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CARDIOGENIC SHOCK: ROLE OF REVASCULARIZATION IN CLINICAL MANAGEMENT

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Abstract: Cardiogenic shock (CS), one of the most serious cardiovascular emergencies, is characterized by a critical drop in cardiac output and tissue hypoperfusion, resulting in progressive organ dysfunction and high mortality rates. Mainly associated with acute myocardial infarction (AMI), CS is the leading cause of hospital death in patients with this condition. This study aims to investigate the management of CS in the context of AMI, focusing on early revascularization strategies and their effects on clinical outcomes. Recent evidence on the effectiveness of interventions such as percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) was analyzed, in addition to the challenges in choosing the appropriate therapeutic approach. The need for well-defined protocols to improve survival and reduce complications is highlighted, with an emphasis on personalizing treatment according to patient characteristics.

INTRODUCTION

Cardiogenic shock (CS) is one of the most serious cardiovascular emergencies, characterized by a critical reduction in cardiac output, leading to tissue hypoperfusion, progressive organ dysfunction, and high mortality, even with advanced therapeutic interventions. (Crispino et al., 2025) Predominantly associated with acute myocardial infarction (AMI), CS is the leading cause of hospital death in these patients, with rates ranging from 40% to 50%, remaining virtually unchanged over the last decade. (Thiele et al., 2021)

Despite significant advances in the treatment of acute coronary syndromes, therapeutic progress in CC remains limited. The lack of randomized clinical trials with high statistical power makes it difficult to define consistent guidelines, resulting in clinical practices often based on expert consensus rather than robust evidence. (Tehrani et al., 2020; Thiele

et al., 2021) Although early revascularization is one of the few strategies with proven efficacy, many aspects of management, such as the choice and timing of inotropic agents, circulatory assist devices, and invasive hemodynamic monitoring, remain controversial and nonstandardized. (Crispino et al., 2025)

Emerging data from multicenter registries, particularly in the United States, point to the importance of structured and integrated approaches based on clinical protocols that prioritize rapid diagnosis, early intervention, continuous hemodynamic monitoring, and coordinated multidisciplinary care. (Tehrani et al., 2020) Such strategies have demonstrated a positive impact on survival and reinforce the need for a reformulation of current care paradigms.

In this context, early revascularization stands out as a central intervention in the management of CC secondary to AMI, with the potential to restore myocardial perfusion and interrupt the cascade of hemodynamic deterioration. This review aims to critically analyze the role of revascularization in the context of cardiogenic shock, exploring the latest evidence, the clinical challenges that remain, and the prospects for standardizing care based on well-defined therapeutic algorithms.

METHOD

This study is a literature review that aims to critically analyze recent evidence on the role of revascularization in the management of cardiogenic shock. The research was conducted through a systematic survey of scientific articles in the PubMed database, selecting publications from the last five years. The descriptors used were: "Cardiogenic Shock," "Revascularization," "Treatment," and "Diagnosis," in order to identify relevant and up-to-date studies on the topic.

In addition, the screening of studies followed the PRISMA guidelines for systematic reviews, ensuring greater transparency and reproducibility of the selection process. The critical evaluation of the included articles considered the methodological design, sample size, patient follow-up, and statistical robustness, giving greater weight to level A evidence, as classified by the European Society of Cardiology guidelines (Thiele et al., 2021). This approach sought to minimize bias and ensure that conclusions were based on high-quality scientific data.

Full-text articles addressing the relationship between revascularization (percutaneous or surgical) and clinical outcomes in cardiogenic shock were included, with priority given to clinical trials, systematic reviews, robust observational studies, and clinical guidelines. Duplicate studies, articles outside the scope of the proposed topic, and publications not indexed in the PubMed database were excluded.

RESULTS AND DISCUSSION

Most patients with acute myocardial infarction complicated by cardiogenic shock (AMI-CS) have multivessel coronary artery disease, with estimates pointing to more than 70% of cases. However, less than 4% of these patients undergo emergency coronary artery bypass grafting, which highlights a significant disparity between the prevalence of the condition and the application of the corresponding surgical therapy. Observational studies indicate that percutaneous coronary intervention (PCI) and CABG have similar mortality rates in the context of AMI-CS, although the number of direct comparative evidence is still limited. (Tehrani et al., 2020)

The randomized clinical trial CULPRIT--SHOCK represented an important milestone in understanding the management of revascularization in AMI-CS. Its results demonstrated that the strategy of exclusive revascularization of the culprit artery was associated with lower rates of death and need for renal

replacement therapy at 30 days, when compared to immediate multivessel PCI. (Thiele et al., 2021) The composite event rate in the culprit lesion group was 45.9%, compared with 55.4% in the multivessel PCI group, with a significant reduction in mortality (RR 0.83; 95% CI: 0.71–0.96; p = 0.01).

