Mekanisk hjertekompresjon ved hjertestans

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Hjertestans ved anafylaksi og bruk av LUCAS|

- 30 år, sectio pga preeklampsi
- Promiten og Macredex iv medfører hypotensjon, bronkospasme, bevissthetstap og moribund tilstand
- Pas intuberes, får adrenalin iv og trakialt, barn forløses
- Ingen palpabel puls og ingen pulsasjon i aorta, sinusrytme på scop (PEA)
- Manuell hjertekompresjon i 30 min, adreanlin, antihistamin, steroider, noradrenalin-infusjon og væske intravenøst

- Etter 15 min med LUCAS pulsgivende hjerterytme (45 min etter hjertestans)
- Sedert og lagt på respirator til neste dag
- Tryptase 95,3 mikrogr/l
- Vekket, ingen sekvele, øm i toraks

Chest 99, Welsh TL et al

- Inverse relationship between duration of CPR and survival after in-hospital cardiac arrest
- 80 % mortalitet ved behov for HLR etter 20-30 min
- Ingen overlevende til utskrivelse ved resucsitering mer enn 30 min

Case report

Use of an automatic mechanical chest compression device (LUCAS) as a bridge to establishing cardiopulmonary bypass for a patient with hypothermic cardiac arrest☆

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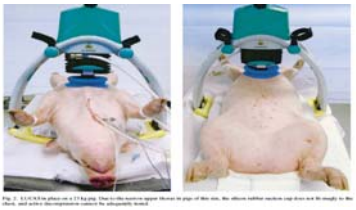
- Mars 03 mann funnet livløs , fastfrosset til bakken
- Oppstart med HLR 08:01, til UUS under pågående HLR, temp 20-21,5 gr C, dilaterte lysstive pupiller, asystole på EKG
- LUCAS startet 08:34, 4 l på HLM 09:13, 09:55 temp 26 gr C, VF konvertert til pulsgivende hjerterytme (ROSC)
- Av HLM etter 140 min.
- Vekket og ekstubert på intensiv, hjem til lokalsykehus etter 6 dager. God mental funksjon etter 14 dager.

- LUCAS: Lund University Cardiopulmonary Assist System
- ROSC: return of spontaneous circulation
- Dårlig kvalitet på manuell HLR etter få minutter (Hightower et al ,L.Wik et al.)
- Dårlig kvalitet på manuell HLR under transport (Stapleton et al , JEMS)

Evaluation of LUCAS,a new device for automatic mechanical compression and active decompression resuscitation
Resuscitation 02,Stig Steen et al



- Randomisert studie på 12 griser med indusert VF viser signifikant bedre cardiac output, carotid artery bloodflow, end-tidal CO2, aorta- og koronar-perfusjon med LUCAS-HLR sammenliknet med manuell HLR
- 83 % ROSC i LUCAS-gruppe
- Ingen ROSC i manuell HLR-gruppe

Verdier etter 5 min resuscitering

MANUELL HLR	LUCAS-HLR
aortic pressure 33 mmHg	42 mmHg
right atrial pressure 23 mmHg	38 mmHg
Coronary perfusion pressure 10 mmHg	17 mmHg
CO 0,5(17%)	0,9 (27%)

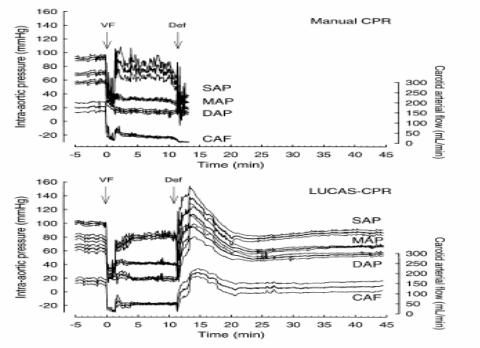


Fig. 7. The pressure- and carotid flow curves in the Group I pigs. There was no ROSC in the manual Group, 5 of the 6 animals obtained ROSC with LUCAS-CPR. Data shown as mean ± S.E.M., $n = 6$ ($n = 5$ after defibrillation in lower panel). CAF = carotid arterial blood flow, SAP, MAP, DAP = systolic, mean and diastolic intrathoracic aortic pressure. VF = induction of ventricular fibrillation. Def = defibrillation.

