Συσκευές υποστήριξης κυκλοφορίας / ζωής στην Μονάδα Εντατικής Θεραπείας και το Αιμοδυναμικό

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ΓΝΑ «Η ΕΛΠΙΣ»
Conflict of interest

- Conflict of interest: None
Causes of cardiac arrest, focusing on causes relevant to the Catheterization Laboratory

**Acute ischemia**
Myocardial infarction (STEMI and NSTEMI and primary angioplasty)
Embolism
Coronary vessel dissection
Perforation of large vessel (e.g., aorta)
Perforation of a heart cavity

**Acute ischemia (as a complication)**
From the use of wires or catheters
From balloon/stent expansion
By injection of contrast media or intracoronary injection of cold liquids
Air embolism
Parasympathetic-like bradycardia and hypotension
Feeling fear/pain
Bezold/Jarisch reflex
Serious allergic reaction to the contrast medium
Acute loss of large amount of blood in retroperitoneal hematoma
   (in cases of femoral access)
Advanced Life Support

Unresponsive and not breathing normally?

Call Resuscitation Team

CPR 30:2
Attach defibrillator/monitor
Minimise interruptions

Assess rhythm

Shockable (VF/Pulseless VT)

1 Shock
Minimise interruptions

Immediately resume CPR for 2 min
Minimise interruptions

Non-shockable (PEA/Asystole)

Return of spontaneous circulation

Immediately resume CPR for 2 min
Minimise interruptions

IMMEDIATE POST CARDIAC ARREST TREATMENT
- Use ABCDE approach
- Aim for SaO₂ of 94-98%
- Aim for normal PaCO₂
- 12 Lead ECG
- Treat precipitating cause
- Targeted temperature management
The Cath Lab is sometimes referred to as the “ideal” place for a CA to occur:

- Lots of stuff - plenty of help
- Staff well trained in critical cardiac care
- ECG monitoring allows for rhythm disturbances to be immediately recognized
- Etiology usually known (catastrophic coronary or myocardial event)
- Opportunity usually exists to treat, even correct the underlying issue

Cardiac arrest in the Cath Lab

- Cardiac arrest (commonly VF) may occur during PCI for STEMI or non-STEMI, but it may also be a complication of angiography.

- In this special setting with immediate response to monitored VF, defibrillation without preceding chest compressions is recommended.

- If needed for failed defibrillation or immediately recurring VF, immediate defibrillation may be repeated up to two times.
If VF persists after the initial three shocks or ROSC not immediately established with certainty, chest compressions and ventilations must be initiated without further delay and a cause for the unresolved problem sought with further coronary angiography.

Cardiac arrest in a patient with LM and 3VD, STEMI and Cardiogenic Shock
Manual CPR in the Cath Lab
Disadvantages of manual CPR in the Catheterization Laboratory

**Difficulty of execution**
- Limited space around the table
- Excessively stretched operator hands
- Unstable table position
- Increased duration of compressions

**Excessive operator exposure to ionizing radiation:**
- Hands under the amplifier
- Head near the generator and amplifier

**Poor quality of images of cardiac catheterization**
On an angiography table with the image intensifier above the patient, delivering chest compressions with adequate depth and rate is almost impossible and exposes the rescuers to dangerous radiation.

Therefore, early transition to the use of a mechanical chest compression device is strongly recommended.
Automatic Mechanical Chest compression Devices
Advantages of automatic CPR in the Catheterization Laboratory

- Uninterrupted chest compressions without the need for change between rescuers
- Better quality of chest compressions at a constant rhythm and depth
- No exposure of the rescuer to ionizing radiation
- Less staff in the Cath Lab
- Performing PCI with more ease

✓ Specific problems related to their use are:
  
  - the time required for their placement, which can be reduced to 10-15 s with continuous training, and
  
  - the limited ability for proper fluoroscopy across all projection planes during PCI (the metal parts or/and the volume of the devices prevent front and rear projections)
The Lund University Cardiac Arrest System (LUCAS) is a gas- (oxygen or air) or electric-powered piston device that produces a consistent chest compression rate and depth.

It incorporates a suction cup on the end of the piston that attaches to the sternum and returns the sternum to the starting position when it retracts.
The Setup of the LUCAS devise
The mechanical chest compression device LUCAS in its anterior-posterior position on the chest allows oblique views.
Coronary Intervention with the LUCAS device on

The LUCAS-CPR algorithm

Coronary Ostium diastolic pressure
20-25mmHg

Right atrial diastolic pressure 5 mmHg

Box-like pressure during LUCAS compression. Satisfactory coronary perfusion pressure.

