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Cardiopulmonary Resuscitation (CPR) Success Rates in Prehospital Settings: A Review of EMT Interventions

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ABSTRACT

Introduction: Typically, in the majority of individuals experiencing cardiac arrest outside of a hospital setting, cardiopulmonary resuscitation (CPR) is begun by first responders such as non-transporting firemen or police, or by emergency medical service (EMS) workers. The disparity in survival results between CPR initiation by first responders and EMS remains uncertain.

Aim of work: To explore the emergency medical technicians' (EMT) interventions and success rates of cardiopulmonary resuscitation (CPR) in prehospital settings.

Methods: The keywords" emergency medical technicians, EMT, interventions, success, rates, cardiopulmonary, resuscitation, CPR, prehospital settings" were used to conduct a thorough literature search in the MEDLINE database in order to find relevant publications published between 2017 and 2024. Using the proper search terms, Google Scholar was utilized to find and access pertinent scientific publications. Various inclusion criteria were used to choose which articles to select.

Results: The research included in this study were published from 2017 to 2024. The research included a discussion segment that was broken into many specific elements. Topics covered include the Current CPR Guidelines, CPR and Prehospital Success and EMT intervention for CPR.

Conclusion: The American Heart Association (AHA) has stressed the significance of high-quality chest compressions and prompt defibrillation in the resuscitation of cardiac arrest. The AHA strives for a chest compression percentage of 60%. However, there are other methods available, including as intraosseous access, supraglottic blind insertion airway devices, and hands-on defibrillation, which may further enhance results. Team-focused CPR (TFCPR) has been used to optimize the process of reviving patients experiencing cardiac arrest in prehospital settings. Nevertheless, the survival rates for patients who are outside of the hospital are lower than the global average, which highlights the need for enhanced regulations and training. The management of the airway during cardiac arrest is a subject of debate, since there is minimal evidence available from hospital settings. The findings from studies comparing bag-valve-mask ventilation with advanced airway placement have been inconclusive.

Keywords: emergency medical technicians, EMT, interventions, success, rates, cardiopulmonary, resuscitation, CPR, prehospital settings.

INTRODUCTION

OHCA, or out-of-hospital cardiac arrest (OHCA), is a prominent global cause of mortality (Høybye et al., 2021). Annually, there are around 356,000 cases of cardiac arrests that happen outside of a hospital setting. Unfortunately, the chances of survival after adjusting for risk are just 8.3%, which is rather low (Odom et al., 2022). In the last ten years, many clinical study studies have changed the way we approach resuscitation for cardiac arrest. During this period, there has been a gradual improvement in results. This transformation has been led by prehospital medicine, which has prioritized a uniform and efficient method of doing cardiopulmonary resuscitation (CPR). It only covers the critical interventions that have been shown to improve patient-centered outcomes: regaining spontaneous circulation (ROSC), surviving long enough to be admitted to the hospital, surviving long enough to be discharged from the hospital, and—above all—surviving with intact neurological function.

Despite recent advancements in the treatment of OHCA, the survival rate for OHCA remains at a mere 10% even in highly industrialized nations (Myat et al., 2018). Several research have been carried out to find characteristics that might enhance the likelihood of survival after OHCA. According to many studies (Goto et al., 2018; Munot, 2023; Morgan, 2018), early defibrillation with an automated external defibrillator (AED),

shockable initial rhythm, age, witness status, bystander CPR, and ambulance response time are all associated with the likelihood of an over-the-counter (OHCA) death. While several variables have been confirmed as being significantly associated with a higher chance of survival, that of many other variablesare quite unclear. Few factors may affect the chances of survival after OHCA and some of these factors may occur before or during the period of transfer to the medical facility. A number of issues are important in this case and these include the patient's age, gender and race/ethinicity. Also, the aspects connected to the event, the place of the arrest, the condition of the witness or people Performing CPR to the bystander. EMS refers to the system through which the dispatchers, CPR and standard of CPR are managed. Myat et al. (2018) also discussed variables linked to the therapy factors, which include; medication, airway control and the general in-hospital medical treatment. Differences in pre- and in-hospital variables could account for differences in the survival of OHCAs across a nation or region, although the specific effect of every component on OHCA outcomes is still unknown (Schnaubelt et al., 2020).

Some characteristics are easier to understand why they will be helpful, for example, the rate of bystander CPR, whereas others may in themselves not seem helpful, but could potentially be of great benefit in the case of cardiac arrest. Some of the executed randomized controlled investigations concern the effects of pre-hospital medications and procedures: injection of epinephrine; techniques of advanced airways management (AAM); mechanical chest compression device (MCD) (Wang et al., 2018). Over time, other possibly confounder elements like the ability of EMS staff, and the differences in EMS systems can influence OHCA results (Tanaka et al., 2018).

