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Role of mechanical CPR and/or assisted devices (ITD, ACD)

廖文進

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Role of mechanical CPR and/or assisted devices (ITD, ACD)

- **Classes of Recommendation & Levels of Evidence**
- **Highlights**
- **Devices to Support Circulation**
  - **Impedance Threshold Device**
  - **Active Compression-Decompression CPR**
    - **Active Compression-Decompression CPR + Impedance Threshold Device**
  - **Mechanical Chest Compression Devices: Piston Device**
  - **Load-Distributing Band Devices**
  - **Extracorporeal Techniques and Invasi Perfusion Devices**
- **Conclusion**

New AHA Classification System for Classes of Recommendation and Levels of Evidence

CLASS I (STRONG) — **Benefit >>> Risk**

Suggested phrases for writing recommendations:

- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

New AHA Classification System for Classes of Recommendation and Levels of Evidence

CLASS IIa (MODERATE) **Benefit >> Risk**

Suggested phrases for writing recommendations:

- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — Benefit ≥ Risk

Suggested phrases for writing recommendations:

- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — Benefit = Risk

(Generally, LOE A or B use only)

Suggested phrases for writing recommendations:

- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

New AHA Classification System for Classes of Recommendation and Levels of Evidence

CLASS III: Harm (STRONG) **Risk > Benefit**

Suggested phrases for writing recommendations:

- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

New AHA Classification System for Classes of Recommendation and Levels of Evidence

LEVEL A

- High-quality evidence‡ from more than 1 RCTs
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

LEVEL B-R (Randomized)

- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

New AHA Classification System for Classes of Recommendation and Levels of Evidence

LEVEL B-R (Randomized)

- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

LEVEL B-NR (Nonrandomized)

- Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

New AHA Classification System for Classes of Recommendation and Levels of Evidence

LEVEL C-LD (Limited Data)

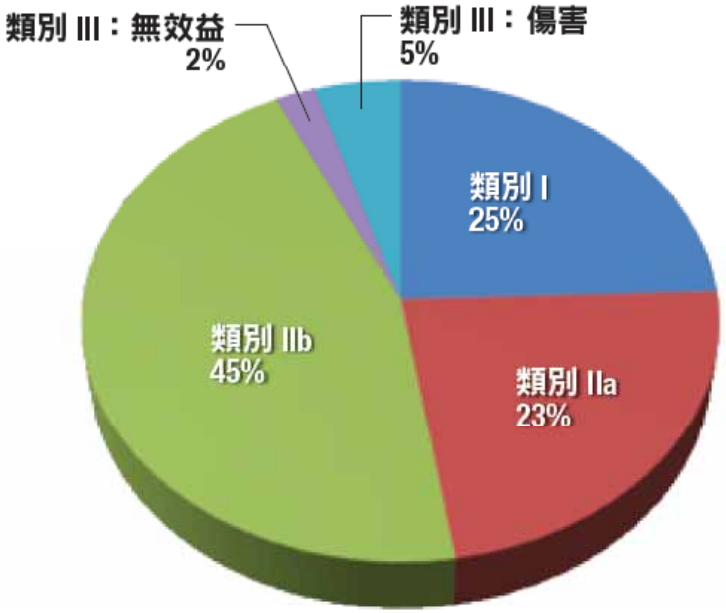
- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL C-EO (Expert Opinion)

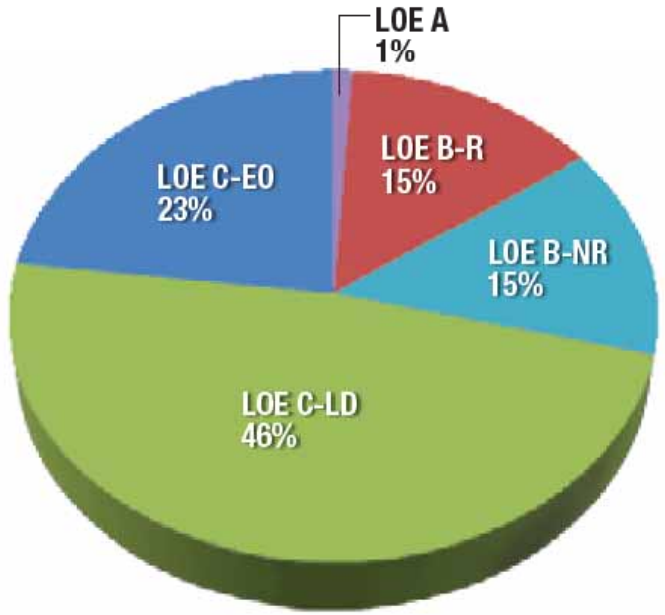
Consensus of expert opinion based on clinical experience

建議類別與證據等級分布
(2015 年 AHA 準則更新資訊中
總計 315 項建議的分布百分比)

