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EDITORIAL COMMENT

Ischemic heart disease management and prognosis: Focus on the details at onset for results in the future

A cicatriz define o prognóstico na cardiomiopatia isquémica: todos os detalhes desde a hora da reperfusão interessam

João Primo

Centro Hospital de Vila Nova de Gaia/Espinho, Vila Nova de Gaia, Portugal

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Early reperfusion is very important to improve the prognosis of patients after acute myocardial infarction (AMI), saving viable tissue and preserving left ventricular function. Primary percutaneous coronary intervention (PCI) was one of the major advances in modern cardiology. However, it also has changed the characteristics of the ventricular scar and of potential post-infarction ventricular tachycardia (VT). Wijnmaalen et al. found that the characteristics of low-voltage scars after myocardial infarction are different in patients with and without reperfusion therapy. Early reperfusion is associated with less dense and fewer confluent electroanatomic scars, and no transmural fibrosis at all, which can give rise to faster spontaneous and inducible VTs. The authors further concluded that the electrophysiological findings matched the histological data, with electroanatomic patchy scar patterns and smaller dense scars corresponding to thick layers of surviving myocardium in early reperfused patients.[1]

We may think that complete revascularization should solve the problem of ischemia per se, sparing left ventricular function and preventing further scar formation and the possibility of intra-fibrotic channels able to maintain re-entrant VTs and result in sudden cardiac death. This goal is very difficult to achieve as it depends on the time between the start of chest pain and direct balloon artery reperfusion, which is dependent on a series of factors.

The coronavirus disease (COVID-19) pandemic has disrupted healthcare around the world. There was a substantial increase in mortality that could not be attributed to COVID-19 deaths alone.[2] For patients suffering from ST-elevation myocardial infarction (STEMI) but not covid itself, current data not only indicate significant reductions in admission rates and catheterization laboratory activation, but also longer delays to reperfusion, which may have contributed to higher mortality during the pandemic.[3] In a very recently published paper, Ivan Lechner et al. analyzed data from the ongoing, prospective MARINA-STEMI cohort study, which includes STEMI patients treated with primary PCI at the Heart Center of Innsbruck. Myocardial damage was evaluated by cardiac magnetic resonance imaging (MRI) in all patients. They compared STEMI patients admitted during the COVID-19 pandemic at a time of major public health restrictions with patients admitted at the same time of the year in the previous years without pandemic restrictions, and they found a significant increase in infarct size suggesting worse short- and long-term outcomes in these patients.[4]

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E-mail address: joaojoseprimo@gmail.com

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We know that the size and complexity of the scar, as well as occurrence of multiple scars after STEMI, as assessed by MRI, impact on the prognosis and are independently associated with an increased risk of death and hospitalization for heart failure (HF) during follow-up.[5]

The implantable cardiac defibrillator (ICD) is a well-established treatment for patients with ischemic heart disease (IHD) and low left ventricular ejection fraction (LVEF).[6] However, there are many gaps in the evidence for its use in patients with IHD and preserved or less reduced ejection fraction. Some of these patients may also benefit from the ICD depending on their overall prognosis and not only their LVEF. ICDs are a very useful tool, but recurrent therapies have been associated with an increase in all-cause mortality, hospitalizations for HF and impaired quality of life.[7] Therefore, preventing ICD shocks, even appropriate ones, is crucial to prevent shock-related morbidity and mortality.

In this issue of the Journal, Gustavo Lima da Silva et al. provide follow-up data on 64 consecutive patients with IHD who were referred to their center for a first radiofrequency catheter ablation (RCA) procedure for VT using high-density mapping.[8] The authors carefully collected data from June 2015 to June 2020, including all consecutive patients with IHD, with or waiting ICD implantation, referred for a first RCA procedure for VT using high-density mapping technology, mainly with CARTO 3 and a 20 electrode PentaRay® catheter (Biosense Webster, almost 80% of cases), but also Ensite Precision and a 16 electrode HDGrid® catheter (Abbot), or Rhythmia and a 64 electrode Intellamap Orion® basket catheter (Boston Scientific). Inclusion criteria were a previous myocardial infarction (MI) or ischemic scar documented on cardiovascular imaging, with sustained monomorphic VT documented on surface electrocardiography or ICD tracings requiring external cardioversion or ICD shock. A history of MI was present in 59 (92%) patients, with a mean time from last MI of almost 11 years.

