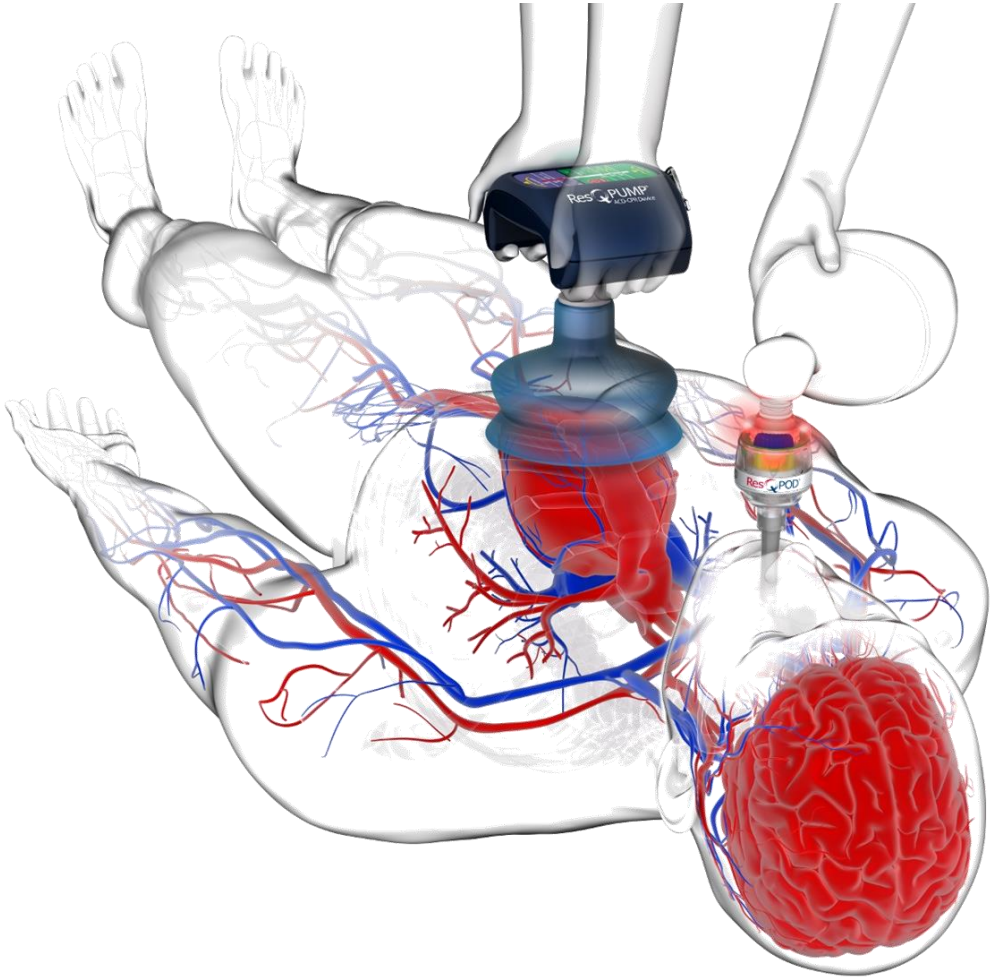
ResQCPR™ System

ZOLL®

Training Presentation



TFD-EMS
Ver. 1 09/15

Agenda

- ResQCPR System: Definition and Labeling
- IPR Therapy
- Physiology of Conventional CPR
- ResQPOD ITD 16 and Instructions for Use
- ResQPUMP ACD-CPR Device and Instructions for Use
- Physiology of ResQCPR
- Research Data: ACD-CPR with an ITD
- Hands-On: Components and Scenarios
- Evaluations

What is the ResQCPR System?

- Comprised of two device components:
  - **ResQPOD® ITD 16,** an impedance threshold device (ITD)
  - **ResQPUMP® ACD-CPR Device,** which allows user to perform active compression decompression cardiopulmonary resuscitation (ACD-CPR) with 10 kg of lift

How is the ResQCPR System Unique?

- Only CPR adjunct on the market with an FDA-approved survival indication.
- Clinical study has demonstrated a 49% improvement in 1-year survival compared to conventional CPR
- Devices work synergistically to optimize perfusion.
- No other device on the market does this or performs true ACD-CPR.

Device Labeling

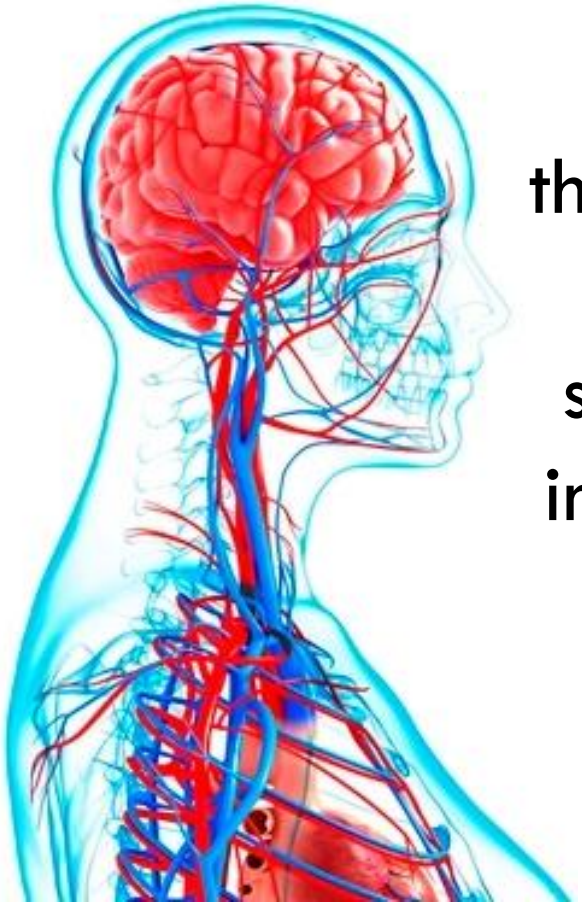
- **Indication**
  - The ResQCPR System is intended for use as CPR adjunct to improve the likelihood of survival in adult patients with non-traumatic cardiac arrest.
- **Contraindications**
  - None
- Always use the devices in accordance with your organization's approved protocol for use.

Warning

- Improper use of the ResQCPR System could cause serious injury or ineffective CPR. It should only be used by personnel who have been trained in its use.
- Just like conventional CPR, proper ResQCPR System training consists of:
  - Instruction by a qualified educator
  - Didactic component, followed by assessment of knowledge
  - Hands-on component, followed by skills competency assessment
- Frequent refresher training is strongly recommended.
- All users should read and understand the instructions for use (IFUs) provided in the packaging before use.

IPR Therapy

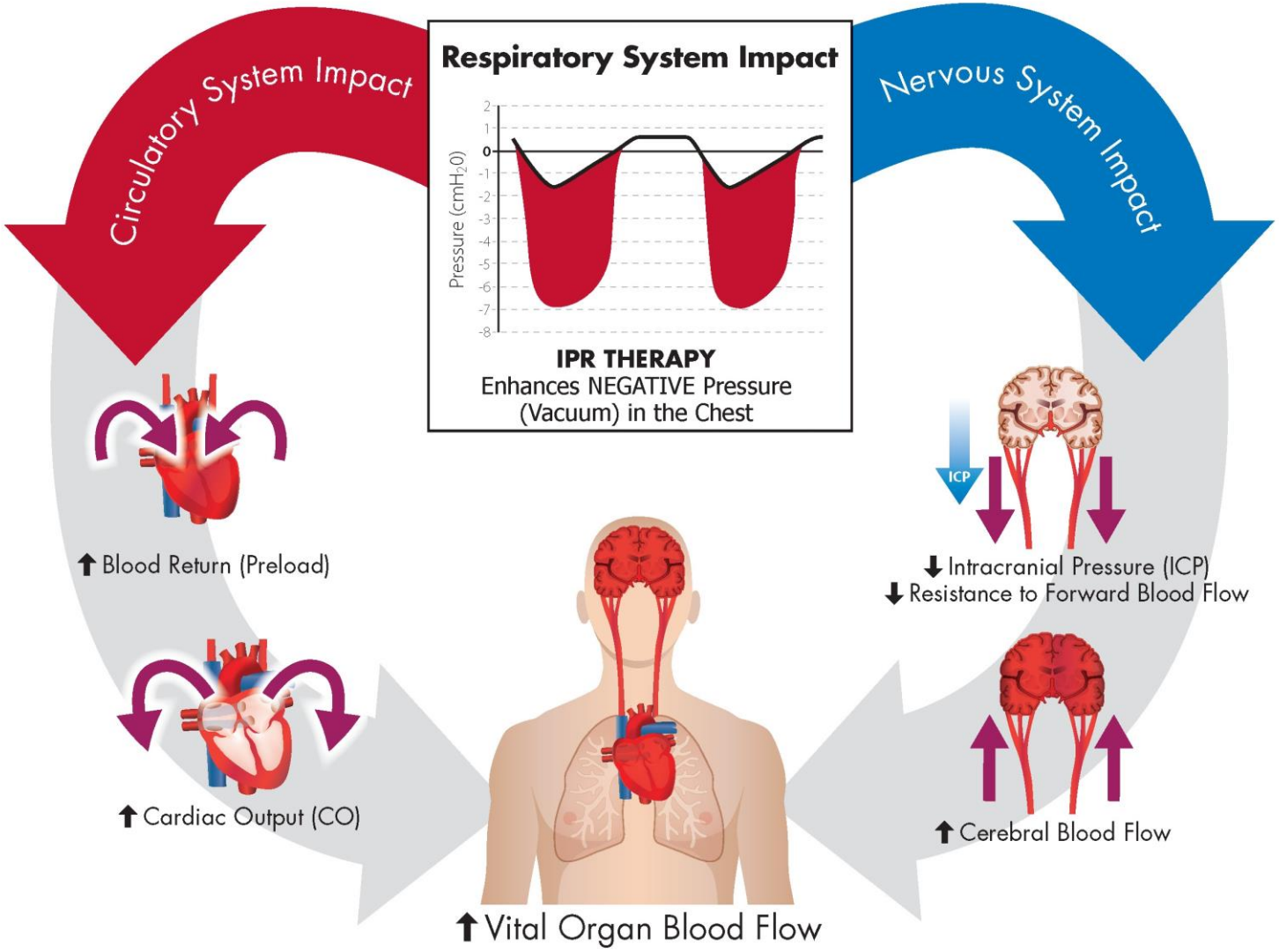
What is IPR Therapy?



Intrathoracic Pressure Regulation (IPR) is a therapy that enhances *negative* pressure in the chest and has been shown in studies to effectively improve circulation of blood to the brain and other vital organs.

Langhelle et al. Resuscitation 2002;52:39-48.

