

Mechanical Cardiopulmonary Resuscitation (CPR): Lucas Chest Compression System

Dr Keith Ho
Registrar
NUH Emergency Department

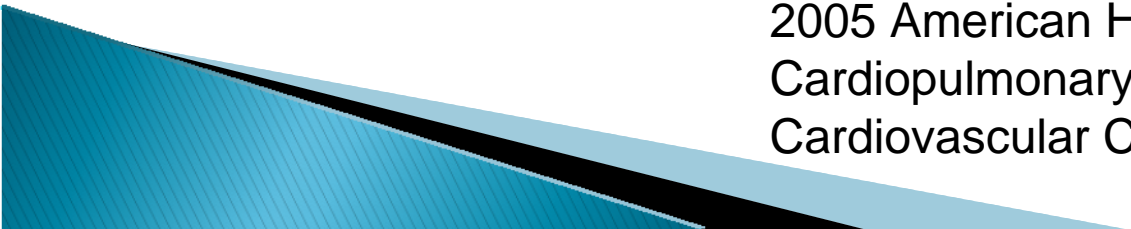
CPR

- ▶ Why is it important?
- ▶ Provides Oxygen to the brain and the heart
 - Coronary Perfusion Pressure
- ▶ Early bystander CPR: can **double or triple** the victim's chance of survival from sudden cardiac arrest



CPR: Recommendations

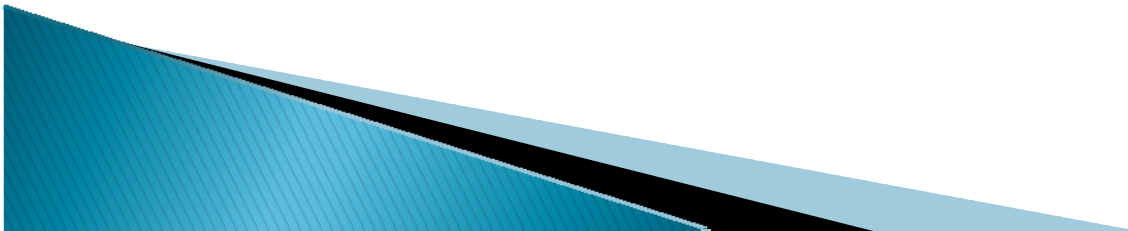
- ▶ Compression to ventilation ratio : 30:2
- ▶ Compression rate : 100 per minute
- ▶ Compression depth : 4–5 cm
- ▶ Allow the chest to completely recoil after each compression
- ▶ Equal compression and relaxation times.
- ▶ Minimize interruptions in chest compressions



2005 American Heart Association Guidelines for
Cardiopulmonary Resuscitation and Emergency
Cardiovascular Care

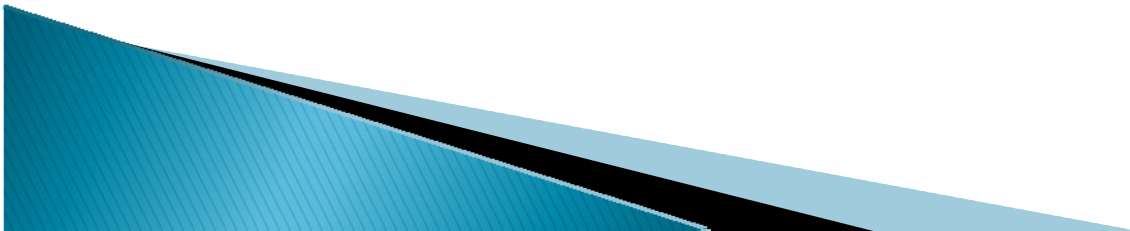
CPR: Human factors

- ▶ Significant fatigue and shallow compressions are seen after 1 minute of CPR
- ▶ Rescuers may deny that fatigue is present for 5 minutes
- ▶ When 2 or more rescuers are available, it is reasonable to switch the compressor about every 2 minutes
 - Problem of excessive interruptions of CPR



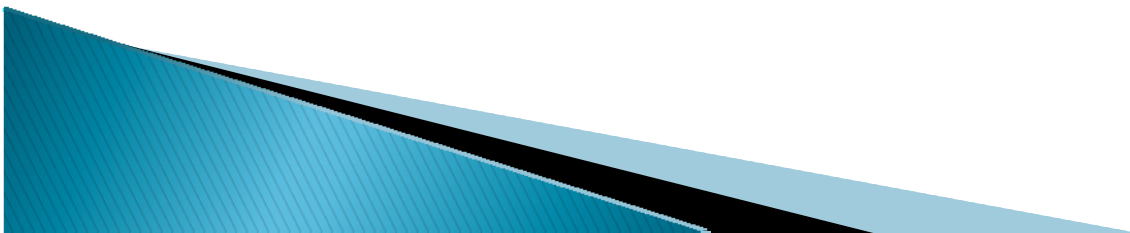
Mechanical CPR

- ▶ Enable hands-free compressions in most situations
- ▶ **Frees up rescuers to focus on other life-saving tasks**
 - Ventilation
 - Administer medication
 - Defibrillation