Coronary artery diastolic pressure

Coronary perfusion pressure

Atrial diastolic pressure

Pressure in the left coronary artery/aortic root on the left side. Pressures in the right atrium on the right side.

Coronary perfusion pressure = Coronary artery diastolic pressure – atrial (coronary sinus) diastolic pressure = Coronary perfusion pressure

The load-distributing band (LDB) is a circumferential chest compression device composed of a pneumatically or electrically actuated constricting band and backboard.
AutoPulse, Zoll
Figure 3. Arterial blood pressure trace with AutoPulse activation during cardiac arrest that followed left main stem occlusion after TAVR. During automated chest compressions, a systolic blood pressure of 120 mm Hg was achieved. The white arrow marks the pause of the AutoPulse with an unassisted blood pressure 40 mm Hg.
Use of automatic mechanical chest compression devices

- Data are available only from their use by non-medical staff for victims of out-of-hospital CA.
- Four multicenter studies:
  - Auto Pulse Assisted Prehospital International Resuscitation (ASPIRE),
  - Circulation Improving Resuscitation Care (CIRC),
  - Prehospital Randomized Assessment of a Mechanical Compression Device in Cardiac Arrest (PARAMEDIC), and
  - LUCAS in Cardiac Arrest (LINC),

Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial

Gavin D Perkins, Ranjit Lall, Tom Quinn, Charles D Deakin, Matthew W Cooke, Jessica Horton, Sarah E Lamb, Anne-Marie Slowther, Malcolm Woollard, Andy Carson, Mike Smyth, Richard Whitfield, Amanda Williams, Helen Pocock, John J M Black, John Wright, Kyee Han, Simon Gates, PARAMEDIC trial collaborators*

Summary

Background Mechanical chest compression devices have the potential to help maintain high-quality cardiopulmonary resuscitation (CPR), but despite their increasing use, little evidence exists for their effectiveness. We aimed to study whether the introduction of LUCAS-2 mechanical CPR into front-line emergency response vehicles would improve survival from out-of-hospital cardiac arrest.

Methods The pre-hospital randomised assessment of a mechanical compression device in cardiac arrest (PARAMEDIC) trial was a pragmatic, cluster-randomised open-label trial including adults with non-traumatic, out-of-hospital cardiac arrest from four UK Ambulance Services (West Midlands, North East England, Wales, South Central). 91 urban and semi-urban ambulance stations were selected for participation. Clusters were ambulance service vehicles, which were randomly assigned (1:2) to LUCAS-2 or manual CPR. Patients received LUCAS-2 mechanical chest compression or manual chest compressions according to the first trial vehicle to arrive on scene. The primary outcome was survival at 30 days following cardiac arrest and was analysed by intention to treat. Ambulance dispatch staff and those collecting the primary outcome were masked to treatment allocation. Masking of the ambulance staff who delivered the interventions and reported initial response to treatment was not possible. The study is registered with Current Controlled Trials, number ISRCTN08233942.

Findings We enrolled 4471 eligible patients (1652 assigned to the LUCAS-2 group, 2819 assigned to the control group) between April 15, 2010 and June 10, 2013. 985 (60%) patients in the LUCAS-2 group received mechanical chest compression, and 11 (<1%) patients in the control group received LUCAS-2. In the intention-to-treat analysis, 30 day survival was similar in the LUCAS-2 group (104 [6%] of 1652 patients) and in the manual CPR group (193 [7%] of 2819 patients; adjusted odds ratio [OR] 0.86, 95% CI 0.64–1.15). No serious adverse events were noted. Seven clinical adverse events were reported in the LUCAS-2 group (three patients with chest bruising, two with chest lacerations, and two with blood in mouth). 15 device incidents occurred during operational use. No adverse or serious adverse events were reported in the manual group.

Interpretation We noted no evidence of improvement in 30 day survival with LUCAS-2 compared with manual compressions. On the basis of ours and other recent randomised trials, widespread adoption of mechanical CPR devices for routine use does not improve survival.
✓ **No statistically significant difference in mortality** was shown between manual chest compressions and the use of automatic thoracic compression devices in patients suffering from out-of-hospital CA.

Use of automatic mechanical chest compression devices

- However, it is worth mentioning that the same guidelines state that they could be used in special cases, such as:
  - A limited number of CPR providers,
  - Long-lasting CPR,
  - Cases of hypothermia, and
  - Use in a moving ambulance,
  - In the angiography suite,
  - During preparation for extracorporeal CPR (ECPR)
Data on the use of these devices in the Cath Lab are limited and based on individual clinical case reports.

