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Making the Golden Hour Count: STEMI Cardiac Arrest Rescued by Immediate CPR and A 15-Minute Door-To-Balloon Time

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Abstract

Sudden cardiac arrest in patients with ST-segment elevation myocardial infarction (STEMI) requires an immediate and highly coordinated emergency response to optimize survival and neurological outcomes.

We report a case of a previously healthy 38-year-old male who suffered sudden cardiac arrest while being transferred to planned percutaneous coronary intervention (PCI) following an anterior wall myocardial infarction (AWMI) diagnosis. High-quality cardiopulmonary resuscitation (CPR) was initiated immediately by trained hospital personnel when the patient collapsed en route to the cardiac catherization (CATH) laboratory.

A 12-lead ECG pointed towards AWMI, and coronary angiography revealed a 99% proximal LAD occlusion. Primary PCI with stent placement was completed with an ultra-rapid 15-minute door-to-balloon time.

Severe hypokalemia was identified as a likely arrhythmogenic trigger. The patient achieved full neurological recovery and preserved cardiac function at discharge and remained clinically stable one year post-event.

This case underscores how immediate CPR, rapid team coordination, and system readiness can produce excellent outcomes even in physiologically high-risk scenarios.

Keywords: Anterior Wall Myocardial Infarction; Cardiopulmonary Resuscitation; Door-to-Balloon Time; Emergency Cardiac Care; Left Anterior Descending Artery Occlusion; Percutaneous Coronary Intervention; ST-Segment Elevation Myocardial Infarction; Systems Efficiency.

Introduction

ST-segment elevation myocardial infarction (STEMI) is a time-critical emergency in which rapid reperfusion therapy significantly influences survival and long-term recovery. Primary percutaneous coronary intervention (PCI) remains the gold-standard treatment, with door-to-balloon (D2B) time serving as a major quality indicator of system efficiency. Current American College of Cardiology/American Heart Association (ACC/AHA) guidelines recommend a D2B time of ≤90 minutes for primary PCI, with many systems striving for even shorter times when feasible (O’Gara et al., 2013).

Despite advances in care, however, achieving these goals can be difficult in low- and middle-income countries due to fragmented referral pathways, delayed ECG acquisition, and limited system-level coordination (Mullasari et al., 2022). Low-cost, process-driven solutions—including smartphone-based communication and pre-activation of catheterization labs—have enabled hospitals in resource-constrained settings to meet guideline-recommended D2B times (Awasthi et al., 2024; Abrahim et al., 2024).

We present a clinically instructive case of a young, previously healthy male who experienced sudden cardiac arrest en route to the cardiac catherization (CATH) laboratory (lab) after being diagnosed with anterior wall myocardial infarction (AWMI). In this case, PCI was completed within 15 minutes of hospital arrival. This report highlights how immediate, high-quality cardiopulmonary resuscitation (CPR) and ultra-rapid PCI within 15 minutes exemplify the impact of system-level readiness and coordinated emergency response in ensuring survival and full neurological recovery.

Case Presentation

A 38-year-old male with no prior cardiovascular history presented to the emergency department with acute-onset chest pain. A 12-lead electrocardiogram (ECG) revealed ST-segment elevations in leads V2–V4, consistent with an AWMI. The hospital’s STEMI alert protocol was immediately activated, and the patient was prepared for primary PCI.

While being transferred to the cardiac CATH lab, the patient suddenly collapsed and became unresponsive and pulseless. On-site trained personnel initiated immediate, high-quality CPR. ROSC was achieved within minutes, and the patient regained full neurological responsiveness without evidence of hypoxic brain injury. The initial cardiac rhythm was monomorphic ventricular tachycardia (VT).