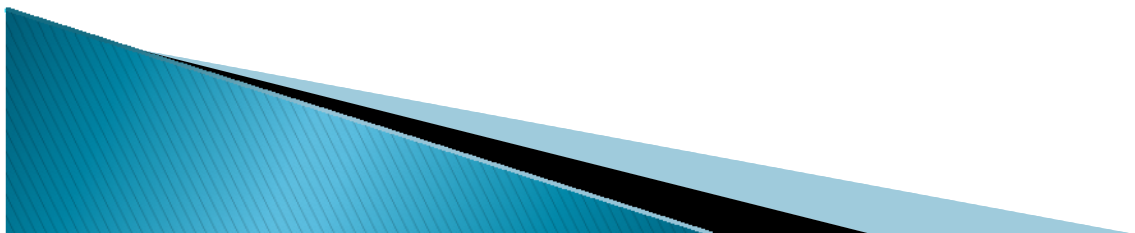
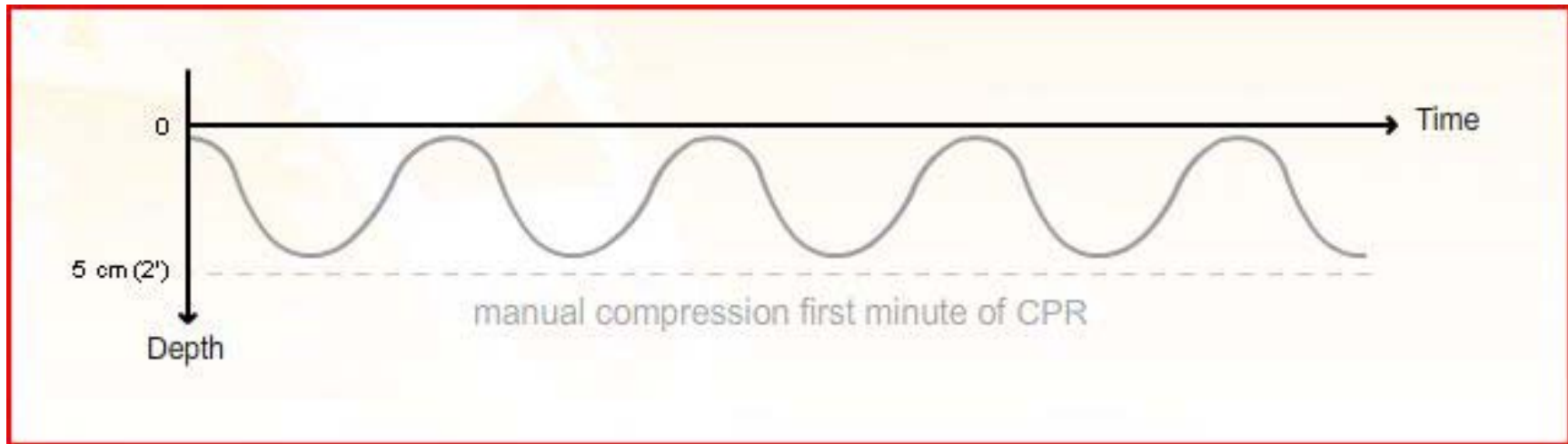


Mechanical CPR

- ▶ Provide good circulation during patient transport
- ▶ Enhance safety during transport for both EMS personnel and the patient
- ▶ Provide consistent, effective and uninterrupted compressions



