Sound Feedback of Metronome can Improve High Quality Cardio Pulmonary Resuscitation

A Systematic Review

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Keywords: Chest compression, Metronome, Cardio Pulmonary Resuscitation.

Abstract: Rhythm and depth of chest compression during cardiopulmonary resuscitation often doesn't meet the guidelines in achieving high quality CPR in simulation of manikin. The objective of this review was to analyse the metronome effect in chest compression simulation. We searched international journals from the following electronic databases; ProQuest, EBSCO, Springer Link, Sage, Science Direct, Google Scholar start from 2012 to 2016 with keywords; metronome, compression, and CPR. Five RCT articles were reviewed and analysed from 504 journals found. Metronome can improve chest compression correctly in long time duration. Further research needed with larger sample size and randomized controlled trial design.

1 BACKGROUND

Cardiopulmonary Resuscitation (CPR) is a basic aid to help save lives suffering from sudden cardiac arrest. In recent years it has been proved that patients suffering from sudden cardiac arrest depend on the depth and compression rhythms that are performed to save lives. The chest compression rhythm should be 100-120 beats per minute because it is very difficult to maintain the rhythm without any feedback.

In recent years, an increase in quantitative evidence has shown that cardiac survival of sudden cardiac arrest depends on the quality of the depth and rhythm of CPR performed. High quality CPR improves survival. Improving the quality of CPR can save lives. The optimal level for compression is 100-120 per minute, it feels quite heavy and difficult to maintain without any guidance in the person who performed chest compression. (American Heart Association, 2015).

The American Heart Association's (AHA) recommendation measures 5-6cm depth for chest compressions. From the research results obtained when the chest compressed too slow, too fast, too much, or too little, then the clinical negative effect (Cave, 2010). Patients with sudden cardiac arrest in the hospital should immediately have a heart attack or external CPR with specific procedures and applicable guidelines. In order for a good prognosis should be given this CPR action with high CPR quality.

The successful resuscitation of pre-hospital CPR depends on many factors. The quality of chest compressions or so-called High Quality Cardio Pulmonary Resuscitation (HQCPR) has been identified as a factor that affects survival after CPR (Semeraro et al., 2011). The intended HQCPR is CPR given its depth and proper rhythm, full chest recoil chances remain to be done as well as minimal interruption or interference and avoid excessive ventilation (Cave, 2010). The delay between watching a heart attack and CPR's performance in emergency medical care suggests that CPR riders increase the likelihood of unexpected rhythm and survival after witnessing a heart attack outside the home. According to existing guidelines, witnesses can only provide cardiac compression (hands-only CPR) (Buléon et al., 2013).

Patients' resuscitation (CPR) after a heart attack has attracted the attention of scientists and doctors for decades. The physiological underlying lifesaving process when CPR (cardiopulmonary resuscitation) remains only partially understood and often controversial (Lurie, 2016). Quality analysis of CPR by the National Institutes for Consortium Prehospital Resuscitation shows that errors in general and harmful CPR actions. Nearly mid-time until CPR is stopped, emphasis is placed on rhythm and depth

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beyond the recommended range of AHA (American Heart Association) (Stiell 2012, Idris 2012, Idris 2015). The ILCOR Guide (International Liaison Committee on Resuscitation) emphasizes the importance of chest compression quality in cardiopulmonary resuscitation (CPR). By 2016, the incidence of Outdoor Medical Looting more than 350,000. Bystander managed to do CPR 46.1% and was rescued as much as 12%. While in the same year the In-Hospital incidence of Cardiac Arrest of 209,000 was saved 24.8% while the survival rate in children was not recorded (American Heart Association, 2015).

Real-time feedback devices have proven their ability to improve the quality of cardiac compression performed by trained rescue teams outside hospitals and in hospitals due to heart attacks. (Park et al., 2014). Metronome beats are the simplest and cheapest feedback system. The use of audible metronome to guide the level of chest compression is one strategy to improve the effectiveness of chest compression. Previous research on metronome guidance during CPR has shown better adherence to recommended chest compression rates In another study reported better survival rates compared to the historical control group when the metronome was attached to the ambulance defibrillator (Fletcher D, 2008). Audio level level guidance significantly improves chest compression rate and CO2 tidal concentration during CPR (Kern, et al, 2010; Milander et al, 1995). Successful resuscitation of cardio-pulmonary pre-hospital (CPR) depends on many factors. The quality of chest compressions has been identified as a factor that affects survival after CPR (Valenzuela, 2005).