Admission lab investigations revealed severe hypokalemia (2.6 mmol/L), mild hypocalcemia (1.9 mmol/L), mild metabolic acidosis (pH 7.30), and slight hyponatremia (131 mmol/L). The underlying cause of the hypokalemia was uncertain, but possible contributors included prior diuretic exposure, poor dietary intake, stress-induced catecholamine surge, or intracellular potassium shift secondary to acute ischemia. Hypokalemia is a well-recognized proarrhythmic factor due to impaired Na^+/K^+-ATPase activity and intracellular calcium overload, which lower the threshold for ventricular arrhythmias, particularly in ischemic myocardium (Skogestad & Aronsen, 2018; Garadah et al., 2010).

The patient was rapidly stabilized, and primary PCI was initiated within 15 minutes of collapse. Coronary angiography revealed a 99% subtotal occlusion with thrombus in the proximal left anterior descending (LAD) artery. Figure 1 shows the proximal LAD stenosis before intervention. Successful reperfusion was achieved via balloon angioplasty and drug-eluting stent placement, restoring normal coronary flow. Figure 2 demonstrates restored vessel patency post-PCI. Serial ECGs demonstrated resolution of ST-segment elevation and re-establishment of sinus rhythm.

Following the procedure, the patient was monitored in the intensive care unit, extubated within 24 hours, and discharged three days later with preserved left ventricular function and complete neurological recovery. At one-year follow-up, the patient remained clinically stable with no recurrence of ischemic symptoms or arrhythmias.

Table 1: Key laboratory findings at admission and during initial stabilization

Test	**Result**	**Normal Range**	**Interpretation**
Potassium (K^+)	2.6 mmol/L	3.5–5.1	Severe hypokalemia
pH (arterial blood)	7.30	7.35–7.45	Mild metabolic acidosis
Total Calcium (Ca^{2+})	1.90 mmol/L	2.31–2.59	Mild hypocalcemia
Creatinine	1.17 mg/dL	0.70–1.30	Normal renal function
Total Leukocyte Count (WBC)	11.3×10^9/L	4.0–11.0	Mild leukocytosis
Sodium (Na^+)	131 mmol/L	136–146	Mild hyponatremia
Bicarbonate (HCO_3^-)	19.2 mmol/L	22–26	Reduced buffering capacity
Base Excess (BEecf)	–6.0 mmol/L	–3.0 to +3.0	Metabolic acidosis

Legend: This table summarizes the most relevant laboratory findings during the patient’s acute event. Severe hypokalemia and borderline hypocalcemia likely contributed to electrical instability, while mild acidosis and leukocytosis reflect acute stress response and resuscitation physiology.

