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A history of mechanical devices for providing external chest compressions☆

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Summary The importance of providing good quality chest compressions with limited interruptions has been emphasised by the Resuscitation Guidelines 2005. The difficulties of providing consistent, good quality, chest compressions manually are well documented and attempts have been made to devise mechanical means to achieve this. Many see the development of mechanical devices as a new phenomenon; however, as with many other components of resuscitation science, they have in fact been available for a number of years. This paper provides a brief historical review of some of the mechanical devices which have been invented over the last 45 years in order to deliver external chest compressions. It also suggests some reasons why these devices failed to become a regular part of resuscitation practice.

Introduction

The development of the Lund University Cardiopulmonary Assist System (LUCAS), has interested the resuscitation community as it is hoped that this device may lead to an increase in survival from cardiac arrest.[1] It has been subjected to a number of clinical trials and is currently being used by some ambulance services. However, the use of mechanical means to compress the chest is not a new phenomenon. A recent review reported on 15 automatic or manual mechanical devices that are, or have been, available for use during resuscitation attempts.[2] A recent literature search has revealed some further inventions, and it is interesting to trace the history of these devices and consider why they failed to become an accepted adjunct during resuscitation attempts.

Long before Jude, Kouwenhoven and Knickerbocker produced their seminal paper on closed chest compressions, Pike et al. had recorded in 1908 a method of 'Extra-thoracic massage' that they had studied on dogs.[3] They noted that compressing the chest of a dog was 'exceedingly laborious and often cannot be kept up for a sufficiently long time'. With the help of Professor J.L. Kessler they developed a machine to massage the heart both externally and internally. However, they reported that applied externally it was no better than manual methods and applied internally it was less effective.

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at 10.1016/j.resuscitation.2007.01.002.

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For the next 50 years opening the chest and giving internal cardiac massage was the only technique used during cardiac arrest and the idea of using any type of mechanical device appears to have been forgotten. However, as soon as closed chest massage was reported in the early 1960s, so ideas about using mechanical devices to assist with this procedure also developed. A brief chronological list of some of these devices will now be related.

1961

Harkins and Bramson[4] reported on an electropneumatic machine which Bramson had designed to overcome the disadvantages that they perceived in giving external chest compressions manually. Designed to fit over a standard hospital stretcher it required compressed gas to drive a spring-loaded piston with a force of between 60 and 75 pounds (27—34 kg), onto the patient's sternum (Figure 1). In addition to this machine being used in a cardiac arrest, they also suggested that it could be used to assist a failing heart as it was possible to synchronise it with an ECG monitor.

Dotter et al. [5] devised an artificial circulator which consisted of a thrusting mechanism mounted on a supporting frame (Figure 2). This was powered by an electric motor which was set to operate at 60 strokes/min. They describe testing the device on an adult cadaver and using it on a 75-year-old male who had suffered a cardiac arrest. Unfortunately, the patient died and they note that the post mortem showed multiple rib fractures which indicated 'inexperience with, or limitations of, the methods employed'. They also indicated that they were working on a second model which would use a smaller motor. A literature search did not reveal any references relating to this subsequent model.

Figure 2 The artificial circulator (Source: Dotter et al.[5]).

1962

Nachlas and Siedband[6] described the development of a portable pneumatic pump for external chest compression (Figure 3). They reported that they were developing a different version which would be lighter in weight and available from the Westinghouse Electric Corporation. They recorded the successful use of this device during experiments with dogs and also that they had used it during resuscitation attempts with three patients. They did not indicate whether these attempts resulted in a successful outcome, however in the summary of this article they refer to recording arterial pressures in 'three recently deceased persons'.

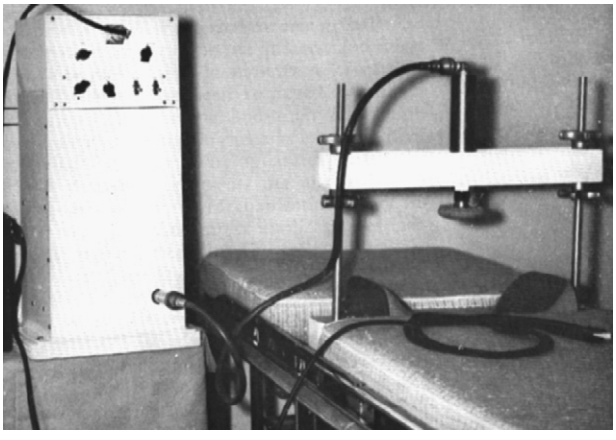

Figure 1 The Cardiac Massage Unit (Source: Harkins and Bramson[4]).

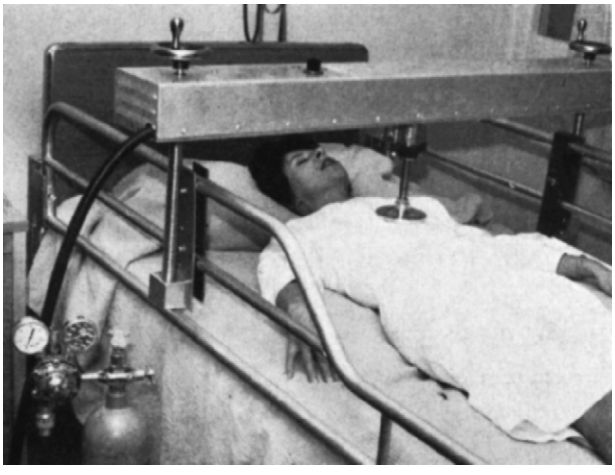

Figure 3 The External Cardiac Massage Unit (Source: Nachlas and Siedband[6]).