

Evaluation of LUCAS

by Dorset Ambulance Service - UK

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Introduction

Cardiac arrests in the out-of-hospital setting are associated with poor survival rates, with only 2% reportedly surviving to discharge (Colquhoun & Jevon, 2000). Historically the concepts of CPR and early defibrillation are seen as key treatment interventions.

However, LUCAS, a relatively new chest compression/decompression device, has been shown to be superior to manual chest compressions at maintaining circulation during CPR. This article discusses the evaluation of LUCAS in clinical use by Dorset Ambulance Service in the UK.

Background

In adults, the recommended rate for chest compressions is 100/minute, with a ratio of chest compressions to ventilations of 15:2 (Resuscitation Council UK, 2000) yet when performed optimally, chest compressions only achieve 30% of the normal cerebral perfusion (Resuscitation Council UK, 2000). Many studies have shown that due to rescuer fatigue, manual chest compressions can become ineffective after only a few minutes (Hightower 1999 and Ashton et al 2002). Whilst Stapleton (1999) also suggested that chest compressions can't be performed effectively during transport and that this process may itself be dangerous.

Stroke volumes generated by chest compressions appear quantitatively related to coronary perfusion pressure and thereby to the effectiveness of CPR (Klouche et al, 2002).

Indeed Paradis et al (1990) measured the coronary perfusion pressure in 100 patients in cardiac arrest, and found that only a coronary perfusion pressure of 15 mmHg or more was associated with ROSC. This corresponds well with data from animal studies carried out by Steen et al (2002). Manual chest compressions are rarely effective enough to provide coronary perfusion pressures of greater than 10 mmHg (Steen et al, 2002).



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LUCAS - How to...

1. Verify that a sudden cardiac arrest has occurred
 - Responsiveness?
 - No respiration
 - No pulse
2. Start manual compressions
 - Make 100 compressions per minute
 - Ventilate the patient twice
 - Position your hands in the correct position
 - Provide sequences of 15 compressions to every two ventilations
3. Unpack LUCAS from the bag
 - Open the bag
 - Connect the gas tube to the gas cylinder or to the gas outlet
 - Prepare other staff of your intention to apply LUCAS
4. Interrupt manual chest compressions
 - Work on each side of the patient
 - Take the LUCAS back board out of the bag
 - Place the back board under the patient
 - Place the patient's arms outside the sides of the back board
 - Apply the upper part of LUCAS to the back board
 - Verify that the support legs are locked to the back board (listen for the "click" sound)
 - Adjust the patient's position in relation to the suction cup
 - Lower the suction cup and press it firmly towards the patient's chest
 - Activate LUCAS

Steen et al (2002) suggest it takes 1-2 minutes to achieve a coronary perfusion pressure compatible with survival, with each interruption in the cycle of compressions e.g. with change of rescuer, intubation, or ECG analysis, resulting in an instant fall coronary perfusion pressure. On resuming compressions there is some delay before the original coronary perfusion pressure is adequate (Sato et al 1997).

During Defibrillation ECG analysis that requires a pause in chest compressions > 15 seconds before each shock worsens prognosis and increases the severity of post resuscitation myocardial dysfunction (Yu et al, 2002).

Pre-defibrillation chest compressions

In cardiac arrests > four minutes duration, survival rates appear to increase when defibrillation is preceded by chest compressions (Cobb et al 1999 and Wik et al, 2002). Nieman et al (1992) demonstrated that a brief period of myocardial perfusion prior to defibrillation improves outcome following prolonged VF, whilst Berg et al (2002) suggest that Providing CPR for 90 seconds prior to defibrillation substantially increases survival in prolonged and unwitnessed VF arrests.

While evaluating the LUCAS device, Steen et al (2002) demonstrated that defibrillation is more likely to be successful, and prognosis maximised, if it is undertaken during on-going CPR.

The optimal solution would therefore be for chest compressions to be undertaken during defibrillation and for interruptions to be kept to a minimum. This can be achieved by using LUCAS, a new gas driven CPR device providing automatic chest compressions and active decompressions. It delivers 100 compressions per minute and has proven in animal studies to deliver significantly better perfusion/oxygenation than standard CPR (Steen et al, 2002).



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LUCAS in Dorset Ambulance : staff training and assessment

Three members of staff attended a LUCAS instructor's course run by Swedish Paramedics. Cascade training on the use of LUCAS was then provided to 100 paramedics and technicians. The training included the physiology of chest compressions and the operating features of LUCAS, including application and use. Research papers related to LUCAS were available on the Trust intranet site and staff were encouraged to access the manufacturer's website:www.jolife.com for further information.

