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EDITOR'S NOTE

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Greetings dear Readers,

At the outset I would like to express my gratitude to Dr Kanwar and Dr Madgula for consenting to be guest authors for this issue of The Revival. They have through a case illustration highlighted the fact that higher mortality was seen in patients with acute myocardial infarction related shock and heart failure related shock. The application of SCAI Stage E (A) that is diagnosis of ACS related Cardiogenic Shock to this patient underlined the upgradation in urgency of management and institution of VA ECMO and swift resuscitation.

Dr Kanwar and Dr Madgula have made a valid point that effective management of Cardiogenic Shock requires a robust institutional framework and interconnectedness to identify, escalate and treat patients in a timely manner to get optimum results. They have proposed the development of Regional CS teams who will implement these strategies to achieve best outcomes for the patients.

I thank our guest authors for their valuable insights and increasing our scope of knowledge on the management of CS. On behalf of our Editorial team, I wish our dear Readers a Happy Reading!

Dr Manoj Durairaj
Editor "The Revival"

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Dear Colleagues,

This issue of REVIVAL features an excellent overview on the updated cardiogenic shock classification by two US-based heart failure and transplant cardiologists. As part of the innovative and revolutionary Cardiogenic Shock Working Group, Dr Kanwar and her team based in Pittsburgh have published extensively on this topic over the past 2-3 years. We are privileged to have this excellent review especially intended for our REVIVAL readers. Cardiogenic shock is a dynamic field requiring contributions from all cardiac specialties, surgeons, interventionalists, imaging specialists and intensivists to achieve desired outcomes. Such case-based examples are a testament to this fact.

Sincerely,
Dr Talha Meeran
Sub Editor "The Revival"

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Special thanks to Dr Anantha S. Madgula and Dr Manreet K. Kanwar for authoring this month's article.

Designed by Maithili Kulkarni

PRESIDENTIAL MESSAGE

Dr. Julius Punnen

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Dear members of SfHFT,

The case shown by Drs Madgula and Kanwar illustrates the importance of the early use of temporary mechanical support in Cardiogenic shock. In this case, the need for MCS was more obvious, being SCAI Stage E Cardiogenic Shock. ECMO was appropriately initiated before angiogram or PCI and in addition, LV Venting was also achieved. The 2022 SCAI classification has very clear and easy recommendations for stratification of cardiogenic shock.

Sometimes there is a hesitancy among treating physicians to institute temporary mechanical support and there is a tendency towards increasing the dose and number of vasoactive agents. It is well known that higher number and dose of these medications correlates with mortality up to 80%. In our country, ECMO remains a surgeon driven program and very few cardiologists like to use it in patients with acute myocardial infarction undergoing emergent PCI. Though the number of such cardiologists are increasing, everyone who does emergent PCI should also be able to do peripheral ECMO with some venting strategy included. There seems less reluctance for use of Impella® 2.5 hopefully this will lead to better utilization of appropriate temporary mechanical circulatory support. Over time, more choices for temporary mechanical supports may become available, making the choice of the right device for the right situation more critical. Surely, skills for percutaneous cannulation of peripheral vessels are easier for cardiologists than surgeons and since one is in the cardiac catheterization laboratory, imaging is also readily available making accurate placement of cannulas possible. Given the expertise in mitral valve interventions, septal puncture and placing either the end holes of the multi-holed drainage cannula in the left atrium across a septal puncture dilated with a TYSHAK® balloon or if placing after ECMO is initiated, by placing an additional cannula across the septum connected to the drainage line. Adding an Impella to an ECMO circuit is a good option for venting the LV if it wasn't for the prohibitive costs involved in comparison to a surgically placed LV vent.

Mechanical circulatory support is expensive and many times the hesitancy to use these are related to recommending expensive forms of therapy in the face of high possibility of the exercise being futile, given the high mortality of cardiogenic shock. In some instances, a small increase in cardiac index may suffice to tide over this crisis and IABP might be sufficient to provide that. If one thinks of cost in Rupees per liter of increased output, surely IABP will score higher than most other forms of mechanical supports and this may be the reason apart from ease of use why this is the most frequently used support despite negative trial results.