The objective of this study was to assess the efficiency of substrate mapping ablation based on high-density mapping catheters, so far, the best technology for VT ablation. Therefore, it was reasonable not to have a control group, as the prognosis of such patients without ablation would have been poor (low LVEF, HF, recurrent ICD shocks).

The methods and tools used in this study are the current state-of-the-art. The high-density mapping catheters improve mapping resolution. This is most significant in areas of heterogeneous scar distribution and in close proximity to the recording catheter. In these areas, the small and closely spaced multielectrode bipoles are subject to less tissue averaging effects, allowing detection of surviving myocardial bundles within an area of heterogeneous scar. These catheters also enable us to pace closer to these areas, as the output threshold of multielectrode-mapping catheters within low-voltage areas is lower because of increased electric current density at the electrode–tissue interface. This may be advantageous for pace or entrainment mapping.[9] Local abnormal ventricular activity (LAVA) was defined as sharp high frequency ventricular potentials, distinct from the far-field ventricular electrogram occurring anytime during or after the ventricular electrogram,[10] and were manually annotated on each substrate map. LAVAs were identified in all patients in this study. After substrate mapping, programmed ventricular electrical stimulation from the right ventricle apex was performed. Activation maps of induced VTs were obtained for any hemodynamically stable sustained monomorphic VT. Whenever possible, the VT protected isthmus location was confirmed by entrainment techniques, and the VT exit point was confirmed by pace-mapping. Modern tools that help us when performing substrate mapping were used, including: Ripple mapping®, SparkleMap® and Lumipoint®. They were employed as adjunctive mapping tools to improve the visualization of the scar channels, when the CARTO 3, Ensite Precision or Rhythmia EAM systems were used, respectively.

The secret of successful ablation is detailed and sometimes repeated mapping. The authors preferred initially to perform ablation of the protected isthmus in the presence of sustained and tolerated monomorphic VT circuits, followed by other regions with LAVAs. In case of non-inducible or hemodynamically non-tolerated VT, regions with LAVAs were ablated.

The results were quite good: The endpoint of LAVA elimination was achieved in 93.8% of patients and was effective for arrythmia control. After a single RCA procedure, 90% of patients were free from appropriate ICD shocks at 1one year, with the success rate slightly decreasing to 85% at two years. The first appropriate ICD shock occurred at a median of eight months following the first procedure but, in 27% of patients, it only occurred after three years. Also, the proportion of patients experiencing VT storm decreased from 39% to 1.6%. Overall survival was 89% and 84% at one and two years, respectively, with most deaths related to advanced HF.[8]

Coronary care units developed in the 1960s when it became clear that close monitoring by specially trained staff, cardiopulmonary resuscitation, an external defibrillator and medical measures could reduce mortality from complications of AMI. By the middle of the 1980s, it was the time for fibrinolytic therapy, first intracoronary and subsequently intravenously. Since then, a special emphasis has been placed on artery patency. In the 1990s, there was widespread use of primary PCI and the organization of protocols for shortening the time to chest-pain-balloon. In the 2020s, high-density mapping technologies as well as advanced catheters may further improve the outcome of post-MI patients who present with sustained VT. Similar to the increasing number of intensive care units and PCI angiography rooms, there is a need for an increased number of electrophysiology laboratories, with better access to trained physicians and new technologies. Only then will we be able to provide proper and timely treatment of patients with complex arrhythmias such as VT or atrial fibrillation.

Conflicts of interest

The author has no conflicts of interest to declare.

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