LUCAS (Lund University Cardiac Arrest System) In Hospital Cardiac Arrest Antonius Hospital

Published: 07-05-2009
Last updated: 05-05-2024

The primary objective is to show superiority in survival of the modified method with the LUCAS Chest Compression System, compared to the conventional manual resuscitation method in patients suffering from witnessed In-hospital cardiac arrest Primary…

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Cardiac arrhythmias
Study type	Interventional

Summary

ID

NL-OMON32989

Source
ToetsingOnline

Brief title
LIHA

Condition

- Cardiac arrhythmias

Synonym
Cardiac arrest, heart attack

Research involving
Human

Sponsors and support

Primary sponsor: Sint Antonius Ziekenhuis
Source(s) of monetary or material Support: Ministerie van OC&W

Intervention

Keyword: arrest, LUCAS, mechanical, resuscitation

Outcome measures

Primary outcome

Primary endpoint is the ROSC for more than 20 minutes of witnessed In-hospital cardiac arrests when resuscitated with the LUCAS Chest Compression System.

Secondary outcome

The secondary objectives are to show superiority in survival for the modified method with the LUCAS chest compression system compared to the conventional manual resuscitation method in patients suffering from witnessed in-hospital cardiac arrest by measuring the following secondary endpoints:

·Restoration of spontaneous circulation (ROSC) defined as spontaneous palpable pulse < 20 minutes and ROSC > 24 hours

·Survival to hospital discharge without severe neurological impairment (CPC 1 or 2).

·Survival 1 and 6 months after cardiac arrest without severe neurological impairment (CPC 1 or 2).

·Primary endpoint comparing LUCAS protocol starting in less than 6 minutes vs more than 6 minutes from emergency call

Tertiary objectives

·Survivors have less post-resuscitation subendocardial infarction measured with delayed contrast enhancement on MRI when resuscitated with LUCAS compression system compared to manual chest compressions

·Degree of transmural infarction after resuscitation diagnosed with delayed contrast enhancement is predictive for functional improvement in myocardial function after 6 months

Study description

Background summary

BACKGROUND AND RATIONALE
Annual incidence of resuscitation for out-of-hospital cardiopulmonary arrest of cardiac etiology is 49.5*66 per 100,000 population based on data from Scotland and from five cities in other parts of Europe [1].The incidence of in-hospital cardiac arrest is difficult to assess because it is influenced heavily by factors such as the criteria for hospital admission and implementation of a do-not-attempt-resuscitation (DNAR) policy. In a general hospital in the UK, the incidence of primary cardiac arrest (excluding those with DNAR and those arresting in the emergency department) was 330/100,000 admissions [2]. using the same exclusion criteria, the incidence of cardiac arrest in a Norwegian University hospital was 150/100,000 admissions [3]. The likelihood of a successful resuscitation without neurologic compromises depends mainly on time of onset cardiac arrest till restoration of adequate systemic circulation. The European resuscitation council (ERC) defined stepwise actions in *the chain of survival* for optimizing survival of a sudden cardiac arrest [4]. They include early recognition of the emergency and activation of the emergency services, early CPR, early defibrillation and early advanced life support. One problem that militates against greater success is the difficulty to perform effective and uninterrupted compressions over time. Although the artificial maintenance of blood flow (by chest compressions) is essential for survival if a shock cannot be given very quickly, the theoretical 25% of normal cardiac output that might be obtained by compressions are unlikely to be achieved during the great majority of resuscitations. Computer print-outs from automated defibrillators show that compressions are given on average only during 36% of the available resuscitation time even when performed by experienced rescuers [5].Trained first responders who compress at a rate of 120/min when providing CPR still end up with only 38 compressions per minute over the resuscitation time because of ventilatory and other interruptions [6]. Moreover, the depth of compressions,

even when given by healthcare professionals, is generally appreciably less than what is recommended in guidelines [7, 8]. Whatever quality is achieved over the first minute or so rapidly deteriorates if a single rescuer is involved [9].
New methods to achieve consistent and high quality compressions are needed for in en out of hospital cardiac arrests.