There is also reluctance in using hemodynamic monitoring with a continuous cardiac output monitor in patients with cardiogenic shock. General intensive care physicians who deal with non-cardiac patients have found it unnecessary to use hemodynamic monitoring in their patients. However, this cannot be extrapolated to cardiac patients in general who are in low cardiac output and cardiogenic shock in particular. Hemodynamic monitoring gives invaluable information about the state of the circulation and the SCAI classification takes cardiac index and PCWP also into consideration. Early use of hemodynamic monitoring can help the clinician to take action even before the blood pressure is affected and as the patient is deteriorating in terms of values measured on hemodynamic monitoring, institute mechanical support early giving a higher chance of survival. As we know, in profound shock lasting for longer, there is a dissociation of the micro and macro circulation and we can only address macrocirculation with even the most sophisticated devices, once this dissociation occurs it will not help in addressing the microcirculation which is what determines tissue perfusion. Once more commonly applicable tools to measure microcirculation reliably becomes available that also may help us take timely action in treating cardiogenic shock which unfortunately continues to carry a high mortality despite all the advances in care.

Once again, I thank the authors for highlighting an important and practical classification of cardiogenic shock and illustrating that with a well-managed case who was in extremis with very little chance of survival in the absence of timely appropriate action.

With warm regards,

Julius Punnen

President, Society for Heart Failure and Transplantation

ADVANCEMENTS IN THE CLASSIFICATION OF CARDIOGENIC SHOCK

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Introduction

Cardiogenic shock (CS), a life-threatening condition resulting from severe cardiac dysfunction, necessitates accurate classification and timely intervention for improved patient outcomes. Initially, the Society for Cardiovascular Angiography and Interventions (SCAI) proposed a five-stage classification in 2019, which laid the foundation for subsequent studies and risk stratification[1]. (Figure) However, subjectivity in interpreting these stages led to heterogeneity among studies[2-5]. To address this limitation, an update was released in 2022, providing a more granular classification and incorporating objective parameters[2]. The following case will provide an illustrative scaffolding into the diagnosis and management of CS.

Case presentation:

A 55-year-old female with history of coronary artery disease with prior percutaneous coronary intervention to her left circumflex artery and normal baseline LV systolic function presented to the emergency room via EMS. She was at an outdoor event when she developed sudden onset pain in her chest, radiating to her jaw, shortly followed by syncope. Her rhythm was identified as ventricular fibrillation (VF). Return of spontaneous circulation was initially achieved with defibrillation, however, enroute to the hospital she had multiple more episodes of VF. She was resuscitated in the emergency room and placed on mechanical circulatory support with veno-arterial extracorporeal membranous oxygenation (ECMO) for SCAI Stage E CS. Electrocardiogram showed ST elevations in inferior leads. She was emergently taken to the cardiac catheterization lab and underwent percutaneous intervention to her right coronary artery. An intra-aortic balloon pump was placed for LV venting, and she was admitted to our

cardiac surgical intensive care unit. She was decannulated from ECMO on day 5 and subsequently discharged after a prolonged recovery in the hospital.

Discussion:

The SCAI classification separates CS into five stages, ranging from SCAI Stage A, which included patients at risk for the development of CS, such as those with acute myocardial infarction or acute and/or acute on chronic heart failure symptoms to SCAI Stage E included patients in an "Extremis" state, characterized by circulatory collapse and often refractory cardiac arrest with ongoing cardiopulmonary resuscitation. While this classification provided a much-needed framework, the interpretation of these stages varied subjectively, resulting in heterogeneous classification of patients across studies[2-5]. The National Cardiogenic Shock Initiative identified on retrospective analysis that SCAI shock stage at admission and at 24 hours was associated with strong association with mortality at both time points[6]. A prospective study then identified that an elevate SCAI shock stage was associated with worse outcomes[7].

To address the subjectivity limitation in SCAI staging, an update was released in 2022, providing a more granular classification based on expert consensus illustrated in figures 1 and 2 [2]. The 2022 SCAI update divides CS into five stages. Stage A includes hemodynamically stable patients who are not experiencing signs or symptoms of cardiogenic shock but are at risk for its development. Stage B encompasses patients with clinical evidence of hemodynamic instability, such as hypotension, tachycardia, or abnormal systemic hemodynamics, without evidence of hypoperfusion. Stage C comprises patients with clinical evidence of hypoperfusion requiring mechanical or pharmacological support. Stage D includes patients with clinical evidence of shock that fails to improve or worsens despite escalated therapy. Finally, Stage E encompasses patients with refractory or imminent circulatory collapse. Additionally, an 'arrest modifier' was introduced for patients with cardiac arrest and concern for anoxic brain injury. The update also provides physical exam findings, laboratory results, including expected lactate levels, creatinine changes, liver function, blood pressure, and certain invasive hemodynamic parameters. Furthermore, the update proposes a 3-axis model for evaluating and prognosticating cardiogenic shock, incorporating shock severity, phenotyping, and identifying etiology, as well as considering risk modifiers such as age, cardiac arrest, systemic inflammatory response, and frailty [2].

