ABSTRACT

YOUNG, MELANIE TALANDA. Using an Artificial Neural Network to Detect Activations during Ventricular Fibrillation. (Under the direction of Susan Manning Blanchard.)

Ventricular Fibrillation (VF) is a severe cardiac arrhythmia that can result in sudden death, a leading cause of death in the United States. During VF, the electrical activity of the heart becomes disordered, the ventricles contract erratically, and an insufficient supply of blood is pumped to the body. Identification of the electrical activation sites during VF is important for the understanding and improved treatment of the disorder. Unipolar electrograms of four pigs were recorded following the induction of VF. The data from the VF recordings was preprocessed using a Rule-Based Method (RBM) , a Current Source Density (CSD) method, and a Transmembrane Current Method (TCM) to separate local activations from distant activity. RBM uses the magnitude of the derivative of the voltage to identify activations. CSD is a scalar quantity that represents the magnitude of the current source or sink. TCM estimates a value proportional to the transmembrane current. A feedforward artificial neural network (ANN) using backpropagation was trained to identify the local activations in the electrograms of VF based on the RBM and CSD calculations. Another feedforward ANN using backpropagation was trained using data preprocessed with not only RBM and CSD, but also TCM. In order to improve the ability of the ANNs to detect local activations, a new training method, called staged training, was utilized. In staged training, the ANNs were trained in stages using different sets of training examples. Examples were included in a particular training set based on the minimum magnitude of the voltage derivative. When training was done

in stages, both the ANN with RBM and CSD data only and the ANN with RBM, CSD, and TCM data were able to more accurately distinguish activations. Overall, the ANN, which used only RBM and CSD data, produced better results than the ANN that also included TCM data.

USING AN ARTIFICIAL NEURAL NETWORK TO DETECT ACTIVATIONS DURING VENTRICULAR FIBRILLATION

by
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PERSONAL BIOGRAPHY

I was born in Torrance, California but spent most of my childhood in southwest Michigan. I moved back to warmer climates in 1983 to attend Duke University in Durham, North Carolina. I received my A.B. in Political Science and German from Duke University in 1987. Subsequently, I became interested in Bioengineering and decided to pursue graduate studies at North Carolina State University.

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