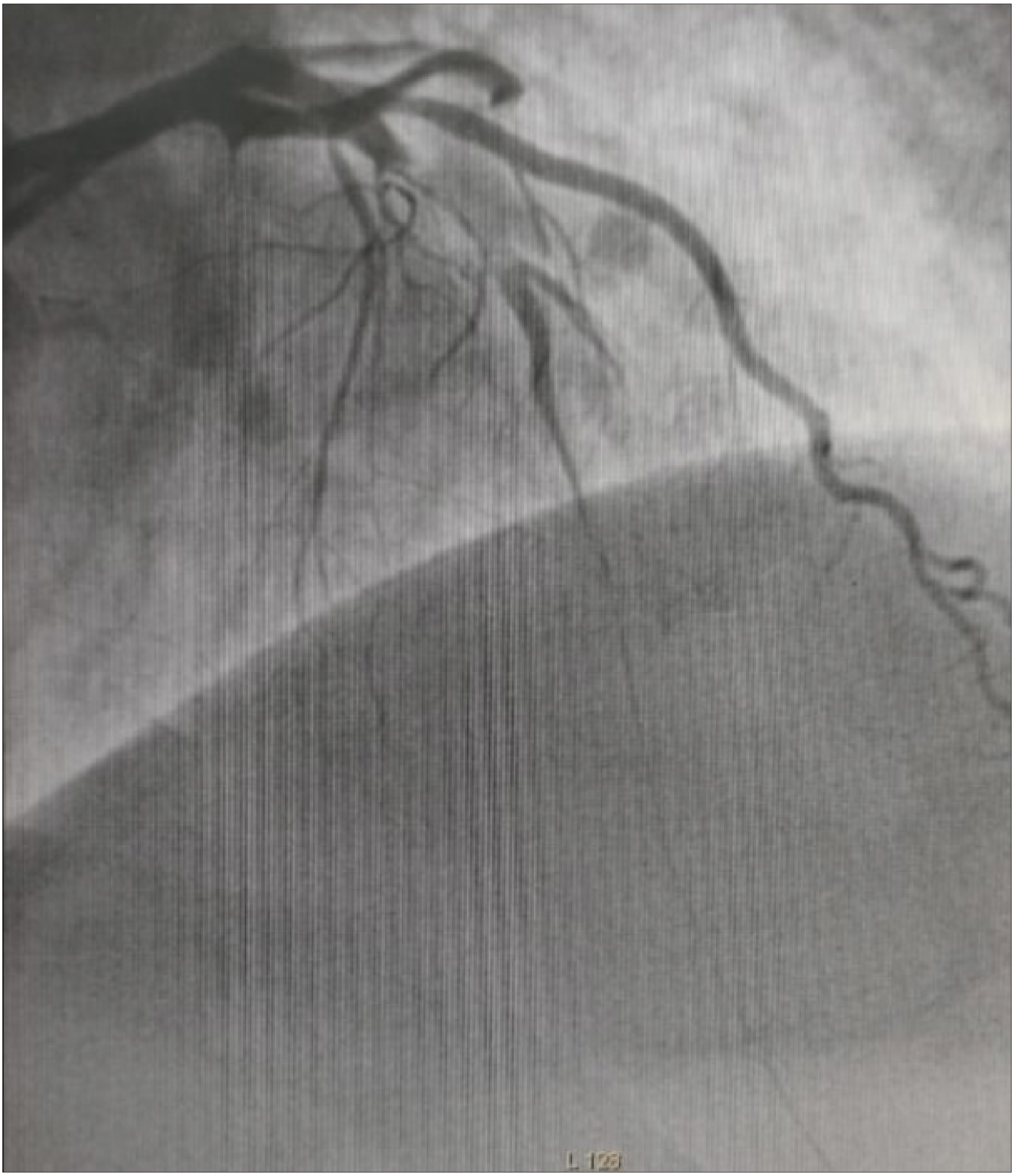

Figure 1: Coronary angiogram showing significant stenosis in the proximal segment of the left anterior descending (LAD) artery, with markedly reduced luminal diameter and impaired distal perfusion, prior to intervention.