Alternative methods of delivering compressions
Mechanical devices can offer one way to achieve good quality resuscitations in terms of both rate and depth of compressions. Such methods have been in use in some centers for many years. The first publication comparing manual and mechanical compressions was published in 1978 [10], when devices had already been in use for at least 10 years. One device (Thumper, Michigan Instruments Inc., US) was shown to provide compressions comparable to those delivered manually *under ideal conditions* [10], whilst several others attest to the ability of mechanical CPR to be a successful life support technique [11, 12, 13, 14]. The hemodynamic advantages of mechanical compression have been well summarized by Wik [15].

Mechanical compression can be achieved in several ways: by simple piston-type devices that press in the chest in the area usually covered by the hands during manual compressions, by circumferential inflating vests, by devices that compress alternately the chest and abdomen, and by others that alternately compress and decompress. The equipment in the first two groups have - until recently - been cumbersome and heavy, difficult to apply, unstable when positioned, unsuitable for use during transport of patients, and expensive to purchase and run. Recently, two retrospective studies with AutoPulse (ZOLL, US), a device using circumferential chest compressions, were published with promising results [16, 17]. This was followed by a prospective cluster randomized multicenter trial that, however, was early terminated due to lack of benefit in 4 hrs survival, worse neurological outcome and a trend towards worse survival [18]. Problems with the study was that the application time for the tested device was prolonged resulting in delayed compressions. Another issue was study protocol violation by one of the major centers.
Lucas Chest Compression System
LUCAS Chest Compression System (JOLIFE AB, Sweden) is a pneumatic gas-driven device that provides automatic mechanical chest compressions. LUCAS Chest Compression System delivers sternal compression at a constant rate to a fixed depth by a piston with the added feature of a suction cup that helps the chest return back to the normal position. It compresses 100 times per minute to a depth of 4-5cm in adherence with International scientific guidelines on CPR (ref). It is easy to apply, stable in use, relatively light weighted (6.5 Kg), and well adapted to use during patient movement on a stretcher and during ambulance transportation. The device has been on the market since 2002 in Europe. Detailed descriptions of the device and experimental data showing increased cardiac output and cortical cerebral flow compared to manual standardized CPR have been published [19, 20].

The first human, cluster-controlled pilot study, published in 2006, in a 2 tier ambulance system, could not manage to show any advantage when replacing manual chest compressions in the recommended ACLS algorithm. The delay to treatment with LUCAS Chest Compression System was substantial with a median time of 18 minutes from the alarm. Furthermore, in this study defibrillation was not delivered during ongoing mechanical compressions [21]. A second randomized pilot study in Uppsala, Sweden, was closed in April 2007. Preliminary results are more encouraging [22]. LUCAS Chest Compression System has the additional advantages that it can be used during movement of a patient on a stretcher and can be used easily within any ambulance, an environment that is notoriously difficult for manual compressions and indeed one that carries a real risk of injury to healthcare professionals attempting to deliver them effectively [23]. No randomized studies have been published regarding LUCAS Chest Compression System for In-Hospital cardiac arrest.

The need for compressions before and after defibrillation

Even in the recent past, one of the tenets that has been considered beyond debate is the need to defibrillate the cardiac arrest victim as soon as the opportunity exists, provided a *shockable rhythm* is present. However, over the last years, new data have challenged this dogma. Observations from Seattle based on comparisons with historical data and published in 2000 [24] suggested that benefit might come if compressions were given electively before defibrillation if more than four minutes had passed after the collapse This study was followed by a randomized study from Oslo in 2003 which confirmed the benefit of compressions prior to *late defibrillation* [25]. In the latest international consensus on resuscitation it is thus recommended to give chest compressions before attempting defibrillation in unwitnessed out-of-hospital cardiac arrest, where prolonged arrest might be the fact [26].

