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Effects of Neo Automatic Code on the Accuracy of Chest Compression Depths in Cardiac Arrest Patients

Rendi Editya DARMAWAN[1)], Untung SUJIANTO[2)], Nana ROCHANA[2) *)]

[1] *Master Program in Nursing, Faculty of Medicine, Diponegoro University, Indonesia*
[2] *Department of Nursing, Faculty of Medicine, Diponegoro University, Indonesia*

ABSTRACT

Objective: to analyze the effects of manual chest compression using neo automatic code on the accuracy of compression depths. Methods: This study used a quantitative, post test quasi-experimental design with a control group. The samples were 74 cardiac arrest patients in two hospitals in Surakarta and Klaten, who were selected using purposive sampling technique. The data were analyzed by the Mann-Whitney test. Results: the mean of accuracy of compression depth in the control group was 68.10 ± 17.60%, and in the treatment group was 83 ± 6.04%. The result of statistical analysis showed that there were differences in the accuracy of compression depth in the intervention and control group with p-value of 0.000. Conclusion: there were effects of manual chest compression using neo automatic code on the accuracy of compression depths. Neo automatic code could improve the accuracy of chest compression depths.

Keywords: *cardiac arrest, chest compression, compression depth accuracy, neo automatic*

The burden of cardiac arrest in health sectors is substantial with an estimated 424,000 and 275,000 cardiac arrests occuring each year in the USA and in Europe respectively. Moreover, a number of patients who survived cardiac arrest in North America and the UK in 2016 were less than 10% [(1)]. However, the incident of cardiac arrest in Indonesia has not been reported though the prevalence of cardiac diseases and cerebro vascular accidents in 2013 were reported high of 3,180,408 and 2,137,941 respectively. These high numbers would potentially result in high incidents of cardiac arrest [(2)]. Therefore, timely and high quality cardiopulmonary resuscitations (CPRs) are needed to increase cardiac arrest survivors.

Following the highlights of the 2015 American Heart Association (AHA) guidelines update for CPR, it recommends rescuers to compress the chest of adult cardiac arrest victims at 100 to 120 compression rates per minute with the depth of 5 to 6 cm, to allow full chest wall recoil, and to minimize interruptions of chest compressions [(3)]. Professional rescuers, however, often do not deliver high quality CPRs regarding compression rates and depths [(4–8)]. Avoiding excessive compression rates may lead to more compressions of sufficient depths [(6)]. This problem can be solved using metronome [(9)].

The metronome is a tool to guide the CPR providers in keeping an accurate chest compression rates [(9).] A higher rates of recommended chest compression is needed for metronome-guided CPRs to obtain high quality chest compressions [(10)]. The new generation of metronome is The Neo Automatic Code.

Neo Automatic Code is an android based application tool to control CPR chest compressions at the rates of 100 rates per minute. It has two guiding modes of CPR which are standard CPR and compression-only CPR. Moreover, it allows the rescuers to give rescue breaths and to check pulses without interrupting compressions. Neo automatic code enables the rescuers to control their breathings as they do not need to count the compressions, and to prevent them from being exhausted. Therefore, recommended chest compression depths may higly be obtained [(11)]. A preliminary study of Neo Automatic Code-guiding CPRs in a mannequin showed that Neo Automatic Code produced 2253 (86.70%) recommended chest compressions out of 2598 compressions [(12)]. However, there is still no evidence regarding the effect of Neo Automatic Code on the cardiac arrest patients. This study, thereby, aimed to analyze the effect of manual chest compression using Neo Automatic Code on the accuracy of compression depths. Our hypothesis was that there were effects of manual chest compression using Neo Automatic Code on the accuracy of compression depths.

*Corresponding author : Nana Rochana; Department of Nursing, Faculty of Medicine, Diponegoro University, Jalan Prof. H. Soedarto, SH, Tembalang, Semarang, Indonesia ; (024) 76480919; Email : na2rochana@gmail.com

METHODS

This study used a quantitative, post test quasi-experimental design with a control group. The sample size was counted according to the previous studies was idris et al [5] resulting in 74 cardiac arrest patients. The respondents were divided into treatment and control groups who were selected using purposive sampling techniques in two hospitals in Surakarta and Klaten from May to June 2017. Inclusion criteria for the samples were that patients were resuscitated on a solid surface, patients were attached with bed site monitors, chest compressions was done by certified emergency nurses or certified emergency/anaesthesiology physicians with more than 20 of body mass index (BMI). Exclusion criteria for analysis were do-not-resuscitate cardiac arrest patients. The treatment group was given Neo-Automatic-Code guiding chest compressions while the control group was given standard chest compressions. The accuracy of chest compression depths was measured from the number of R waves with the height more than 10mV.

Ethics

This study obtained an ethical clearance from The Health Research Ethics Committee of Faculty of Medicine, University of Diponegoro with ethical clearance number of 176 / EC / FK-RSDK / IV / 2017. This study also granted permissions to undertake research from two hospitals in Surakarta and Klaten. Research ethic priciples were maintained during the study by giving informed consents to the patient's families, delivering standard CPRs as AHA guideline to the treatment and control groups, using initials for respondents, keeping respondent's personal details confidential, no coercion to participate in the study, and using certified emergency practitioners as the CPR providers to minimize the harm.

