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Editorial

Improving the Initial Prediction of Prognosis in Survivors of an Out-of-hospital Cardiac Arrest

Hacia una mejor predicción inicial del pronóstico de los supervivientes a una parada cardiaca extrahospitalaria

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INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is a leading cause of mortality.[1,2] It is defined as the loss of mechanical cardiac function and the absence of systemic circulation that occurs outside hospital. In Western countries, there is an average of 49 OHCA per 100 000 persons/y with an average survival rate at discharge of 6.7%.[3]

OHCA may have a cardiac or noncardiac origin.[4] OHCAs of cardiac origin are usually triggered by atherosclerotic plaque rupture leading to complete occlusion or by the cracking, fragmentation, or embolization of thrombotic material.[5] More than 80% of individuals who experience sudden cardiac death have an underlying coronary disease, whose prevalence increases with age and is more common in men.

In OHCA survivors, initial systemic ischemia and subsequent reperfusion give rise to a process known as "postcardiac arrest syndrome".[6] This complex process has 4 main components: brain injury, myocardial dysfunction, systemic ischemia, and reperfusion response. Despite the significant development of out-of-hospital emergency services and decreasing response times, the prognosis of OHCA patients remains dismal. When cardiopulmonary resuscitation (CPR) is initiated, survival rates range from 1% to 30% depending on the country, city, and scenario analyzed (urban or rural).[7] In Spain, the estimated survival rate of OHCA patients who undergo CPR is 13%. Of these, 25% survive with neurological sequelae of varying severity.[8] The first documented cardiac arrest rhythm has predictive power. The 30-day incidence of death or unfavorable neurological outcome in OHCA patients with defibrillable arrhythmias (tachycardia or initial ventricular fibrillation) and nondefibrillable arrhythmias is 36% to 47% and 86% to 89%, respectively.[9] From the first day onward, the main cause of death of resuscitated OHCA patients is withdrawal of care due to suspicion or certainty of severe neurological damage.

In this scenario, one of the most pressing issues for relatives and health care workers is to quickly obtain reliable information on the probability of obtaining a satisfactory neurological outcome. From the time of admission, concerns are focused on the possible risk of survival with major irreversible neurological sequelae or limiting the therapeutic effort in patients who could survive with a good quality of life. In addition to the suffering of their families, the treatment of these patients has a marked impact on the health care resource use (long stays in critical units, expensive procedures, and the intervention of multiple specialists in their care). This aspect could be avoided by concentrating therapeutic efforts on viable patients rather than on nonviable patients. Unfortunately, no single clinical finding, test or protocol is sufficiently accurate to determine the neurological prognosis of all OHCA patients. Early information on a high probability of poor prognosis can sometimes lead to a "self-fulfilling prophecy", in that treatments are stopped, which inexorably precipitates a bad outcome. Therefore, it is crucial to reach an initial valid neurological prognosis.[10]

INITIAL TREATMENT AND ASSESSMENT OF OHCA SURVIVORS

The first approach to an OHCA patient should be to optimize the quality of resuscitation by providing any complementary and necessary approach to reduce mortality.[3] Initial treatment comprises resuscitation measures performed by medical staff, who must follow a series of treatment algorithms,[10–13] provide optimal airway maintenance, and administer appropriate medication. After resuscitation and arrival at hospital, the first priority should be to implement circulatory, respiratory, and temperature treatment measures. The initial approach should include sedation, intubation, and hemodynamic stabilization, and achieving a target temperature as early as possible. Oxygen concentrations must be managed to achieve an arterial blood saturation of 94% to 98%. Shock is very common in the postresuscitation period, and so the most appropriate treatment measures (eg, fluids, norepinephrine, and dobutamine) should be initially implemented. One of the most important aspects in neuroprotection is temperature control, because it can suppress pathways that may lead to late cell death and decrease cerebral metabolism, thus reducing the release of excitatory amino acids and free radicals.[12] Moderate hypothermia can have neuroprotective effects in patients with OHCA caused by ventricular arrhythmias who become unconscious after the return of spontaneous circulation (ROSC).[14] This approach can even be used in cardiac arrest survivors with initial rhythms that cannot be defibrillated.[15] The target temperature should be between 32 °C and 36 °C and should be maintained for at least 24 hours, especially

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in patients who remain comatose after OHCA with an initial shockable rhythm.

The most common cause of OHCA in adults who survive with ROSC is coronary disease, which should be assessed as soon as possible with ECG and echocardiography. All patients with ST-segment elevation on ECG should undergo coronary angiography and those without it should also be considered as candidates for the procedure.[16] Patients with acute coronary occlusion should undergo coronary revascularization.