Both experimental [27,28] and clinical [29,30] evidence exists that *hands-off* time (time without compressions) causing a deterioration in the waveform of ventricular fibrillation that is associated with a fall in coronary perfusion pressure. At the same time, it has long been known that equilibration of pressures on the arterial and venous sides of the circulation occurs relatively slowly [31], accompanied by dilatation of the right ventricle and constraint of the left ventricle - a finding that has been stressed recently in animal experiments [32] and confirmed by both autopsy [33] and post-mortem radiological findings [34]. Even successful defibrillation of a heart with a constrained left ventricle with a seriously impaired effective diastolic filling pressure (influenced by intra-pericardial pressure [35]) cannot restore an effective circulation. Moreover, effective contraction of a dilated right ventricle does not occur sufficiently quickly to relieve pericardial pressure and permit an effective contractile force in the left ventricular myocardium (that depends on fiber stretch) before complete cardiac arrest is likely to recur.

A second reason why late defibrillation is unlikely to be successful unless supported by compressions is metabolic rather than hemodynamic but it is likely

to exacerbate the loss of contractile power of the left ventricle. The fall in myocardial ATP resulting from ischemia has a predominant effect on the extrusion calcium pump which causes calcium overload [36]. Indeed this leads to contracture rather than contraction, and without early relief causes an irreversible condition known to surgeons as *stone heart*.
Thus delay in resuscitation is associated with decreasing prospects of a successful outcome after a defibrillatory shock even if a coordinated waveform is achieved briefly (pulseless electrical activity). The findings add a convincing hemodynamic explanation for the empirical observations of the value of cardiopulmonary resuscitation given as a prelude to defibrillation unless defibrillation can be provided very quickly after the onset of circulatory arrest. The current *window of opportunity* for a good prospect of effective resuscitation from ventricular fibrillation has been clearly shown to be approximately 5 minutes from call to shock [37], an interval widely accepted as a high priority goal for EMS care [26]. The concept has developed into different phases of management and priority of resuscitation attempts, with the first being the electrical phase lasting four minutes and the second being the circulatory phase over another six minutes [38]. The electrical phase matches very persuasively the time taken in experimental work for equilibration of the arterial and venous pressures after induction of fibrillation [28], after which the hemodynamics militate strongly against any return of an effective circulation unless compressions are given. The time course of this equilibration is matched very closely over the first 30 seconds for which human data are now available from measurements at the time of implantation of automatic implantable cardioverter defibrillators (AICDs) [39].
We have no evidence from randomized trials, including the one cited above [25], that compressions given before defibrillation even for very recent cardiac arrest has any adverse effect on overall survival. The interval from collapse to defibrillation - or the possibility thereof - is always very hard to judge and estimates are unreliable. We believe, therefore, that a policy of primary compressions is best tested for all cardiac arrest cases unless the arrest is monitored and occurs when a defibrillator and a trained operator are immediately at hand.
Uninterrupted compressions may also be useful after defibrillation. There may be risk to ultimate survival in leaving the newly defibrillated left ventricle unsupported by compressions during the procedures to check for an effective cardiac output. A small retrospective study of downloads from defibrillators has showed that a median time of more than 40 seconds may elapse between shock given by an AED and first compressions, half of which was due to human factors and not analysis time [40]. The surest way of providing support when it is needed would be to provide chest compressions as a routine for a set period before attempting to discover whether or not there had been a return of spontaneous circulation. The advantages are likely to outweigh any arrythmogenic hazard from mechanical stimulation of a vulnerable heart.

Cardiac Magnetic Resonance Imaging after resuscitation
Predicting functional improvement of myocardial function after acute MI is well

established with Magnetic Resonance Imaging (MRI). Contrast-enhanced (CE) MRI can characterize acute myocardial infarction with 2 well-defined CE patterns as follows: (1) First-pass images performed immediately after contrast injection often demonstrate areas of reduced CE MRI or hypoenhancement in the endocardial core of the infarct, corresponding to microvascular obstruction[44,45]. (2) Delayed images (10 to 20 minutes after contrast injection) demonstrate regional signal hyperenhancement, corresponding to myocardial necrosis. Improvement of segmental circumferential shortening late after infarction can be predicted by CE patterns early after MI. Regions with normal CE pattern display the most improvement in circumferential shortening, whereas regions with early hypoenhancement do not improve regional contractility. In regions with delayed hyperenhancement, improvement in circumferential shortening is inversely related to the degree of transmural involvement [46]. Although multiple studies are preformed with MRI focusing on brain injury after a successful resuscitation, no studies are involved in analyzing residual myocardial function after a successful resuscitation.