Staff were assessed practically

using an ALS manikin. They had to confirm cardiac arrest, start CPR and then apply the LUCAS device without stopping CPR for longer than 20 seconds. Practical assessment included:

- ◆ Confirming cardiac arrest and starting CPR
 - ◆ Unpacking and assembling LUCAS
 - ◆ Applying the back plate & assembling the upper part
 - ◆ Connecting the supporting legs to the back plate
 - ◆ Adjusting LUCAS and ensuring correct positioning and height of the suction cup
 - ◆ Activating LUCAS
 - ◆ Defibrillation with LUCAS attached
- Candidates were also required to sit a short 16 question multi-choice paper (pass mark was 100%).

LUCAS: implementation

The LUCAS device was placed on 10 front-line ambulances in Poole and Bournemouth. This conurbation has the advantage of having the highest number of cardiac arrest patients and two receiving hospitals in close proximity able to receive them.

LUCAS: protocol for use

LUCAS was used in all adult patients when CPR was indicated. On arrival at the scene, manual CPR was started and the LUCAS device was applied simultaneously. Once set up, LUCAS ran for 2 minutes before being stopped while ECG analysis was undertaken (10 seconds maximum). This allowed for skin preparation pad placement and other necessary interventions to be performed, LUCAS was then restarted and the patient was defibrillated (if indicated) while the device was running. LUCAS was kept running for 10 seconds post-defibrillation before it was stopped again for ECG analysis.

Contra-indications for using LUCAS:

- ◆ patients < 16 years of age
- ◆ patients too small for the device (suction cup not compressed when lowered as far as possible)
- ◆ patients too big for the device (upper part cannot be locked to the backboard)
- ◆ risk of fire or sparks i.e. hazardous to use oxygen
- ◆ late pregnancy (3rd trimester) - mother in left lateral position

Initial Results

Data was collected from 43 events when the LUCAS device was used. The Utstein form was used, together with a three-page purposely designed evaluation form.

43 non-trauma cardiac arrests were treated with the LUCAS device. 11 had ROSC on arrival at A+E and 3 had a measurable ROSC at some stage during CPR. In all patients improved oxygen saturation levels were noted when using LUCAS.

This small-scale evaluation of the LUCAS device suggests that LUCAS is significantly better at achieving ROSC than standard CPR.

Authors note: The data above does not necessarily present a true reflection as in the 1st 8 cases the device was not used by the crews as treatment but was used to establish Transportation effects. We therefore expect Rosc to be higher when used from arrival at scene.

The staff survey on the use of LUCAS was very encouraging. 100% found it easy to use and were confident in using it. 98% wanted to continue using LUCAS. In particular, all staff found using LUCAS in a moving ambulance very helpful, freeing up the paramedic to undertake other interventions e.g. administer drugs.

When using LUCAS, the need to administer epinephrine could be questioned, since It is recommended to administer epinephrine 1mg

regularly during CPR to improve coronary and cerebral perfusion (Resuscitation Council UK, 2000), yet When using LUCAS, blood pressures of 120/80 were achieved in most cases and VF appears to coarsen. The benefits of administering epinephrine during CPR when using LUCAS are therefore questionable. The authors suggest therefore the use of epinephrine in patients with LUCAS running and with palpable radial pulses is perhaps not required. Further research required.

Initially some minor problems were identified with the LUCAS device. Some of the height adjustment handles cracked around the screw joint, which did not affect the operational effectiveness of the LUCAS device. The manufacturers had encountered a similar problem in Sweden and a new handle, made of a stronger plastic and fixed with a self-tapping screw, was therefore designed. This new handle was fitted



to all of the operational LUCAS devices and to date there have been no more reported problems. Some of the hoods were also initially broken in transit from Sweden, these too have now been resigned and are now stronger. In addition the new LUCAS is now fitted with a more flexible hose, making it easier to connect the oxygen cylinder in operational ambulances.

Conclusion

The results from this small evaluation are very encouraging. Dorset Ambulance Service is now in the process of sharing their data with others and hope to soon begin a full Research Study into the effectiveness of the device. They are pleased with the ROSC thus far and have many fascinating cases which are still being evaluated. They have learned to use the presence of pulses to aid Diagnoses and are studying the effects of lucas in Converting Asystole into VF.

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Dorset Ambulance are pleased to be able to provide a safer more effective treatment to patients in Cardiac Arrest and will aim to keep you up to date with findings.

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