Manual CPR

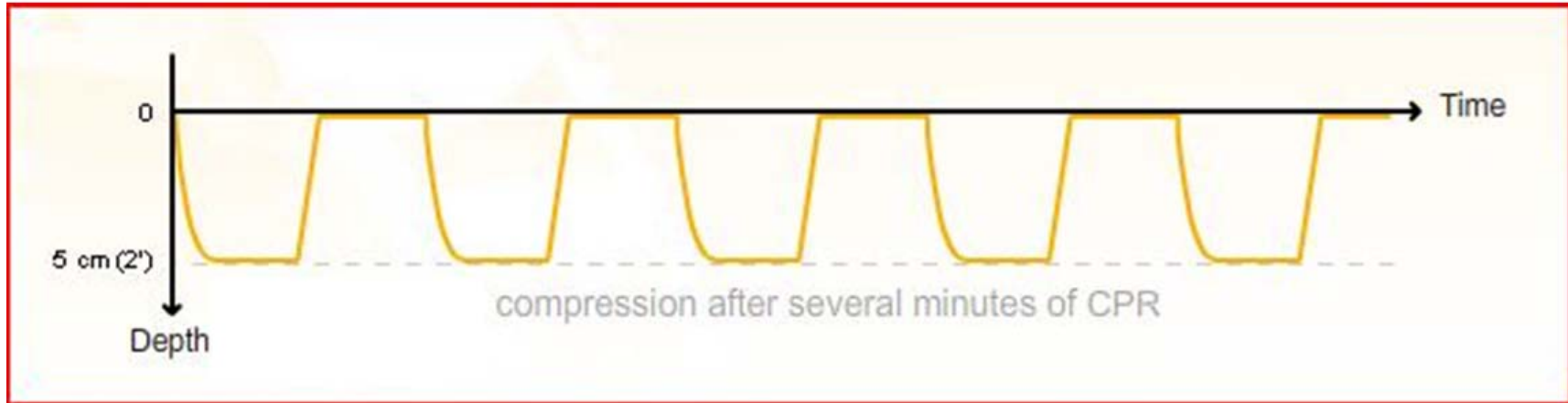


Manual CPR

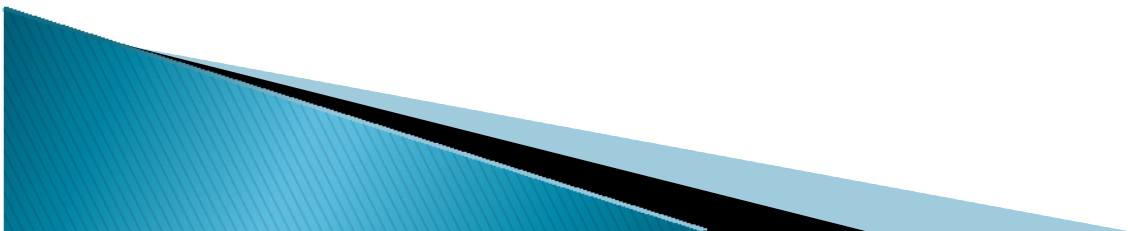


- ▶ Difficult to keep up good cardiac compressions for more than a few minutes
- ▶ Common errors: Too slow. Too shallow. Not allowing complete recoil

Mechanical CPR



- ▶ Consistent compressions over time
- ▶ Independent of rescuer technique or fatigue



LUCAS Chest Compression System



LUCAS: Power source & Operation

- ▶ Fully pneumatic (compressed air)
- ▶ Gas driven piston
- ▶ Breathing air from a portable compressed air cylinder

