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An Overview of Survival Rate in Pediatric ICU Following Cardiac Arrest: Review Article

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ABSTRACT

Background: Cardiac arrest can be described as the absence of central pulses, unresponsiveness, and apnea as clinical manifestations indicating the termination of functional mechanical heart activity. There is no way to tell for sure how common out-of-hospital cardiac arrests happen in children, but the estimated rate is 9 for every 100,000 person/years. Whereas, the rate in intensive care units is 0.94 for every 100 admissions. In order to maintain optimal blood pressure, cardiac output and systemic perfusion, fluids and vasoactive, inotropic and inodilator medications should be titrated as needed, such as norepinephrine, dobutamine and milrinone. Even while mechanical circulatory support helps patients who aren't going into cardiac arrest, it hasn't been linked to better clinical outcomes, and it's not suggested whether it can be used routinely in patients who have already gone into cardiac arrest.

Objective: Survival in pediatric critical care units after cardiac arrest is little understood, making it imperative that additional research should be conducted in this area in order to better the treatment given to those who have experienced a cardiac arrest. **Methods:** The databases were searched for articles published in English in 3 data bases PubMed, Google scholar and science direct as well as Boolean operators (AND, OR, NOT) had been used such as survival rate in pediatric ICU and cardiac arrest OR cardiopulmonary resuscitation (CPR) in pediatric and in peer-reviewed articles between April 2009 and June 2021.

Conclusion: The survival rates of infants and young children are higher than those of older children, and this variation in survival is mediated by the varying rates of bystander CPR or automated external defibrillators (AED) use. Children with Out-of-Hospital cardiac arrest had a better survival rate.

Keywords: Pediatric, Survival, Cardiac arrest.

INTRODUCTION

Cardiovascular arrest is defined as the absence of functional mechanical activity of the heart, as well as apnea, unresponsiveness, and absence of central pulses. Blood supply to vital organs such as the brain, kidneys, and heart muscle has been restricted, resulting in a lack of oxygen. Having a cardiac arrest is one of the most devastating situations a person can face in his lifetime. Healthy youngsters and individuals with underlying medical issues can both experience it [(1)].

The frequency of pediatric cardiac arrests in hospitals in the United States is unknown, however CPR is provided to 5,000 to 10,000 children annually, according to estimates [(2)]. Accounting for 0.77% of all children admitted to the hospital, averaging 0.77 children per 1000 hospitalizations every year [(3)].

This review article aimed to investigate the survival in pediatric critical care units after cardiac arrest, which is little understood, making it imperative that additional research be conducted in this area in order to improve the treatment given to those who have experienced a cardiac arrest.

Causes of arrest in pediatric ICU:

Age and sex:

A research has shown that the number of male cardiac arrest victims was higher than the number of female victims. There was a reduced mortality rate for children under the age of 10, as has been reported by some writers. In the multivariate analysis, gender, age, and weight were not revealed to be significant risk variables [(4)]. Infants and children are more likely to have cardiac arrest due to respiratory or oncohematologic conditions. Therefore, the results could have been impacted by this. The survival advantage in in-hospital cardiac arrest among children of different ages persists even after correcting for all possible confounding pre-arrest, arrest, and resuscitation variables, as demonstrated by **Meaney *et al.*** [(5)].

Preexisting conditions, past neurological state, and previous therapy:

Only hematologic and oncologic disorders were found to be significant mortality risk factors in the multivariate analysis of numerous patients with preexisting conditions. Other researchers have also come to the same conclusion. As stated by other writers, pre-arrest neurological status was normal in most patients, and it did not have any bearing on survival [(6)].

Definition of cardiac arrest characteristics:

Arrest Causes:

According to previous research, pulmonary and heart disorders were the most common causes of cardiac arrest. Sepsis was also a common cause of cardiac arrest in our study, which was considerably more common than earlier studies. A study of adults found that sepsis was more likely in nations with a lower HDI. In cardiac arrest, sepsis was one of the worst prognostic factors. This shows the need of adopting measures to identify and treat sepsis as soon as possible [(7)].

Rhythm:

In contrast to previous, recent studies in children, which found that bradycardia was more common, asystole was the most commonly observed first heart rhythm. This shows that many cardiac arrests' patients

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were misdiagnosed because of a delay in diagnosis. 6% of our subjects had shockable rhythms (VF and pulseless VT), which is in line with previous investigations on children. In a multivariate analysis, rhythms that shock people have much greater survival rates [8].

When to initiate cardiopulmonary resuscitation?

Out-of-hospital cardiac arrest survival is thought to be heavily influenced by the amount of time that passes between the time of arrest and the start of resuscitation. For an in-hospital cardiac arrest, the time to begin resuscitation is usually short, which may explain why there were no significant changes in prognosis according to resuscitation start time in a recent study. While it is difficult to correctly measure this delay, these results should be viewed cautiously [9].