In order to provide a more objective assessment of the various SCAI stages, the Cardiogenic Shock Working Group proposed criteria in 2022[8]. Parameters for hypotension, hypoperfusion, and treatment intensity were defined and their association with mortality was confirmed. Formal criteria were then proposed for each SCAI stage, and their association with mortality was verified[8]. It was also identified that the maximum shock stage during admission found higher mortality with higher shock stage in patients with acute myocardial infarction related shock and heart failure related shock[9].

Our patient presented with out-of-hospital cardiac arrest and was promptly identified to be in SCAI stage E shock, indicating the severity of her condition. Due to her out of hospital cardiac arrest and ongoing CPR at admission, the arrest modifier was

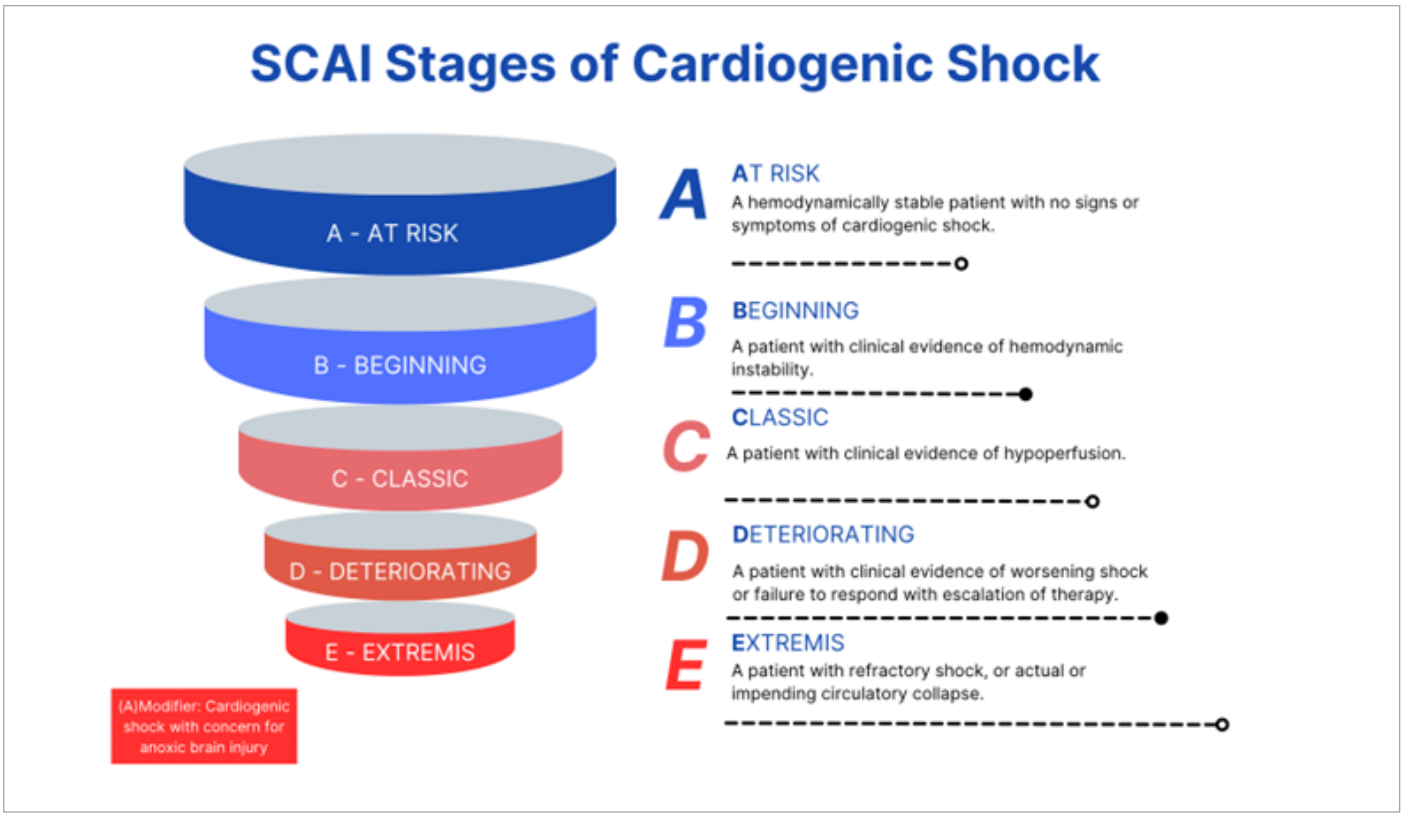

Figure 1: Updated SCAI Shock Stages – adapted from Naidu, S. S., et al. (2022). "SCAI SHOCK Stage Classification Expert Consensus Update: A Review and Incorporation of Validation Studies." Journal of the American College of Cardiology 79(9): 933-946.

applied giving her SCAI stage E(A). The patient's diagnosis of ACS-related cardiogenic shock further emphasized the urgency of her management. The reported in-hospital mortality rate of 80% in patients with ACS-related SCAI stage E shock at admission heightened the significance of the case [4]. Given the gravity of the patient's prognosis, a swift decision was made to escalate support to VA ECMO. This approach successfully salvaged the patient and provided us with the necessary time to proceed to the cardiac catheterization lab.