2015 年建議類別



證據等級 (品質)



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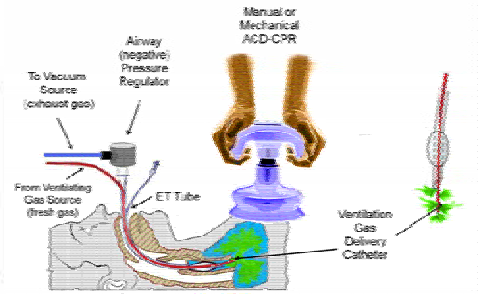
Highlights

- **Conventional CPR consisting of manual chest compressions interspersed with rescue breaths is inherently inefficient with respect to generating significant cardiac output.**
  - A variety of **alternatives and adjuncts to conventional CPR** have been developed with the aim of **enhancing cardiac output** resuscitation from cardiac arrest.
    - **Compared with conventional CPR, many of these techniques and devices require specialized equipment and training.**



Summary of Key Issues and Major Changes

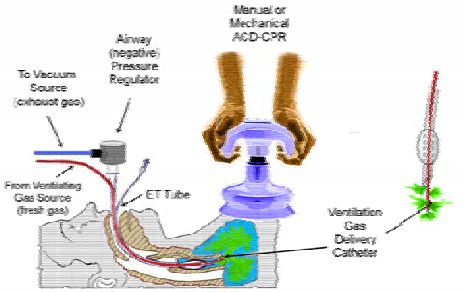
阻抗閥門裝置

- The routine use of the **impedance threshold device (ITD)** as an adjunct to conventional CPR is not recommended.
- The use of the **ITD plus active compression decompression CPR** is associated with improved neurologically intact survival for patients with OHCA.

機械胸部按壓裝置

- **The routine use of mechanical chest compression devices is not recommended,** but special settings where this technology may be useful are identified.
- The use of **ECPR** may be considered for selected patients in settings where **a reversible cause of cardiac arrest is suspected**.



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Devices to Support Circulation

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Impedance Threshold Device

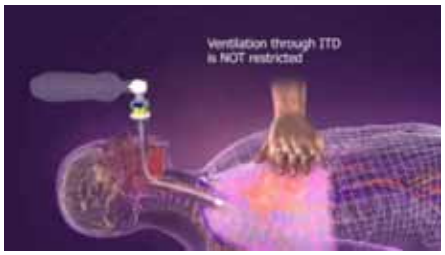
阻抗閥門裝置

- The impedance threshold device (**ITD**) is a pressure-sensitive valve that is attached to an **endotracheal tube** (ETT), **supraglottic airway**, or **face mask**.
- The **ITD limits air entry into the lungs during the decompression phase of CPR**, enhancing the negative intrathoracic pressure generated during chest wall recoil, thereby improving venous return to the heart and cardiac output during CPR.

2015 updated: ***The routine use of the ITD as an adjunct during conventional CPR is not recommended. (Class III: No Benefit, LOE A)***

The combination of ITD with active compression-decompression CPR may be a reasonable alternative to conventional CPR in settings with available equipment and properly trained personnel.

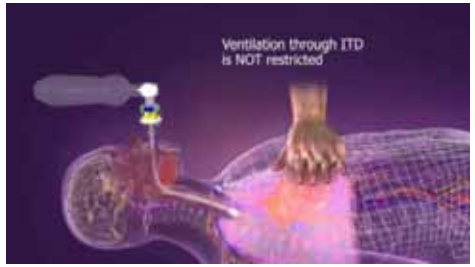
Provides Therapeutic Benefit During	Inspiration	Chest wall recoil phase of CPR
Intended for	Spontaneously breathing patients	Patients requiring assisted breathing (e.g. cardiac arrest)
Valve Cracking "Opening" Pressure	-7 cmH_2O	-10 cmH_2O
Valving Mechanism	Partially impedes airflow into the lungs until threshold of -7 cmH_2O is reached	Completely impedes airflow into the lungs until threshold of -10 cmH_2O is reached
Other Features	O_2 port permits administration of supplemental oxygen	Timing lights promote proper ventilation and chest compression rates



Impedance Threshold Devices

Why:

- One large multicenter randomized clinical trial **failed to demonstrate any improvement associated with the use of an ITD** (compared with a sham device) as an adjunct to conventional CPR.
- Another clinical trial demonstrated a benefit with the use of active compression-decompression CPR plus an ITD when compared with conventional CPR and no ITD.
  - However, confidence intervals around the primary outcome point estimate were very broad, and **there is a high risk of bias on the basis of co-intervention** (the group receiving active compression decompression CPR plus the ITD also had CPR delivered using CPR quality feedback devices, while the control arm did not have the use of such feedback.