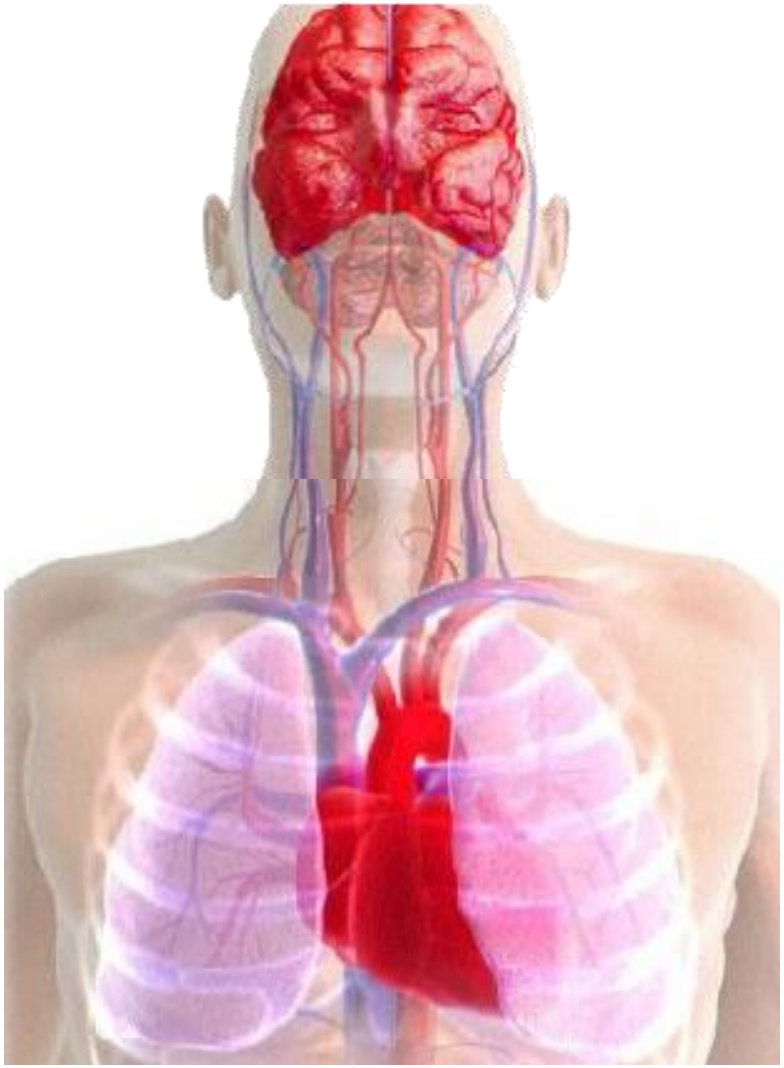
IPR Therapy


Circulatory System Impact
Respiratory System Impact
Nervous System Impact
Pressure (cmH2O)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
IPR THERAPY
Enhances NEGATIVE Pressure
(Vacuum) in the Chest
ICP
⬆ Blood Return (Preload)
⬆ Cardiac Output (CO)
⬇ Intracranial Pressure (ICP)
⬇ Resistance to Forward Blood Flow
⬆ Cerebral Blood Flow
⬆ Vital Organ Blood Flow

Physiology of Conventional CPR

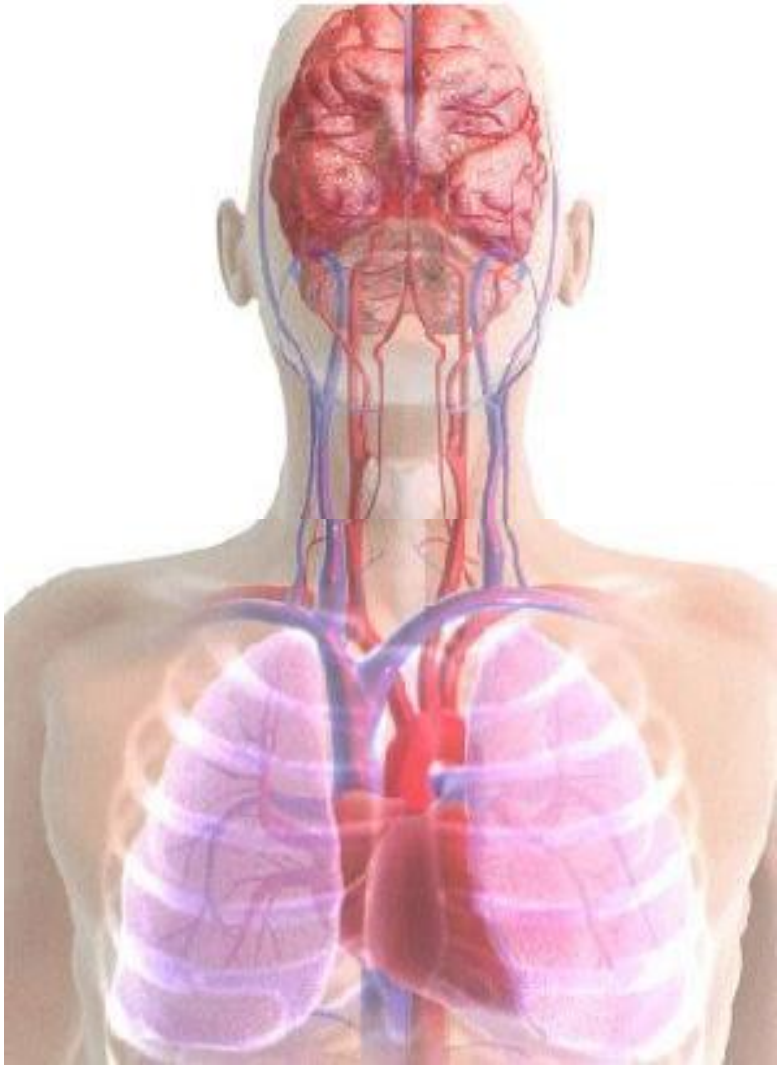
Understanding how conventional CPR circulates blood provides the foundation for understanding the physiology of ResQCPR

Key to Survival & Quality of Life



Provide optimal blood flow to vital organs until the heart can be restarted

Conventional CPR – Limited Blood Flow



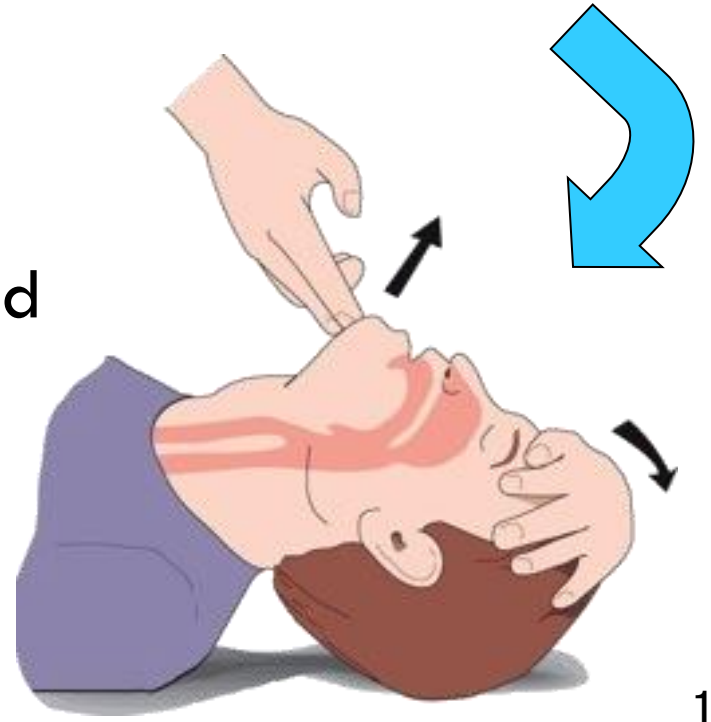
25 – 40%

of normal blood flow to heart and brain

Andreka et al. Curr Opin Crit Care. 2006;12(3):198–203.

Why is Blood Flow Limited in CPR?

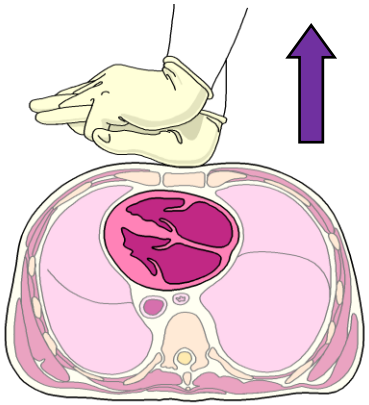
- Chest wall relaxation creates negative pressure (i.e. vacuum)
- As the chest wall relaxes air rushes into chest through an open airway
- Diminishing the negative pressure = decreased preload and cardiac output



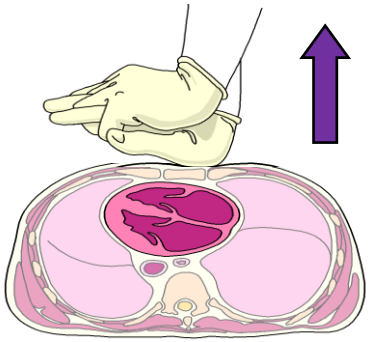
Why is Blood Flow Limited in CPR?

Development of vacuum (to create PRELOAD) is dependent upon the ability of chest wall to passively recoil.