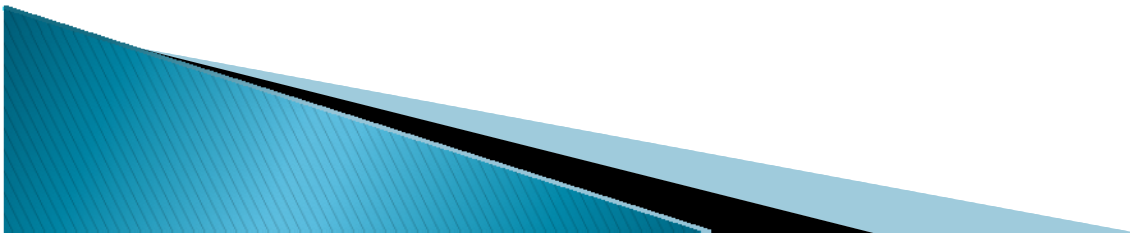


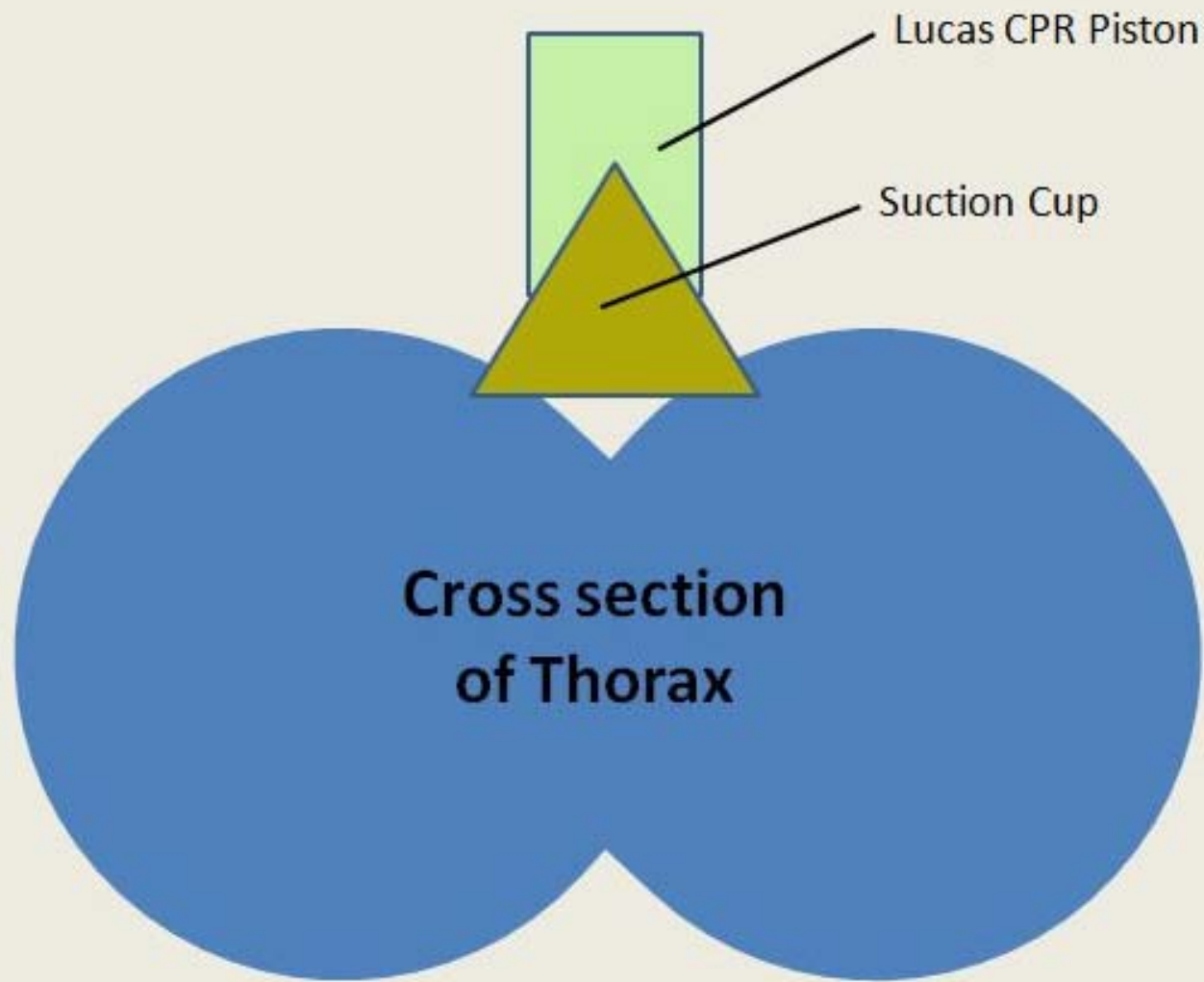
LUCAS: Technical Information

- ▶ Fits on most patients
- ▶ Can be applied quickly: “no-flow” of less than 20 seconds
- ▶ Compact: 65 x 33 x 25 cm
- ▶ Lightweight (unit only): 6.3 kg



Active Decompression CPR (ACD CPR)



