Journal of Clinical and Nursing Research

Research Article

Comparative Study of Mechanical and Manual Compression in the Resuscitation of Patients with Out-of-hospital Cardiac Arrest

Bing Han*, Lan Hong

Department of Cardio-Thoracic Surgery, People's Hospital of Deyang city, Deyang 618000, Sichuan Province, China

Abstract: ***Objective:*** To analyze the effect of mechanical and manual compression on the resuscitation effect of out-of-hospital cardiac arrest patients. ***Methods:*** The 40 trained medical personnel who are skilled in bare hand compression and cardiopulmonary resuscitation machines were divided into two groups with 20 people in each group. The control group consists of a bare hand compression group while the observation group consists of cardiopulmonary resuscitation group. The two groups of people performed heart compression on the simulated person and observe the effect of the two compression methods on the patient during the cardiac arrest operation. ***Results:*** The resuscitation success rate in the control group was 65%, the resuscitation success rate in the observation group was 90%. The systolic blood pressure, heart rate, blood oxygen saturation, the accuracy rate of compression depth frequency, and interruption time in the observation group (cardiac resuscitation compression group) were significantly better than the control group (bare hand compression group). ***Conclusion:*** The use of mechanical compression has a small error rate, a high success rate, saves time and effort, and can effectively help patients. It is worth promoting and applying.

Key words: Mechanical compression; Manual compression; Cardiac arrest; Cardiac arrest resuscitation

Publication date: March, 2020

Publication online: 31 March, 2020

***Corresponding author:** Bing Han, doctor_hanbing@sina.com

1 Introduction

Cardiac arrest is a common clinical disease. When a patient has a cardiac arrest, failure to perform cardiac resuscitation in time will cause the patient's death. The use of cardiac resuscitation for patients can greatly save patients' lives and rescue patients from the edge of death. At present, there are two main clinical uses for cardiac resuscitation in patients with cardiac arrest. One is manual cardiac resuscitation which assists the patient with cardiac resuscitation and requires high technical skills of the operator. The other is mechanical compression which uses medical equipment to perform cardiac resuscitation on patients. Relatively speaking, the operation process is relatively simple. High-quality compression can improve the success rate of cardiac resuscitation. This article mainly discusses the application effect of manual and mechanical compression in cardiac arrest. The report is now as follows.

2 Materials and methods

2.1 General Information

The main laboratory object of this article is a simulated person. The main operators are medical personnel who are proficient in bare hand compression and cardiopulmonary resuscitation machines. A total of 40 medical personnel are selected from the hospital, including 19 male medical staff, with a maximum age of 41 and a minimum age of 32, the average age is 38.5 years old. There is 21 female medical staff with a minimum age of 30 and a maximum age of

45, the average age is 37.5 years old. Among them, there is 12 medical staff with a college degree, 22 medical staff with a bachelor degree and 6 medical staff with a master degree. Age and education have no effect on the research results, the difference was not statistically significant (P>0.05). After training, the 40 medical personnel who are skilled in manual compression and cardiopulmonary resuscitation machines are divided into two groups on average with 20 people in each group. The control group is the manual compression group, and the observation group is the cardiopulmonary resuscitation group. The two groups of people performed heart compression on the simulated person and observed the effect of the two compression methods on the patient during the cardiac arrest operation.

2.2 Operation method

(1)Equipment inspection: Before the experiment, check the relevant equipment and ensure the normal use and operation of the equipment will not affect the experimental results. The vehicles and equipment to be used during the experiment are installed in advance to ensure that the physical locations of the two groups are exactly the same, and the experimental results of the two groups are compared.

(2)Training laboratory: The medical personnel of the observation group and the control group performed short-term high-quality compression on the simulated human in the laboratory, respectively. The frequency of the compression was operated in accordance with international standards. The frequency of the compression was maintained to be more than 100 times per minute and the depth of compression was maintained at 5-5.5 cm. The observation group used the installed cardiopulmonary resuscitation machine to perform cardiac resuscitation compression on the simulated person while the control group performed using bare hand compression. Cardiac compressions were performed for 2 minutes and 4 minutes in each group to check the compression effect, and the two groups were trained before the experiment.

(3)Transfer operation of simulated patients. The training laboratory is close to the hospital, and the total distance is less than 20 minutes. Only two red street lights need to be passed on the line. In order to ensure that the external environmental impact of the two groups of personnel is the same, the same operating vehicle is used during the operation. The driver of the vehicle is operated by the same person.

