НАУЧНЫЙ ЖУРНАЛ
НАУКА И МИРОВОЗЗРЕНИЕ

УДК-364.01

AUTOMATED LIFTING WHEELCHAIR FOR DISABLED PEOPLE

Muhammetvepayeva Chemen

4 th year student, Cyberphysical systems faculty of the Oguzhan Engineering Technologies University of Turkmenistan

Sozenova Sapargul

4 th year student, Cyberphysical systems faculty of the Oguzhan Engineering Technologies University of Turkmenistan

Jumayeva Ayperi

4 th year student, Cyberphysical systems faculty of the Oguzhan Engineering Technologies University of Turkmenistan

Chohova Lale

4 th year student, Cyberphysical systems faculty of the Oguzhan Engineering Technologies University of Turkmenistan

Introduction

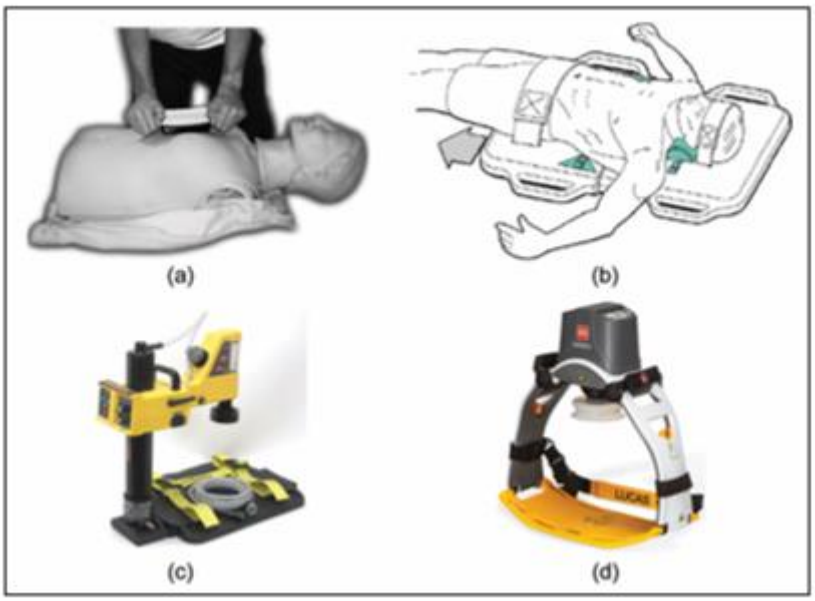
Cardiac arrest is a sudden diminution of heart activity which impairs the effective pumping of blood. More than 420,000 people suffer an out-of-hospital cardiac arrest in the United States every year, and the American Heart Association (AHA) estimates that this number will increase in the next years. In the last 50years, research has steadily improved cardiopulmonary resuscitation (CPR), but there is still much to do, since survival rates remain low. The effectiveness of the CPR depends on many factors, where the promptness and the quality of the resuscitation procedure are the most important. All the optimal parameters of such procedure, like execution timing, chest compression rate, and chest compression frequency are stated in the AHA guidelines.

Automatic CPR devices have been devised to solve some problems that reduce the effectiveness of the manual CPR. The first of these problems, probably the most important, is the fatigue that rescuers experience during CPR. In fact, the human chest has a viscous damping that dissipates part of the energy applied during the massage, so that energy has to be continuously supplied by the rescuer.

CPRdevices

The main categorization of CPR devices consists of the design approach. Previous and current versions follow two types of concepts: manual and automatic. Figure 1 shows examples of one manual—(a) CPR PRO Cradle—and three automatic devices—(b) EM-CPR, (c) LifeStat, and (d) LUCAS.

Manual devices are auxiliary components with the purpose to drive the rescuers on a step-by-step procedure in order to perform a more effective CPR massage by acoustic and visual signals. In some devices, a further scope is to reduce the fatigue of the rescuer with a mechanical advantage or a more efficient application of the compressing force. On the contrary, the automatic devices are able to provide autonomously the chest compression with welldefined depth and rate. CPR devices may be also categorized into the following:



- chest massage action—compression/decompression;

- actuation type—electric, pneumatic, and magnetic.

Most of the devices are designed to be light and compact for out-of-hospital CPR, while the EM CPR, the parallel manipulator, and the pGz are intended for in-hospital CPR only (Table 2). All the devices, but the CardioPump and the LUCAS, perform exclusively chest compression. On the contrary, the CardioPump and the LUCAS alternate compression with active decompression by a suction cup that forces the thorax back to its uncompressed volume. Active decompression increases the venous return by decreasing the intrathoracic pressure, and consequently increases the overall flow, especially if coupled with an impedance threshold device (ITD). However, com paring the effectiveness of active compression decompression cardiopulmonary resuscitation (ACD CPR) delivered by the CardioPump to manual CPR, Gunaydın et al.