COMPLETE Recoil



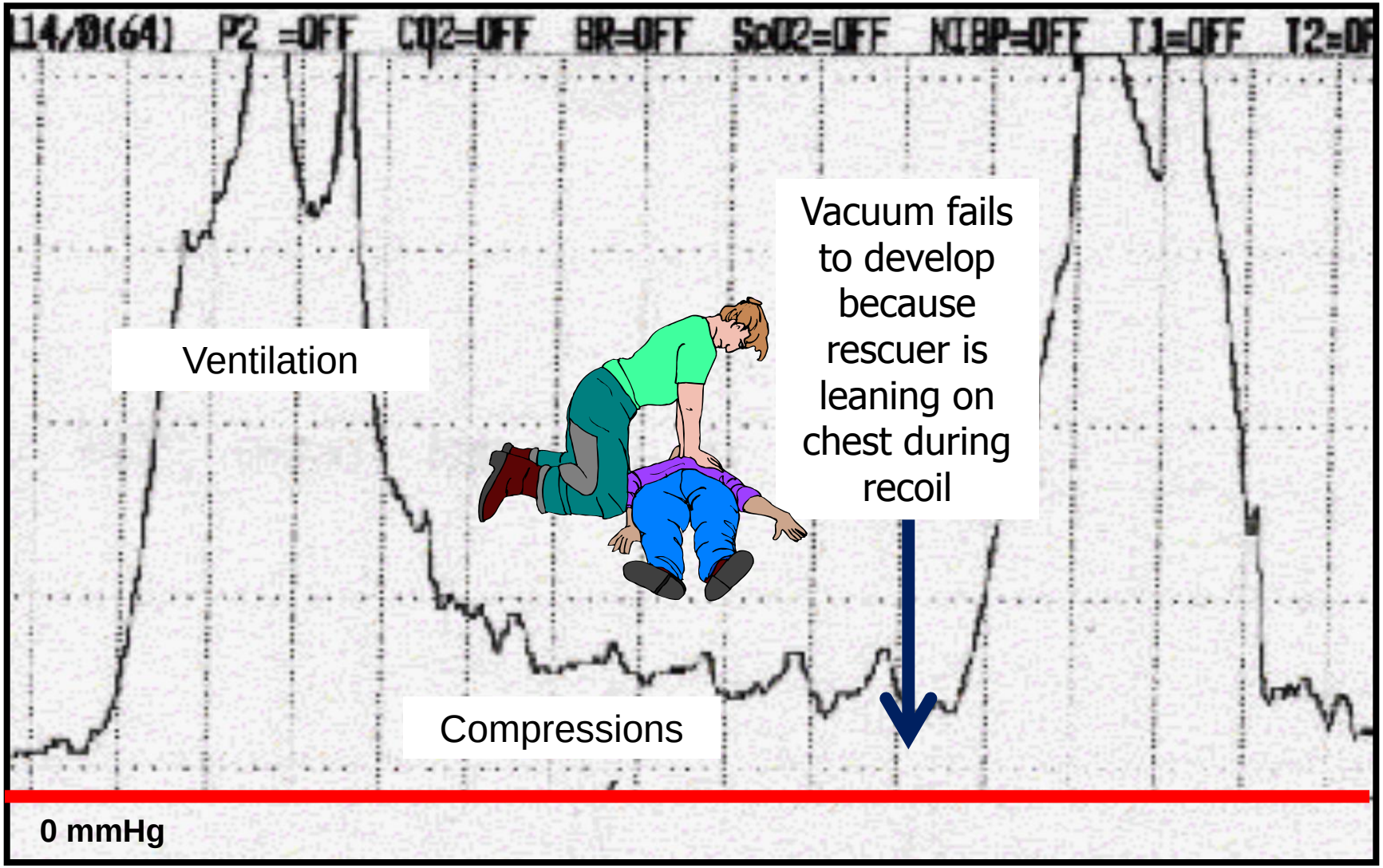
INCOMPLETE Recoil



Causes of incomplete chest wall recoil:

- Rescuer fatigue
- Stiff/non-compliant chest
- Broken ribs

Incomplete Chest Wall Recoil Inhibits Vacuum



ResQPOD® ITD 16

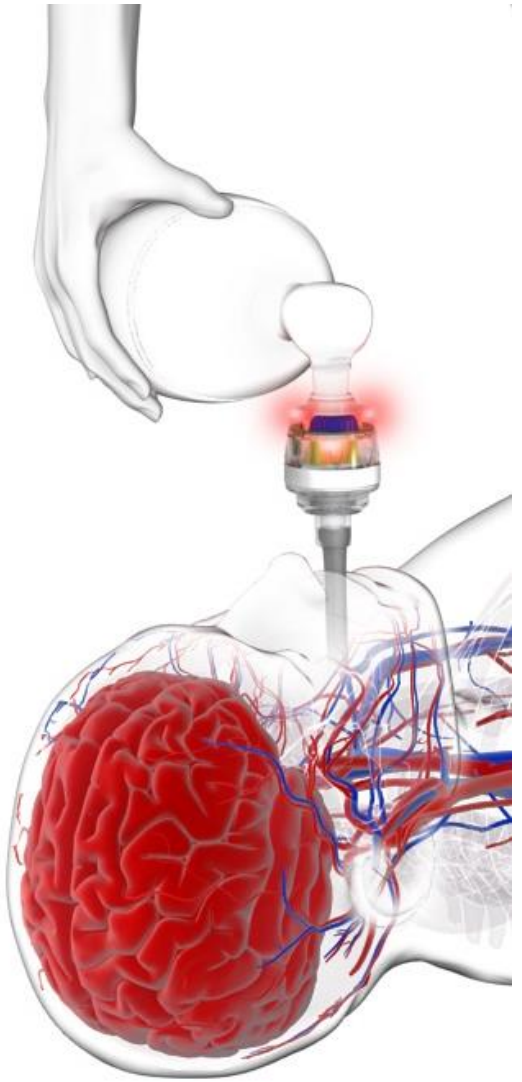
ResQCPR System Component

ResQPOD Impedance Threshold Device (ITD)

The ResQPOD selectively prevents air from re-entering the lungs during chest wall recoil.

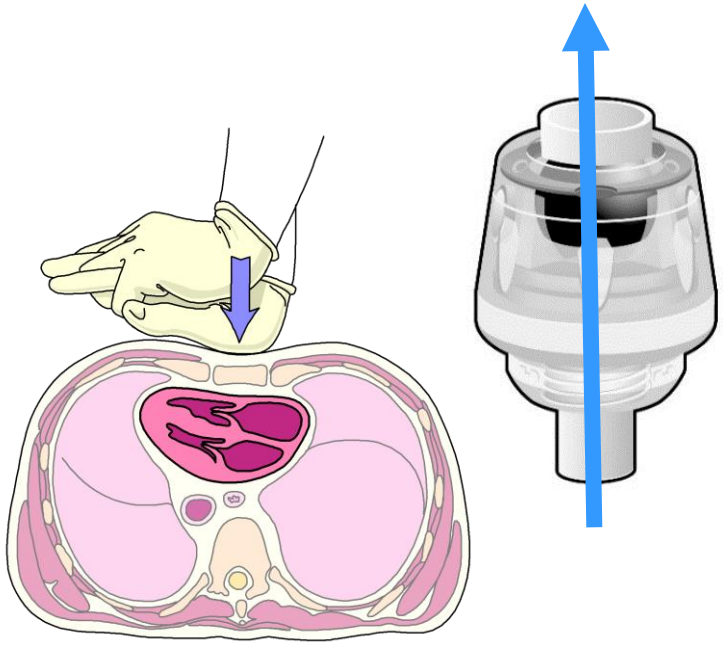
This enhances the vacuum needed to pull blood back into the heart and lower ICP.

As a result, more blood is circulated to the brain and vital organs until the heart can be restarted."



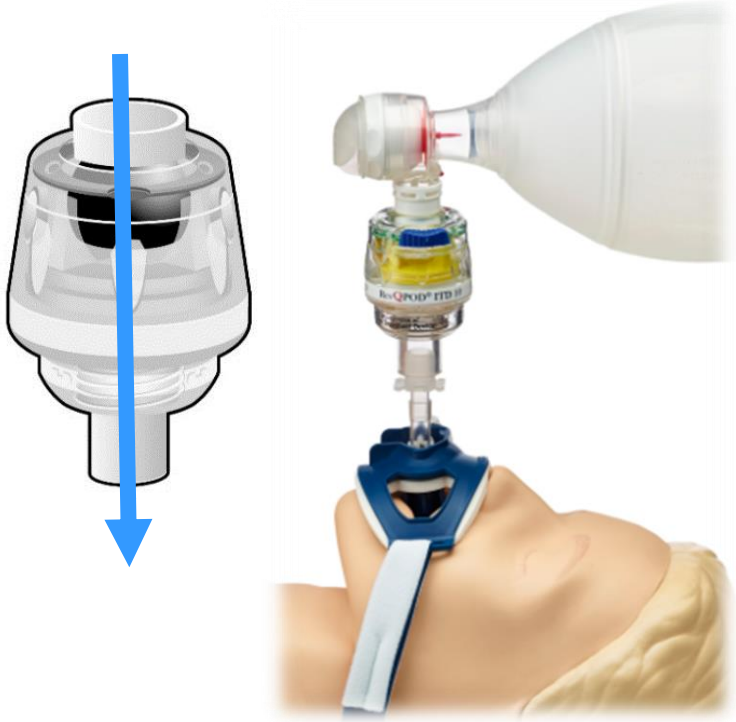
Airflow Through the ResQPOD

Chest Compression



Patient can freely exhale.

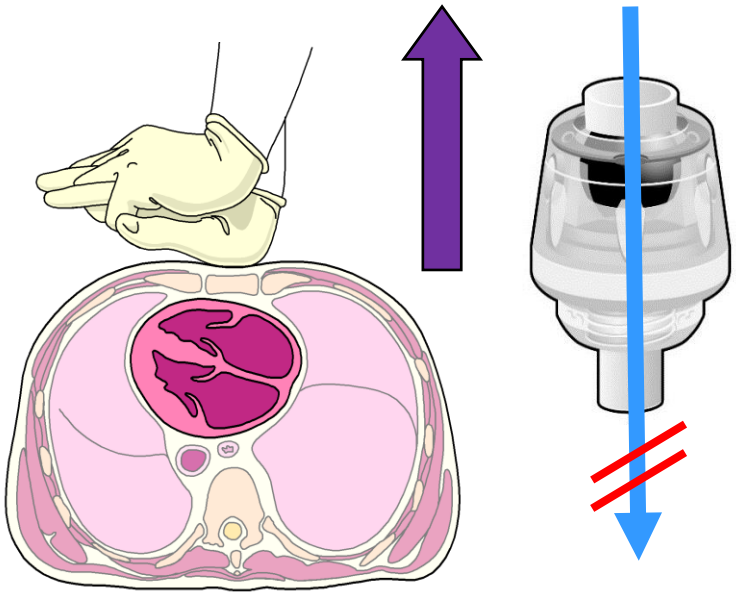
Patient Ventilation



Patient can be freely ventilated.

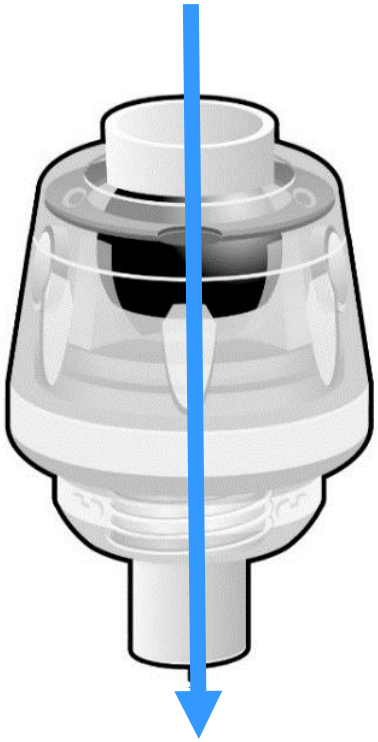
Airflow Through the ResQPOD

Chest Wall Recoil



Influx of air is selectively restricted, enhancing the vacuum in the chest.

Spontaneous Breathing



Air will enter if patient creates at least -16 cmH_2O pressure with respiratory effort.