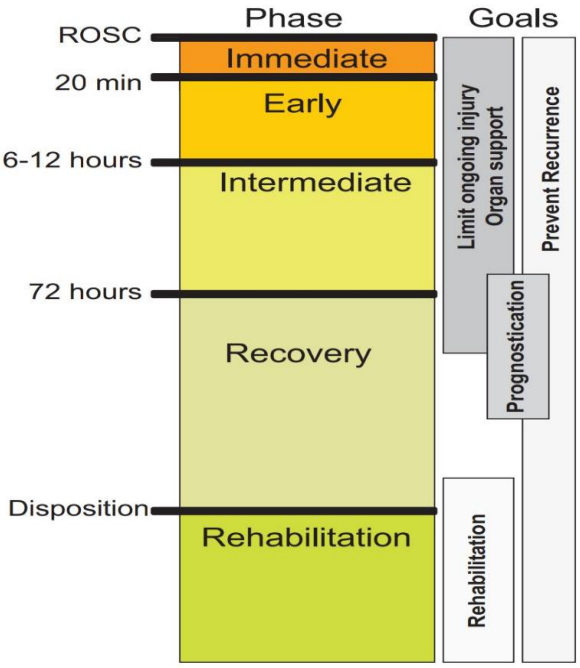

Figure (1): Phases of post cardiac arrest syndrome [10].

Resuscitation methods:

More advanced life support treatments and larger epinephrine doses were associated with a higher mortality rate in patients with a cardiac arrest. But the most significant resuscitation predictor of mortality was the length of time that life support measures were used. A total life support time of more than 10 minutes was discovered as a risk factor in the multivariate investigation. Extracorporeal membrane oxygenation (ECMO) resuscitation may be required in institutions that have this technology available, as this finding emphasizes the need of initiating steps for early resuscitation [11].

Treatment plan in the medical setting:

According to previous studies, patients who experienced several cardiac arrests had a greater mortality rate, but the difference was insignificant in the **Ballesteros and colleagues** [12] investigation**.** Patients who lived had an excellent neurological result, but this could only be assessed in 60% of those who did. Surviving without any long-term effects was on par with other pediatric trials [13].

Infant and child end-of-life decision-making is among the most difficult and significant professional obligations for doctors who care for them, and it is among the most essential and meaningful professional responsibilities for families [14].

How long a patient spends in the PICU before passing away, depending on the cause of death and whether or not a DNR order is in place? It took 5.4 and 4.4 days longer for individuals who died after a failed resuscitation and the diagnosis of brain death, respectively, to come to terms with their mortality [15].

Intensive care unit admissions and outcomes for children with cardiac arrest:

In one tertiary center's research of cardiac arrest PICU admissions, 2.4 out of every 1000 patients were admitted to receive treatment for their injuries or conditions [16]. Respiratory, cardiac, and gastroenterological illnesses were the most prevalent initial diagnoses in cardiac arrest patients. Acute lower respiratory tract infections and acute diarrheal diseases were the most common underlying respiratory and gastrointestinal diseases, but chronic comorbid problems were more commonly linked to cardiac disease (congenital heart disease) [17]. It was hypoxia that was more frequently connected to chronic respiratory infections and respiratory-related causes, while acute diarrheal diseases were more likely to produce circulatory failure or hypovolemic shock in the gastrointestinal tract [18].

A fraction that has clinical significance during endotracheal intubation procedures, 23.3% of cardiac arrests occurred, mostly in the Emergency Department and Hospital Wards. It is alarming that the majority of endotracheal intubation operations were not reviewed by senior clinicians, given that most of these patients were likely in peri-arrest phase at the time of intubation and therefore had a high anticipated risk of cardiac arrest [19]. That's why senior professionals should always be present to monitor emergency endotracheal intubation, which is considered a high-risk technique. For cardiac arrest, CPR is the primary therapeutic option. Paediatric cardiac arrest can be considerably improved by effective CPR, with proper depth and rate of chest compression, alternating with breathing and oxygen. The strongest predictive factor of survival in children is a brief period of CPR, however there is inadequate evidence to indicate when to stop CPR [20].

On univariate analysis, there was a correlation between CPR duration and death in the PICU, however there was no correlation between CPR duration and neurological prognosis using the POPC scale. In addition, in a multiple regression analysis, the length of resuscitation was no longer found to be a predictor of PICU mortality. Considering that only a limited percentage of individuals survived, more large-sample prospective studies are needed to corroborate these findings [21]. After a cardiac arrest, shock was the most

common complication, with acute renal injury and neurological damage showing up equally frequently. As previously was shown in a different study that the neurological outcomes of patients who had effective CPR and ROSC were good in a substantial percentage of those who survived to be discharged from the hospital [16].

With an expected 43.2% mortality rate, the 42.7% hospital mortality rate is in line with the PIM2 score at admission of 0.7, which shows better-than-predicted PICU survival. There was no way to estimate the change in neurological status from pre-arrest to post-arrest status in this study, and further inquiry is needed to address this issue [22]. Most patients (n=39; 76.5%) who were released from the hospital, they had satisfactory neurological outcomes, with scores suggesting normal function or just slight disability. Only six (11.8%) of the survivors were severely disabled. 76.7% of patients who survived to discharge had an excellent neurological result according to the POPC scale, according to these findings [17, 23].

CONCLUSION

The survival rates of infants and young children are higher than those of older children, and this variation in survival is mediated by the varying rates of bystander cardiopulmonary resuscitation (CPR) or automated external defibrillators (AED) use. Children with Out-of-Hospital cardiac arrest had a better survival rate.

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