Statistics

For every compression, the bed site monitors automatically showed R waves. Researchers recorded the number of R waves and the number of chest compressions performed using hand counters. The accuracy of compression depths was measured by the percentage of the number of R waves with the height more than 10 mV on the bed side monitor with the total chest compression performed. Data on age, sex of the patient, presenting heart rhythm and the main illnes were extracted from medical records. The data were analyzed by the Mann-Whitney test.

RESULTS

by group as can be seen from table 1. The result showed that the majority of respondents in intervention and control group were 41-60 years and female. The most common rhythm in intervention and control group shortly before cardiac arrest was unshockable rhythm which were 37 respondents (100%) and 32 respondents (86%) respectively. The leading cause of cardiac arrest patients in intervention group was non cardiac (n=32, 86%) followed by cardiac (n=5, 14%) and in control group was non cardiac (n=29, 79%) followed by cardiac (n=8, 21%).

The result showed (table 2) that intervention group had on median of accuracy of compression depth was 85% $\pm$ IQR 77.5 and control group was 72% $\pm$ IQR 53.5. Figure 1 showed means of accuracy of compression depth in intervention group was 83% ± 6.04 and means of accuracy of compression depth in intervention group was 68% ± 17.60%. The range of chest compression depth accuracy in the treatment group were 70-92% while the accuracy in the control group ranged 29-96%. This meant that the treatment group had all fraction of accuracy above 60% compared to the control group which half of them were below 60%.

The total 74 cases met the inclusion criteria, and complete data. Demographic characteristics for the study population were stratified

The result of statistical analysis showed p value of 0.000 meaning that there were differences in the accuracy of compression depths in the intervention and control group (p-value<0.05). There was a significant effect of manual chest compression using neo automatic code on the accuracy of compression depth.

DISCUSSION

The study showed that, during hospital resuscitation by professional rescuers, the accuracy of compression depth was 29-96%. The means and standard deviation of accuracy of compression depth in intervention group 83% ± 6.04 greater than control group 68% ± 17.60%. The accuracy of compression depths in the intervention group which used Neo Automatic Code was far higher than the control group. Neo Automatic Code allows the rescuers to deliver compression rates constantly at 100x/min, so that appropriate compression depths could be achieved. Rescuers only follow codes for compressions, so that did not need count and makes a sound. Recuers can breathe freely, so

that did not easily tired and make optimal compression depths [11].

On the other hand control the group did not use neo automatic code. An absence speed regulator controlling compression rates yields chest compression faster than using neo automatic code. An increase of chest compression rates causes fatigue among the rescuers, which consequently decrease the accuracy of compression depth [4–6,13,14].

Field et al [14] show that faster compressions lead to reduced compression depths. Monsieurs et al [6] state that high compression rates are common and can be caused by stress or by the inability of rescuers to assess and control the compression rate. Very low compression rates were uncommon and may be associated with specific activities potentially interrupting chest compressions such as aspiration, intubation and defibrillation [6].

Other than compression rates, accuracy of chest compression depth related to the physical fitness of the rescuer. The weight of the rescuer is an important factor in the compression depth (4). Perkins et al [15] find that bed height affects maximal compression forces, and makes effects on accuracy of compression depth. Jantti et al [16] showed the surface under the patient may affect the cardiopulmonary resuscitation (CPR) quality. The result of statistical analysis showed that there were differences in the accuracy of compression depth in the intervention and control group (p-value<0.05). This is due an absence of speed regulator to control compression rates resulting in differences in the accuracy of compression depth.

Limitations of this study was that core diseases in this study were heterogen.

Table 1. Demographicss and study characteristics stratified by group

Characteristics	Intervention group	Control group
Age		
18-40 years	5 (14 %)	6 (16 %)
41-60 years	19 (51%)	17 (46 %)
>60 years	13 (35 %)	14 (38 %)
Gender		
Male	11 (30 %)	17 (46 %)
Female	26 (70 %)	20 (54 %)
Hearth rhythm		
Shockable	0 (0%)	5 (14 %)
Unshockable	37 (100%)	32 (86%)
Main illness		
Cardiact	5 (14 %)	8 (21 %)
Non Cardiact	32 (86 %)	29 (79 %)

Table 2. A*ccuracy of compression depth* stratified by group

Group	Median (Q2)	Q1	Q3
Intervention	85,00%	77,50%	87,50%
Control	72,00%	53,50%	81,00%

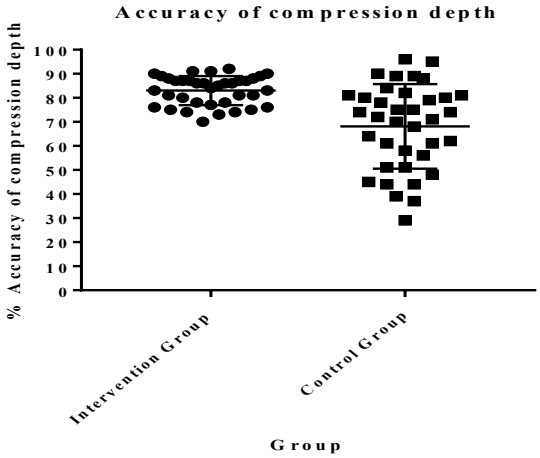

Figure 1 Accuracy of compression depth

CONCLUSIONS

There were effects of manual chest compression using neo automatic code on the accuracy of compression depth. Neo automatic code could improve the accuracy of chest compression depth. Rescuer of cardiac arrest patient must have knowledge about factors that can be improve chest compressions depth such as weight of rescuer, hard board, and chest compressions rate.

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