Chest compression action becomes superficial from the standard of half the time of action and its rhythm is more than the standard rhythm. One minute after the start of CPR in the manikin has made tired of the masseuse so that effect on the effectiveness of massage (Gutwirth, Williams, & Boyle, 2009).

The purpose of this study was to compile a review of the use of metronome in CPR as feedback during actual exercise or resuscitation. What is the effectiveness of using metronome in CPR action?

2 METHODS

This review was arranged in correlation with American Heart Association Guidelines 2015 evidence evaluation process. Expert review of the search technique egy and findings were listed by the worksheet evaluation experts.

2.1 Eligibility Criteria

2.1.1 Participants

The cardiopulmonary provider should be a nurse as a health care practitioner (HCP), defined as the person whose primary role is the provision of health services. Subjects can be manikins to overcome the quality outcomes of CPR or human heart attack to overcome both quality and survival outcomes of CPR. Heart attacks can occur in hospitals or outside hospitals.

2.1.2 Interventions

Several studies measured the quality of CPR using monitors that detect chest wall motion and, at a minimum, can measure the level or depth of cardiac compression being considered for inclusion. Since the main purpose of our review was to determine whether the use of metronome feedback devices was able to improve the performance and actual outcomes of CPR and the outcome of heart attacks, rather than teaching tools to improve skills acquisition, it was decided that metronome feedback devices should be used at the time of a heart attack or simulation of arrest. The Manikin researches investigating the feedback effects during exercise alone, but not during simulation of resuscitation trials, and human studies that provide delayed feedback in the form of briefing or performance evaluation are equally excluded. Studies that investigate the use of unchanged timing and metronome devices or provide feedback depending on detected CPR quality are also excluded.

2.1.3 Comparison

Intervention (use of CPR in real time with metronome feedback devices) compared to CPR comparison groups performed without using the device.

2.1.4 Results

The main outcome for human studies is the patient's survival of hospital outlays with good neurological outcomes. Secondary outcomes in human studies include other patient survival data (ROSC, life (spontaneous circulation) upon arrival to the emergency department, survival to hospital discharge). For human and manicured studies,

enhanced CPR markers are extracted: CC level, CC depth, and proportion of time without CPR (fraction without flow). We also collect data about the side effects and user satisfaction of the device.

2.1.5 Types of Studies

Published original research articles on random and non-randomized intervention studies, as well as observational studies with comparator groups included. Animal studies, case studies, reviews and opinions are not included.

2.1.6 Search Strategy

Systematic literature searches using the terms and strategy were conducted in electronic databases: ProQuest, EBSCO, Spinger Link, Sage, Science Direct, and Google Scholar start from 2012 to 2016. The articles describe the effects of metronome on the precise rhythm of the appropriate massage in the inclusions. The article title reviewed by reviewers and which articles are irrelevant will be removed. Titles and abstracts with clearly unrelated content removed. Excerpts marked as "included" or "indefinite" by one of the reviewers are included in the next level of review.

Abstracts that tend to be relevant in in-depth reviews are then continued by reviewing existing manuscripts. Disagreements at the full article stage are resolved despite consensus with all reviewers. The agreement between writers at each stage is calculated using kappa statistics. A record is kept of all excluded studies at the full text stage, along with the reason.

2.2 Study Selection

In the study sought 504 journals. After deleting duplicates, 349 titles are reviewed for relevance. Of these 36 titles appears relevant to the research questions that lead to a detailed review of the abstract. Eight more articles are discarded in this phase so 28 articles for full review. From review 5 the list is identified. The 5 articles are relevant to the intended research objectives (figure 1).

3 RESULTS

According to the study reviewed by Kern results A unique combination tock and voice prompting metronome was effective at directing correct chest compression and ventilation rates both before and after intubation. It is mentioned that during CPR with a bag/valve/mask the target compression rate of 90–110min−1 was achieved in 5/34 CPR sessions (15%) for the control group and 34/34 sessions (100%) for the metronome group (p<0.001).

