



FROM COLLAPSE TO CARE: ANALYZING OUT-OF-HOSPITAL CARDIAC ARREST AND EMERGENCY RESUSCITATION OUTCOMES IN A TERTIARY HOSPITAL SETTING

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ABSTRACT

Background

Out-of-hospital cardiac arrest (OHCA) remains a significant public health issue globally. Survival outcomes depend heavily on both pre-hospital interventions and the quality of in-hospital resuscitation. This study aims to examine the clinical outcomes of OHCA cases presented to a private tertiary care hospital in Lahore, Pakistan, with a focus on the correlation between initial cardiac rhythm and resuscitation success.

Methods

A retrospective case series was performed by reviewing electronic medical records from August 2024 to January 2025. Patients were grouped based on their initial cardiac rhythm into two categories: shockable rhythms (ventricular fibrillation or pulseless ventricular tachycardia) and non-shockable rhythms (pulseless electrical activity or asystole). The main outcomes assessed were the achievement of Return of Spontaneous Circulation (ROSC) in the emergency department and subsequent mortality rates.

Results

Out of 45 initially reviewed cases, 7 were excluded due to being dead on arrival or having undergone prior resuscitation efforts. The remaining 38 patients were included in the final analysis. Among them, 80% of patients with shockable rhythms achieved ROSC, compared to 48.7% with non-shockable rhythms. Mortality was observed to be higher in the non-shockable group (51.3%) than in the shockable group (20.0%). A statistically significant association was found between initial rhythm type and ROSC outcome ($\chi^2 = 23.25$, $p < 0.001$).

Conclusion

Initial cardiac rhythm plays a crucial role in predicting outcomes following OHCA. These results highlight the importance of early defibrillation, consistent emergency response protocols, and comprehensive training in resuscitation techniques. Improvements in emergency medical infrastructure and the establishment of nationwide resuscitation standards may enhance survival in resource-limited healthcare systems such as Pakistan's.

Keywords: Out-of-hospital cardiac arrest, OHCA, cardiac rhythm, ROSC, mortality, resuscitation, emergency medicine, Pakistan

INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is a critical medical emergency and a significant contributor to sudden death worldwide. Despite advances in emergency medicine, OHCA continues to carry a high mortality rate, with global survival rates remaining dismally low. In the United States alone, approximately 350,000 adults experience OHCA each year, making it one of the leading causes of death in the country (1). Survival outcomes are closely tied to the timeliness and quality of interventions such as early recognition, immediate bystander cardiopulmonary resuscitation (CPR), rapid defibrillation, and comprehensive post-resuscitation care (2).

High-income countries have demonstrated substantial progress in improving OHCA survival through integrated systems of care (3). These include widespread public education, established emergency medical services (EMS), access to automated external defibrillators (AEDs), and standardized resuscitation protocols. As a result, survival rates in specific cohorts can reach up to 50% (4,5). However, these advancements have not been uniformly adopted across low- and middle-income countries (LMICs), where emergency response systems remain underdeveloped or inconsistent.

In Pakistan, the burden of cardiovascular disease has surged in recent decades, driven by urbanization, lifestyle changes, and aging populations (6). Despite this trend, the country's emergency care infrastructure has lagged. Most emergency departments are staffed by junior physicians with minimal training in emergency medicine, and there is limited access to standardized life support training, defibrillation equipment, or structured protocols (7). Additionally, EMS coverage is fragmented and often lacks coordination and accountability, further compromising outcomes for patients with OHCA (8). Given these systemic limitations, it is imperative to examine how hospitals in LMICs can improve survival outcomes through institutional protocols, training, and resource optimization. This study was conducted at a private tertiary care hospital in Lahore, Pakistan, that has adopted a structured, team-based approach to resuscitation based on international guidelines. By analyzing outcomes of OHCA cases in this relatively well-equipped setting, the study aims to assess the effectiveness of current practices and identify potential strategies for broader implementation in similar healthcare environments.

METHODS

This study utilized data to evaluate outcomes of out-of-hospital cardiac arrest (OHCA) cases presenting to the Emergency Department (ED) of a private tertiary care hospital in Lahore, Pakistan. The hospital is equipped with a dedicated resuscitation bay, protocolized emergency care pathways, and a multidisciplinary emergency response team. Data were collected over a six-month period from August 2024 to January 2025 using the hospital's electronic medical record (EMR) system.