Studies are being conducted on new approaches to this complex group of patients. In OHCA patients without ST-elevation on ECG, randomized studies are underway to compare the use of immediate vs delayed coronary angiograms. Other studies are investigating various optimal hemodynamic scenarios after ROSC, very early hypothermia, and pharmacological neuroprotection.[16] In patients without out-of-hospital ROSC and with factors that may indicate favorable prognosis, studies are also underway on the immediate use of extracorporeal cardiopulmonary circulation via mechanical circulatory support.[16]

PREDICTORS OF PROGNOSIS IN OHCA SURVIVORS

Several studies have described marked variations in mortality and morbidity after OHCA. Although some predictors of prognosis are intuitively obvious, the impact of many other factors has not been sufficiently clarified.[3] Predictive patient and event factors related to different systemic factors or therapeutic aspects have been categorized. Age, different comorbidities, and socioeconomic status have also been identified as relevant predictors of survival.[3] It is well established that an initial defibrillable arrhythmia is an important predictor of survival.[1] However, nondefibrillable rhythms, such as asystole and electromechanical dissociation, are associated with a much higher mortality rate.[1] Survival and neurological function vary according to the severity of the ischemic trigger, the cause of cardiac arrest, out-of-hospital actions, and the patient's state of health before cardiac arrest.[9]

The need to maintain sedation and neuromuscular blockade in OHCA patients decreases the accuracy of the clinical examination and makes it extremely difficult to determine their prognosis in the first moments after resuscitation. Current guidelines emphasize the need to wait for some time after the return to normothermia to assess the likelihood of poor neurological outcome and minimize false-positive rates. Little is known about the prognostic value of the different variables available at the time of hospital admission after resuscitation. In the absence of perfect predictors of prognosis, the timely application of multimodal approaches is needed to assess these patients.

In an article recently published in *Revista Española de Cardiología*, Pérez-castellanos et al.[17] developed and externally validated an early predictive model of long-term prognosis in a series of OHCA survivors. This study included comatose patients admitted after OHCA. It describes a validated predictive model designed with variables obtained at the time of hospital admission to calculate the probability of survival without significant neurological damage at 6 months of follow-up. This prospective multicenter study was conducted in Spain and included consecutive adult OHCA survivors. Two of the participating hospitals (with 153 patients) created the predictive model and a third hospital (with 91 patients) performed an external validation of the model. Patients were treated according to current recommended standards (eg, adequate sedation, hypothermia, mechanical ventilation, pharmacological support, early coronary angiography, and coronary revascularization if indicated). Neurological outcome was assessed using the Pittsburgh Cerebral Performance Category (CPC). The main objective was to determine 6-month survival with favorable neurological outcome defined as CPC 1 (good recovery) or 2 (moderate disability).[17] Unfavorable neurological outcome was defined as CPCs 3, 4, or 5 (severe disability, vegetative state, or death, respectively).

During hospital admission, 53% of the patients died (71% due to postanoxic brain damage, 19% due to cardiogenic shock, and 11% due to other causes). At 6 months of follow-up, 4 more patients died (3%). Regarding neurological outcome at 6 months, 97% of the survivors did not have significant neurological sequelae (CPC 1 or 2). In the study group, 5 variables at admission were independently associated with an unfavorable outcome (death or CPC > 2) at 6 months. The 5 variables were nondefibrillable rhythm, older age, high lactate concentrations, longer time to ROSC, and diabetes mellitus. A scale was designed called SALTED. A predictive model was constructed that, when applied to patients in the validation group, showed an area under the curve of 0.82 (sensitivity 73.5%; specificity 78.6%).[17] Similar results were obtained when the model was recalculated excluding patients with a noncardiac cause of OHCA.

The study identified 5 variables that are easily obtained in the first moments after resuscitation. These 5 variables can be used to estimate the probability of survival without significant neurological damage at 6 months. Different predictive models have been used to assess the prognosis of OHCA patients.[17] In several of the models, the 5 variables have been described jointly or separately as predictors of poor prognosis.[17] However, the study[17] has several positive aspects: recommended measures were used to treat patients after resuscitation, all predictive factors were easily identified at the time of hospital admission, the outcome assessed consisted of mortality and severe neurological damage at 6 months, and the designed predictive model was externally validated. On the other hand, it would be useful to develop a calculator that could be used on mobile devices to estimate the probability of an unfavorable prognosis.

The study has a number of limitations. There were significant differences in the baseline characteristics of the patients in the study group and those in the model validation group. Similar to other studies that have attempted to develop predictive models, it was difficult to obtain the exact time between the moment of cardiac arrest and the start and duration of resuscitation maneuvers, both of which are predictors of subsequent outcome. Likewise, there was a high rate of false-positives, and thus some patients could have been classified as having a poor prognosis, whereas their subsequent outcome could have been favorable. Therefore, these early prediction models should only be used to provide family members with reliable information and to establish the comparative outcomes of OHCA patients in registries or in clinical trials. However, these models should never serve to limit therapeutic effort or to guide specific treatments that may negate effective initial therapies by their being considered unnecessary in these early stages of the process. The decision to limit therapeutic efforts should be delayed for more than 72 hours once normothermia is achieved and an approach is implemented that addresses multiple dimensions.

CONCLUSIONS

The published study was conducted in a group of OHCA survivors. It presents a predictive prognostic model based on a group of clinical variables that are easy to identify at the time of hospital admission. It would be useful to develop a calculator that could be used on mobile devices to estimate the probability of an unfavorable outcome. The model can provide relevant initial and complementary information to assist in the complex decision-making and strategic planning needed when facing the uncertain prognosis of these patients.

CONFLICTS OF INTEREST

None declared.

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