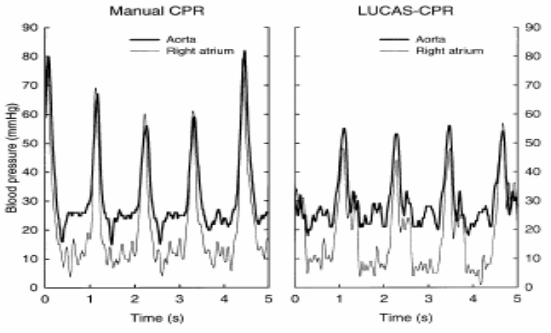


Fig. 8. Typical pressure curves obtained in a 20 kg pig during manual CPR and during LUCAS-CPR. The area between the curves for intrathoracic aortic pressure and right atrial pressure gives a picture of the coronary perfusion pressure. Note the biphasic positive curves and greater area between the curves during LUCAS-CPR.

LUCAS-CPR vs manual CPR

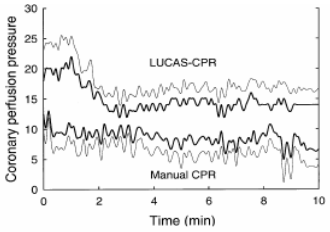


Fig. 9. The coronary perfusion pressure obtained during manual CPR vs. LUCAS-CPR in pigs (Group I). The coarse line shows the mean value. S.E.M. (thin line) is shown only on one side for the sake of clarity. $n = 6$ in both groups.

- 16 griser fikk 90 sek med VF før oppstart med LUCAS i 30 min, deretter defibrillering
- Gruppen med ROSC hadde signifikant høyere koronart perfusjonstrykk, end-tidal CO2 og høyre carotid blodflow

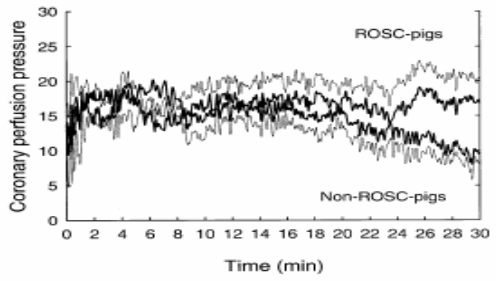


Fig. 11. The coronary perfusion pressure in pigs with ROSC vs. pigs without ROSC (Group II). Data shown as mean ± S.E.M., $n = 8$ in each group. S.E.M. is shown only on one side for the sake of clarity.

Kunstig toraksmodell

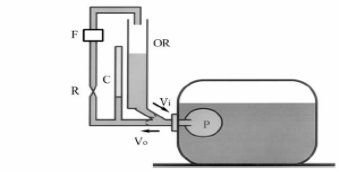


Fig. 3. The artificial thorax model used. P = pressure measurement within a soft plastic bag. Vo = mechanical outlet valve. R = resistance, regulated with a tube compressor. C = compliance (Windkessel effect), regulated by an air-filled side tube. F = flow measured continuously by a flow probe. OR = open reservoir for regulation of filling pressure. Vi = a large inlet valve for rate-unlimited filling of the bag during the decompression phase.