Found no statistical differences in return of spontaneous circulation (ROSC), discharge rates, and survival rates in the outcome of 181 out-of hospital and in-hospital events.

The LifeStick acts quite differently from the other devices because it performs an interposed abdominal compression–cardiopulmonary resuscitation (IAC CPR), that is, abdominal compressions alternated to chest compressions. The cyclic alternation of chest and abdominal compressions doubles the flow, allowing to decrease the depth of compression, and therefore the danger of ribs and sternum injuries. However, compressions have to be less vigorous to prevent injuries to vital organs because the abdomen is softer than the thorax. CardioPump, CPR PRO, CPR RsQ Assist, and LifeStick are manual tools that concentrate on the sternum the energy provided by the rescuer, while Animax, Cardiac Responder, corpuls cpr, Heartsaver, LifeStat, LifeBelt, Lifeline ARM, LUCAS, Thumper, Weil Mini, Weil SCC, and the parallel manipulator act with a piston or a compressing pad. The AutoPulse and the hydraulic–pneumatic band compress the chest on a wider area by a wrapping band, while the vest does the same with a device analogous to a large blood pressure cuff. The Weil Mini and the Weil SCC act on the sternum with a compressing piston and, simultaneously, on the whole chest cavity with a torso restraint placed around the patient. On the contrary, the EMCPR and the pGz do not exert any force on the thorax. The EM-CPR stimulates the contraction of both the diaphragm and the abdominal muscles by magnetic impulses generated by coils, and such a rhythmic contraction of the abdominal muscles pumps blood from the abdomen, which contains about 20%–25% of the total blood of the body. In addition, it provides a negative pressure ventilation which aids rather than impedes circulatory output. Therefore, ventilation and circulation result from a single intervention. The pGz device generates hemodynamic effects in a completely different way because it is the periodic acceleration along the spinal axis that moves the blood in the cardiovascular and pulmonary systems. Furthermore, the inertia forces acting in the abdominal area compress and dilate the diaphragm to reproduce natural breathing.

The CardioPump, the CPR PRO, and the CPR RsQ Assist are the lightest and most compact devices because they have no moving parts. The CardioPump has two components: a handle with a gauge that measures the force applied to the thorax, and a suction cup for active decompression. The CPR RsQ Assist is similar, but it has no gauge. The CPR PRO is intended for compression only. The LifeBelt and the LifeStick are manual device too, but they are slightly heavier than the previous ones. Animax is different because it is powered manually, but it has moving parts. Therefore, it is heavier than the other manual devices. Dimensions and weight of the EM-CPR, the pGz, the parallel manipulator, the vest, and the hydraulic–pneumatic band are not defined because their development is still in progress.

Being designed for in-hospital use only (save the hydraulic–pneumatic band), they do not have the dimensional constraints that portable devices have to comply with. All the other devices (AutoPulse, Cardiac Responder, corpuls cpr, Heartsaver, LifeStat, Lifeline ARM, LUCAS, Thumper) have similar weight, except Weil Mini and Weil SCC, which are comparable to the manual devices.

In order to be approved, devices must comply with the AHA and the European Resuscitation Council guidelines for CPR, above all to compress with a rate of at least 100 compressions per minute with a depth of 50mm. Manual tools do not have technical data of this sort because the effective rate and depth of compression are attained by the rescuer who uses them. However, the LifeStick requires a lower compression rate than the CardioPump and the CPR RsQ Assist because of its double pumping effect and the danger to injure the abdomen. Cardiac Responder, Heartsaver, LifeStat, and Thumper compress with a rate of 100 compressions per minute, while Weil Mini has a rate slightly higher. The corpuls cpr is more versatile because it can adjust the rate in a range of 40 compressions per minute, from a minimum of 80 to maximum of 120. On the contrary, the AutoPulse has a fixed rate of only 80 compressions per minute because it has a greater effect on hemodynamics at lower rates, as the vest, which compresses at 60 compressions per minute. Before starting, Thumper calculates the anterior–posterior chest diameter to deliver the right sternum deflection. Similarly, the AutoPulse adjusts automatically the band to the patient's chest and, measuring its circumference, calibrates the compression depth. Therefore, the depth at which the two devices compress is relative to the dimension of the patient. All the other devices compress with an absolute depth that can often be adjusted to the dimension of the chest.

An essential requirement for a successful device is the positioning time because CPR has to start as early as possible to be effective: according to the manufacturers, this time varies from a minimum of 10s (Weil Mini) to a maximum of 30s (AutoPulse).