(4)The specific operation process of the control group. After the medical staff of the control group arrived at the rescue site, they immediately performed high-quality manual compression cardiac resuscitation on the patient. The operation frequency of high-quality cardiac resuscitation was maintained to be 100 times per minute and maintain the depth of the patient's external chest compression at 5.0-5.5 cm[1]. When performing the operation, it was confirmed that the compression force received by patients is vertically downward. In order to ensure the vertical compression of the force, the position of the medical staff is determined according to the height of the patient's body, either standing on the patient or kneeling on the patient. When the position is not appropriate, one can adjust own height to facilitate manual resuscitation on the patient. The position of the compression is usually at the lower half of the sternum and the two shoulders should be directly above the patient's sternum. When pressing, the medical staff's arms need to be naturally straightened, and the two elbow joints cannot be bent. Medical staff should ensure that the elbows, shoulders, and wrists form a plane surface during compression and use the weight of the body to perform manual compression cardiopulmonary resuscitation[2]. While chest compressions, mouth-to-mouth blows were performed. The ratio of the number of bare hand compressions to the frequency of mouth-to-mouth blows was 30:2[3].

There are 8 points to highlight during the whole process. First, confirm the accuracy of the position during the compression. This is an important guarantee for cardiopulmonary resuscitation, and it is also important to avoid secondary damage to the patient caused by bare hand compression. Second, when pressing the patient's external chest, caution on the position of the hands. Both hands must be placed on top of each other to operate the patient. If the medical staff's hands are not overlapped but are crossed, the pressing force on the patient's external chest is not concentrated on the sternum of the patient, which is likely to cause secondary injuries to the patient and cause the patient's ribs to fracture. Third, the entire compression process must be regular and stable. Too quickly or too slow, alternating between fast and slow will result in meaningless bare hand cardiopulmonary resuscitation. At the same time, it must ensure that there is no interruption in the rescue process, or it will cause serious consequences. Fourth, one should not use

excessive force when performing compression, which can easily cause heart damage and secondary injuries to important body organs in patients. Fifth, one must be cautioned to the completeness of relaxation when retracting the pressing hand and relaxing the patient's chest cavity. Ensure that the patient's chest cavity can be completely relaxed to ensure sufficient blood volume. At the same time, ensure that the palm cannot leave the chest cavity, as to avoid positional deviation which will reduce the compression effect. Sixth, the compression time is equal to the time of relaxation. The purpose is to ensure that the heart can fully remove the blood from the thorax and the blood can fully return to the thorax. Seventh, when performing cardiopulmonary resuscitation on the patient, the direction of the force is vertical downward, and the body is fixed while pressing. The correct compression posture is an important criterion to ensure compression conditions. Eighth, in the initial stage of bare hand compression combined with mouth-to-mouth blows operation, one needs to measure and check the vital signs of the patients every 4-5 cycles. In the later stage of compression, the patient's vital signs should be checked every 4-5 minutes to control the time of the vital signs within 10 seconds[4].

(5)The specific operational process of the cardiopulmonary resuscitation machine. First, connect the cardiopulmonary resuscitation equipment. After removing the air source pipe, plug it into the main unit of the device and connect the other end to the air outlet of the oxygen cylinder, adjust the working pressure at this time to maintain the working pressure at 0.35-0.6 Mpa, which is the most suitable working pressure at this time. The patient is fixed with the patient's back neck is in the shape of cardiopulmonary resuscitation, and the patient's head is tilted back to ensure a completely opened airway without being closed[5]. Press the machine's head down to confirm the pressing position and determine the accurate pressing position, and install an oxygen mask on the patient to ensure the patient's breathing and fix the breathing stroke in a corresponding way. Secondly, the choice of cardiopulmonary resuscitation. The patient is in cardiac arrest, adjust the ventilation compression mode and ratio of the cardiopulmonary resuscitation machine to 30:2, adjust the ventilation volume of the cardiopulmonary press to the ventilation scale required for the patient's cardiac arrest, and use the key to control the operation and shutdown of the cardiopulmonary resuscitation machine. When setting the parameters of the cardiopulmonary resuscitation machine, set the parameters as the depth and frequency of bare hand pressing, with a depth of 5 cm and a frequency is 100 times per minute. When the operation is completed, turn off the cardiopulmonary resuscitation machine after all the lights are off, then turn off the power of the cardiopulmonary resuscitation machine and then pull out from the trachea. Lastly, during the operation of the cardiopulmonary resuscitation machine, the matters to be noted include that the valve of the oxygen cylinder must be opened slowly when it is opened. Do not open it quickly. Perform the operation of the cardiopulmonary resuscitation machine in accordance with the prescribed operating protocol and maintain the air pressure at 0.35 - 0.6 Mpa to prevent the cardiopulmonary resuscitation machine from working properly. When using the cardiopulmonary resuscitation machine, the position of the body must be on the resuscitation board, and the pressing position must be confirmed to avoid secondary injury to the patient and cause the occurrence of rib fractures[6].