ResQPOD® ITD 16

Instructions for Use

Using ResQPOD on a Facemask

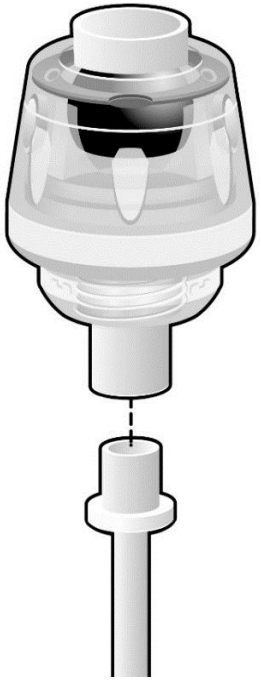
- Connect the ResQPOD to the facemask.
- Spread out mask cushion and apply to face.
- Open the airway, lifting jaw to facemask.
- Establish and maintain tight face seal with mask throughout chest compressions using 2-handed technique.
- Connect ventilation source to top of ResQPOD.

Using ResQPOD on a Facemask

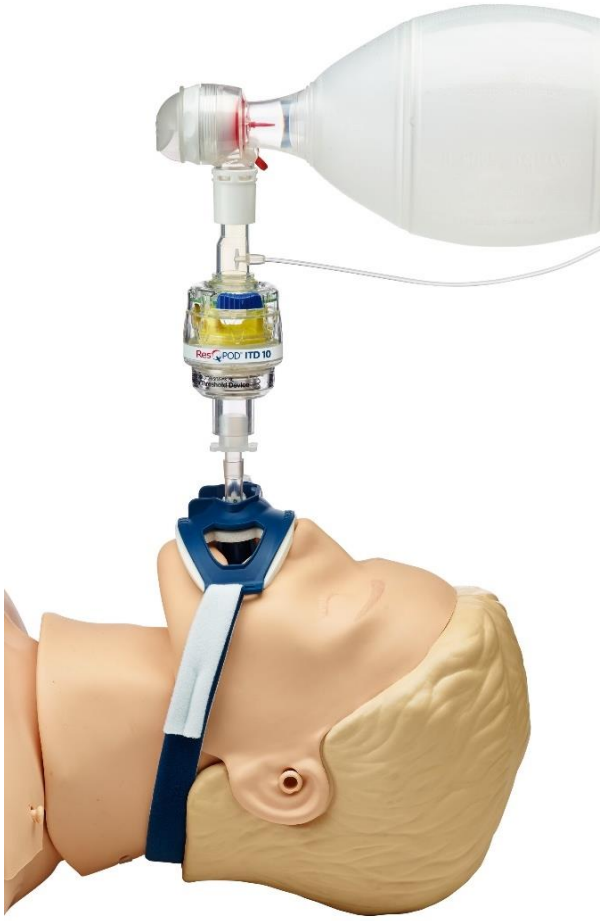
- Best:
  - Person managing the airway keeps 2 hands on the facemask at all times
  - Another rescuer provides the ventilation.

If only two rescuers are present, the compressor can reach over and ventilate with one hand during the pause in compressions.

Using ResQPOD on an Advanced Airway (e.g. ET Tube)



- Confirm tube placement.
- Secure with commercial tube restraint.
- Connect ResQPOD to airway.
- Place $ETCO_2$ detector between ResQPOD and ventilation source (preferred).



Using ResQPOD on an Advanced Airway (e.g. ET Tube)

- Connect the ventilation source to top of ResQPOD.
- Turn on timing assist lights.
- Ventilate during decompression phase (preferred) at timing light flash rate of 10/min.

ResQPOD Use

- Perform CPR at recommended compression to ventilation ratios.
- Ventilate over one second until chest rises.
- Do not hyperventilate!
- Clear secretions from the ResQPOD by blowing out using the ventilation source.
- Deliver ET meds directly into tube (not through ResQPOD).

ResQPUMP®

ACD-CPR Device

ResQCPR System Component

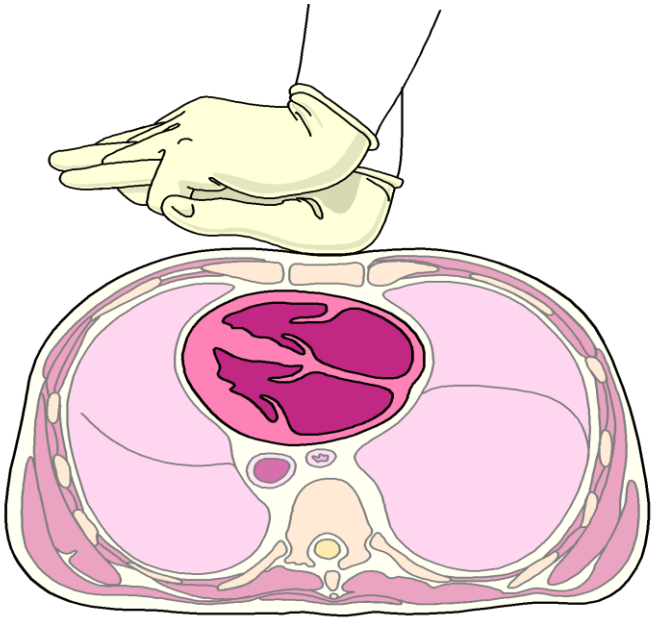
What is the ResQPUMP?

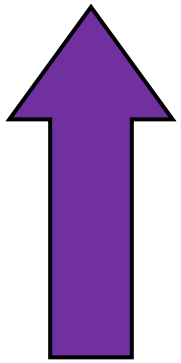
- Allows rescuer to actively compress AND actively re-expand the chest (i.e. provide ACD-CPR) with 10 kg of force
  - *No other device on the market does this*
- Complete and ACTIVE recoil further enhances intrathoracic vacuum and preload, especially in combination with ITD.

