Shock Teams: A Call to Action for the Brazilian Cardiology Community

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Introduction

Despite advances in diagnosis and treatment over the last 30 years, especially in myocardial reperfusion therapies, mortality from cardiogenic shock remains high worldwide, with 50% of cases resulting in adverse outcomes.[1,2] In particular, there has been an increase in the incidence of non-ischemic cardiogenic shock (ie, associated with acute and/or advanced chronic heart failure), which has led to a shift with less patients hospitalized due to acute ischemic syndromes in critical cardiology units..[3,4]

In the last decade, due to persistently high mortality and the complexity of presentation and treatment involved in cardiogenic shock, especially of non-ischemic etiology, some institutions, particularly in the United States, developed process of care to improve outcomes for these patients, resulting in "shock teams", which were based on other successful initiatives to manage critical situations through multidisciplinary teams acting according to systematized protocols, such as rapid response teams, trauma teams, and stroke teams.[5,6]

In Brazil, however, data on cardiogenic shock are scarce and there are no reports of initiatives involving shock teams.[2] The shock team concept which uses a standardized treatment algorithm including team activation criteria and mechanical circulatory support (MCS) based on hemodynamic variables, was studied by Tehrani et al in Virginia, USA.[7] In this study, implementation of this system led to a significant increase in the 30-day survival of cardiogenic shock patients compared to the previous year. The main elements for successful shock teams are early recognition and rapid and coordinated movement by a team that includes interventional cardiologists, advanced heart failure specialists, cardiac surgeons and intensivists.[7,8] The team should focus on quickly classifying the stage of cardiogenic shock and taking appropriate measures to minimize onset of the multiorgan damage spiral over the next few hours. This team requires a recognized leader (referred to in a recent editorial as the "shock doc") who coordinates the team's activities, outlines the treatment goals, and determines the the checkpoints at which the results should be assessed.[9] The shock doc, the first person to be activated when there is a trigger, is responsible for coordinating the other team members and ensuring that treatment is implemented according to protocol, such as scheduling MCS and additional etiologic and prognostic assessments, allocating intensive care beds, and coordinating systematic reassessment of treatment (Central illustration).[9]

In our viewpoint, the first step toward structuring a shock team is the institutional perception of the topic's relevance and prioritize cardiogenic shock care institutionally. Institutional leadership must endorse the allocation of staff, time, and resources necessary to implement this initiative. This represents a *sine qua non* condition for subsequent development of a treatment algorithm that defines the role of each of each agent in the process of care. In order to achieve better outcomes, it is critical that team members are willing to work in a patient-centered strategy.[10]

In the shock team's algorithm, certain basic assumptions should be clear and prioritized: rapid identification and stratification of shock, mandatory hemodynamic monitoring, minimized use of vasopressors, and early use of MCS.[7] Easy-to-understand outcome definitions should be determined. Simple and uniform language for cardiogenic shock staging can help determine goals and standardize scientific communication. Recently, the Society for Cardiovascular Angiography and Interventions suggested a 5-stage classification system for cardiogenic shock (A-E) that has been increasingly used and has high prognostic impact.[11]

Hemodynamic monitoring in cardiogenic shock

In contemporary cardiogenic shock treatment, it is essential to recognize the role of invasive hemodynamic monitoring, which provides data to support bedside decision-making. In fact, routine early invasive hemodynamic monitoring in cardiogenic shock with a pulmonary artery catheter can help the team identify early cardiogenic shock, classify myocardial dysfunction as uni- or biventricular, adjust therapy according to the predominant hemodynamic profile, objectively assess the hemodynamic response to treatment, and escalate or de-escalate MCS levels.[12] The increasing use of this tool in cardiogenic shock seems associated with the increasing use of MCS, although its relevance as a prognostic tool has also been reinforced by measuring variables indicative of left and/or right ventricular dysfunction.[13,14]

Mechanical circulatory support in cardiogenic shock

The early use of MCS devices, such as intra-aortic balloon pump, extracorporeal membrane oxygenation (ECMO), and Impella devices, has been associated with better outcomes in cardiogenic shock.[7] However, best results depend on quick proactive decision-making, in which the shock team plays a fundamental role. Institutions must go beyond the basic training necessary to use MCS and develop expertise with