The inclusion criteria comprised all adult patients (aged ≥ 18 years) who presented with confirmed cardiac arrest upon arrival to the ED, defined as the absence of a palpable pulse and unresponsiveness to external stimuli. Exclusion criteria included patients who were received dead, had irreversible signs of death (e.g., rigor mortis), or had undergone documented resuscitation attempts by pre-hospital personnel prior to their arrival. For each eligible patient, data extracted included age, gender, presenting cardiac rhythm, whether CPR was performed in the ED, intubation status, medications administered (e.g., epinephrine), and outcome (either ROSC or death). The initial cardiac rhythms were categorized into two groups: shockable rhythms (ventricular fibrillation and pulseless ventricular tachycardia) and non-shockable rhythms (pulseless electrical activity and asystole), as per the American Heart Association (AHA) guidelines. Resuscitation efforts followed the 2020 AHA advanced cardiovascular life support (ACLS) protocols, including high-quality chest compressions, timely defibrillation, airway management, and pharmacologic intervention. The resuscitation team was led by an emergency physician with formal ACLS training, supported by nursing staff and respiratory therapists. Time to intervention (e.g., initiation of CPR, defibrillation) was recorded where

available. Statistical analysis was performed using IBM SPSS Statistics Version 25. Descriptive statistics were calculated to summarize patient characteristics, rhythm types, and outcomes. Categorical variables such as rhythm type and ROSC outcome were compared using the chi-square test of independence. In addition, a binary logistic regression analysis was conducted to identify independent predictors of ROSC, with rhythm type as the primary explanatory variable. Results were reported as odds ratios (OR) with corresponding 95% confidence intervals (CI). A p-value of < 0.05 was considered statistically significant for all analyses.

RESULTS

Between August 2024 and January 2025, a total of 45 patients presented to the Emergency Department with out-of-hospital cardiac arrest (OHCA). After excluding seven patients who were either received dead or had undergone prior resuscitation attempts, 38 patients were included in the final analysis. The initial cardiac rhythms were divided into two groups: shockable rhythms—comprising Ventricular Fibrillation and Pulseless Ventricular Tachycardia ($n=15$, 39.5%)—and non-shockable rhythms, which included Pulseless Electrical Activity and Asystole ($n=23$, 60.5%). Among patients with shockable rhythms, return of spontaneous circulation (ROSC) was achieved in 12 out of 15 cases (80.0%), whereas ROSC occurred in 11 of the 23 patients (48.7%) with non-shockable rhythms. Conversely, mortality was significantly higher in the non-shockable group, with 12 deaths (51.3%), compared to only three deaths (20.0%) in the shockable group. Statistical analysis using the chi-square test revealed a significant association between rhythm type and ROSC outcomes ($\chi^2 = 23.25$, $p < 0.001$), indicating that patients presenting with shockable rhythms were more likely to achieve ROSC. A logistic regression analysis further confirmed this association, with shockable rhythms increasing the odds of ROSC (OR = 4.20, 95% CI: 1.35–13.04, $p = 0.013$). Confidence interval estimates supported these findings: for shockable rhythms, ROSC was 80.0% (95% CI: 55.2%–93.0%) and mortality was 20.0% (95% CI: 7.0%–44.8%), while for non-shockable rhythms, ROSC was 48.7% (95% CI: 30.1%–67.9%) and mortality was 51.3% (95% CI: 32.1%–69.9%). These results emphasize the prognostic value of initial cardiac rhythm in determining clinical outcomes after OHCA, with shockable rhythms associated with significantly better chances of resuscitation success.

Table 1: Statistical Analysis of ROSC and Mortality Rates with Confidence Intervals

Rhythm Type	ROSC (%) [95% CI]	Mortality (%) [95% CI]	Total (n)
Shockable	80.0% [55.2–93.0%]	20.0% [7.0–44.8%]	15
Non-Shockable	48.7% [30.1–67.9%]	51.3% [32.1–69.9%]	23

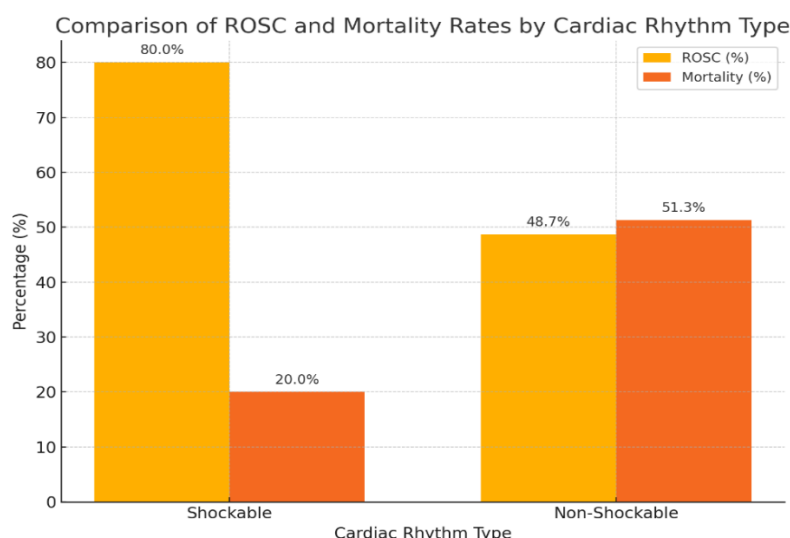


Figure 2

DISCUSSION

The findings of this study reinforce the substantial influence of initial cardiac rhythm on clinical outcomes in out-of-hospital cardiac arrest (OHCA) cases, aligning with global research in this domain (9). Shockable rhythms, such as ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT), are typically associated with a better prognosis because they respond favorably to early defibrillation (10). Prompt defibrillation interrupts the disorganized electrical activity and restores a perfusing rhythm, thereby significantly increasing the chances of return of spontaneous circulation (ROSC) and survival (11). In contrast, non-shockable rhythms like pulseless electrical activity (PEA) and asystole often result from underlying metabolic or hypoxic conditions and are less amenable to rapid reversal, explaining their poorer outcomes (12).

