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Editorial

Critical care networks for the treatment of cardiogenic shock. Where and how should the shock code be implemented?

Redes asistenciales para el tratamiento del *shock* cardiogénico. Código *shock*. ¿Dónde y cómo implementarlo?

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Cardiogenic shock (CS) remains the leading cause of death among patients admitted to hospital with acute myocardial infarction (AMI). The incidence of CS is currently estimated at between 3% and 13%,[1,2] and mortality remains very high (40%-50%) despite attempts to improve medical treatment and the development of new ventricular and circulatory assist devices.[3] Various definitions of SC have been used over the years, the most widely accepted perhaps being that provided in the latest European Society of Cardiology guidelines on heart failure.[4] These guidelines define CS as severe heart failure featuring hypotension despite adequate filling status (systolic blood pressure < 90 mmHg) together with clinical or analytical signs of hypoperfusion (eg, cold sweaty extremities, oliguria, elevated serum lactate).[4] Although further confirmation is not obligatory in clinical practice, it can be useful to support diagnosis with hemodynamic parameters, such as a reduced cardiac index or elevated pulmonary capillary wedge pressure. However, these parameters cannot be applied generally because they exclude some types of CS, such as those principally affecting the right ventricle. Unfortunately, a major drawback of the ESC definition is that it includes patients with widely varying disease severity (from those who respond to low-dose inotropic treatment to those requiring a ventricular-assist device). This patient heterogeneity likely underlies the failure of clinical trials to demonstrate a clear survival benefit for the various treatments for CS that have been used and tested over the years. The need for a better classification of CS is addressed in a recently proposed grading scale that more precisely stratifies the disease severity seen in CS patients. Based on the INTERMACS scale for the use of ventricular-assist devices in heart failure,[5] the new scale classifies CS patients into 5 disease stages (A to E) covering the whole spectrum of CS severity.[6] The new scale will allow better differentiation of CS patients, as well as the development of treatments tailored to different grades of disease severity.

The precise incidence of CS after AMI in Spain in not known, but the rate can be reliably estimated from periodically published well-designed multicenter registries.[7,8] The latest of these registries is DIOCLES, compiled in 2012. The DIOCLES study estimated CS incidence among patients with ST-segment elevation acute coronary syndrome (STEACS) at 8.7%.[8] Unfortunately, no further registry reports have been published since then, and there are therefore no available data on the impact of the many recent developments in Spain related to the treatment of acute ischemia patients. These developments include the establishment of programs for STEACS treatment in Spanish autonomous communities, the expansion of catheterization labs, and the advent and use of new ventricular-assist devices in CS patients.

An attempt to fill this gap comes in a recent article published in the *Revista Española de Cardiología* by Sánchez-Salado et al.[9] The authors conducted a retrospective analysis of a multicenter cohort selected from the Spanish National Health System (NHS) Minimum Data Set. The study examined data on patients with a diagnosis of STEACS-related CS between 2003 and 2015. A total of 331 193 eligible STEACS episodes were identified, of which 19 963 (6.03%) were linked to CS. The study provides important information about how the treatment of CS secondary to AMI has changed in the last decade, with a focus on how treatment varies according to the type of hospital. One of the most encouraging findings is the general decline in mortality over this period, from 82% in 2003 to 67% in 2015. A major contributing factor here has been the increased use of coronary revascularization, especially via percutaneous access, which increased from 19.2% to 59.5% over the same period. Indeed, the study shows that coronary revascularization is the treatment most strongly associated with improved prognosis of CS patients (odds ratio = 0.29; 95% confidence interval, 0.26-0.32).

Without question, another standout finding of the study is the better prognosis of patients treated at centers with a cardiac intensive care unit run by the cardiology service. Sánchez-Salado et al. argue that centralizing the care of CS patients in high-volume centers can reduce mortality, and their position is supported by the data they present, which show an almost 7-point reduction in adjusted mortality compared with admissions to centers where intensive care is not dependent on the cardiology service ($65.3\% \pm 7.9\%$ vs $72\% \pm 11.7\%$; $P < .001$). The study by Sánchez-Salado et al. is rigorous, and its main strength is the large sample size achieved by analyzing the NHS Minimum Data Set. This resource contains information on all patients treated at NHS-affiliated public hospitals (irrespective of survival), thus covering 98.4% of the Spanish population.

