Cardiovascular Research: The left and right ventricles differ in their ability to withstand the effects of cardiac arrest

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The findings, published in Cardiovascular Research*, show that the right ventricle has greater metabolic resilience than the left during cardiac arrest caused by ventricular fibrillation.*

A study led by scientists at the Centro Nacional de Investigaciones Cardiovasculares Carlos III (CNIC) provides new insights into **ventricular fibrillation** (VF), the most dangerous type of cardiac arrhythmia.

The study, published in the journal *Cardiovascular Research*, demonstrates that electrical signals recorded during cardiac arrest caused by VF provide crucial information about damage to the heart and other vital organs, including the brain.

Ventricular fibrillation is one of the main causes of sudden cardiac death. An estimated 17,000 sudden cardiac deaths occur in Spain each year, most of them the result of malignant arrhythmias like VF. Most VF episodes occur outside hospital, where survival rates are significantly lower, at below 10%. Survival is so low because disorganized ventricular electrical activity immediately halts effective blood pumping, causing global ischemia and, if not reversed, death within minutes.

The study, led by Dr. David Filgueiras Rama, leader of the Advanced Development in Arrhythmia Mechanisms and Therapy group at the CNIC, also shows that the right ventricle is better able than the left ventricle to withstand the loss of blood perfusion and oxygen supply during cardiac arrest. “This difference generates electrical activation gradients in the heart that track the development of the underlying injury. Moreover, the surface electrocardiogram (ECG) signal during ventricular arrhythmia-associated cardiac arrest can be used to predict the likelihood of neurological recovery after hospital admission,” explains Dr. Filgueiras Rama.

The study found that these differences were more pronounced between the epicardium (outer heart surface) and the endocardium (inner surface), although differences were also maintained between the epicardial layers of the right and left ventricles. The greater resistance of the right ventricle was reflected in longer preservation of its native electrical activity, consistent with better metabolic preservation and greater tolerance of ischemia. These findings were confirmed by computer simulations performed in collaboration with the Universidad Politécnica de Valencia.

“The clinical results support the prognostic value of the surface ECG in cardiac arrest caused by ventricular fibrillation, showing that it can identify those patients who are more likely to recover without severe neurological sequelae,” says Dr. Filgueiras Rama.

Dr. Jorge García Quintanilla, a senior researcher in the CNIC group and a member of CIBERCV, the Spanish cardiovascular research network, adds that “the findings provide valuable information that could guide the development of therapies aimed at protecting the left ventricle and improving its resistance to ischemia during cardiac arrest.”

CNIC researcher Dr. Andrés Redondo Rodríguez, first author on the study and also a CIBERCV member, highlights the importance of a multidisciplinary approach to tackling complex arrhythmias such as VF, helping to drive the development of new therapies in a field that has seen limited progress in recent decades.

The study was conducted through collaboration with the following institutions: Instituto de Investigación Sanitaria del Hospital Clínico San Carlos (IdISSC); Centro de Investigación Biomédica en Red de Enfermedades Cardiovasculares (CIBERCV); Instituto de Investigación Sanitaria de la Fundación Jiménez Díaz, Centro de Investigación e Innovación en Bioingeniería (Ci2B) de la Universidad Politécnica de Valencia, Fundación Interhospitalaria para la Investigación Cardiovascular (FIC) and Universidad Complutense de Madrid.

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