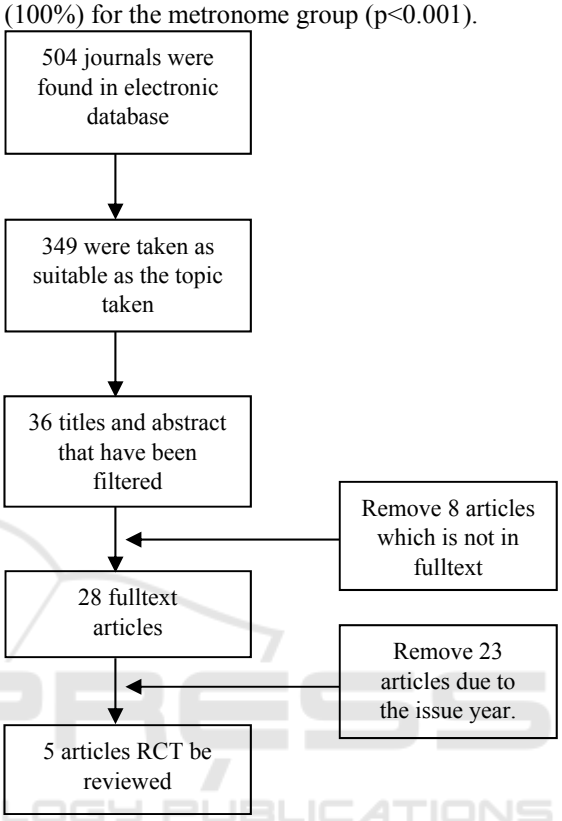

Figure 1: Study Selection and Search Strategy.

An excessive ventilation rate was not observed in either the metronome or control group during CPR with a bag/valve/mask. During CPR with a bag/endotracheal tube, the target of both a compression rate of 90–110/min and a ventilation rate of 8–11/min was achieved in 3/34 CPR sessions (9%) for the control group and 33/34 sessions (97%) for the metronome group (p<0.001). Metronome use with the secured airway scenario significantly decreased the incidence of over-ventilation (11/34 EMT pairs vs. 0/34 EMT pairs; p<0.001) (Kern et al., 2010).

Further research conducted by Hafner mentioned that the control subjects had a higher mean compression rate both immediately (121 [standard deviation {SD} = 21] vs. 109 [SD = 15] cpm; Presented as a poster presentation at the American College of Emergency Physicians Scientific Assembly and Research Forum, San Francisco, CA, October 2011. Supported with a Graduate Medical Education Grant from the University of Illinois

College of Medicine at Peoria. 95% confidence interval [CI] of mean difference 4-19; p = 0.002) and at follow-up (120 [SD = 20] vs. 111 [SD = 13] cpm; 95% CI of mean difference 2-16; p = 0.014).

Compression rates stratified to 100-120 cpm demonstrated no difference between groups initially (39% vs. 48%; p = 0.382), but more experimental subjects main- tained these rates at follow-up (43% vs. 74%; p = 0.003). Utilization of new music metronomes during standard CPR training for the layman improves the proportion of subjects who do chest pacing properly during long-term follow-up, even without the aid of music being played. The introduction of the music metronome has no effect on the depth of the chest compress or the true percentage of emphasis on preliminary or follow-up testing, although this size is low in both populations. The music metronome also has no effect on participants' willingness to perform CPR or their perception of maintaining adequate levels of compression. The use of music metronomes represents an easy-to-teach and cost-effective modality to help laypeople in steady chest compressions (Hafner, Jou, Wang, Bleess, & Tham, 2015).

The Zimmerman study resulted in 155 participants performing 2 rounds of chest compressions (74 with metronome at first and 81 with metronome during second cycle of CPR). There was a significant increase in the average percentage of compression given at adequate levels (90-100 pressure per minute) with the metronome compared to 72% vs 50%; mean difference [MD] 22%; 95% confidence interval [CI] , 15% to 29%). No significant differences were noted in the average percentage of compression at acceptable depth (38-51 mm) (72% vs 70%, MD 2%, 95% CI, 22% to 6%). The metronome has a greater influence among medical students (73% vs 55%, MD 18%, 95% CI, 8% to 28%) and the population of children and co-workers (84% vs. 48%; MD 37%; 95% CI, 27% to 46%) but not among nursemaid children (46% vs 48%; MD 23%; 95% CI; 219% to 14%). The degree of chest compressions during CPR can be optimized with the use of metronome. These findings will help medical professionals adhere to the American Heart Association guidelines (Zimmerman et al., 2015).