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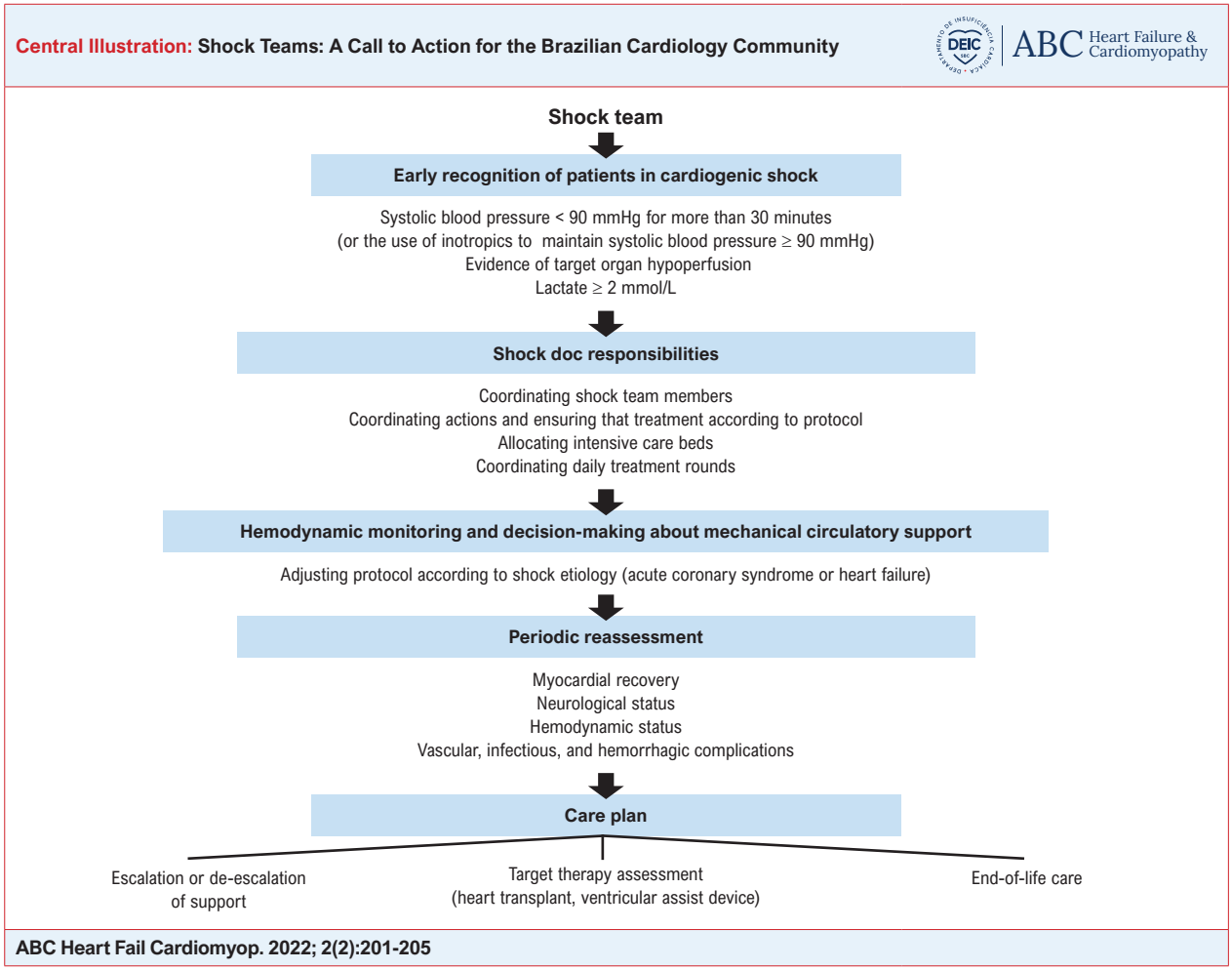

Central illustration – *A shock team based strategy to manage cardiogenic shock.*

these technologies. In Brazil, not many centers have different circulatory devices on the shelf, with the only one available in the Brazilian Unified Health System being the intra-aortic balloon pump. However, centers in different parts of the world have led initiatives to reduce cardiogenic shock mortality through veno-arterial ECMO (VA-ECMO) and Impella devices, especially the latter in cases of shock associated with acute myocardial infarction.[15]

In Brazil, few reports have been published on experiences with VA-ECMO and Impella in the context of cardiogenic shock, which might reflect the difficulties that both public and private institutions have in obtaining this technology. The most recent data on cardiogenic shock in our country came from a multicenter prospective cohort funded by a philanthropic project that provided training and implementation of MCS in the public sector. This study evaluated 49 patients treated with MCS, either ECMO (71%) or Impella (29 %), between 2018 and 2020.[2] The main causes of cardiogenic shock were acute myocardial infarction (45%) and decompensated heart failure (20%), with an overall mortality of 61%. Despite the high rate of deaths and complications, there was a progressive improvement in outcomes over the two years of study (83% vs 40% mortality, $p = 0.002$), which suggests that improvement in MCS results involves a learning curve.[2]

