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New Mechanical Methods for Cardiopulmonary Resuscitation (CPR) Literature Study and Analysis of Effectiveness

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In a recent German multicenter study, 25% of the patients who suffered a witnessed cardiac arrest outside the hospital were resuscitated successfully and were discharged from the hospital. Approximately 100,000 people suffer a fatal cardiac arrest in Germany annually, which is about ten times more than deaths resulting from motor vehicle accidents. New devices and techniques for cardiopulmonary resuscitation (CPR) have been developed in order to enhance the efficacy of chest compressions during CPR. The purpose of the present article is to review mechanisms of blood flow during CPR, to discuss CPR devices and techniques (vest CPR, CPR with interposed abdominal compressions, active compression-decompression (ACD) CPR, phased chest and abdominal compression-decompression CPR, and to further evaluate results from subsequently published laboratory and clinical studies. Vest CPR performs chest compressions with a pneumatic pump, which is able to compress the entire thorax with great force while minimizing injury. This device was developed to achieve an optimal driving force of the thoracic-pump mechanism during CPR. After promising results in laboratory studies and further technical development, vest CPR increased coronary perfusion pressure (CPP) in a clinical study even after 45 min of unsuccessful advanced cardiac life support. Currently, this device is being evaluated in an international multicenter study in Europe and the United States. A vest for employment by the emergency medical service (EMS) is in preparation. Interposed abdominal compressions during relaxation of the chest may augment artificial blood flow. In some laboratory studies, this mechanism resulted, in part, in promising data, and in another did not achieve better survival rates in comparison with standard CPR. No benefit of abdominal compressions was shown in an investigation in an EMS, whereas in a clinical study patients who were treated with interposed abdominal compressions were more likely to survive and be discharged from the hospital. However, in a follow-up study of in-hospital patients with asystole or pulseless electrical activity, abdominal compressions resulted in higher 24-h survival, but not hospital discharge rate, when compared with standard CPR. In animal studies ACD CPR produced increased CPP, end-tidal carbon dioxide, minute ventilation, and short-term survival. Subsequently performed clinical studies confirmed the data from the laboratory investigations; however, the hemodynamic advantage of ACD CPR did not result in increased long-term survival and a better neurological outcome in both in- and out-of-hospital cardiac arrest patients. To date, the reason why better hemodynamic variables did not result in better outcomes is unknown. A combination of ACD CPR with interposed abdominal compressions raised cerebral blood flow by approximately 60%, but did not augment myocardial blood flow in comparison with standard CPR. Recently, a device was developed to administer phased chest and abdominal compression-decompression CPR; this technique has been tested in an animal study and showed significant hemodynamic advantages and better survival compared with standard CPR. Clinical investigations of this device are being performed. In summary, since the rediscovery of chest compressions more than 35 years ago, this intervention has not changed significantly. Objective data from laboratory and clinical studies such as systolic blood pressure, CPP, and the gold standard for the efficacy of CPR, long-term survival and neurological outcome, will determine if a new device or technique can replace standard-CPR. Despite the new developments, it is mandatory to perform standard CPR correctly with a chest compression rate of 80-100/min and a depth of 38-50 mm.