In the guidelines, their use is clearly adopted in supporting patients undergoing PCIs or CT scan and in prolonged CPR (class IIa), and most importantly, it is emphasized that they should be used by suitably trained staff.
Correspondence

Successful primary PCI during prolonged continuous cardiopulmonary resuscitation with an automated chest compression device (AutoPulse)

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The term ECPR is used to describe the initiation of **cardiopulmonary bypass during the resuscitation** of a patient in cardiac arrest.

This involves the emergency **cannulation of a large vein and artery** (e.g., femoral vessels) and initiation of veno-arterial extracorporeal circulation and oxygenation.

The goal of ECPR is to **support patients between cardiac arrest and ROSC**, while potentially reversible conditions are addressed.

ECPR is a complex process that requires a highly trained team and specialized equipment.
Percutaneous Left Ventricular Support Devices

1. IABP

2. Impella

3. TandemHeart

4. ECMO
IABP, although widely available and easy to operate and implant under emergency settings, is ineffective in total circulatory collapse.
Impella

It is widely available, can be rapidly implanted through femoral access sheaths, and provides good circulatory support.
Although TandemHeart provides **significant circulatory support**, its widespread use is likely to be **limited** due to the requirement of transseptal puncture to place the left atrial cannula, which may be difficult, and possibly hazardous, during cardiac arrest, even in skilled hands.
ExtraCorporeal Membrane Oxygenation

ECMO

The ECMO system consists of a centrifugal pump, a heat exchanger, and membrane oxygenator.

ECMO has the advantage of **correcting hypoxemia in addition to providing powerful circulatory support**, but may require additional staff to support implantation and device operation.
Extracorporeal membrane oxygenation–assisted primary percutaneous coronary intervention may improve survival of patients with acute myocardial infarction complicated by profound cardiogenic shock☆,☆☆

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Extracorporeal membrane oxygenation–assisted PCI for patients with AMI that is complicated by profound CS may improve the 30-day and 1-year survival rates.
Under the circumstances of **refractory VT/VF**, for patients with AMI presented with CS receiving primary PCI, the **survival rate was significantly improved** in the era when **ECMO assistance** made possible.
# Comparison of Percutaneous Left Ventricular Support Devices

<table>
<thead>
<tr>
<th></th>
<th>IABP</th>
<th>Impella 2.5 L</th>
<th>Impella 3.8 L</th>
<th>Impella 5 L</th>
<th>TandemHeart</th>
<th>ECMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmentation of CO (L/min)</td>
<td>0.3–0.5</td>
<td>2.5</td>
<td>3.8</td>
<td>5</td>
<td>3.5–4</td>
<td>&gt; 4.5</td>
</tr>
<tr>
<td>Vascular access</td>
<td>7–9-F femoral artery</td>
<td>13-F femoral artery</td>
<td>14-F femoral artery</td>
<td>22-F subclavian artery or femoral artery</td>
<td>21-F inflow left atrium (TS); 15/17-F outflow via femoral artery</td>
<td>18–21-F inflow right atrium; 15–22-F outflow via femoral artery</td>
</tr>
<tr>
<td>Cannula implantation technique</td>
<td>Seldinger</td>
<td>Seldinger</td>
<td>Seldinger</td>
<td>Surgical cutdown</td>
<td>Surgical, trans-septal puncture</td>
<td>Surgical or Seldinger</td>
</tr>
<tr>
<td>Ease of implantation</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Pump mechanism</td>
<td>Pneumatic</td>
<td>Axial</td>
<td>Axial</td>
<td>Axial</td>
<td>Centrifugal</td>
<td>Centrifugal</td>
</tr>
<tr>
<td>Rhythm dependent</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Oxygenator</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

There is insufficient evidence to recommend the routine use of ECPR for patients with cardiac arrest.

In settings where it can be rapidly implemented, ECPR may be considered for select patients for whom the suspected etiology of the cardiac arrest is potentially reversible during a limited period of mechanical cardiorespiratory support (Class IIb, LOE C-LD).
Conclusions

✓ The appearance of **CA in the Cath Lab**, although uncommon, is a very stressful and extremely urgent situation.

✓ It is not an exaggeration to say that the Cath Lab is the **best place for a CA to occur**.

✓ **Educated rescuers** resuscitate and save CA victims' lives.

✓ Use of **Circulation/Life Support Devices in the Cath Lab** maybe life saving in **certain cases of CA** in the Cath Lab

✓ Therefore, knowledge and implementation of their use by **trained Cath Lab staff** (medical and nursing) is imperative.
Ευχαριστώ για την προσοχή σας