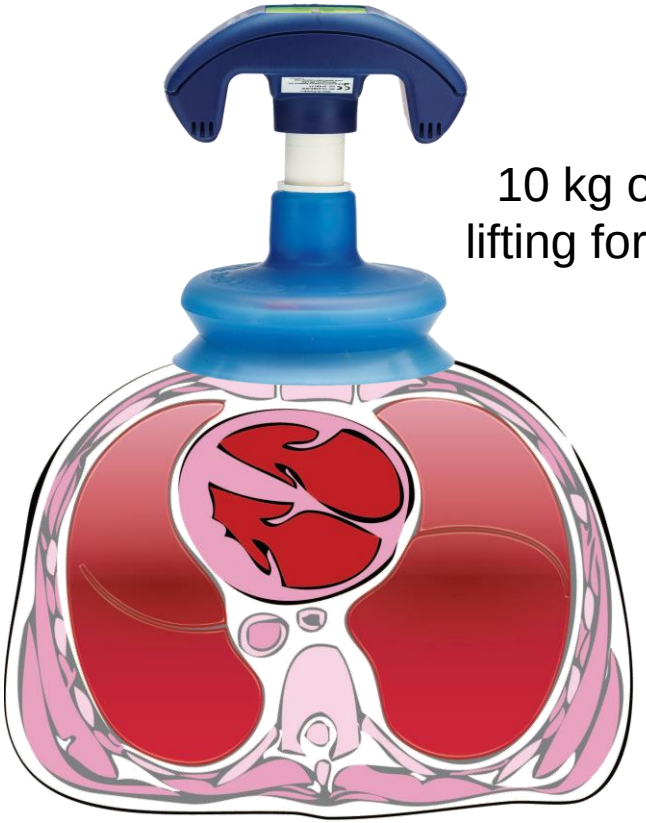
Optimizing Chest Wall Recoil

Passive Recoil

Active Decompression







Conventional CPR

ACD-CPR

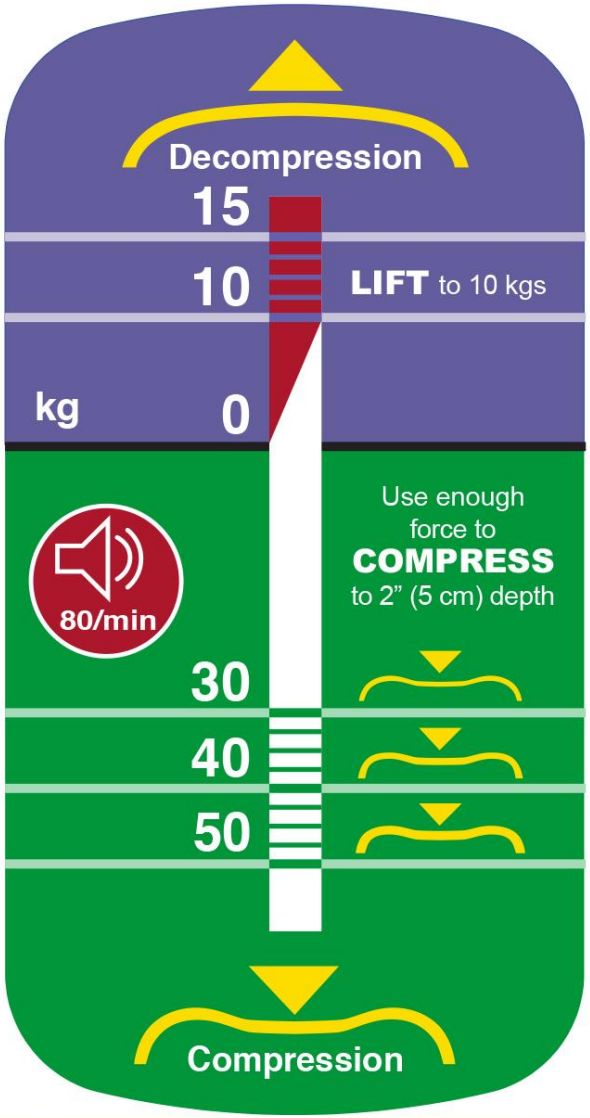
Metronome

Promotes proper compression rate

METRONOME

Press once to turn ON

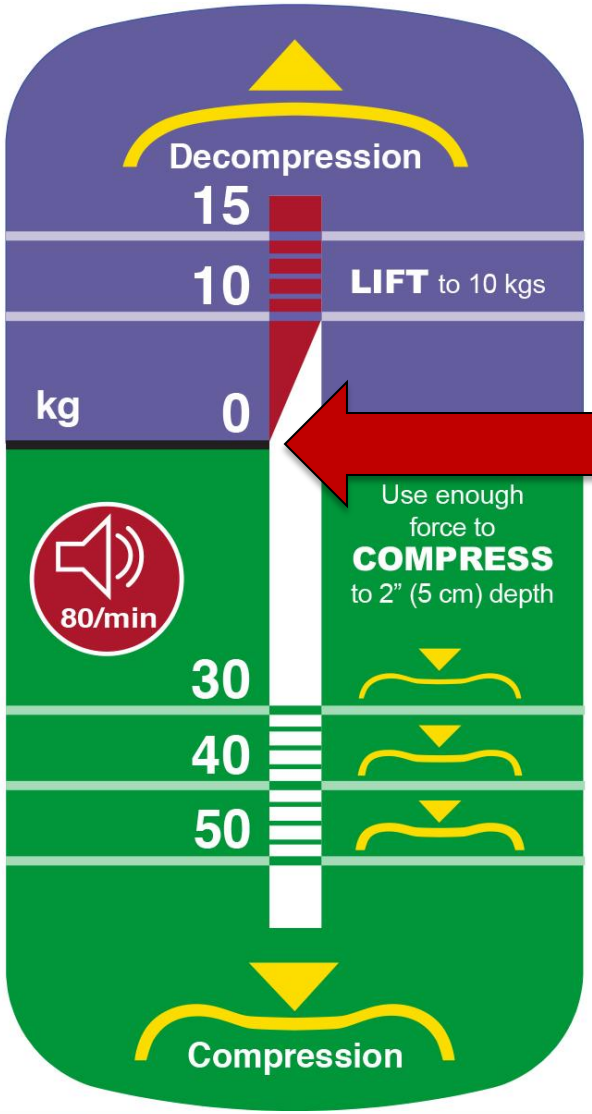
Press again to turn OFF



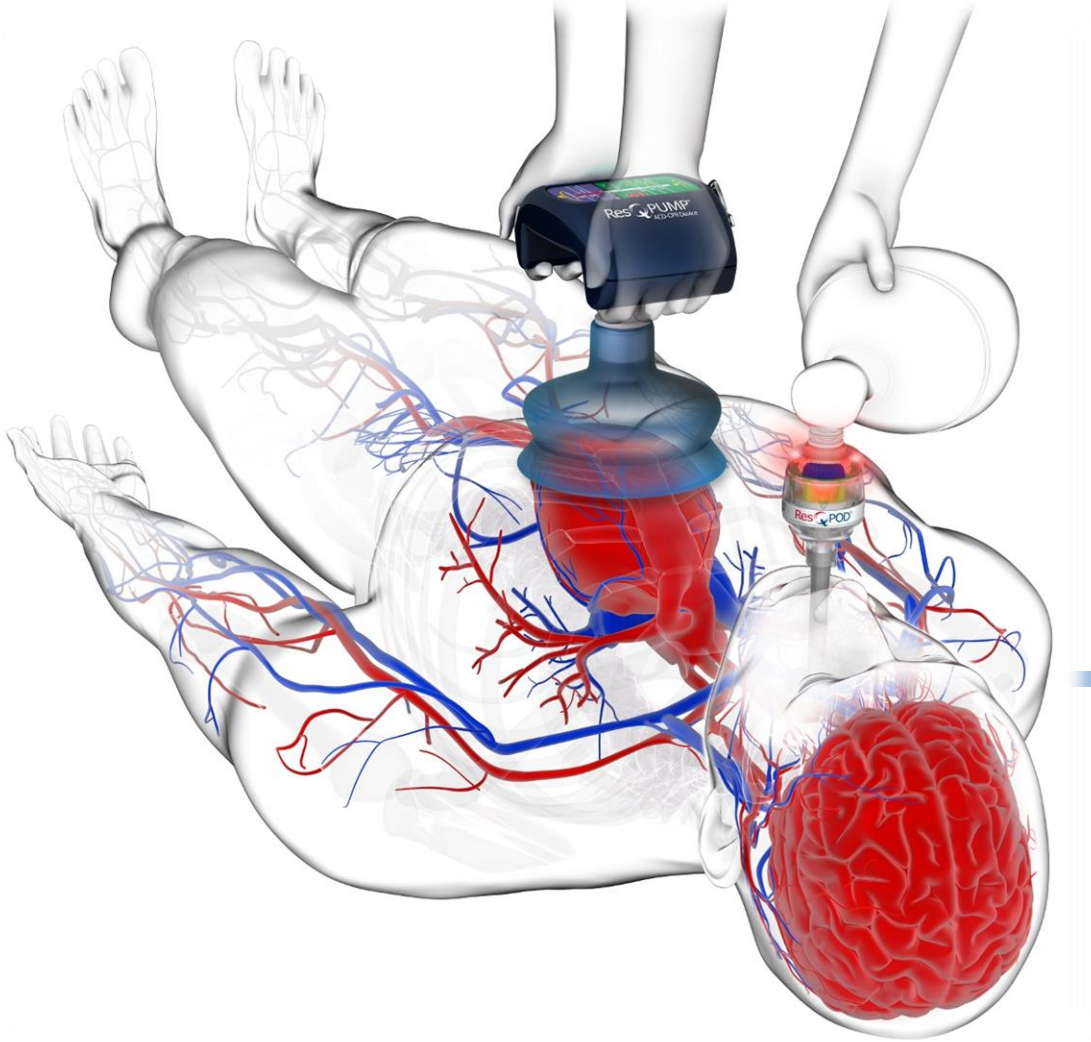
Force Gauge

Purple area guides LIFTING forces

Green area guides COMPRESSION forces

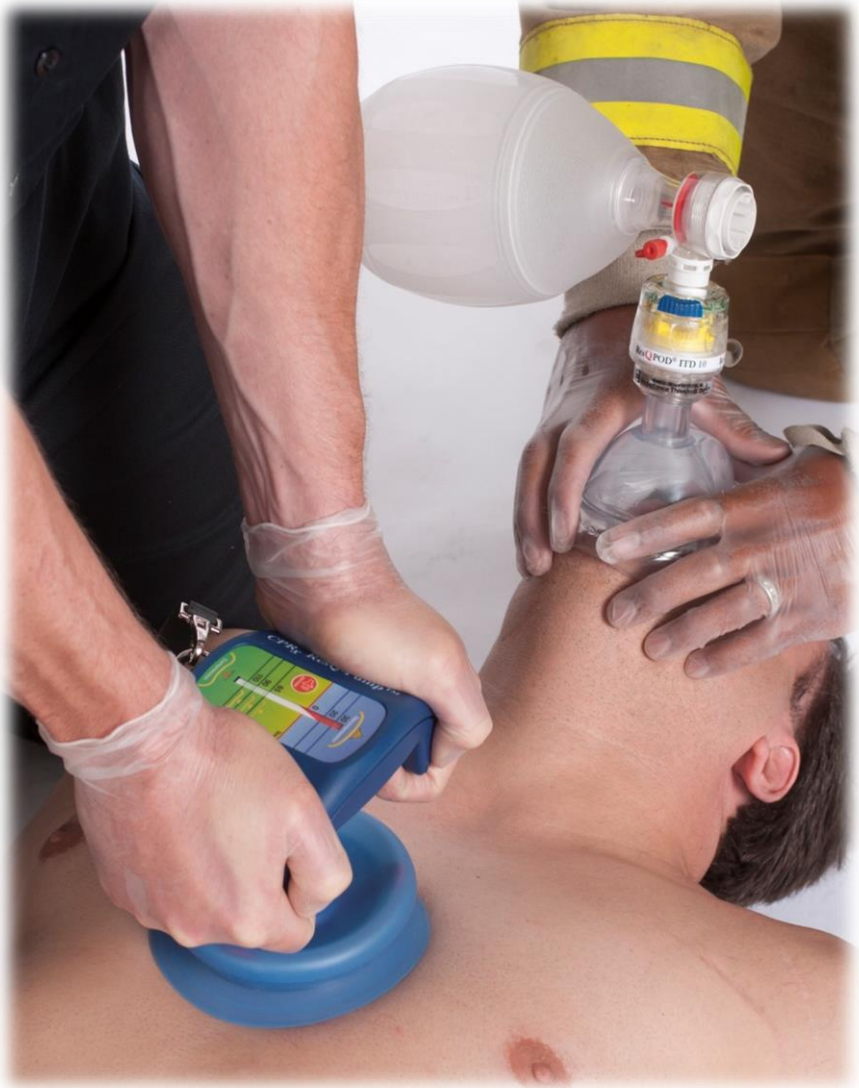


Bottom of red arrow at ZERO indicates no lift or compression being applied



Physiology of ResQCPR

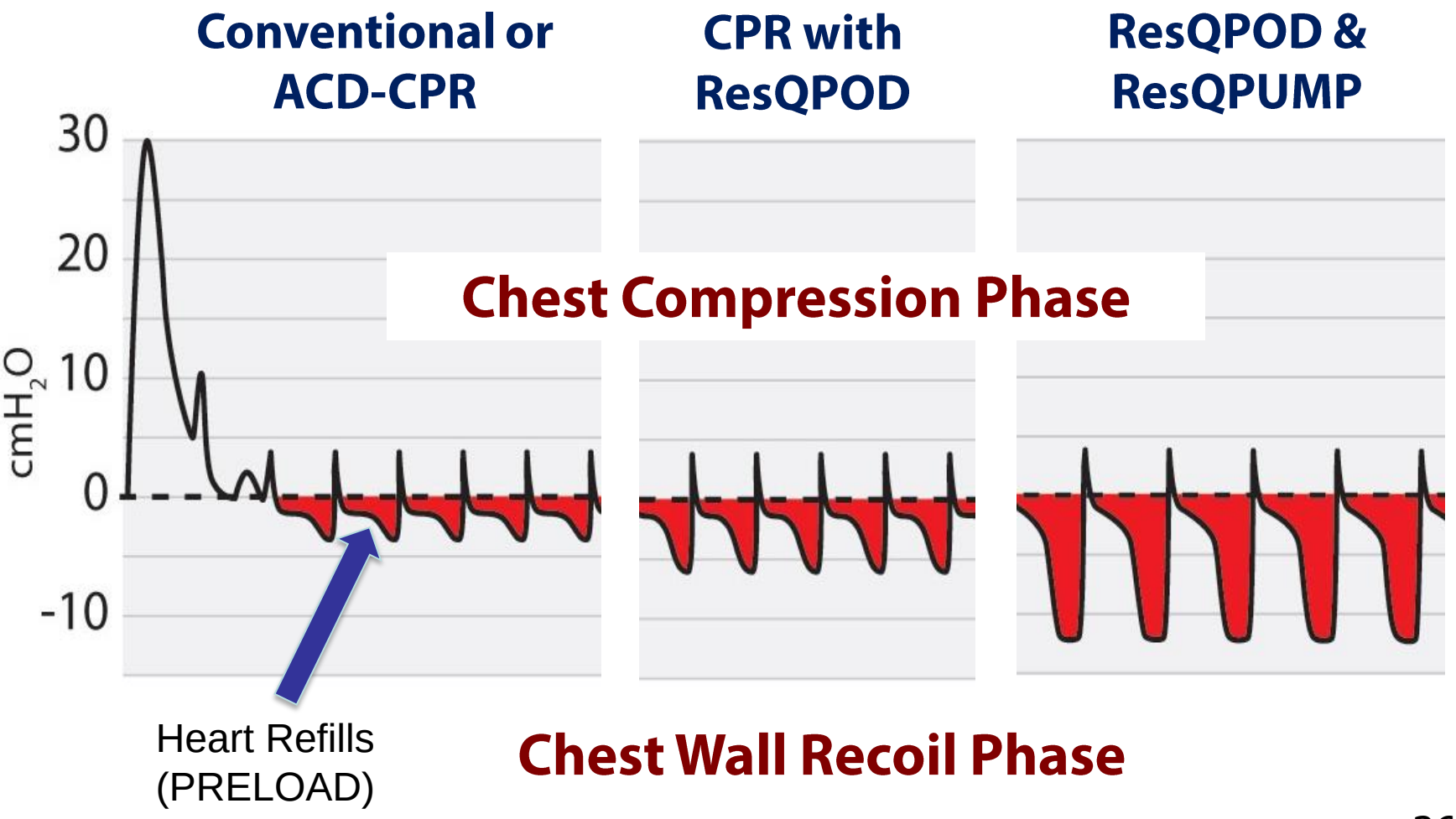
Devices are Synergistic



- **ResQPOD**
  - Prevents influx of air to enhance intrathoracic vacuum
- **ResQPUMP**
  - Expands chest to allow for development of greater vacuum