Devices to Support Circulation

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Active Compression-Decompression CPR

- **Active compression-decompression CPR** (**ACD-CPR**) is performed with a device that includes a suction cup to actively lift the anterior chest during decompression.
  - The application of external negative suction during the decompression phase of CPR creates negative intrathoracic pressure and thus potentially enhances venous return to the heart.
  - When used, the device is positioned at midsternum on the chest.

2015 updated: ***There is insufficient evidence to recommend for or against the routine use of ACD-CPR. ACD-CPR may be considered for use when providers are adequately trained and monitored. (Class IIb, LOE B)***

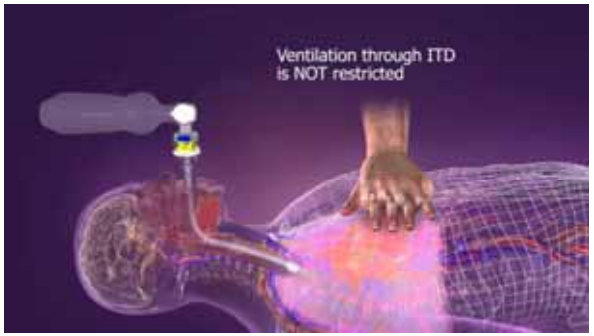
Active Compression-Decompression CPR

❖ Why:

- Results from the use of ACD-CPR have been mixed.
- In several studies **ACD-CPR improved ROSC and short-term survival** compared with conventional CPR.
  - Of these studies, 3 showed improvement in neurologically intact survival.
- In contrast, **1 Cochrane meta-analysis of 10 studies** involving both in-hospital arrest (826 patients) and out-of-hospital arrest (4162 patients) and several other controlled trials comparing **ACD-CPR to conventional CPR showed no difference in ROSC or survival**.
  - The meta-analysis did not find any increase in ACD-CPR–related complications.

Active Compression-Decompression CPR + Impedance Threshold Device

- **ACD-CPR** is believed to act synergistically with the **ITD** to **enhance venous return** during chest decompression and improves blood flow to vital organs during CPR.
  - Commercially available ACD-CPR devices have a gauge meter to guide compression and decompression forces and a metronome to guide duty cycle and chest compression rate.



Active Compression-Decompression CPR + Impedance Threshold Device

- The combination of ACD-CPR with an ITD has been studied in 4 RCTs reported in 5 publications.
  - Two of these trials evaluated ACD-CPR with the ITD in comparison with ACD-CPR alone. The first of these used femoral artery catheters to measure improved hemodynamic parameters but found **no difference in ROSC, 24-hour survival, or survival to hospital discharge**.
  - In a follow-up RCT of 400 patients, the ACD-CPR with a functioning ITD increased 24-hour survival, but again there was **no difference in survival to hospital discharge or survival with good neurologic function** as compared with the ACD-CPR with sham ITD group.

2015 updated: ***The existing evidence, primarily from 1 large RCT of low quality, does not support the routine use of ACD-CPR+ITD as an alternative to conventional CPR. The combination may be a reasonable alternative in settings with available equipment and properly trained personnel. (Class IIb, LOE C-LD)***

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Mechanical Chest Compression Devices:Piston Device

機械胸部按壓裝置

- A mechanical piston device consists of **an automated compressed gas- or electric-powered plunger positioned over the sternum**, which compresses the chest at a set rate.
  - Some devices incorporate **a suction cup** at the end of the piston that is designed to actively decompress the chest after each compression, whereas others do not.

Mechanical Chest Compression Devices:Piston Device

2015 updated: *The evidence does not demonstrate a benefit with the use of mechanical piston devices for chest compressions versus manual chest compressions in patients with cardiac arrest.*
Manual chest compressions remain the standard of care for the treatment of cardiac arrest**, **but mechanical piston devices may be a reasonable alternative for use by properly trained personnel**. **(Class IIb, LOE B-R)

2015 updated: *The use of mechanical piston devices may be considered in specific settings where the delivery of high quality manual compressions may be challenging or dangerous for the provider (eg, **limited rescuers available, prolonged CPR**, **during hypothermic cardiac arrest**, **in a moving ambulance**, **in the angiography suite**, **during preparation for extracorporeal CPR [ECPR])**, provided that rescuers strictly limit interruptions in CPR during deployment and removal of the devices**. (Class IIb, LOE C-EO)***

Mechanical Chest Compression Devices:Piston Device

❖ Why:

- Two large RCTs, the Prehospital Randomised Assessment of a Mechanical Compression Device in Cardiac Arrest and LUCAS in Cardiac Arrest trials, have **compared the use of LUCAS against manual compressions for patients with OHCA**.
  - Together, these studies enrolled 7060 patients, and **neither demonstrated a benefit for mechanical CPR over manual CPR** with respect to early (4-hour) and late (1-and 6-month) survival.
  - The PARAMEDIC study demonstrated **a negative association between mechanical chest compressions and survival** with good neurologic outcome at 3 months as compared with manual compressions**.**
- Three small (largest sample size of 50 patients) RCTs found **no differences in early survival** despite improvements in end-tidal CO2 in patients randomly assigned to mechanical piston devices in 2 of these 3 studies.