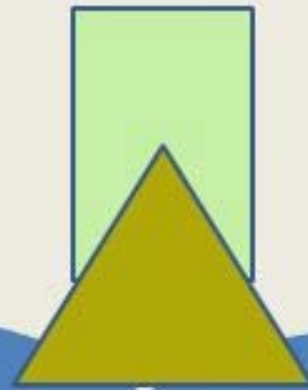


Lucas CPR Piston

Suction Cup

**Cross section
of Thorax**

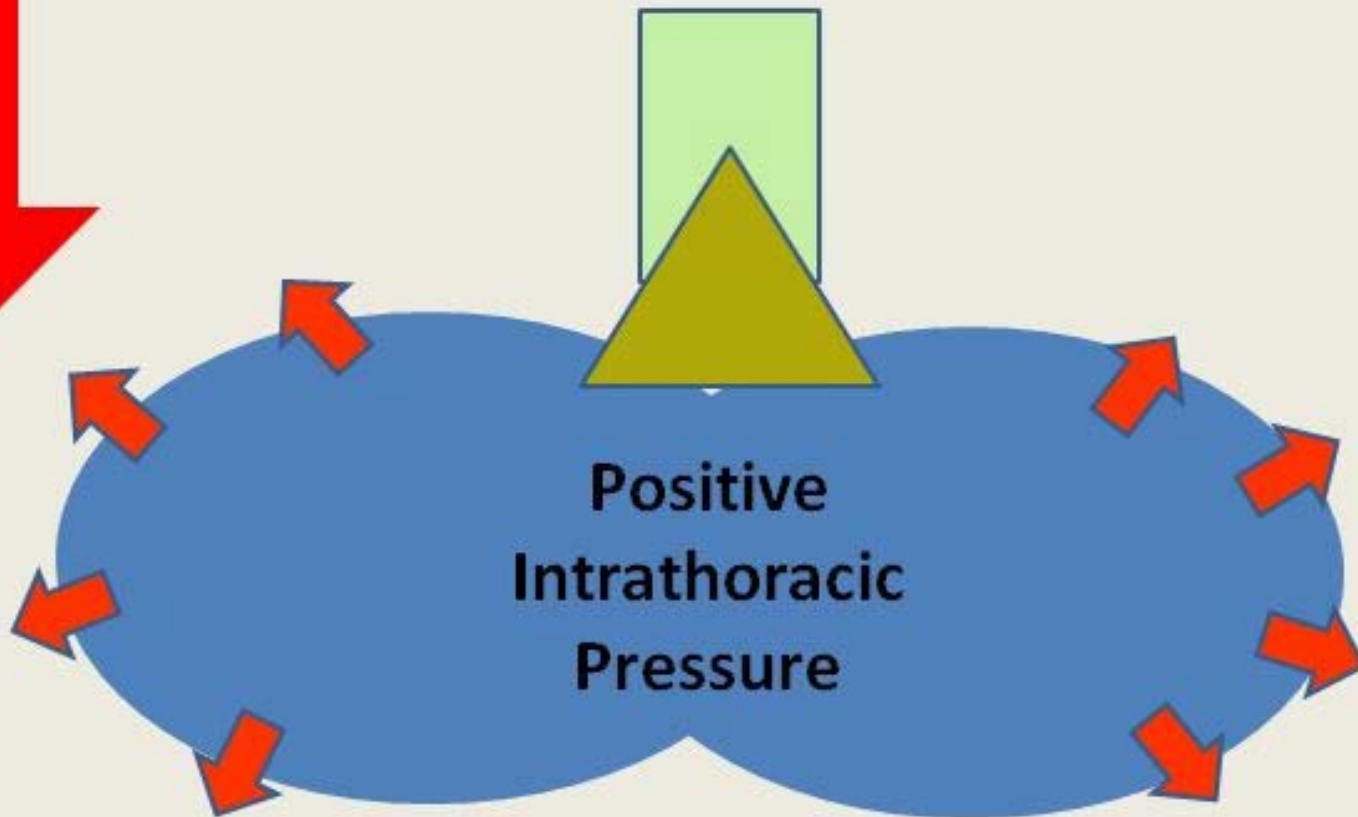
**Compression
Phase**