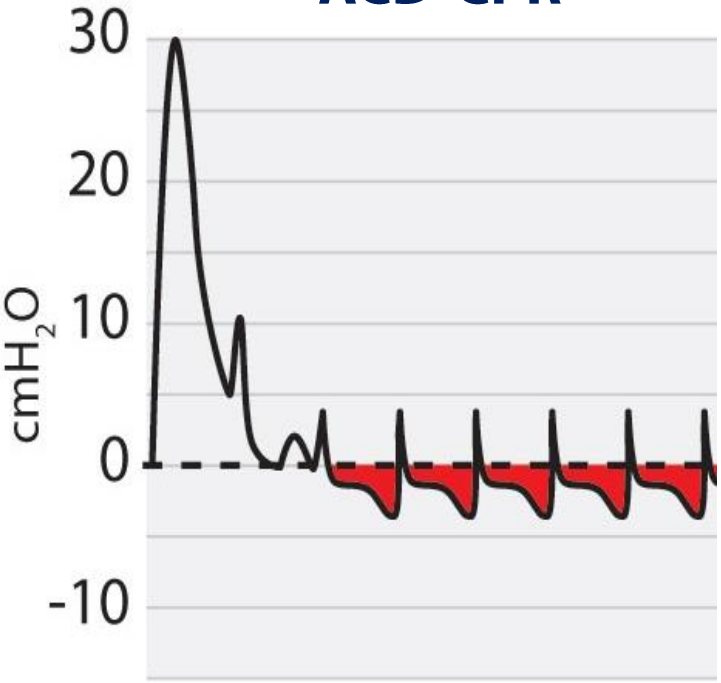
Results in improved perfusion and likelihood of survival

Airway Pressures During CPR



ResQPOD ITD 10 vs ITD 16

Conventional or ACD-CPR

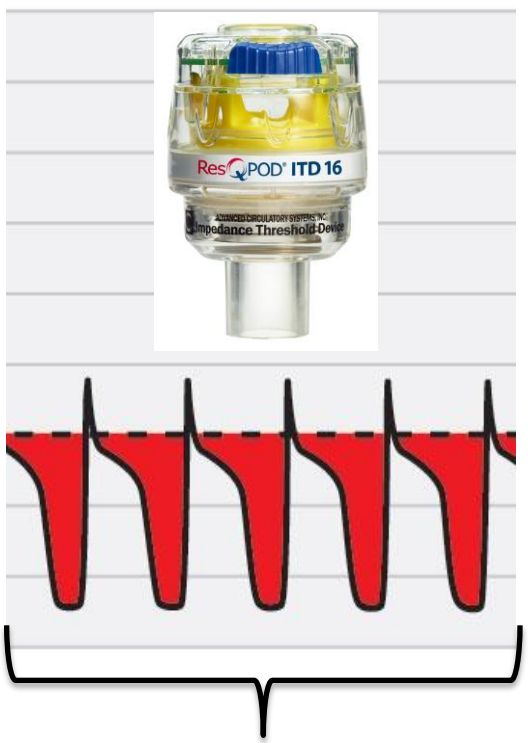


Chest Wall Recoil Phase

CPR with ResQPOD

Permits vacuum formation to -10 cmH_2O

ResQCPR

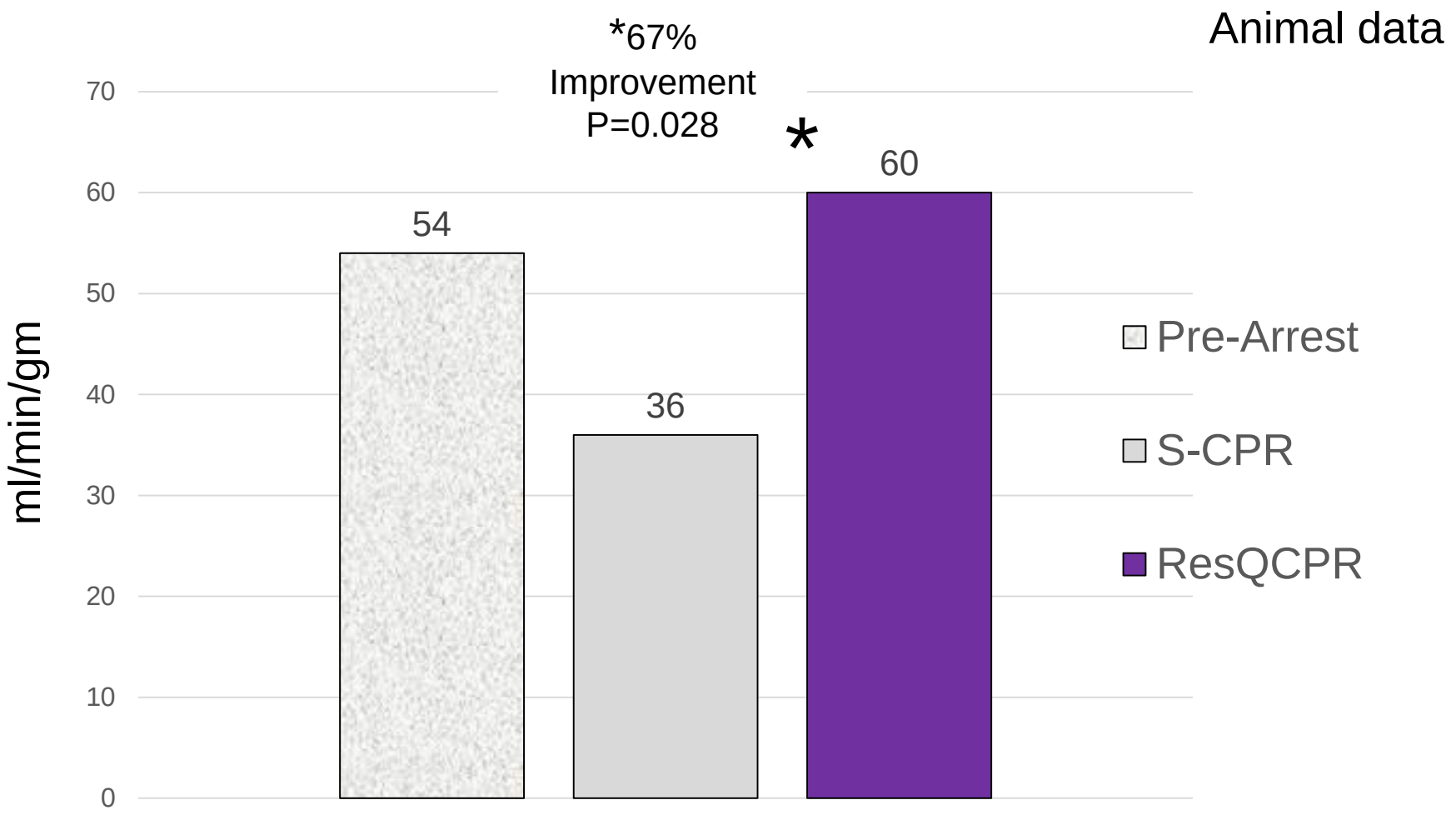


Permits vacuum formation to -16 cmH_2O

Research Data

Use of an ITD with ACD-CPR

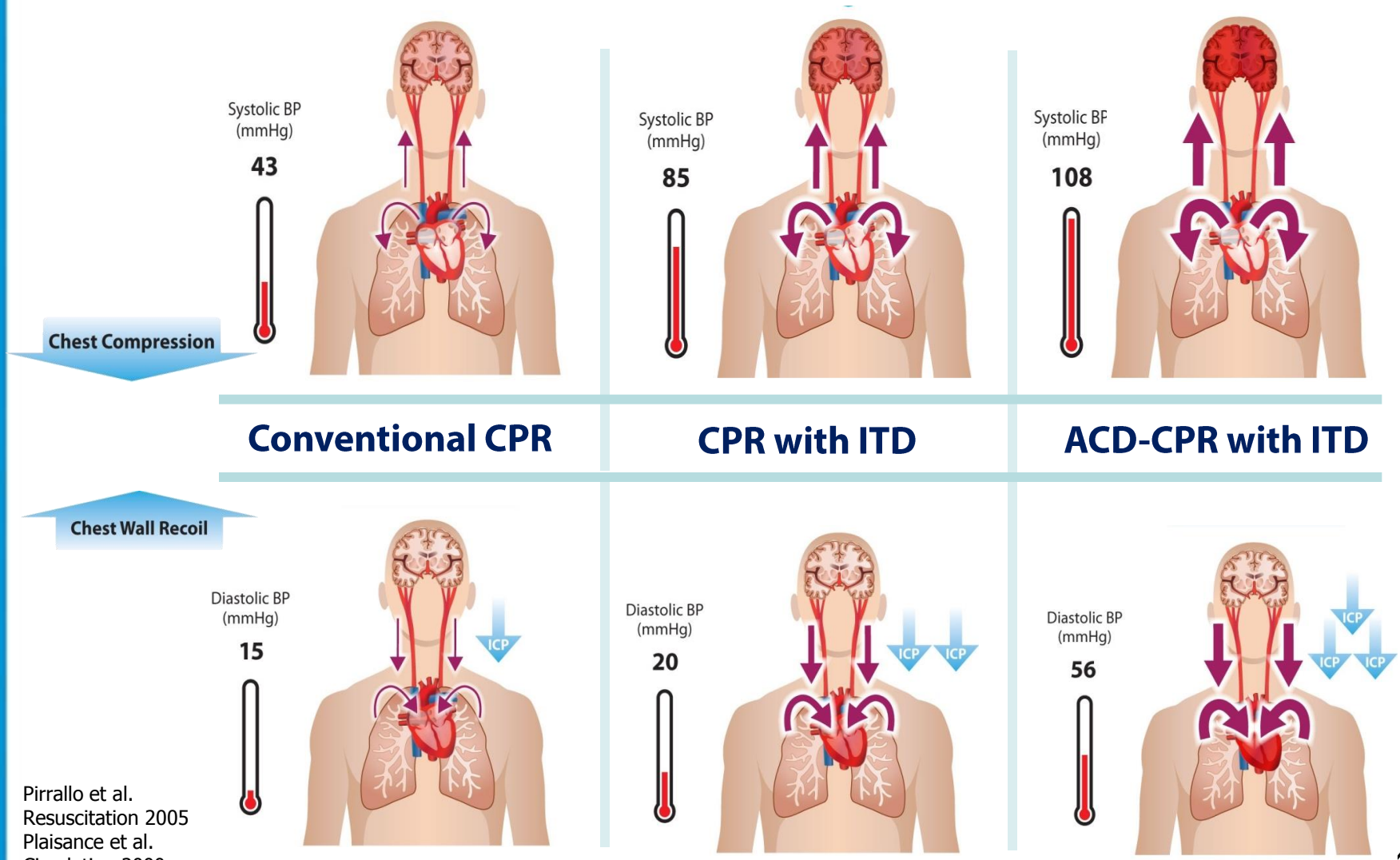
Near-Normal Blood Flow to the Brain



Voelkel et al. Pediatr Res 2002;51:523-527. Pre-clinical data may not be indicative of clinical outcomes.

