Machine Learning-Based Prediction of Refractory Ventricular Fibrillation During Cardiac Arrest

This technology uses machine learning to analyze ECG data during cardiac arrest and predict whether a patient's heart rhythm will require 3 or more defibrillation shocks during resuscitation. It enables earlier identification of patients who may require alternative or advanced interventions.

What is the Problem?

Out-of-hospital cardiac arrest (OHCA) is a leading cause of death worldwide. A significant proportion of these cases involve ventricular fibrillation (VF), a life-threatening heart rhythm that requires immediate defibrillation. However, not all VF responds to shocks—some cases are "shock-refractory," meaning that VF persists or recurs despite multiple defibrillation attempts. Currently, there is no reliable way to identify shock-refractory VF early during resuscitation, which delays the use of potentially beneficial treatments.

What is the Solution?

This technology provides the first known method to predict shock-refractory VF based solely on the electrocardiogram (ECG) collected by the defibrillator during resuscitation. It applies a machine learning model to ECG segments recorded before and after the first defibrillation attempt. The model analyzes time-frequency features extracted from the ECG signal to determine the likelihood that the VF will not respond to the first two defibrillation attempts. This prediction can be made in real time and used to guide clinical decisions, such as earlier administration of antiarrhythmic drugs, expedited hospital transport, or alternative defibrillation strategies (e.g. double sequential shock). The approach has been validated using data from a large OHCA registry and has moderately good predictive performance.

What is the Competitive Advantage?

-Enables earlier identification of patients unlikely to respond to defibrillation, allowing for more timely and targeted administration of guidelines-based (antiarrhythmic drugs) or experimental (double defibrillation) interventions.

-Uses ECG data already available to the defibrillator during resuscitation, requiring no additional hardware or invasive procedures.

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Category

Device/Cardiovascular
Selection of Available Technologies
Diagnostic

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-Employs a machine learning model trained and validated on real-world cardiac arrest data from over a thousand patients, highlighting its clinical applicability.

-Can be integrated into existing defibrillator systems or emergency response protocols to support decision-making in the field.

Patent Information:

WO2024097141A1

References

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