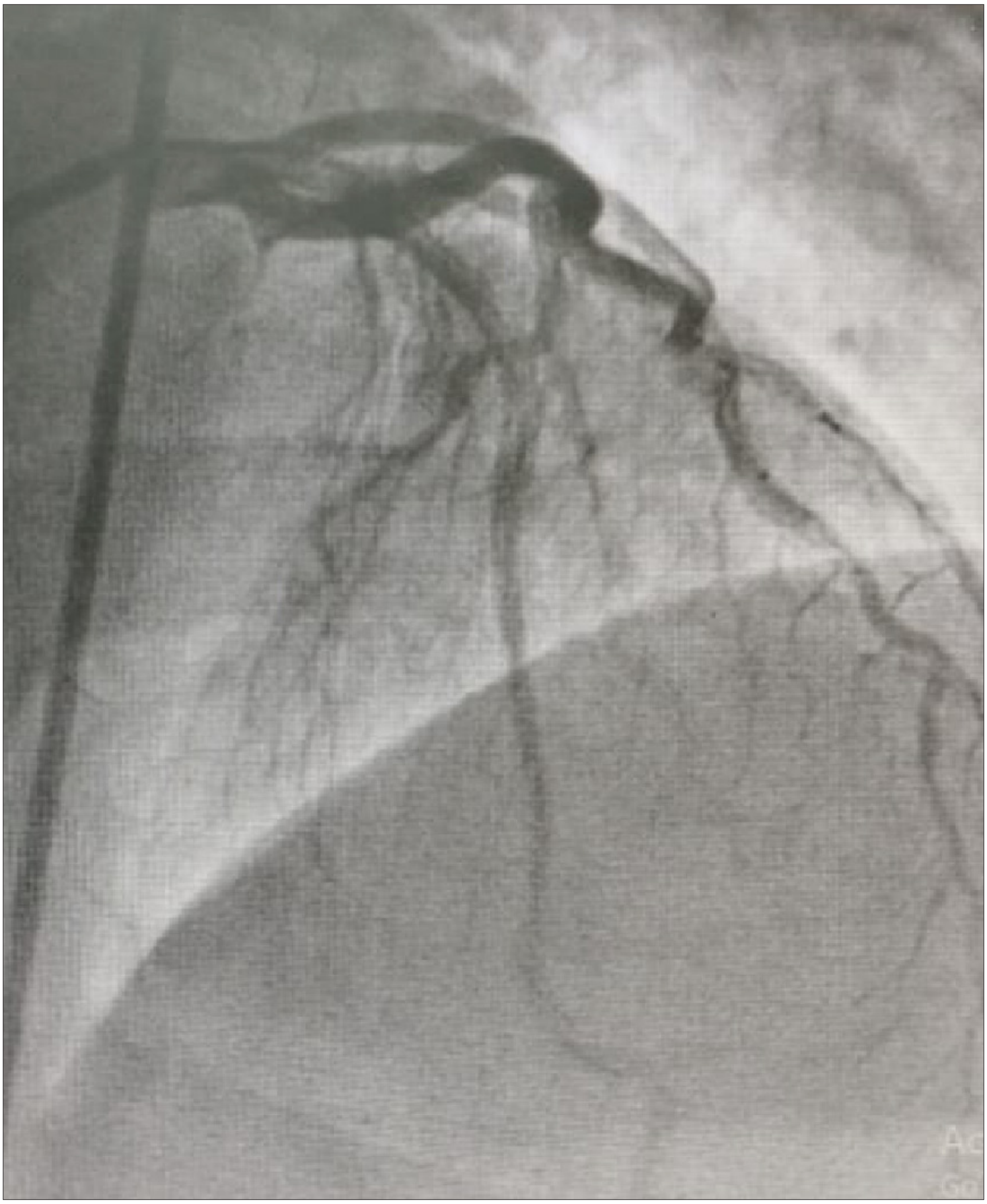

Figure 2: Post-percutaneous coronary intervention (PCI) image demonstrating successful balloon angioplasty and stent deployment at the site of previous LAD stenosis, with restoration of normal vessel patency and improved distal flow.

Discussion

Time-Sensitive STEMI Management

A comprehensive review of cases published over the past two decades has shown that shorter door-to-balloon (D2B) times are strongly associated with reductions in long-term major adverse cardiovascular events (MACE) (Mentias et al., 2017). Delays in reperfusion are directly associated with higher mortality; even small increments in treatment time worsen long-term outcomes (De Luca et al., 2004). This underscores the need for seamless and rapid activation of reperfusion pathways.

Strategies such as prehospital ECG transmission and early catheterization-lab activation consistently shorten D2B times and improve outcomes (Afolabi et al., 2007, Yue et al., 2020). In this case, those strategies were effectively integrated, resulting in an ultra-rapid 15-minute D2B time despite cardiac arrest during transfer to the CATH lab. This achievement highlights the value of a well-drilled emergency response and real-time coordination between clinical teams.

Although the patient experienced cardiac arrest en route to the CATH lab, the total D2B time, measured from hospital arrival to successful PCI, was 15 minutes, including brief resuscitation. Because diagnosis and CATH lab activation had already occurred, this interval accurately reflects system performance.