Experience with cardiogenic shock teams

Key studies have been published recently by centers that implemented shock teams (Table 1). Although none of these were clinical trials, the data demonstrated that working in a team led to better outcomes in patients with cardiogenic shock, regardless of ischemic or non-ischemic etiology.[7,16-19]

Challenges to implementing a cardiogenic shock team

Among the numerous challenges to implement a cardiogenic shock team, the first one is to make it clear that systematized shock management remains an unmet need. After this, creating a team requires recruiting personnel with expertise in critical cardiac patients who are full-time available, either virtually or in person. It is equally important to ensure periodic training and protocol review, especially at institutions that have a low volume of patients with cardiogenic shock. Naturally, these training sessions should include other relevant personnel, eg, intensive care unit nurses and nurse

technicians, perfusionists, and respiratory therapists. In Brazil, teams working in cardiac intensive care units must be restructured according to the growing new profile of critical cardiac patients, uniting these professionals to jointly define action strategies and recognize the shock doc as the central figure in this process.[10] Finally, it would be desirable to plan shock care as a hub-and-spoke model in the health system network, with a resourse-hierarchy among institutions. Those with the infrastructure and trained personnel to implement MCS or other advanced therapies would be designated as hubs, receiving cases that were initially evaluated and treated at spokes, ie, institutions with fewer resources.[15] Such a strategy could save both material and human resources, leading to better outcomes.

Conclusions and outlook for Brazil

Improving cardiogenic shock outcomes is a common goal in many regions of the world. However, to move forward with such projects in Brazil, it is critical to have a broader and deeper knowledge of national cardiogenic shock data. As an initial step, it would be strategic for each large public or private institution to register its cases of cardiogenic shock, ideally discriminating between ischemic (post-infarction) and non-ischemic origin. Next, ongoing processes of cardiogenic shock treatment must be identified, including points for improvement, establishing an institutional protocol that can be implemented and monitored with universally accepted metrics. Successful creation of a cardiogenic shock team requires institutional support and recognition of the players involved. It can only happen after thorough planning based on data that accurately reflect the local conditions of each institution. As part of this design, there is a pressing need to expand access to advanced MCS technologies in order to align national policy with international best practice and achieve improvement in cardiogenic shock outcomes. Finally, a joint initiative involving the Brazilian Society of Cardiology's Department of Heart Failure to create a national cardiogenic shock registry would be most opportune, providing data to improve the entire care process for this serious and challenging clinical condition.

Author Contributions

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Table 1 – Experience with cardiogenic shock teams in the literature

Authors, year, institution	N	Shock etiology	Mechanical circulatory support	Study design	Outcome
Basir et al., 2019[18] Multicentric	171	Only patients with AMI who underwent percutaneous revascularization	100%	Prospective	72% survival to hospital discharge in patients treated by shock protocol
Tehrani et al., 2019[7] INOVA Heart and Vascular Institute	204	40% secondary to AMI and 60% to other causes	64%	Observational, prospective	Mortality reduction after implementing structured protocol and shock team. 30-day survival: 43% vs. 57.9% pre- vs. post-implementation. 1-year survival: 76.6%.
Taleb et al., 2019[19] University of Utah	244	65% secondary to AMI and 35% to other causes	100%	Retrospective, prospective	30-day mortality reduction in patients treated by shock team (HR 0.61; 95% CI 0.41–0.93; p=0.02)
Lee et al., 2020[16] University of Ottawa Heart Institute	100	13% secondary to AMI and 87% to other causes	39%	Retrospective	Mortality reduction among patients treated by shock protocol in median follow-up of 240 days (HR 0.50; 95% CI, 0.28-0.99; p = 0.03)
Papolos et al., 2021[17] Multicentric[2]	1.242	27% secondary to AMI and 73% to other causes	40%	Retrospective	Mortality reduction among patients admitted to centers with shock team (OR 0.72 95%; CI 0.55-0.94; p = 0.016)

AMI: acute myocardial infarction; CI: confidence interval; HR: hazard ratio; OR: odds ratio. [1] American hospitals participating in the National Cardiogenic Shock Initiative*. [2] American hospitals participating in the Critical Care Cardiology Trials Network.*

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