While significant advances have been made in identifying and staging CS, the effective management requires a robust institutional framework and interconnectedness to identify, escalate, and treat patients in a timely manner. One promising intervention is the development of regional CS teams. Although the concept has shown some effectiveness, its widespread utilization remains limited due to the resource-intensive nature of implementation[10]. Another development aimed at increasing accessibility to this information is the creation of a mobile phone application that eliminates the need to search for or memorize parameters, which may not be feasible. Future steps could involve implementing automatic screening of all hospitalized patients using electronic health records to identify CS patients with high sensitivity, thereby reducing reliance on individual assessments and potentially being implemented at a healthcare system level.

In conclusion, although significant progress has been made in the field of CS, there remains a compelling need for further advancements. The implementation of SCAI staging as a routine tool in daily practice holds immense promise for improving the care of CS patients. The updated SCAI shock stages exhibit strong prognostic capabilities at 24 hours post-admission, emphasizing the crucial importance of regular reassessment throughout the patients' hospital stay [11]. By bridging the gap between guidelines and bedside application, we can effectively enhance patient outcomes and pave the way for a more comprehensive approach to managing CS.

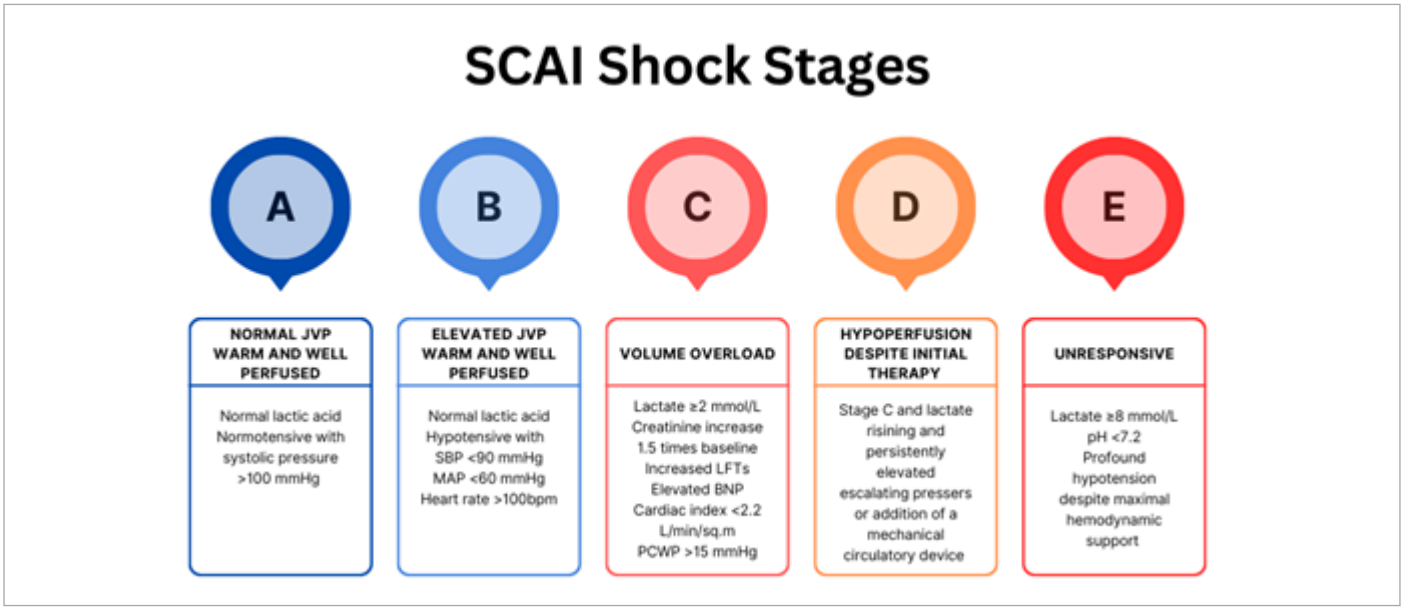

Figure 2: SCAI Shock Stages adapted from Naidu, S. S., et al. (2022). "SCAI SHOCK Stage Classification Expert Consensus Update: A Review and Incorporation of Validation Studies." Journal of the American College of Cardiology 79(9): 933-946.

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