Prehospital CPR, mechanical compressions and autopsy findings

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ABSTRACT:

In individuals not surviving prehospital cardiopulmonary resuscitation (CPR), pathologists at the University Hospital of Lund, Sweden, have observed injuries related to mechanical CPR. Several rib and sternal fractures were seen, some mediastinal bleedings and a few aortic rifts. In achieving better results from prehospital mechanical CPR, we have used an automatic mobile compression-decompression device. This has prolonged resuscitation times and efficacy. With this new method, however, more CPR related injuries seem to occur and may be anticipated. It is essential to evaluate possible complaints from surviving patients as well as to consequently perform autopsies on patients not rescued.

Background

CPR with mechanical compressions is being used more and more. In Skane of southern Sweden with 1.2 million inhabitants, the commercial LUCAS® device has been in use since 2003 as an aid in performing effective CPR (1,2). The overall results using LUCAS® in resuscitation have been encouraging. It has been demonstrated that it is possible to treat patients with an unstable coronary circulation, in performing percutaneous coronary intervention (PCI) while using LUCAS® as an external cardiac pump throughout the procedure. Clinical studies have shown that the individual CPR provider will be effective with manual heart compressions for only some minutes (3). The introduced chain of survival from cardiac arrest to final treatment with PCI is facilitated by the ability to transport the patient with an ongoing CPR in the ambulance and during the initial treatment. In contrast, manual CPR will generally be interrupted (4). Furthermore, while transporting a patient with ongoing mechanical compressions, the ambulance team can be safely belted during the transport.

Technical data, methods and results

LUCAS® produces CPR with 100 compressions and decompressions per minute and with a stroke-length of 5 cm for a normal adult person according to international guidelines. If there is an abnormally high intrathoracic resistance, the stroke-length is automatically reduced by the machine. LUCAS® is run by pressurized air or oxygen with a consumption of approximately 70 liters per minute. LUCAS® sustains continuous compressions/decompressions during the whole period of resuscitation.

We found the following types of tissue damage at autopsy on patients treated with mechanical compressions during CPR. Most frequently, costal, parasternal and sternal fractures were seen. These fractures were often multiple, exceeding the number observed in Lund in deceased patients after manual CPR. In some cases, there were retrosternal and also mediastinal haemorrhages. In a few cases, an atypical rift/rupture of the ascending aorta was found and in one case, there was extensive haemorrhage within the ventral myocardium.

Discussion

The total number of post CPR injuries in non-survivors is not known, since e.g. costal fractures may be relatively frequent, but more rarely reported. Furthermore, a given CPR treatment is not regularly indicated on the referral sheath. Without such an indication the pathologist may not focus on potential CPR-related injuries.

The range of reported complications and injuries due to CPR varies widely according to the literature. Hoke and Chamberlain in 2003 suggested the initiation of more systematic reports, especially when mechanical compressions are used (5). Negative side effects will probably be more commonly seen with mechanical compressions than with traditional manual compressions, due to the higher effect and sometimes longer resuscitation times. Since the normal rate of complications in manual CPR is not fully known there are difficulties in comparing the different groups of patients undergoing CPR. In Skane we intend to create a database for all patients undergoing CPR and we recommend the clinicians to note and specify more clearly what kind of CPR was given. There may be patients with special risk factors, whose treatment perhaps should be modified. Further studies could promote differentiated treatment strategies and the development of CPR-devices.

References:

1. Steen S, Liao Q, Pierre L, Paskevicius A, Sjoberg T. Evaluation of LUCAS, a new device for automatic mechanical compression and active decompression resuscitation. *Resuscitation* 2002; **55**: 285-299.
2. Nielsen N, Sandhall L, Schersten F, Friberg H, Olsson SE. Successful resuscitation with mechanical CPR, therapeutic hypothermia and coronary intervention during manual CPR after out-of-hospital cardiac arrest. *Resuscitation* 2005; **65**: 111-113.
3. Hightower D, Thomas SH, Stone CK, Dunn K, March JA. Decay in quality of closed-chest compressions over time. *Annual Emergency Medicine* 1995; **26**: 300-303.
4. Stapleton ER. Comparing CPR during ambulance transport. Manual vs. mechanical methods. *JEMS* 1991; **16**: 63-64, 66, 68 passim.
5. Hoke RS and Chamberlain D. Skeletal chest injuries secondary to cardiopulmonary resuscitation. *Resuscitation* 2004; **63**: 327-338.