Since the prehospital variables are known to play a crucial role in the survival of the OHCA patients, the objective of this study is to review the treatment provided by the EMTs and the CPR outcomes in out of hospital cardiac arrest.

Aim Of Work

To explore the emergency medical technicians (EMT) interventions and success rates of cardiopulmonary resuscitation (CPR) in prehospital settings.

METHODS

In undertaking this review, only scientific literature review data was retrieved from correctly indexed sources like Google Scholar and also PubMed. Additional search keywords used were; emergency medical technicians, EMT, interventions, success rates, cardiopulmonary rescue, CPR, prehospital care. In order to determine the relevance of the literature, a set of quite rigid criteria was used in the process of selecting the materials. First, the validity of the articles was determined on the basis of the analysis of their titles and abstracts. Thereafter, tries were made to exclude the crosslisted articles, those with less than full text, non-English articles, abstracts, editorial commentaries, case reports, and other kinds of articles which were not research articles. For the purpose of this review, articles published in the period between 2017 and 2024 only were considered.

RESULTS

Studies used in the current study concerned the EMT actions and CPR outcomes in out-of-hospital conditions. The publications considered were published over the years of between 2017 and 2024. Thus in the discussion part the review was grouped in several section such as Current CPR Guidelines, CPR and Prehospital Success and EMT intervention for CPR.

DISCUSSION

Current CPR Guidelines

The 2020 AHA guidelines for CPR and emergency cardiovascular care reaffirms the core principle of recognising and responding to potentially shocked cardiac rhythms and providing high-quality chest compressions (Berg et al. , 2020). Both experimental and observational studies have also all shown the effectiveness of these interventions in enhancing patient outcomes during cardiac arrest. Resuscitative Outcomes Consortium has presented some of the trials conducted in a recent past and they have shed a lot of light on the parameters that should be adopted while undertaking chest compressions. From the findings it was understood that chest compressions should be given out at a rate of 100-120 per one minute with a depth of 2. 0–2. 4 inches with a full chest recoil after every compression and depth of 5-6 cm for all the three groups: adults, children, and neonates (Nichol et al. , 2021). The AHA stresses that hyperventilation is not recommended during CPR since it causes more pressure on the chest and swelling of the stomach and thus affects the efficacies of the compressions (Kleinman et al. , 2018). Besides, rotation of compressors is desirable more often to avoid provider fatigue (Kleinman et al. , 2018).

Competent CPR is being associated with chest compression fraction – the percentage of the time spent on chest compressions during a cardiac arrest. The AHA suggests targeting a chest compression fraction of 60%, while recognising that the values are still contentious. As for the cardiac arrest condition, IO is recommended to be

just as effective as peripheral or central IV therapy. Administration of IO is usually faster than IV, and when the IO site is in the lower limb, chest compressions are not impaired (Meilandt et al. , 2023). Another technique used is the supraglottic blind insertion airway devices (BIAD) which has been known to be used with lesser time delay and lesser complications compared to endotracheal tubes it maintains breathing and oxygenation while not interrupting chest compression (Meilandt et al. , 2023).

Reducing the amount of time spent during the no-shock period, which happens before defibrillation and after it, is important for increasing survival. One approach to mitigate this pause is to charge the defibrillator during active chest compressions with the goal of being prepared for delivering shock after analysing the rhythm (Otto et al. , 2020). Such an organizational approach has become popular and proved to be effective while not raising the probability of involuntary discharges (Otto et al. , 2020).

Another approach that may be useful to decrease the interval between chest pressings and shock is the hands on defibrillation as it was mentioned by Wight et al. This approach has the potential of improving the way defibrillation is done during CPR. However, some studies have highlighted potential issues with electrical leakage and the possible risks they present to the medical professionals who frequently use nitrile examination gloves during the procedure (Pollack et al. , 2019). While some limited research has suggested that hands-on defibrillation may decrease perishock pauses and increase the chest compression fraction, this practice is not often advised.

CPR and Prehospital Success

The mentioned principles have significantly shifted the practice of CPR. In recent years, prehospital cardiac arrest programs have emerged in local, regional, and state EMS agencies. This program aims to improve cardiac care over the current AHA Advanced Cardiac Life Support (ACLS) algorithm, as defined by Parman et al in 2024. Team-Focused CPR (TFCPR), commonly referred to as high performance CPR or 'pit crew'. CPR is one of the techniques used by hospital physicians to improve the quality of patients experiencing cardiac arrest (Ashburn et al., 2023). TFCPR is a functional and coordinated approach to CPR in which first responders from the hospital recognize and are proficient in their assigned role in cardiac arrest resuscitation in the life of the. The goal is to increase CPR effectiveness, quality, and outcomes. The primary goal of TFCPR is to prioritize early defibrillation to achieve optimal chest compression. This includes paying attention to the correct amount, depth, and recoil of compression, as well as optimizing the percentage of chest compression. The TFCPR design also limits the periods of sustained compression performed by a receiver, thus reducing fatigue that can compromise compression efficiency (Ashburn et al., 2023).