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Load-Distributing Band Devices

- The **load-distributing band** (**LDB**) is a circumferential chest compression device composed of a pneumatically or electrically actuated constricting band and backboard.

2015 updated: *The evidence does not demonstrate a benefit with the use of LDB-CPR for chest compressions versus manual chest compressions in patients with cardiac arrest.* ***Manual chest compressions remain the standard of care for the treatment of cardiac arrest, but LDB-CPR may be a reasonable alternative for use by properly trained personnel. (Class IIb, LOE B-R)***

Load-Distributing Band Devices

- The **load-distributing band** (**LDB**) is a circumferential chest compression device composed of a pneumatically or electrically actuated constricting band and backboard.

2015 updated: *The use of LDB-CPR may be considered in specific settings where the delivery of high-quality manual compressions may be challenging or dangerous for the provider (eg,* ***limited rescuers available****,* ***prolonged CPR****,* ***during hypothermic cardiac arrest****,* ***in a moving ambulance****,* ***in the angiography suite****,* ***during preparation for ECPR****), provided that rescuers strictly limit interruptions in CPR during deployment and removal of the devices.* ***(Class IIb, LOE C-EO)***

Load-Distributing Band Devices

❖ Why:

- While early case series of patients treated with LDB-CPR were encouraging, an observational study exploring a number of treatments related to new guideline implementation suggested that the use of **LDB-CPR was associated with lower odds of 30-day survival** when compared with concurrent patients receiving only manual CPR.
- One multicenter prospective RCT comparing LDB-CPR with manual CPR for OHCA **demonstrated no improvement in 4-hour survival and worse neurologic outcome** when the device was compared with manual CPR. Site-specific factors and experience with deployment of the device may have influenced the outcomes in this study.
- In a high-quality multicenter RCT of 4753 OHCA patients, LDB-CPR and manual chest compressions were shown to **be equivalent with respect to the outcome of survival to hospital discharge.**

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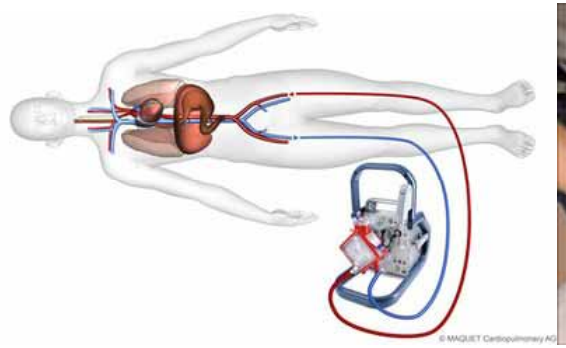
Extracorporeal CPR

- This involves the **emergency cannulation of a large vein and artery** (eg, femoral vessels) and initiation of venoarterial extracorporeal circulation and oxygenation.
  - The goal of ECPR is to support patients between cardiac arrest and restoration of spontaneous circulation **while potentially reversible conditions are addressed.**
    - ECPR is a complex process that **requires a highly trained team, specialized equipment**, and **multidisciplinary support** within the local healthcare system.



Extracorporeal CPR

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

2015 updated: *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)***

- For ECPR, the inclusion criteria are highly variable, most included only patients **aged 18 to 75 years**, with **arrest of cardiac origin**, after **conventional CPR for more than 10 minutes without ROSC**.
  - Such inclusion criteria should be considered in a provider's selection of potential candidates for ECPR.

Extracorporeal CPR

Why:

- There are no data on the use of ECPR from RCTs.
  - Early observational studies in small numbers of witnessed inhospital cardiac arrest (IHCA) and OHCA patients **younger than 75 years with potentially reversible conditions suggested improved survival** when compared with conventional CPR.
  - The **2015 ILCOR ALS Task Force** reviewed several observational studies, some of which used propensity matching. **The results of the studies are mixed.**
    - One propensity-matched prospective observational study enrolling 172 IHCA patients reported greater likelihood of return of spontaneous beating in the ECPR group **and improved survival at hospital discharge**, **30-day**, and **1-year** follow-up with the use of ECPR. However, this study **showed no difference in neurologic outcomes.**
    - A propensity-matched retrospective observational study enrolling 118 IHCA patients showed **no survival or neurologic benefit** with ECPR at the time of hospital discharge, 30-day, or 1-year follow-up

ILCOR: International Liaison Committee on Resuscitation

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感謝聆聽
恭請指教