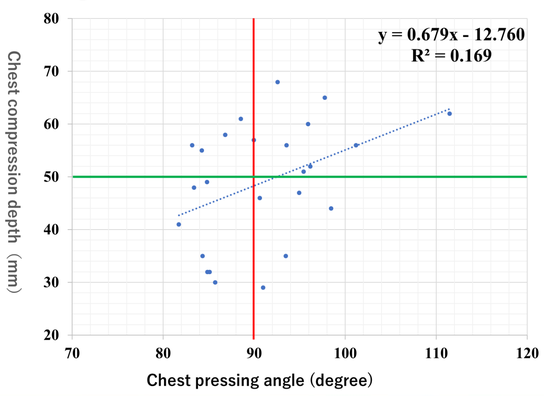


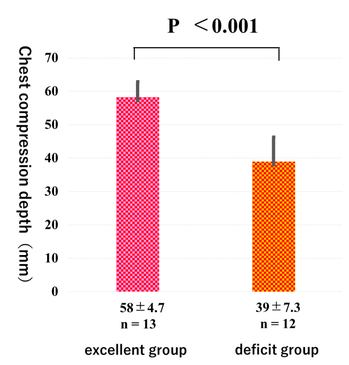
The posture of chest compressions were analyzed byrecording from the left side using a video camera fixed on a tripod, 0.70 m high, and placed 2 m from the top of Resusci Anne's head to the tripod's center.
The posture of chest compression was evaluated by the angle formed (referred to as the chest compression angle) by the rescuer's shoulder, wrist, and waist.

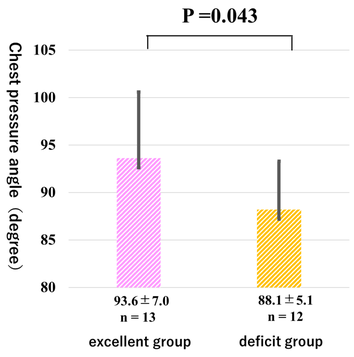
Result

1.Compare chest compressing depth with the chest pressing angle

The 25 subjects were divided according to the average chest compression depth: excellent (≥50 mm; n=13) and deficit (<50 mm; n=12) groups. In the excellent and deficit groups, the average chest compression depth was 58 (SD 4.7) mm and 39 (SD 7.3) mm, respectively, while the chest compression angle was 93.6°(SD 7.0) and 88.1°(SD 5.1), respectively. The chest compression depth and angle were positively correlated (R^2=0.169, y=0.679x-12.760). In the excellent group, 8 subjects achieved a chest compression angle of ≥90°, and 5 subjects <90°. In contrast, in the deficit group, 5 subjects achieved a chest compression angle of ≥90°, and 7 subjects <90°. A chest compression depth of ≤50 mm was obtained by 6 of 8 subjects who achieved a chest compression angle of ≤85°.







2.Compare chest compressing depth with the rescuer's physique

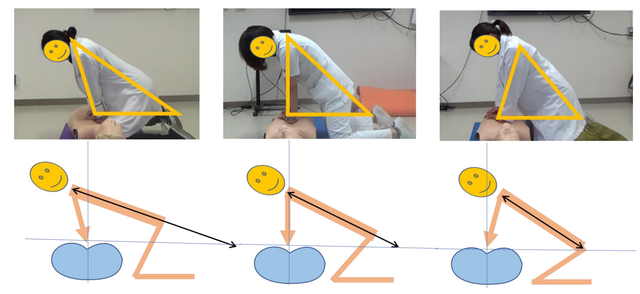
Four of 7 subjects weighing <45 kg obtained a chest compression depth of <50 mm, and the remaining 3 achieved >50 mm. All 7 subjects weighing <45 kg obtained a chest compression angle >90°. Particularly, the chest compression angles of 3 subjects with chest compression depths of ≥50 mm were 93.5°, 96.1°, and 111.4°, respectively. The compression angles of the other 4 subjects were 90.6°, 90.9°, 93.4°, and 94.9°. Despite the weight being ≥45 kg, 7 of 8 people achieved a chest compression depth of ≤50 mm with a chest compression angle of ≤90°.

		chest pressing angle		physique		
		< 90 °	≧ 90 °	< 45Kg	≧ 45Kg	total
chest compressions depth	< 50mm	7	5 (4)	4	8	12
	≧ 50mm	5	8(3)	3	10	13
	total	12	13	7	18	25

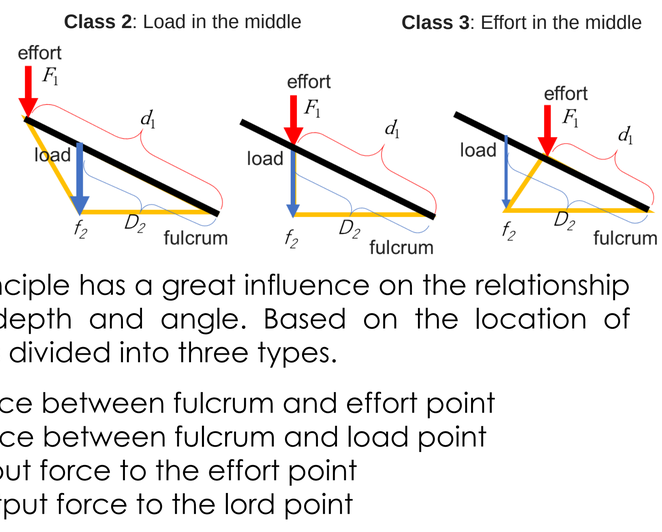
( ) : Number of cases weighing less than 45kg

Discussion

Based on this result, the chest compression depth and angle were positively correlated. Moreover, when the chest compression angle was ≤85°, the chest compression depth was ≤50 mm. Therefore, the chest compression angle should be 90°to the victim's sternum. Another factor is the rescuer's weight. Here, 57% of the rescuers weighing ≤45 kg had a chest compression depth of ≤5 mm. However, it became clear that, even for rescuers weighing ≤45 kg, the greater the chest compression angle, the deeper the chest compression depth.



Lever principle



These results show that the lever principle has a great influence on the relationship between the chest compression depth and angle. Based on the location of fulcrum, load, and effort, the lever is divided into three types.

Lever principle
d1 F1 = D2 f2

d1: distance between fulcrum and effort point
D2: distance between fulcrum and load point
F1: the input force to the effort point
f2: the output force to the lord point

Since the rescuer's compression force and the distance between the rescuer and patient are constant, if the distance between the fulcrum and point of action can be extended, the force applied to the patient's sternum will increase. Based on the principle of leverage in chest compression, by setting the chest compression angle to ≥95°, the power point will be moved away from the fulcrum, and even a lightweight rescuer can perform a chest compression with depth of 50 mm. Conversely, regardless of weight, if the compression angle was ≤85°, the distance between the fulcrum and power point was shortened, and the force to compress the sternum was weak.

Conclusion

high-quality chest compression is achieved by pushing the patient's sternum vertically, but when the rescuer is lightweight, increasing the chest compression depth is possible by increasing the compression angle to ≥95°.

Acknowledgments
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Take-home messages

Chest compression should consider the lever principle.