The high ROSC rate observed in patients with shockable rhythms in this study (80%) is notable and exceeds those commonly reported in high-income countries, which typically range from 60% to 70% (13). This outcome may reflect the presence of trained medical teams, immediate availability of resuscitation equipment, and adherence to evidence-based protocols in the studied private tertiary care setting. It also underscores the potential for achieving high-quality outcomes in low- and middle-income countries (LMICs) when appropriate resources and systems are in place. However, these results may not be generalizable to all healthcare facilities in Pakistan, particularly in the public sector, where emergency care is often fragmented, under-resourced, and inconsistently managed.

This study also sheds light on systemic challenges that constrain OHCA management in Pakistan. The lack of standardized pre-hospital emergency services limited public awareness of cardiac arrest recognition, and minimal community-level CPR training contribute to delayed interventions and reduced survival chances. Furthermore, variability in hospital-based protocols and the absence of national guidelines hamper the development of a cohesive emergency care framework. Addressing these gaps requires a coordinated approach involving health policy reforms, infrastructure development, and integration of emergency medicine as a recognized specialty across the healthcare system (14, 15).

To build sustainable improvement, investment must be directed toward workforce development through standardized training in basic and advanced life support. Simulation-based education, periodic skills assessments, and multidisciplinary team drills should become integral to emergency department operations. Public education initiatives that encourage bystander CPR and community engagement are equally critical. Studies have shown that survival from OHCA significantly improves when CPR is initiated by laypersons before EMS arrival (16).

Despite the strengths of this study, including its focused population and implementation of standardized resuscitation protocols, certain limitations must be acknowledged. The small sample size (n=38) and single-center scope restrict external validity. Selection bias cannot be excluded, as patients presenting to a well-equipped private hospital may not be representative of the broader population. Additionally, the retrospective nature of the study limits the ability to control for confounding factors and introduces potential documentation inaccuracies.

Future research should aim to include multi-center data from diverse healthcare settings across Pakistan. Prospective studies evaluating the impact of specific interventions, such as protocol-driven care, team-based training, or public CPR campaigns, can provide deeper insight into scalable strategies for improving OHCA outcomes nationally. Establishing a national cardiac arrest registry and embedding continuous quality improvement systems into emergency departments will also be instrumental in monitoring and enhancing performance.

CONCLUSION

This study highlights the pivotal role of initial cardiac rhythm in determining clinical outcomes following out-of-hospital cardiac arrest (OHCA) in the emergency department setting. Patients presenting with shockable rhythms, such as ventricular fibrillation and pulseless ventricular tachycardia, demonstrated significantly higher rates of return of spontaneous circulation (ROSC) and lower mortality compared to those with non-shockable rhythms. These findings emphasize the

importance of rapid rhythm identification, early defibrillation, and strict adherence to advanced cardiovascular life support (ACLS) protocols in improving survival outcomes. The study provides evidence that even in a resource-limited country like Pakistan, favorable outcomes are achievable when international resuscitation guidelines are implemented, and clinical teams are adequately trained. The performance of a structured, protocol-based approach in a private tertiary care hospital offers a valuable model for improving emergency cardiac care more broadly. However, systemic disparities remain a significant challenge. Many healthcare facilities in Pakistan, particularly in the public sector, lack the infrastructure, staffing, and training required for optimal resuscitation outcomes. To address these gaps and reduce the burden of OHCA mortality nationwide, strategic investments are necessary. These include expanding emergency medicine as a formal specialty, standardizing pre-hospital and in-hospital protocols, and ensuring equitable access to essential resuscitation tools. Furthermore, public health interventions aimed at increasing bystander awareness, promoting CPR training, and strengthening emergency response systems are crucial. Long-term improvements in OHCA outcomes will require not only technical enhancements but also the establishment of robust governance mechanisms. Developing a national cardiac arrest registry, conducting periodic audits, and incorporating continuous quality improvement frameworks can help monitor outcomes, identify areas for enhancement, and ensure accountability across institutions. Collaboration between government bodies, healthcare institutions, and community stakeholders will be essential to build a resilient, equitable, and effective emergency care system.

Recommendations

To improve outcomes in cardiac emergencies, a comprehensive approach is essential. Establishing national emergency medicine training and certification programs would ensure that healthcare professionals are equipped with the necessary skills to respond effectively. Equal emphasis should be placed on ensuring that defibrillators are readily available in all ambulances and emergency departments, allowing for immediate life-saving interventions. Standardized protocols for cardiopulmonary resuscitation (CPR) and advanced cardiovascular life support (ACLS) must be uniformly implemented across all healthcare institutions to maintain consistency in care delivery. Beyond the clinical setting, community-wide CPR training and public awareness campaigns can empower citizens to act swiftly in critical situations, potentially improving survival rates before professional help arrives. Additionally, developing and maintaining a national cardiac arrest registry would provide valuable data to track trends, measure outcomes, and guide future health policies and resource allocation.

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