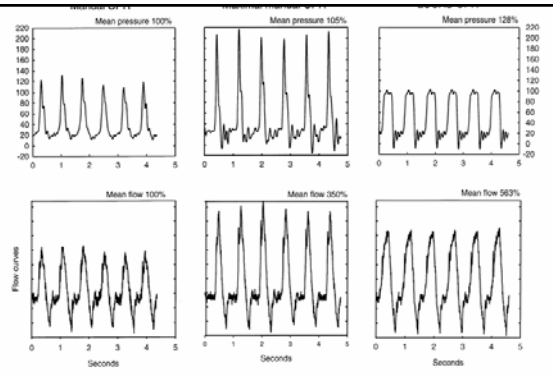


Fig. 6. Typical pressure-flow curves obtained by external compressions on the artificial thorax model. The left panel shows the data obtained when the male rescuer (75 kg body weight) did manual compressions with the force he had been trained to use on an adult patient (these values were defined as 100%). The middle panel shows when the same rescuer performed maximal forceful compressions. The right panel shows LUCAS-compressions. The gas supply was breathing oxygen from a wall outlet (4 bar).

Influence of cardiopulmonary resuscitation prior to defibrillation in patients with out-of-hospital ventricular fibrillation(Cobb et al. J Am Med Assoc 1999)

- Tidlig defibrillering viktigste faktor for overlevelse ved defibrillering mindre enn 4 min etter hjertestans
- 90 sek hjertekomprimering før defibrillering øker overlevelsen hos pas med hjertestans lengre enn 4 min

The critical importance of minimal delay between chest compressions and subsequent defibrillation, S. Steen et al, Recuscitation 2005

Adverse effect of interrupting precordial compression during cardiopulmonary resuscitation(Sato et al.Crit Care Med 1997)

- Eksperimentell studie
- Koronart perfusjonstrykk 26 +-2mmHg under komprimering
- 6+-3mmHg 10 sek etter stans av komprimering, 4+-2 mmHg etter 20 sek
- 80% 24 t-overlevelse ved defib under pågående HLR
- 40% 24t-overlevelse ved befib 10 sek etter stans av komprimering, 0 % etter 20 sek

Treatment of out-of-hospital cardiac arrest with LUCAS, a new device for automatic mechanical compression and active decompression resuscitation☆

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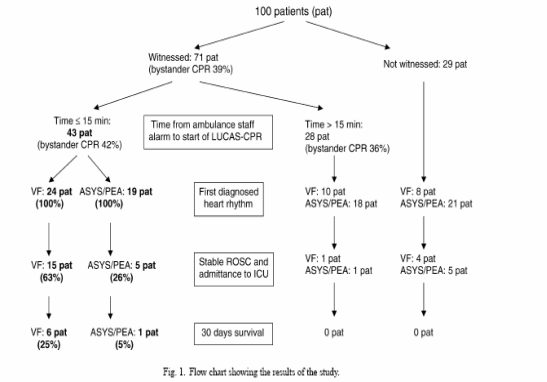

Fig. 1. Flow chart showing the results of the study.

Clinical conseqences of the introduction of mechanical chest compression in the EMS system for treatment of out-of-hospital cardiac arrest
Christer Axelsson et al RESUSCITATION 06

- Ikke bedre overlevelse med mekanisk hjertekomprimering vs standard AHLR
- Svakheter ved studien i disfavør av LUCAS
- 328 pas, 51 % ROSC i begge grupper, i live ved innleggelse 38 % vs 37 %

Increased restoration of spontaneous circulation after cardiac arrest with the Lucas device compared to manual chest compression, Rubertsson 06

- Lucas-gruppe : 9/27 i live ved innleggelse, 2 overlevd sykehusopphold
- Standard AHLR: 3/21 i live ved innleggelse, 1 overlevd sykehus opphold

Konklusjon

- Mekanisk kompresjon og dekompresjon gir signifikant bedre sirkulasjon ved hjertestans sammenliknet med manuell hjertelungeredning i eksperimentelle dyrestudier og kliniske studier
- Andre studier gir ikke signifikant mer overlevelse med mekanisk komprimering
- ERC anbefaler mekanisk komprimering ved spesielle tilstander