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From an organizational standpoint, it seems rational to assign the care of cardiac patients to the same hospital service throughout their stay; such a strategy is likely to ensure better continuity of care and avoid delays and repeat examinations, thus maximizing patient safety and organizational efficiency. This view is supported by RECALCAR registry data from 2012, which recorded lower overall mortality in intensive care units run by the cardiology service than in units without cardiologist input.[10] Despite this evidence, the number of intensive care units run by cardiology services has not increased in Spain to the same extent as in other developed countries. The first coronary units were described by Julian and Wilburne in 1961,[11,12] and the development of modern cardiac intensive care units since then has led to major changes in the care of unstable cardiac patients. The first cardiac intensive care units were created to provide care for the specific subset of AMI patients with potentially fatal arrhythmias.[11,12] These early coronary units focused on 2 key priorities: continuous electrocardiographic monitoring and staffing by physicians and nurses with expertise in cardiopulmonary resuscitation. Over the course of a few years, this centralization of AMI patient care increased understanding of the pathophysiology of ischemic heart disease and facilitated research into drugs and other treatments that markedly reduced morbidity and mortality. The subsequent development of these units has closely tracked the introduction of new treatments for acute ischemia, and the initial focus has now been expanded to include the care of all patients with unstable cardiovascular disease.[13]

The more favorable prognosis of intensive care patients who are treated by cardiologists is likely due to several factors. One is that specialization in cardiology provides extensive knowledge of cardiovascular pathophysiology. Another is that cardiologists have more experience and expertise in the treatment and progression of the various cardiovascular disorders. In addition, it is cardiologists who carry out most of the diagnostic and interventional techniques required by cardiology patients (eg, pacemaker implantation, pericardiocentesis, percutaneous intervention, echocardiography). However, it is not a practical proposition for all cardiology services to run a dedicated cardiac intensive care unit, and this is especially the case of services at small hospitals with a limited staff roster. In this situation, it is therefore necessary to form the aptly named 'multidisciplinary teams'.

One key measure toward improving coordination at such centers is to assign a cardiologist to the intensive care unit. By playing a central role in decision-making and carrying out any necessary complementary examinations, this team member can definitely improve patient treatment.

Another way to support smaller centers would be to implement a 'shock code' program. In the past decade, the expansion in the use of revascularization throughout Spain has been accompanied by the establishment of 'infarction code' programs in the various autonomous communities for the early treatment of acute ischemia patients. This has allowed the centralization of patient care in large hospitals with a round-the-clock primary angioplasty service. Given the success of care networks in improving the prognosis of patients with STEACS, it is reasonable to suppose that networks for the treatment of CS would have a similarly positive impact.[14] This proposition is based on the complexity of the approach required for these patients, including the need for specially trained staff and specialized medical technology, a situation that greatly increases health care costs and is associated with a high rate of complications. If we are to establish CS care networks, we will therefore first need to take an honest look at past mistakes in the organization of patient care and treatment.

The drive to make technical advances available to the whole population has resulted in many hospitals being equipped to carry out most interventions. The availability of treatments close to home is certainly convenient for patients; however, the dispersal of activity among many centers has meant that most hospitals have little accumulated experience. Centralization of complex procedures has been shown to improve outcomes of all types of medical procedures and should be promoted by health care authorities. This applies equally to the treatment of CS, the Achilles heel in the care of patients with advanced heart disease; centralizing the treatment of these patients in high-volume centers will reduce costs and improve prognosis. Achieving this will require the organization of safe interhospital patient transfer, as well as help for families with accommodation and transport from their hometowns to the referral center. Any program for the interhospital transfer of unstable patients needs to minimize the significant morbidity and mortality risk this entails. In recent years, several health care authorities have improved patient survival by establishing mobile teams that travel to the first admission hospital to connect the patient to an extracorporeal membrane oxygenation (ECMO) cardiopulmonary support device before transfer to the referral center.[15] ECMO equipment should therefore occupy a central place in the organization of an agile shock code program, as part of the drive to prioritize early treatment of CS patients and their safe transfer to the referral center.

To conclude, we need to remain focused on the reality that CS is a disease with a high mortality rate. The creation of care networks to centralize the treatment of these patients should be consolidated as a national strategy because concentrating the unavoidably complex treatment of CS patients in high-volume centers will reduce complications and improve outcomes. The published literature shows that the cardiology service should be the cornerstone of the treatment of CS patients across the spectrum of the disease.

CONFLICTS OF INTEREST

None declared.

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