A research was carried out in 2023 by Bai et al. to assess the first success rate of CPR in patients who are having cardiac arrest outside of a hospital environment, along with the attributes linked to this outcome. Clinical data from 429 patients who had cardiac arrest and prehospital CPR at the Fourth Hospital of Hebei Medical University between January 2020 and April 2022 were evaluated. Depending on whether autonomous circulation was restored, the patients were divided into two groups: the successful group and the unsuccessful group (non-ROSC, n = 404). To evaluate the differences in the two groups' ages, CPR beginning times, usage of electric defibrillation, and other pertinent factors, a univariate analysis was carried out. The multivariate research evaluated the protective factors that affect how well CPR works for those going into cardiac arrest outside of a hospital. Cardiogenic patients had the most favorable outcome in terms of cardiopulmonary resuscitation success rate. Traffic accidents and drowning have a relatively little impact in terms of their contribution to overall causes. In addition, the median duration of CPR was 25.0 minutes, ranging from 1.5 to 64 minutes. Significant connections between CPR efforts and factors including age, the time at which CPR is started, the usage of electric defibrillation, and the dosage of adrenaline were shown by the univariate analysis. From the result as obtained from the multivariate logistic regression analysis it was as seen that a number of variables played a significant role in how effective the prehospital CPR was. Age of CA patients, location of CA, the nature of CA, whether CPR was provided by a lay person, the time when CPR was initiated, the time when defibrillation began, duration of tracheal intubation, kind of cardiac rhythm that was present prior to resuscitation, amount of adrenaline given (less than 5mg) and the time when it was administered were some of these variables. This paper aims to identify some of the factors that determine the effectiveness of CPR in treatment of patient who are experiencing prehospital cardiac arrest. Thus, it is crucial to establish the strategies intended to decrease the levels of these risk factors to the population (Bai et al., 2023).

To evaluate the survival outcome of Chinese patients who had CPR and had out-of-hospital CA, Zhou et al. (2023) conducted a study. Over all the return rate of total ROSC was 9. 0%, the total admission survival rate was 5. Discharge mortality rate was 0%, and the total discharge survival rate was 1%. 8%. Also, the chance of re-establishment of ROSC was higher in the patients who received bystander CPR compared to the patients, who did not receive this kind of CPR. 7. The cumulative odds ratio (OR) was 92 in the study. ROS survivors were seen to be significantly more frequent among patients who had CPR started before 5 minutes compared with after 5 minutes with a pooled OR of 5. 92. Pooled OR of ROSC indicated that the recipients of defibrillation had significantly higher risk of return of ROSC than patients who did not receive defibrillation, 8

probability value ≤0. 52. From a global perspective, that of the out-of-hospital CPR are significantly lower than the average in China. Therefore, it becomes pertinent to extend and publicize the policy with regards to deployment of AEDs in public places as well as improving on the CPR training of the health care professionals as well as other people in public service in the whole of the country (Zhou et al. , 2023).

Some factors that influence probability of survival of OHCA arise before arrival of prehospital care; these are influenced by the country or region. Ahn and co-authors (2023) analyzed the potential prehospital factors associated with outcomes of OHCA in a certain city of the Republic of Korea. This investigation only involved adult OHCA patients and they had to have been recruited prospectively. The data collected in this study were retrieved from the citywide OHCA registry, The patients in this study were registered between the years 2018 and 2021. The main outcome was the survival of patients up to the time they were discharged from hospital. The covariates of the study population concerning the clinical outcomes were examined in a multivariable logistic regression model. Age more than 70 years, intubation, SGA, prehospital use of mechanical chest compression device, and longer SC time were found to be the predictors of death in the multivariable logistic regression analysis. From the results obtained it was realized that shockable rhythm, pulseless electrical activity and observed cardiac arrest had a positive relationship with survival. The results of sensitivity analysis are as follows, endotracheal intubation, supraglottic airway, prehospital mechanical chest compression devices and longer scene time interval were significantly connected to reduced likelihood of survival till release from the hospital. Based on the findings from this research, there is merit in revamping the regional method of CPR and attending to the changeable prehospital factors that are associated with lowered probability of survival in OHCA (Ahn et al. , 2023).

