Engineering Involved in Cardiac Arrest Management

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Abstract—Cardiac arrest is one of the leading causes of death in the United States. Every year there are 424,000 out of hospital incidents of cardiac arrest. The rate of survival of patients who underwent an episode of cardiac arrest is about 10%. This paper will explore the various ways cardiac arrest is managed.

I. INTRODUCTION

Cardiac arrest is a term used for an event in which an individual’s heart is beating in such a way that blood is inadequately pumped out to systemic circulation; the most common condition during cardiac arrest is Ventricular Fibrillation. Cardiac arrest can also define a condition where there is absent electrical and mechanical activity, defined as asystole. Ventricular Fibrillation is not entirely understood, and the only way that modern medicine treats it is by defibrillation, the passing of electrical current through the myocardium to depolarize cardiac muscle fibers in hope that the Sinoatrial Node, the “pacemaker” of the heart, restarts normal sinus rhythm.

II. METHODS

A person undergoing cardiac arrest and is in ventricular fibrillation has an electrocardiogram representation of irregular non-organized electrical activity. This is caused because of ventricular contractions that are not organized and inadequate in moving blood into the aorta. The following is a picture of an EKG of Ventricular Fibrillation:

When a device known as a Defibrillator is used. A current is passed across a chest, which depolarizes, or resets, the muscle fibers. The SA node is then expected to restart the systolic rhythm of the heart. Defibrillators work by using a simple circuit comprised of a voltage source, a capacitor, and an inductor. The EMF source is typically an automated transformer which slowly charges the capacitor. Once charged, the healthcare provider will press the button on the machine which will complete a circuit with the capacitor, inductor, and the patient’s chest; this is when the shock is delivered and the heart goes into asystole. Modern defibrillators work by utilizing biphasic currents which sends current back and forth. This creates a more effective defibrillation of the myocardium with potentially less harmful power used. During a study published in The Journal of Mathematical Analysis and Application, a group of researchers created a comprehensive model of the human heart and the current paths that run across the myocardium.

III. RESULTS

The results of the modeling study provided a 3D mapping model of the heart and how current behaves and flows within the boundary of the myocardium. This therefore provides a better reference for creating additional forms of defibrillation, and a much better understanding of the way Ventricular Fibrillation manifests. The following microgram is a rendering of the mathematical models constructed.

IV. DISCUSSION

Cardiac arrest accounts for more than half of the deaths associated with cardiovascular problems. The process of finding new ways to treat the condition both in and out of hospital environments as the potential to save millions of lives. With a 10% chance of survival during the thirty days following a cardiac arrest, finding better ways to improve on the healing and treating of the heart is profoundly important as well as a vital component in the healthcare system.

REFERENCES