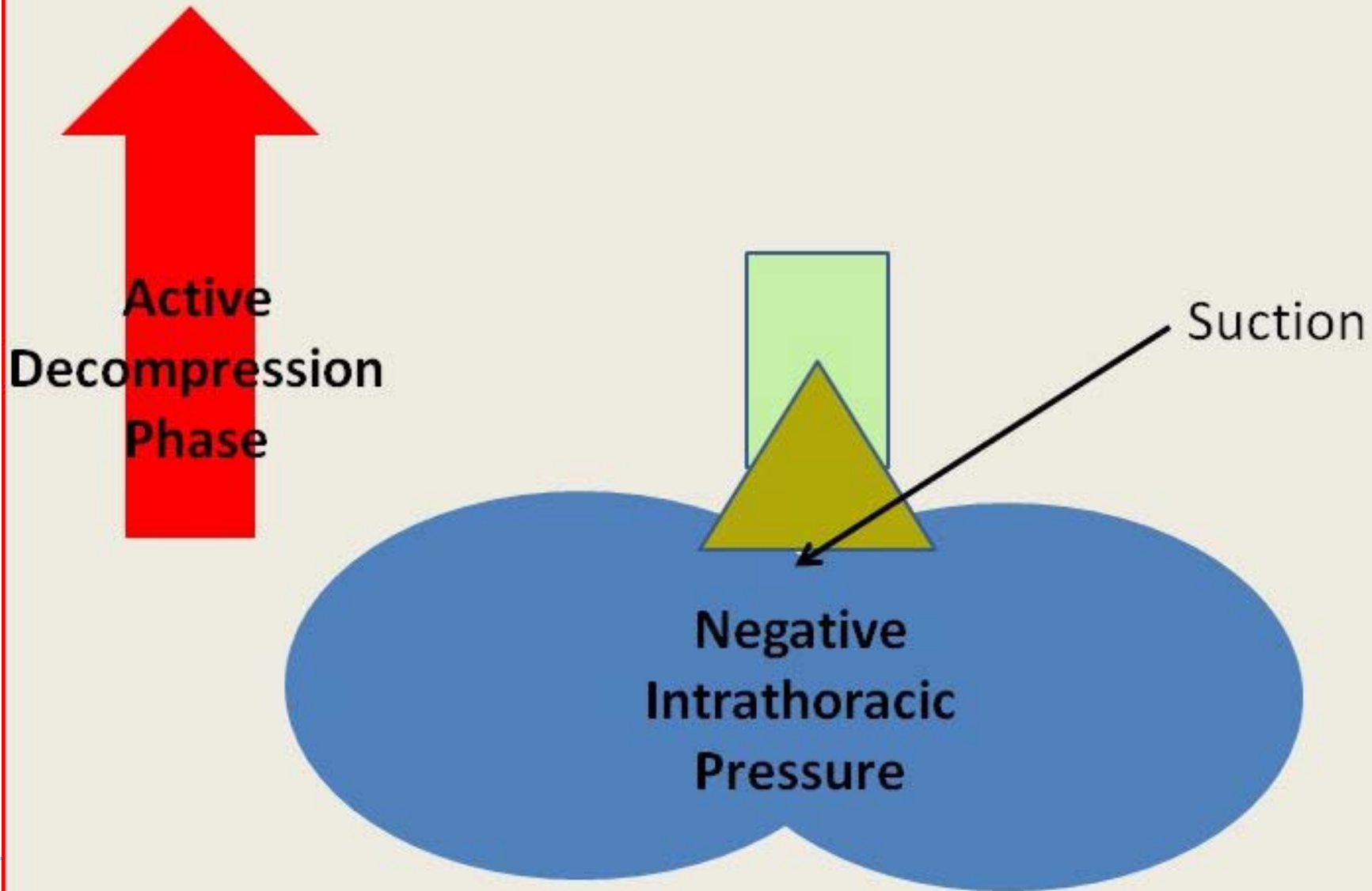
**Positive
Intrathoracic
Pressure**

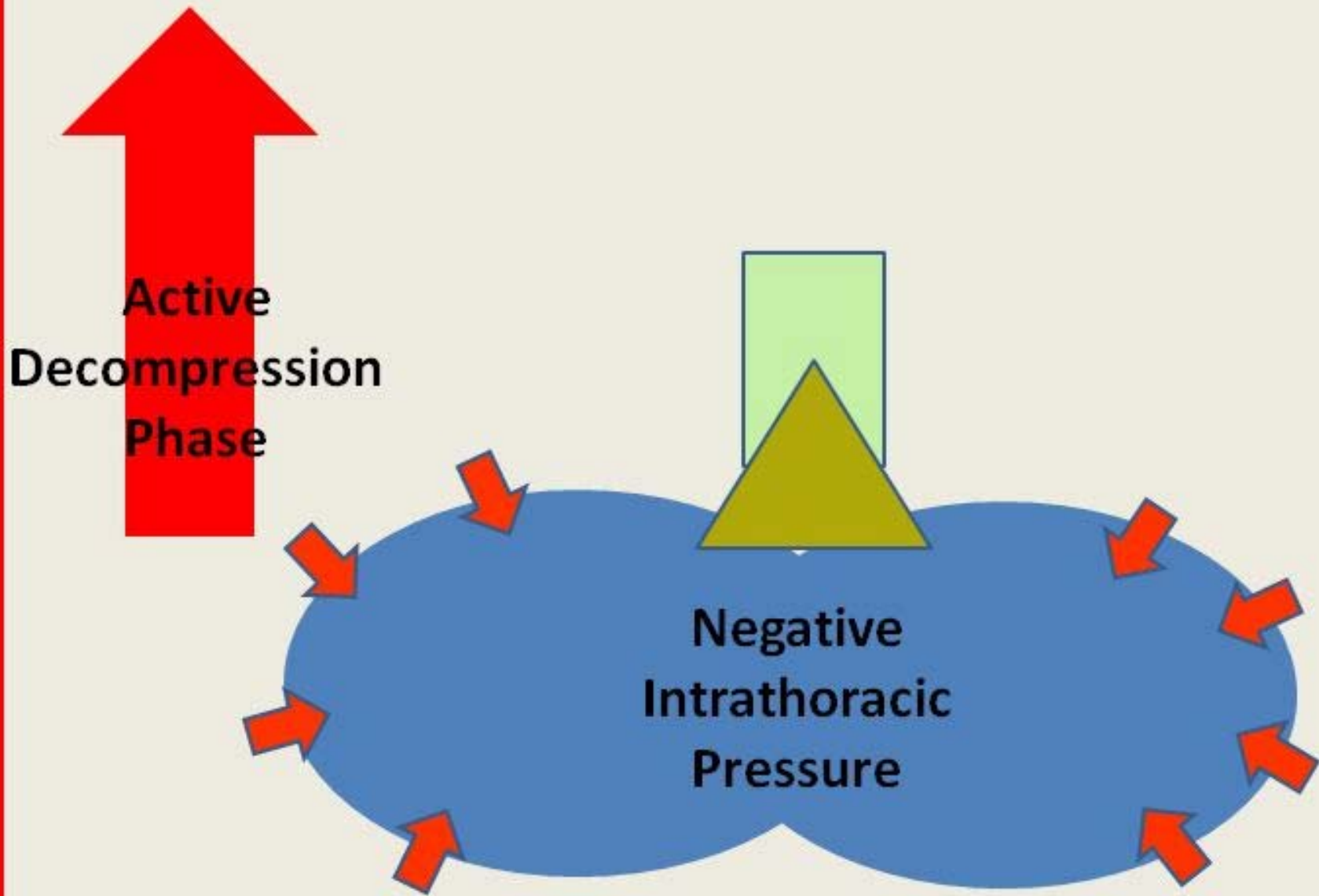


**Compression
Phase**



**Positive
Intrathoracic