EMT intervention for CPR

Airway Management

Airway management during CA is still a controversial issue, and clinical data on this issue are lacking. Previous studies in the prehospital setting comparing bag-valve mask ventilation with a comparable advanced airway showed findings, in contrast to supraglottic BIAD and ETI (Jung et al., 2022) studies of OHCA patients improved airway placement, bag-valve only. Higher survival rates with intact neurological function were demonstrated when mask ventilation was used (Jung et al., 2022). A longitudinal observational study showed a small but statistically significant benefit over ETI compared to BIAD in OHCA cases (Lønvik et al., 2021).

In addition, an important cohort observational study of airway therapy in hospital cardiology was published, adding to the existing prehospital literature (Andersen et al., 2017). The scientists used data from 2000 to 2014, primarily from the AHA's Get with the Guidelines-Resuscitation registry. Researchers matched injection patients from 668 hospitals with participants who were able to distinguish patients who received an injection within the first 15 minutes of administration within the heart and well between those who did not. According to research, intubated patients were less likely to have a satisfactory neurologic outcome, less likely to achieve ROSC (return to spontaneous circulation), and less likely to survive sleep is limited until discharge (Andersen et al., 2017). The findings do not support the clinical use of the first ETI for cardiac arrest, although the retrospective study design does not fully rule out the possibility of confounding by indication. Expert opinion is also divided on airway therapy in heart failure. It is widely believed that more research is needed before definitive global recommendations can be made with confidence (Newell et al., 2018).

Vascular Access

Obtaining intravenous (IV) access might be challenging in people experiencing cardiac arrest. It is crucial to remember that the majority of medications used in cardiac arrest resuscitation have no scientific backing. Furthermore, attempts to get peripheral IV access shouldn't compromise the efficiency of early defibrillation and CPR. As was already established, the most effective way to provide all of the drugs and fluids needed to treat cardiac arrest is via IO access. According to Perman et al. (2024), it is also suitable for taking blood samples and performing laboratory testing. The proximal tibia and distal femur are two insertion sites in the lower extremities that may be easily accessed without obstructing active chest compressions using commercially available equipment that can quickly secure IO access (Philbeck et al., 2022). In accordance with ACLS standards, the use of central venous lines is not recommended as they have limited utility in cases of sudden cardiac arrest without trauma (Perman et al., 2024). Attempts to reach the central venous system during a cardiac arrest may raise the danger of needle-stick injuries and cause considerable interruptions in the effectiveness of chest compressions. In comparison to IO, central venous access is less effective, has a lower success rate on the first try, takes much more time to do, and diverts attention from other crucial duties (Loureiro et al., 2021). Unless specifically indicated by the particular clinical circumstance, such as in situations involving rapid blood product transfusion in instances of severe gastrointestinal bleeding and hemorrhagic shock, central venous access attempts should be delayed until the postarrest phase of resuscitation. In-Patient Ultrasound A crucial tool for forecasting results and identifying problems during CPR is intra-arrest point-of-care ultrasound (POCUS) (Riera et al., 2023). Cardiac standstill seen during first POCUS is linked to the

absence of ROSC and mortality. However, the original results were constrained by the inclusion of participants based on convenience and small sample sizes (Riera et al., 2023).

CONCLUSION

The two cornerstones of early cardiac arrest resuscitation, as reaffirmed by the American Heart Association, are timely defibrillation for cardiac rhythms amenable to electric shock treatment and high-quality chest compressions. Chest compressions should be performed at a rate of between 100 and 120 per minute, making that the chest completely retracts after each compression. The objective of the AHA is to achieve a chest compression fraction of 60%. However, there are other methods available, like as intraosseous access, supraglottic blind insertion airway devices, and hands-on defibrillation, which may further enhance results. The high-performance strategy known asTFCPR has been used to optimize the process of resuscitating prehospital cardiac arrest patients. This approach prioritizes prompt defibrillation and effective chest compressions, while reducing the impact of weariness. The survival rates of individuals experiencing cardiac arrest outside of a hospital setting were lower than the global norm, indicating the need for enhanced policy and training. Older age, endotracheal intubation, supraglottic airway, prehospital mechanical chest compression device usage, and longer scene time intervals were shown to have a detrimental influence on survival in cases of OHCA.

The treatment of the airway during cardiac arrest is a subject of debate, and there is a scarcity of evidence available from inside the hospital setting. Preliminary trials conducted before arrival at the hospital indicate varying outcomes when comparing bag-valve-mask ventilation with advanced airway placement. Some studies indicate a little but meaningful advantage for ETI over supraglottic BIAD in cases of OHCA. Clinical investigations conducted within hospital settings indicate that patients who undergo intubation have a reduced probability of achieving ROSC, poorer rates of survival until departure from the hospital, and worse neurological outcomes. There is a lack of consensus among experts about airway care, and more research is required before definitive worldwide guidelines can be established.

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