Study objective

The primary objective is to show superiority in survival of the modified method with the LUCAS Chest Compression System, compared to the conventional manual resuscitation method in patients suffering from witnessed In-hospital cardiac arrest

Primary endpoint is ROSC more than 20 minutes

Study design

LIHA is a randomized single centre non-blinded clinical trial. Inclusion starts from April 2009 until April 2013. During this time 400 patients will be included.

Intervention

Mechanical chest compression vs conventional manual chestcompressions in a resuscitation. see appendix 1 and 2 from LIHA protocol

Study burden and risks

Benefits & Risks
Potential benefits and risk from mechanical chest compressions on survival and neurologic outcomes are studied. A two centre randomized trial and a pilot trial for conventional manual and LUCAS resuscitation in out of hospital cardiac arrest showed an increased ROSC for LUCAS and no better nor worse survival to discharge [21, 22]. A prospective autopsy study revealed a similar incidence of sternum and rib fractures and no increased side-effects patterns

due to LUCAS.
* Expected injures. Ref; 1. 2005 International Concensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2005;67:195. 2. Englund E, Kongstad PC. Active compression-decompression CPR necessitates follow-up post mortem. Resuscitation 2006; 68:161-162. 3. Rubertsson S, Covaciu L. Mechanical chest compressions with the LUCAS device does not increase the incidence of injuries in cardiac arrest vicitims. In press AHA 2007.

Assessment of safety
Autopsy will performed according to a specified CRF to investigate injuries in both study groups. Number of injuries possibly affecting survival will be studied. This study will be done in a limited number of patients. The goal will be to get autopsy results from a total of 100 study patients.
Adverse events
There will be no non-serious adverse event reporting in this study. Events like rib fractures, sternum fractures and skin bruises are common after CPR using either method and are not needed to be reported as adverse events. However, if events including the above mentioned occur that fall under the Serious Adverse Event definition, they should be reported as serious adverse events.
serious adverse events
SAE is defined as an event directly related to CPR, as judged by investigator/co-investigator and assumed to occur after the randomization in the study, such as incidents that have resulted in:
· Death
· Serious deterioration of health in patient. This may include
- life threatening illness or injury
- permanent deterioration of body function or structure
- prolongation of hospitalization
-conditions that require medical or surgical treatment to prevent any of the above

reporting of serious adverse events
The Investigator should report all serious AE:s by using a Serious Adverse Event Report form.

Contacts

Public
Sint Antonius Ziekenhuis

Koekoekslaan 1
3435 CM Nieuwegein
NL

Scientific
Sint Antonius Ziekenhuis

Koekoekslaan 1
3435 CM Nieuwegein
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

IHCA (In-hospital cardiac arrest)

Exclusion criteria

- Age believed to be less than 18 years
- Known pregnancy
- Patients body size is not fitting in the LUCAS
- Patients 24 hours post trombolysis for any cause
- Non-witnessed cardiac arrest
- Resuscitation in operating room

Study design

Design

Study type: Interventional

Intervention model:	Parallel
Allocation:	Randomized controlled trial
Masking:	Open (masking not used)
Control:	Active
Primary purpose:	Treatment

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	20-06-2009
Enrollment:	400
Type:	Actual

Medical products/devices used

Generic name:	Lund University Cardiac Arrest System
Registration:	Yes - CE outside intended use

Ethics review

Approved WMO

Date:	07-05-2009
Application type:	First submission
Review commission:	MEC-U: Medical Research Ethics Committees United (Nieuwegein)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL26617.100.09