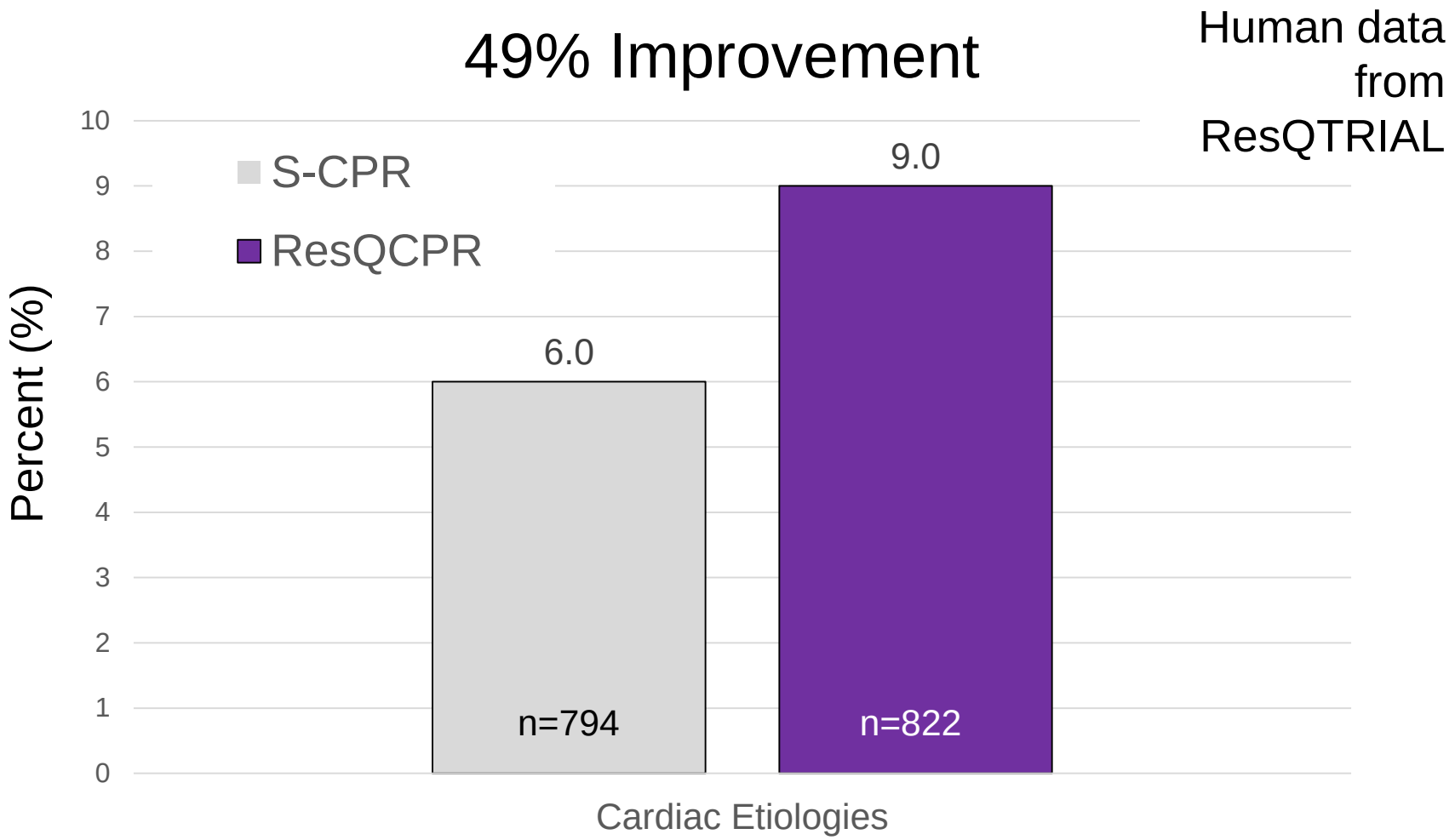
BP and ICP During CPR

Human data



Pirrallo et al.
Resuscitation 2005
Plaisance et al.
Circulation 2000

Survival at One Year



Source: ResQCPR System Summary of Safety and Effectiveness Data submitted to FDA

ACD-CPR (Alone) vs Conventional CPR

- Data is mixed
  - Some studies show short-term benefit for ACD-CPR compared to conventional CPR
  - Some are neutral
  - None show worse results with ACD-CPR alone
- Why?
  - Even though ACD-CPR may do a better job of compressing and decompressing the chest, if the airway is open the body moves more air and not necessarily more blood.
  - An ITD takes away the option to draw air in, and the body then moves more blood.

ResQPUMP®

ACD-CPR Device

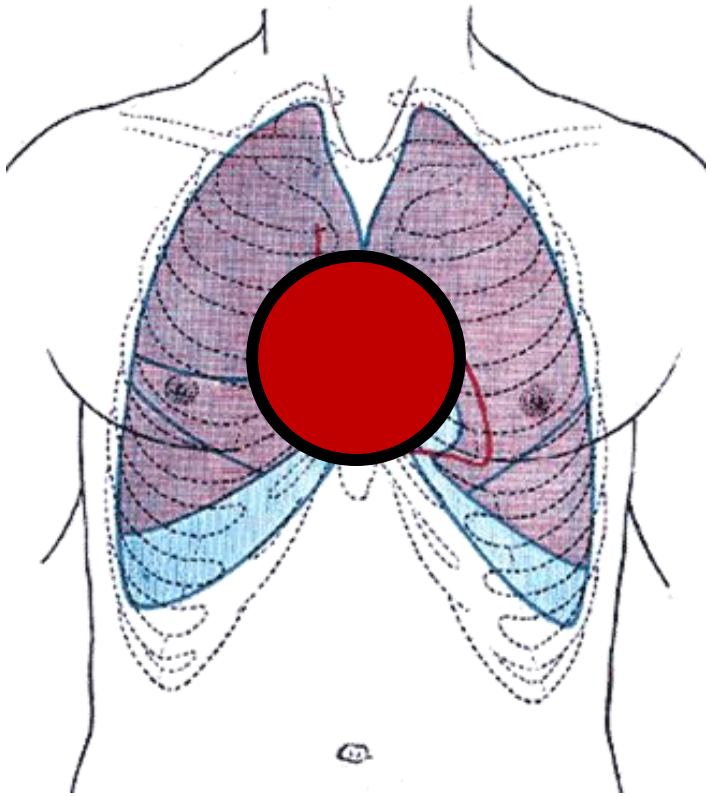
Instructions for Use

ACD-CPR Rate

- **80 is the rate for ACD-CPR**
  - Instead of "Stayin Alive", think "A, B, C, D, E, F, G…"
- Why?
  - Allows more time for heart to fill with the extra blood being returned
  - Rate the FDA approved
- 2-tone metronome
  - Compress on one tone
  - Lift on the other
  - Think "down, up, down, up"
- Metronome is important because most rescuers go faster than they need to!

ResQPUMP Position

- Same position as manual CPR (between the nipples) on lower half of sternum
- Lower edge of suction cup should be above xiphoid.
- Shave or dry the chest if excessively hairy or wet.
- Do not place over defib pads or electrodes.

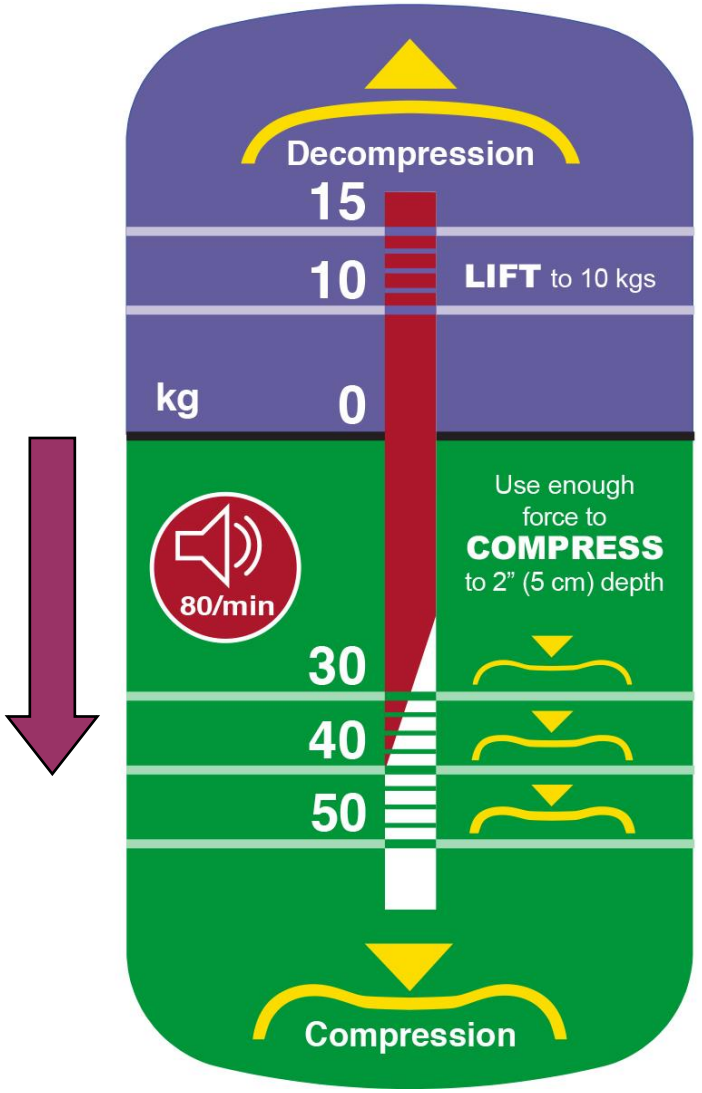


Rescuer Position

- Same as manual CPR
- Shoulders directly over chest
- Arms straight
- Shorter rescuers may benefit from slight elevation with padding.
- Patients on stretcher or gurney:
  - Elevate rescuer on stool next to patient
- Use relaxed hand grip.

