BRIEF SCIENTIFIC REPORT

INDIGENOUS LOW COST EXTERNAL DEFIBRILLATOR

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INTRODUCTION

Ventricular fibrillation is chaotic electrical activity of the heart muscle fibers, which results in failure of coordinated myocardial contraction and virtually no cardiac output[1]. Defibrillation, the only definite treatment, depolarizes the sufficient mass of cardiac myocytes to make the cardiac tissue ahead of the VT or VF wave fronts refractory to electrical conduction. Subsequently, the sinus node or another appropriate pacemaker region of the heart with inherent automaticity can resume orderly depolarization-repolarization, with return of a perfusing rhythm[2]. The equipment used for defibrillation is called "defibrillator".

It is important to note that sudden cardiac arrest claims 350,000 to 450,000 lives per year in the United States alone. Unfortunately, there is no data from Pakistan on this subject. Most victims of cardiac arrest are initially found in ventricular fibrillation. Approximately 80 percent of cases of sudden death from cardiac causes occur at home or out of the hospital. The rate of success of resuscitation in patients with out-of-hospital cardiac arrest has been poor, averaging 2 to 5 percent[3]. Even when patients are resuscitated in the hospital, fewer than one in five patients survive to discharge[4]. When defibrillation is provided immediately after the onset of VF, its success rate is extremely high[5]. In a study of patients who experienced sudden cardiac arrest in Nevada gambling casinos, the survival rate to hospital discharge was 74% for patients who received their first defibrillation no later than 3 minutes after a witnessed collapse[6]. The most important factor for success in resuscitation is time to treatment, in particular, defibrillation. Each minute that defibrillation is delayed the chance of eventual hospital discharge reduces by 8 to 10 percent[7-8].

The Prototype design of **KRL External Defibrillator** (KRLXD) was started in mid 2003 after preliminary study and understanding of functioning. The aim was to design and develop of low cost indigenous External Defibrillator. An External Defibrillator works on the principle of charging a high voltage capacitor up to the voltage determined by the energy selected and then quickly discharging this stored energy with the help of paddles through the chest of the patient. The DC voltage acquired by the charged capacitor ranges to nearly 5000V. The system is micro controller based operated by 12V battery which is rechargeable by the mains. The capacitor charges in 30 seconds and this can be reduced to 10 seconds. The energy selection is displayed on a three digit seven-segment display and ECG is provided on LCD display. The charged energy automatically discharges through an internal load, if the device remains idle for one minute. The four main electronic components of KRLXD are conducting paddles, defibrillator relay and high power supply. The range of energy selection is 5 to 360 joules and energy pulse duration is 10 seconds. Atmel 89C51 Micro controller is the core processor, which controls all the functions of the defibrillator. All major components and the software are indigenously manufactured and designed, which has reduced its cost.

First prototype was tested on dogs on 27th April, 2004 by a team of doctors. This second upgraded version, in which the charging time is reduced to 30

Figure 1: Indigenously designed KRL external defibrillator (KRLXD)

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seconds, ECG display is provided on 128x64 LCD graphics module and synchronization mode is added, has been tested on dogs.

Is it as good as defibrillators available in market? The answer is no, but, it is the first step in the direction. There is room for improvement and making it compatible with international standards. The efficiency has been tested but quality testing is awaited. The main hindrances to quality testing are lack of animal laboratory and ethical issues as far as its human application is concerned. Even at this stage, this prototype is life saving. Inclusion of printer and Interfacing with PC are next proposed steps and indigenous development of Automated External Defibrillator (AED) and Implantable Convertible Defibrillator (ICD) are next goals which are based on similar principles. The local development of this life saving equipment is a major step forward but to make it compatible with available defibrillators, much work has to be done and without saying needs patronage at the highest level to facilitate and encourage biomedical technology and the most important is ensuring the sustainability of the projects.

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