Pressure**





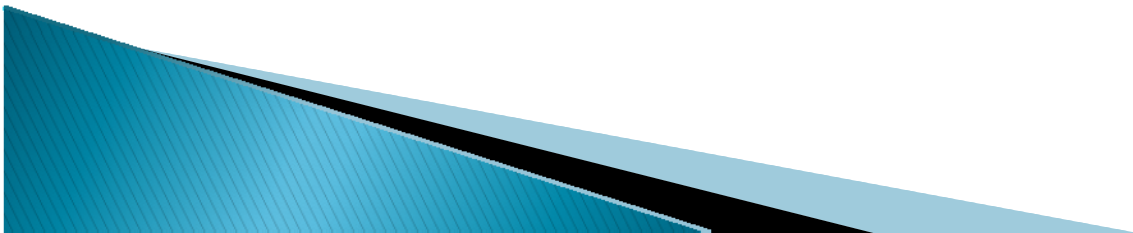
LUCASTM CPR

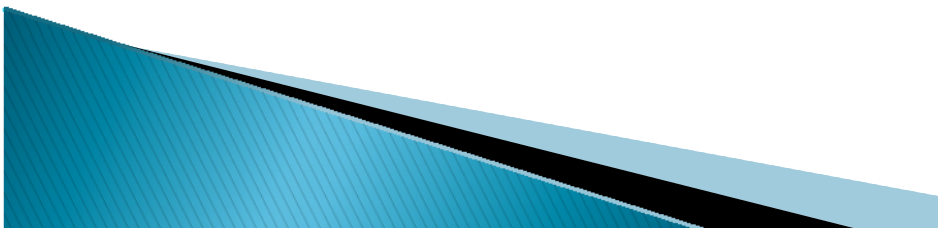
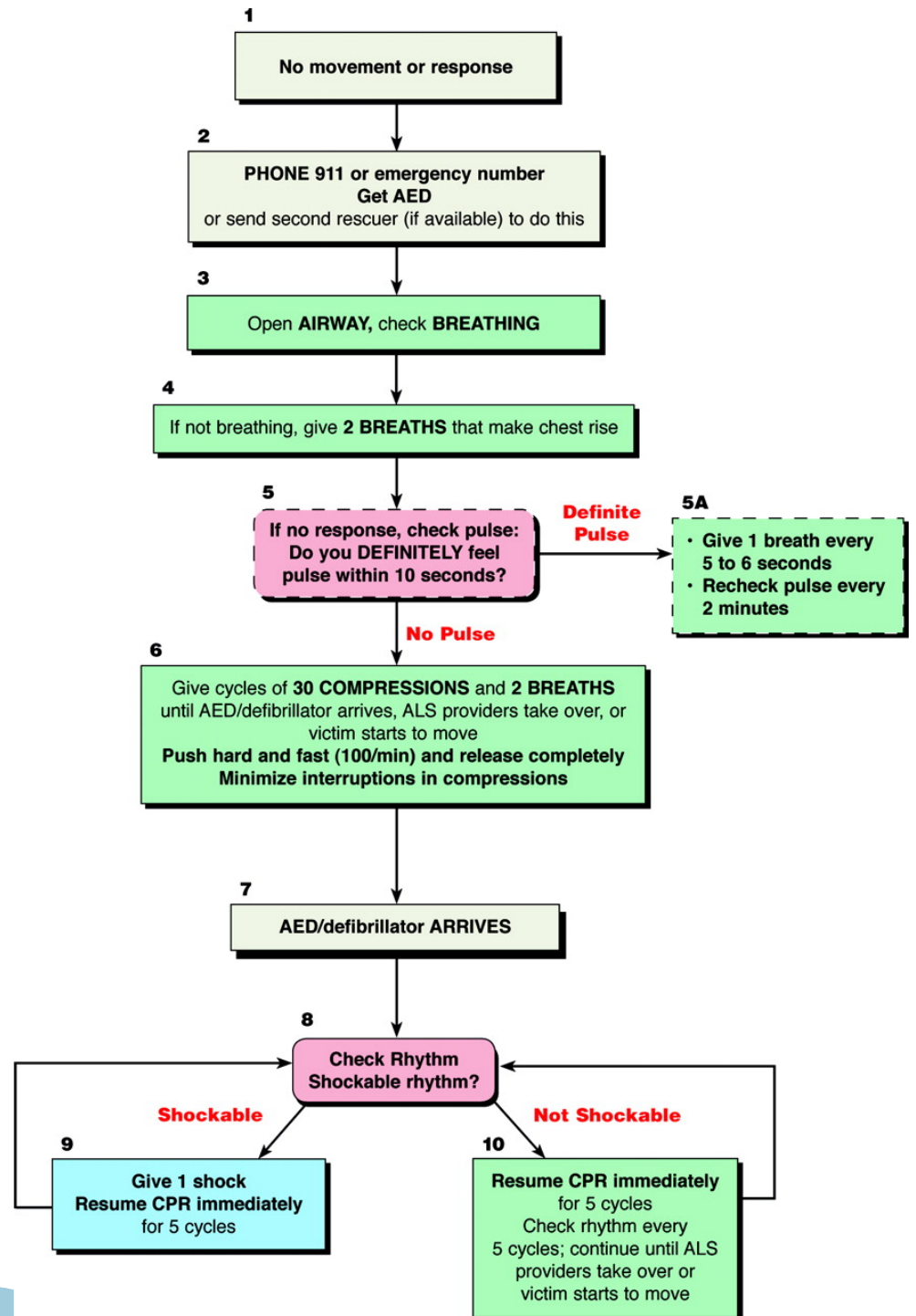
LUCAS CPR