The patient's severe hypokalemia (2.6 mmol/L) and borderline hypocalcemia (1.9 mmol/L), together with transient acidosis, likely contributed to ventricular electrical instability and the onset of ventricular tachycardia in the setting of acute ischemia. Rapid initiation of CPR and immediate coordination between emergency and interventional teams allowed complete neurological preservation, emphasizing the critical importance of institutional readiness in managing in-hospital cardiac arrest.

High-Quality CPR and the Role of Public Education

Prompt initiation of cardiopulmonary resuscitation (CPR) is essential to maintain cerebral and myocardial perfusion following cardiac arrest. Current American Heart Association (AHA) Basic and Advanced Life Support guidelines emphasize that chest compressions should begin immediately upon recognition of cardiac arrest, as irreversible brain injury begins within minutes of absent circulation (Merchant et al., 2020).

In this case, CPR was delivered instantly by trained staff during transport to the CATH lab. Return of spontaneous circulation (ROSC) occurred within minutes, and the patient recovered full neurological function without hypoxic injury, demonstrating the efficacy of high-quality, immediate CPR.

Outside the hospital, most cardiac arrests occur in community settings, where bystander response determines survival. According to the American Heart Association, early bystander CPR can double or even triple survival rates and significantly improve neurological outcomes. National CPR-training initiatives have been associated with higher bystander CPR rates and improved out-of-hospital cardiac arrest survival (Wissenberg et al., 2013).

This case also highlights the need to identify and correct reversible contributors to cardiac arrest, such as electrolyte disturbances. Hospitals and health authorities should collaborate to promote CPR awareness, provide accessible hands-on training, and integrate early layperson responses into coordinated emergency-care systems, which is particularly vital in resource-limited settings.

Innovations to Reduce Door-to-Balloon Time

Globally, targeted workflow optimization and digital communication tools have dramatically improved reperfusion timeliness. In Europe, a "call-to-balloon" dashboard system demonstrated significant improvements in logistic efficiency and reductions in time to reperfusion (Hermans et al., 2017). In the United States, structured "Heart Alert" protocols achieved D2B $\leq$ 90 minutes in 97% of STEMI cases, while app-based coordination shortened D2B by approximately 7 minutes in this study (Levis et al., 2010; Abrahim et al., 2024).

In China, a WeChat-based chest pain platform significantly reduced D2B intervals and improved short-term post-PCI outcomes (Yue et al., 2020). These findings demonstrate that even in resource-limited environments, low-cost technological interventions can significantly accelerate care delivery.

Indian hospitals—especially in semi-urban and rural regions—face persistent barriers such as manual workflows, delayed ECG acquisition, and administrative bottlenecks (Mullasari et al., 2022). In this case, systemic enhancements such as bypassing paperwork, activating rapid STEMI alerts, and mobilizing CATH lab teams in real time enabled ultra-fast reperfusion. These pragmatic, process-driven solutions offer a reproducible model for improving cardiac-emergency efficiency across resource-limited systems.

System-Level Strategies for LMICs

Delays in STEMI management within low- and middle-income countries (LMICs) often stem from fragmented triage systems, limited staff empowerment, and administrative inefficiencies. However, outcome improvements do not rely solely on expanding infrastructure. Process optimization and workflow redesign can yield significant gains in treatment times and survival.

Effective strategies include:

- Real-time ECG transmission from triage to CATH lab,
- Pre-activation protocols for PCI teams based on preliminary diagnosis,
- Mobile-app coordination to enhance interdepartmental communication, and
- Routine ECG and CPR training for non-cardiology personnel.

Such structured, low-cost interventions can dramatically enhance D2B performance even in under-resourced settings.