2.3 Observation indicators

The observational indicators of this study mainly include the patient's heart rate, systolic blood pressure, and blood oxygen saturation after performing two sets of cardiopulmonary resuscitation, and also include the transfer operation of the patient, including the accuracy rate of deep compression frequency and interruption time.

2.4 Statistical methods

SPSS 20.0 software was used for statistical analysis of the data obtained. Count data were expressed as n/% and χ^2 test was used. Measurement data were expressed as $\overline{x} \pm s$, t test was used, and $P<0.05$ was considered statistically significant.

3 Results

3.1 Comparison of CPR effectiveness of cardiac arrest patients in two groups

By comparing the two cardiopulmonary resuscitation methods, the results show that the 20 patients in the control group, namely the bare hand compression group, 13 patients were effective in resuscitation, and the efficiency of successful resuscitation was 65%. The cardiopulmonary resuscitation group in

the observation group, 18 patients were effective in resuscitation and the total effective rate of resuscitation was 90%. The observation group was significantly better than the control group, indicating that the effect of the cardiopulmonary resuscitation group was more significant(Table 1).

Table 1. Comparison of the effects of cardiopulmonary resuscitation in cardiac arrest between the two groups of patients

Group	Effective	Not effective
Control group (n=20)	13 (65.00)	7 (35.00)
Observation group (n=20)	18 (90.00)	2 (10.00)

3.2 Comparison of resuscitation effects in patients with cardiac arrest

Comparison of the effects of cardiopulmonary resuscitation between two groups of cardiac arrest patients (simulators) (Table 2).

Table 2. Comparison of resuscitation effects in patients with cardiac arrest (simulators)

Group	Systolic blood pressure (mmHg)	Heart rate (times/minute)	Blood oxygen saturation (%)
Control group (n=20)	79.11 ± 6.66	111.32 ± 11.78	76.33 ± 7.12
Observation group (n=20)	86.12 ± 7.11	85.90 ± 9.33	91.11 ± 7.16

3.3 Comparison of compression effects between the two groups

Comparison of CPR compression effects between two groups of cardiac arrest patients(Table 3).

Table 3. Comparison of compression effects between the two groups

Group	Accuracy rate of compression depth frequency (%)	Interruption time of compression (s)
Control group (n=20)	55.3	11.2 ± 0.1
Observation group (n=20)	100.0	5.9 ± 0.9
P	<0.01	<0.01

4 Conclusion

Cardiac arrest is a very dangerous condition in clinical medicine. High-quality compression is very important for resuscitating the vitality of the heart. This article mainly compares manual compression with mechanical compression and concludes that using mechanical compression has a lower error rate and a higher success rate. It saves time, effort and can effectively help patients, which is worth promoting.

References

[1] Long SZ, Yu N, Xue LP. Analysis of influential factors of cardiopulmonary resuscitation in 144 patients with cardiac arrest [J]. Minimally Invasive Medicine, 2019, 14(4): 461-463 + 478.

[2] Chen J. Analysis of the effect of cardiopulmonary resuscitation using cardiopulmonary resuscitation on patients with cardiac arrest [J]. China Medical Devices Information, 2019, 25(10): 127-128.

[3] Cen YX. Influence of ventilation mode on the prognosis of patients with cardiac arrest outside hospital and related factors of prognosis of cardiopulmonary resuscitation [D]. Southern Medical University, 2019.

[4] Zhang JL. Analysis of cardiopulmonary resuscitation effect and influencing factors in patients with out-of-hospital cardiac arrest [J]. Electronic Journal of Clinical Medicine Literature, 2018, 5(73): 25-26 + 28.

[5] Li ZX, Liang HY. First aid effect of cardiopulmonary resuscitation combined with mild hypothermia treatment for patients with cardiac arrest outside the hospital [J]. China Continuing Medical Education, 2016, 8(26): 121-122.

[6] Yan H, Li B. Analysis of the clinical effect of out-of-hospital hypothermia treatment and cardiopulmonary resuscitation on the rescue of cardiac arrest patients [J]. Beijing Medical Journal, 2015, 37(11): 1089-1091.