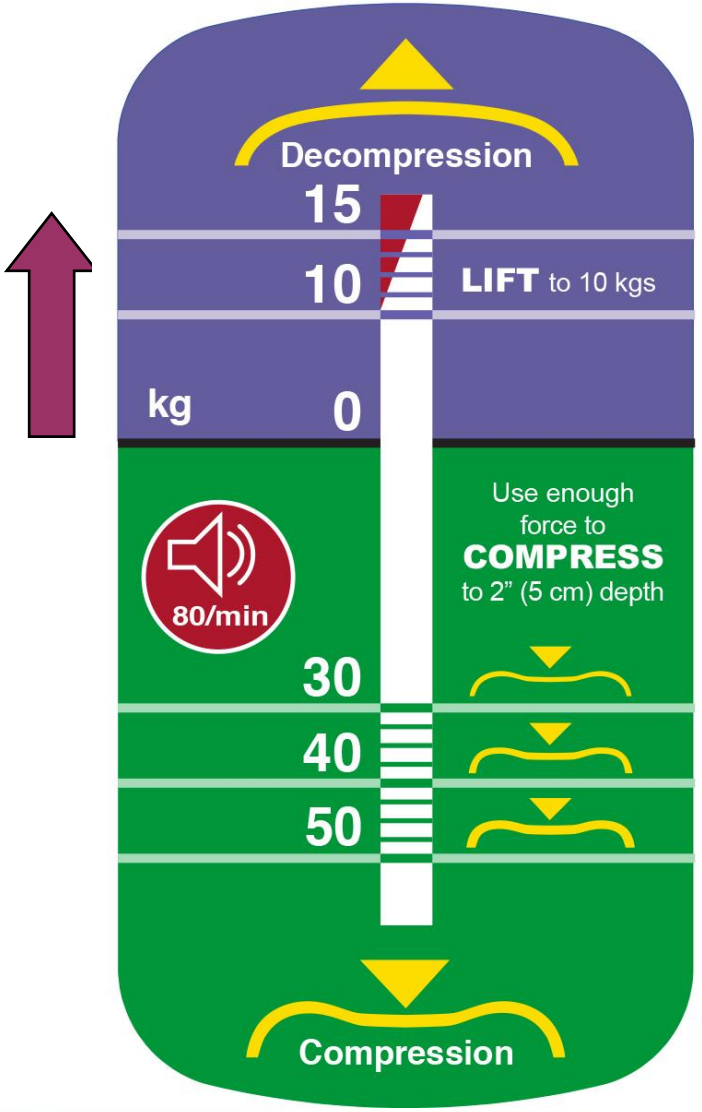
Active Compression

- Same depth as conventional CPR
  - At least 2 inches (or 5 cm)
- Note amount of force needed to compress to that depth
  - Use bottom of red arrow
- Approximate amounts of force needed:
  - Soft chest: ≈30 kg
  - Average chest: ≈40 kg
  - Stiff chest: ≈50 kg
- ≤ 40 kgs should be sufficient for most patients (see figure)



Active Decompression / Lift

- Actively lift the chest until ≈10 kg force
- Not necessary to lift with >10 kg of force.
- Use less lift if cup dislodges before then.



Compress & Lift

- Bend at waist
- Use upper body and thighs to compress and lift.
- 50% duty cycle

Troubleshooting

- Rib fractures
  - Check for proper placement and continue
- Redness or bruising to chest
  - Continue
- Sliding on chest
  - Occurs more often on manikins
  - May be an indication of improper vertical force
  - Reposition quickly and continue

Troubleshooting

- Suction problems
  - Assure proper position and check angle
  - Shave chest if too hairy
  - Dry chest if too wet
  - Continue use unless it's distracting
- Make sure electrode placement does not interfere with suction cup
- If you are unsure if the device is working properly, discontinue and perform manual CPR instead

Warnings

- Do not use ResQPUMP if the patient's chest is not large enough to provide adequate compression and decompression.
- Moisture, gels or lubricants on the chest should be wiped off or it may cause the suction cup to slide around and result in improper position.
- Improper position of the ResQPUMP may result in possible injury to the rib cage and/or internal organs, and may also result in suboptimal circulation.
- The ResQPUMP should not be used in patients who have had a recent (< 6 months) sternotomy. This has not been evaluated but it may potentially cause serious injury.

Following Each Use (per IFUs)

- **Clean device** per IFUs
  - Suction cup can be cleaned and reused, or replaced
- **Check metronome**
  - Hold button down for at least 3 secs
    - Long high-note beep followed by 2 short beeps: battery okay
    - One long low-note beep or no beep: device should be replaced
- **Check force gauge calibration**
  - Attach to smooth surface
  - Pull up; make sure red arrow moves up
  - Push down; make sure red arrow moves down
  - Assure "ZERO" when no force applied
    - Recalibrate if necessary following IFUs

Common Questions

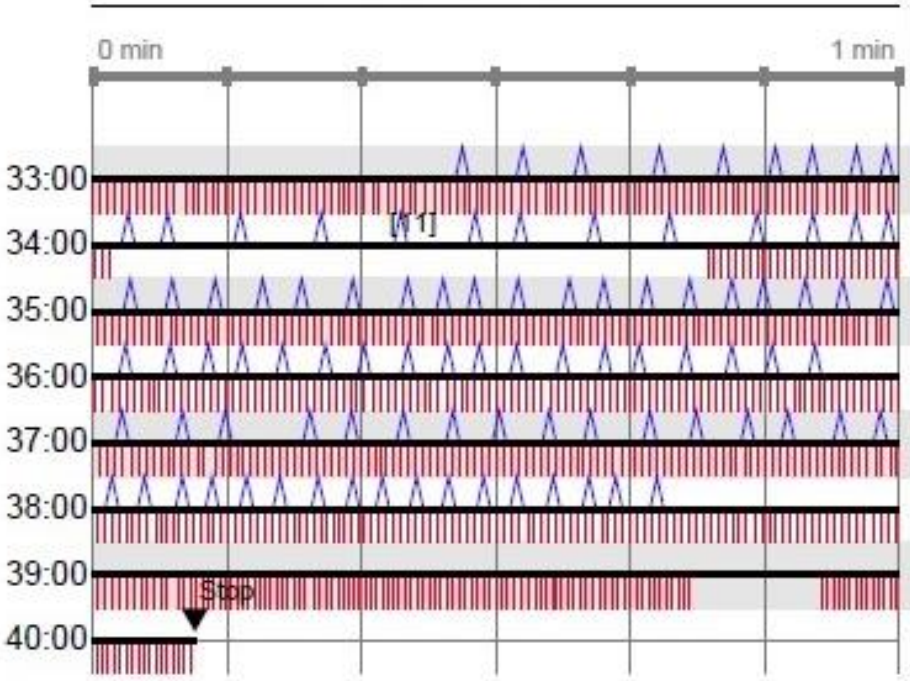
Is ACD-CPR harder to do than manual CPR?

- Saving lives is hard work!
  - You are the patient's heart and lungs.
  - High quality manual CPR is hard work.
- Previous study comparing **ACD-CPR at 80/min** to **manual CPR at 80/min** showed that ACD-CPR required about 25% more work to perform.*
- Recommended rate for conventional CPR is 100 – 120/min.
- Does **ACD-CPR at 80/min** require more energy than **manual CPR at 110/min**?
  - Probably; study underway
  - Rotation recommended at least every 1 min; more often if tired.

*Shultz et al. Resuscitation 1995;29:23-31.

OK City-Tulsa Metro Experience

CPR QUIK-VIEW



Interval Statistics

Compr. ratio, %	Compr. rate	Vent. /min
100	110	9
27	110	13
100	111	19
100	110	18
100	111	16
100	112	17
85	136	--
100	137	--

Metronome discontinued and patient turned over to hospital personnel at 39:00.

Performing High Quality ResQCPR

ResQCPR with Facemask

- Establish unresponsiveness
- Confirm absence of pulse
- Begin compressions @ 80/min
- Attach ResQPOD and establish tight facemask seal
  - Lights on

ResQCPR with Advanced Airway

- Confirm tube placement and secure with commercial tube restraint.
- Move ResQPOD to tube.
- $ETCO_2$ between ResQPOD and ventilation source.
- Turn on ResQPOD lights.
- Continuous compressions at 80/min.
- Ventilate once with each light flash (10/min).

Performing High Quality ResQCPR

- Rotate compression duties 60 seconds
- Check force gauge at regular intervals to assure appropriate compression and lift forces are being maintained.
- Use metronome to guide compression rates.

Signs of Improved LOC with ResQCPR

- Signs of improved blood flow to the brain have been reported, including, but not limited to:
  - Eye opening
  - Gagging, gasping or spontaneous breathing
  - Body movements (purposeful or non-purposeful)
- If these occur, check quickly to see if pulse has returned
  - If not, continue ResQCPR and contact medical control.
  - If yes, discontinue devices and support airway and ventilation as needed.

Return of Pulses

- When return of spontaneous circulation (ROSC) occurs, discontinue use of BOTH devices, and support ventilations as indicated.
- Leaving ResQPOD in place with ROSC will make it more difficult to breathe if spontaneous breathing or gasping occurs.
- If patient is gasping during cardiac arrest, leave ResQPOD in place.
- Resume use of BOTH devices if patient re-arrests.

Bottom line:
If chest compressions are needed: BOTH devices ON
If chest compressions not needed: BOTH devices OFF

Important Reminders

- Devices work best when used together and used early.
- Rotate duties frequently.
- Remove both devices when ROSC occurs.

Conventional CPR vs ResQCPR

		Conventional CPR	ResQCPR
Compression Phase	SAME	Active	
Compression Depth	SAME	At least 2”	
Compression Rate	DIFFERENT	100 – 120/min	80/min
Recoil/Decompression Phase	DIFFERENT	Passive	Active with 10 kg lift
Ventilations	SAME	Duration: over 1 sec Tidal volume: until chest rises	
Compression to Ventilation Ratio with Facemask	SAME	30:2	
Compression to Ventilation Ratio with Advanced Airway	SAME	Continuous compressions; asynchronous ventilations at 10/min	
Ventilation Circuit	DIFFERENT	May or may not include ITD	Includes ITD