A protocol-based acute chest-pain pathway at a tertiary-care center in North India achieved mean D2B times of 65 minutes, with more than 85% of patients treated within 90 minutes (Awasthi et al., 2024). Similarly, collaborative programs under the American College of Cardiology Consortium have reduced D2B times below 60 minutes in multiple Indian hospitals through optimized workflows and staff training (Mullasari et al., 2022). These outcomes align with the STEMI India initiative, which promotes hub-and-spoke models and system-level integration to reduce total ischemic time and improve equity of access (Mullasari et al., 2022). Together, these efforts provide scalable, evidence-based frameworks for improving acute cardiac-care delivery in LMICs.

Global Evidence on STEMI Response

Worldwide registry data demonstrate that shorter reperfusion delays are consistently associated with better outcomes after primary PCI for STEMI. In the United States, large multicenter cohorts have shown that longer door-to-balloon intervals are linked to higher in-hospital mortality (Pinto et al., 2006; Rathore et al., 2009). In Japan, a nationwide J-MINUET substudy reported that shorter door-to-balloon time independently predicted improved long-term clinical outcomes following primary PCI (Nishio et al., 2023). Contemporary analyses further demonstrate that the risk of death, recurrent myocardial infarction, or heart failure increases markedly when total system delay exceeds approximately one hour, underscoring the need for streamlined reperfusion pathways (Mills et al., 2024).

In India, a prospective cohort from Kerala demonstrated that timely reperfusion markedly improved survival, with the lowest mortality observed in the timely-reperfusion group (Mathew et al., 2025); similarly, the Tamil Nadu STEMI Program's hub-and-spoke system increased access to PCI and may improve 1-year mortality (Alexander et al., 2017).

Long-Term Impact of Timely PCI

Timely primary PCI not only reduces early mortality but also influences long-term outcomes. In Kerala, timely reperfusion was associated with significantly lower hospital mortality compared with delayed strategies (Mathew et al., 2025), and the statewide TN-STEMI system in South India has been associated with improved access to PCI and potential improvement in 1-year mortality (Alexander et al., 2017).

The present patient remains clinically stable one year after the event, underscoring the enduring benefit of rapid, coordinated STEMI management and comprehensive post-event rehabilitation.

Clinical Significance

While reperfusion and CPR are established principles in cardiology, this case stands out because of its physiologic complexity and systemic execution. Severe hypokalemia, a rare finding in acute STEMI, markedly increases arrhythmogenic risk through electrical instability. Despite this, immediate CPR, pre-activated PCI readiness, and a 15-minute D2B time led to complete neurologic recovery.

This outcome illustrates how protocol-driven, multidisciplinary coordination can overcome both metabolic and logistical barriers to survival. The case provides a valuable demonstration of how emergency systems optimization can yield exceptional outcomes even in constrained healthcare environments.

Conclusion

This case demonstrates that timely, coordinated STEMI management can result in complete neurological recovery even in the presence of significant metabolic derangement. The combination of immediate CPR, rapid CATH lab activation, and ultra-fast PCI achieved restoration of coronary flow and preserved cerebral function in a high-risk scenario of severe hypokalemia.

Beyond individual success, this experience underscores the impact of institutional preparedness, protocol-driven workflows, and trained multidisciplinary teams in improving survival outcomes. By optimizing system processes and ensuring rapid clinical response, even resource-limited hospitals can achieve results comparable to high-income centers. Sustained investment in training, communication, and emergency-response readiness remains essential for further reducing STEMI-related mortality in low- and middle-income countries.

These findings reinforce international guideline statements that rapid PCI and uninterrupted cerebral perfusion during CPR remain the strongest determinants of neurologic recovery in cardiac arrest complicated STEMI.

Ethical Considerations

This case report was prepared in accordance with the ethical principles outlined in the Declaration of Helsinki and the CARE case reporting guidelines. All identifying information has been removed to preserve patient anonymity. Written informed consent was obtained from the patient for publication of the case details, clinical data, and accompanying images. Institutional ethics committee approval was not required because the report describes a single anonymized case without experimental intervention.

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Conflict of Interest

The authors declare no conflicts of interest related to this case report.

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