The Tastan study reinforces and illustrates that the first evaluation showed that the intervention group participants had an average rate of 107.33 ± 7.29 ± chest compressive per minute, while the control group level was 121.47 ± 12.91. A second evaluation showed that chest compression rates for the intervention and control groups were 106.24 ± 8.72 and 100.71 ± 9.54, respectively. The results of this study indicate that a piece of music allows students to remember the ideal rhythm for chest compression. Conducting chest compression with metronome music can be easily integrated into CPR education because it does not require additional and inexpensive technology (Tastan et al., 2017). There are studies that explain incomplete chest stiffness rates lower at compression rates of 100 and 120 min -1 compared with at 160 min-1 (P = 0.001). The amount of suppression that meets the criteria for high-quality CPR at a rate of 120 min-1 is significantly higher than that at 100 min-1 (p=0.016) in which the highest amount of CPR compression is highest at the 120-1 1 compression rate, and incomplete incompatibility increment occurs with increasing levels of compression (recoil) (Lee et al., 2016)

4 DISCUSSION

This study has identified evidence that the use of CPRs using metronome can provide appropriate CPR skills. The use of the CPR metronomer system during CPR performance in the manikin has consistently improved the quality of CPR. Studies in the early 1990s first identified an association between the quality of CPR and patient outcomes, with better quality CPR associated with improved survival.

Depth and degree of chest compression, interruptions in chest compressions (especially before defibrillation) have an effect on patient outcomes. The evidence in this review strongly supports in showing that CPR with metronome devices is associated with improved quality of CPR. While it may be intuitive to assume that this will lead to improvement in survival, this cannot be assumed as the case. Indeed, none of the studies to date have sufficient strength to show better patient outcomes (return of spontaneous circulation, neurological survival and so on) with CPR metronomes.

For example in a pediatric simulation of the manikin chest compression is performed with and without metronome. It appears that the guide is a metronome improves chest compression at an adequate level but has no effect on depth. This finding is consistent with several studies of adults showing similar results. Research that focuses on CPR only with chest compression without ventilation, causing a shorter delay on chest compression. Initiation of immediate chest

compression is of the utmost importance, as emphasized by respiratory changes airway – breathing - circulation is changed into circulation - airway - breathing sequences proposed in resuscitation guidelines 2010. This guideline is supported by Kern et al, which shows it alone chest compression early heart attacks provide a reasonable reason for circulation, do not jeopardize survival, and are associated with successful outcomes. In addition, in an effort to minimize effect of helper fatigue, CPR is done within 2 minutes for compression. Furthermore, the importance of fatigue aide is emphasized by Hong et al to substantially reduce the quality of CPR as early as the third minute of continuous chest compressions.

There are metronome-based studies that describe an adequate increase in compression rates, but, unlike certain studies, they show a negative impact on the depth of chest compression. There is research focusing on the feedback only - tariff of the metronome because it is easily accessible as part of the defibrillator engine on the code cart and defibrillator in the resuscitation room. The real cause of suboptimal depth of chest compression with metronome guidance is unknown. However, it has been hypothesized that a variety of factors may contribute to superficial compression, including multitasking, rescue rescuers, and rescuers of disruption (concentrating on level management rather than maximum effort).

The effect of greater compression depth is related to increased coronary perfusion pressure, success higher defibrillation, increased cardiac output, and increased clinical outcomes. 5 cm compression depth is more effective than 4 cm in children and adults. The latest AHA guidelines recommend a 5 cm compressive depth in children and adults, in the hope of eliminating confusion when depth ranges are provided. Overall CPR quality is highly dependent on many factors, but is largely important at the level and depth. Therefore, the device is joined Feedback that is heard at both levels and depth can improve the quality of CPR.

4.1 Limitation

The design and review methods used also have some limitations. We review only English articles, and the selection and extraction of data is not done independently by two reviewers. However, in case of doubt, the selection and extracted data are discussed with other authors. We do not use standard methods to assess the quality of each included study. Meta-analysis is not possible because of the heterogeneity of many studies.

5 CONCLUSIONS

The systematic identification of this CPR intervention coupled with the metronome simultaneously brings a good effect on the compression rhythm performed. Because at the time of doing CPR many confounding factors that make the rhythm and accuracy in the acting process becomes less precise. With the presence of a metronome through a literature study undertaken shows the level of significance of the metronome effect. Therefore, the use of guided audio feedback can be a good reference in cardiac arrest management. So that the golden period can be utilized optimally in the effort to save lives by the nurse because the accuracy of CPR is done well.

The evidence suggests that the use of CPR with metronome in clinical practice as part of the overall strategy to improve the quality of CPR may be beneficial. Further studies are needed to assess whether the quality improvement of CPR generated by these devices is translated into improvements in patient focus results. The accuracy of CPR with a metronome to measure the depth of compression should be calibrated to account for the stiffness of the supporting surface where CPR is being performed.

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