In addition, subanalyses of contemporary clinical registries, such as the National Cardiogenic Shock Initiative, have demonstrated that when mechanical circulatory support (MCS) is implanted prior to reperfusion, clinical outcomes—such as mortality, acute kidney injury, and length of hospital stay—are similar between culprit lesion and multivessel revascularization strategies, suggesting the feasibility of the comprehensive approach in well-controlled settings. (Tehrani et al., 2020)

Early revascularization has established itself as an essential strategy in the management of cardiogenic shock secondary to acute myocardial infarction. Although current guidelines recommend rapid revascularization by PCI or CABG, depending on coronary anatomy and response to initial intervention (Thiele et al., 2021), there is still debate about the best approach in patients with multivessel disease, a scenario observed in most cases of AMI-CS. The complexity of the clinical picture, combined with hemodynamic instability and high mortality risk, makes decision--making particularly challenging.

Historically, the SHOCK study provided the basis for the recommendation of early revascularization, although it did not achieve significance in reducing 30-day mortality. However, its long-term follow-up data showed significant reductions in mortality at 6 months, 1 year, and up to 6 years after the initial event, reinforcing the importance of early intervention. (Thiele et al., 2021) These findings, corroborated by subsequent clinical records, justify the current Class IB recommendation for early revascularization.

The main recent contribution to defining the therapeutic approach came from the CULPRIT-SHOCK study, which demonstrated the superiority of PCI limited to the culprit lesion, especially in composite outcomes of mortality and need for renal replacement therapy. It is important to note that many patients in the culprit lesion group subsequently underwent staged revascularization after clinical stabilization, suggesting that a two-step approach may offer a balance between immediate safety and long-term benefit.

In parallel, data comparing CABG and PCI in the AMI-CS setting are predominantly observational, with no robust evidence clearly favoring one technique over the other. Thus, until randomized clinical trials are completed—such as those currently underway in the US and Germany—the type of revascularization should be individualized based on anatomical, logistical, and clinical factors (Thiele et al., 2021).

Recent multicenter analyses also emphasize that the implementation of institutional protocols for the management of cardiogenic shock, incorporating rapid diagnosis, early revascularization, and mechanical circulatory support when indicated, is associated with reduced in-hospital mortality and improved medium-term outcomes (Tehrani et al., 2020; Crispino et al., 2025). These findings reinforce that the effectiveness of the revascularization strategy does not depend solely on the technique used—PCI or CABG—but on its integration into structured, multidisciplinary care, in which hemodynamic stabilization, pharmacological optimization, and continuous monitoring are essential to maximize clinical benefit.

In summary, current evidence favors an initial strategy of revascularization of the culprit lesion by PCI, with complete revascularization performed in stages after stabilization of the condition. This approach is in line with the recommended practice for patients with

AMI with ST-segment elevation without cardiogenic shock, reflecting a trend toward personalization of the therapeutic approach in AMI-CS. Advances in the use of CMS, such as axial flow support, may further expand the possibilities for safe complete revascularization in this context, opening new perspectives for future studies.

CONCLUSION

The management of cardiogenic shock secondary to acute myocardial infarction remains a highly complex clinical challenge with significant morbidity and mortality. In this scenario, early revascularization, mainly through percutaneous coronary intervention, represents one of the few therapeutic strategies with proven impact on patient survival. Contemporary evidence, especially the CULPRIT-SHOCK study, has brought important advances in defining the safest and most effective approach, consolidating revascularization of the culprit artery as the preferred strategy in the acute phase, with the possibility of complete revascularization at a later time, after hemodynamic stabilization.

Despite advances, significant gaps in knowledge remain, particularly regarding the choice between PCI and CABG in patients with multivessel disease, as well as the ideal role of mechanical circulatory support devices. The paucity of randomized clinical trials with high statistical robustness reinforces the need for new studies to allow the development of guidelines based on solid evidence.

Thus, revascularization in the context of cardiogenic shock should be conducted on an individualized basis, considering the anatomical, clinical, and structural particularities of each patient, as well as the availability of institutional resources. The integration of rapid diagnosis, early therapeutic decision-making, rational use of hemodynamic support, and coordinated multidisciplinary care is essential to optimize outcomes and redefine the prognosis of these patients. The future of CC management depends on the consolidation of well-structured care protocols, supported by high-quality clinical research and constant technological advances in interventional and intensive cardiology.

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