Getting to
the heart
of resuscitation

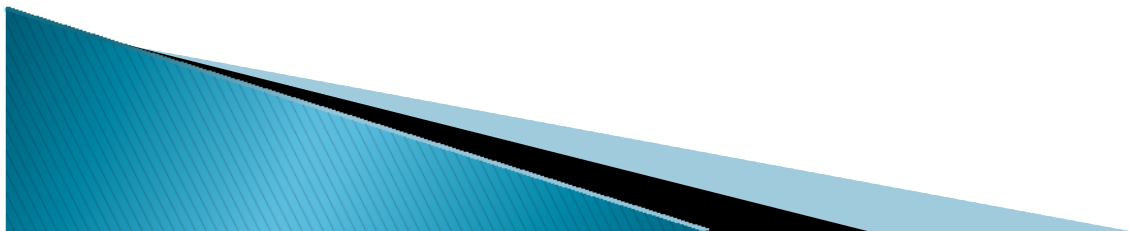


Questions?





- ▶ Treatment of out-of-hospital cardiac arrest with LUCAS, a new device for automatic mechanical compression and active decompression resuscitation.
▶ Resuscitation. 2005 Oct;67(1):25–30
- ▶ Combination of active compression decompression cardiopulmonary resuscitation and the inspiratory impedance threshold device: state of the art.
▶ Curr Opin Crit Care. 2004 Jun;10(3):193–201



▶ **Cochrane Database Syst Rev. 2004;(2):CD002751. Links**

◦ **Comment in:**

- [Evid Based Nurs. 2004 Oct;7\(4\):112.](#)

◦ **Update of:**

- [Cochrane Database Syst Rev. 2002;\(3\):CD002751.](#)

◦ **Active chest compression–decompression for cardiopulmonary resuscitation.**

◦ **[Lafuente–Lafuente C](#), [Melero–Bascones M](#).**

◦ Service de Médecine Interne A, Hôpital Lariboisière, 2, rue ambroise Paré, Paris, France, 75010.

◦ **BACKGROUND:** Active compression–decompression cardiopulmonary resuscitation (ACDR CPR) uses a hand–held suction device, applied mid sternum, to compress the chest then actively decompress the chest after each compression. Randomised controlled trials on use of active compression decompression cardiopulmonary resuscitation have results which are discordant. **OBJECTIVES:** To determine clinical effects and safety of active compression–decompression cardiopulmonary resuscitation compared with standard manual cardiopulmonary resuscitation (STR). **SEARCH STRATEGY:** We searched the Cochrane Central Register of Controlled Trials, MEDLINE and EMBASE. Last search was conducted in January 2004. We checked the reference list of retrieved articles and contacted enterprises manufacturing the active decompression devices. **SELECTION CRITERIA:** All randomised or quasi–randomised studies comparing active compression–decompression cardiopulmonary resuscitation compared with standard manual cardiopulmonary resuscitation in adults with a cardiac arrest who received cardiopulmonary resuscitation by a trained medical or paramedical team. **DATA COLLECTION AND ANALYSIS:** Data were independently extracted. All data were analysed on an intention–to–treat basis. The authors of the primary studies were contacted for more information when needed. Studies were cumulated, if appropriate, and pooled relative risk (RR) estimated. Subgroup analysis according to setting (out of hospital or in hospital) and attending team composition (with physician or paramedic only) were predefined. **MAIN RESULTS:** Ten trials were included: eight were in out–of–hospital settings, one set in–hospital only and one had both in–hospital and out–of–hospital components. Allocation concealment was adequate in 4 trials. The two in–hospital studies were very different in quality (A and C) and size (773 and 53 patients). Both found no differences between ACDR CPR and STR in any outcome. Trials conducted in out–of–hospital settings cumulated 4162 patients. There were no differences between ACDR CPR and STR for mortality either immediately (RR 0.98 [95% CI 0.94 – 1.03]) or at hospital discharge (RR 0.99 [95% CI 0.98 – 1.01]). The pooled RR of neurological impairment, any severity, was 1.71 [95% CI 0.90 – 3.25], with a non–significant trend to more frequent severe neurological damage in survivors of ACDR CPR (RR 3.11 [95% CI 0.98 – 9.83]). However, assessment of neurological outcome was limited and there were few patients with neurological damage. There was no difference between ACDR CPR and STR with regard complications such as rib or sternal fractures, pneumothorax or hemothorax (RR 1.09 [95% CI 0.86 – 1.38]). Skin trauma and ecchymosis were more frequent with ACDR CPR. **REVIEWERS' CONCLUSIONS:** Active chest compression–decompression in patients with cardiac arrest is not associated with clear benefit.