The effect of resuscitation position on cerebral and coronary perfusion pressure during mechanical cardiopulmonary resuscitation in porcine cardiac arrest model

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Abstract 18341: Worsened Survival With Head-up Positional Cardiopulmonary Resuscitation in a Porcine Cardiac Arrest Model
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Conclusions: The result implicated that the head-up 30° position of mechanical CPR worsens survival in a porcine cardiac arrest model.
Conclusions from Korean Studies

Hemodynamics:
The cerebral perfusion pressures increased consistently with head up position, while the coronary perfusion pressure was peak at 30° head up position.

Lessons learned:
Head up during VF without CPR is dangerous
Rapid elevation of head without adequate circulation is dangerous
Whole body head up tilt for prolonged time is dangerous

There is a right way and a wrong way to perform Head Up CPR
Head Up CPR Physiology – What we know

1. Lowers ICP
2. Increases brain blood flow
3. Reduces the concussion with each compression
4. Increases gasping
5. Improve transpulmonary circulation
6. Works with prolonged CPR
7. Requires ITD, at a minimum
8. Need to prime the system before head elevation
9. Whole body head up tilt may be dangerous over time

Pumping blood ‘uphill’ requires more flow than is possible with conventional CPR
Does Head Up CPR Reduce Brain Edema?

The Problem:
Clinically brain edema is common, develops rapidly and is deadly post ROSC

Preliminary findings:
ICP lower in pigs post ROSC with HeadUP CPR during and after resuscitation
rCerO2 higher in pigs post ROSC with HeadUP CPR

Unknowns:
Will Head Up CPR reduce brain edema
Insert Cadaver Video
HUMAN CADAVER CPR STUDY

- Airway
- Aortic
- Right Atrial
- Intracranial Pressure
- Cerebral Perfusion Pressure

mmHg
Effect of Head Up CPR in Human Cadaver

- Intrathoracic pressure
- Intracranial pressure
- Cerebral perfusion pressure

Comparison of Automated CPR + ITD Flat vs. Automated CPR + ITD + Head Up.
Why Rialto Fire Department sees heart attack survival rates 3 times above national average
"Here are some of the elements in Rialto’s success:

• **Automated CPR with Autopulse** that allows department responders to provide other services while machine delivers CPR.

• **Heads up CPR allowing improved blood circulation** and oxygen delivery to the brain.

• **Use of ResQPOD device**, which serves as a regulator to restrict unnecessary airflow into the chest during CPR. This improves blood flow to the brain, fire officials say.

• **Rapid response time and bystander CPR.**"
Protocol Changes in 2015

1) Ensure proper use of mechanical CPR
2) Apply O₂ but defer ventilation 6 mins;
3) Apply impedance threshold device;
4) Automated CPR
5) Raise the backboard 30° (head/torso up position).
1304 cases from in 2014 and 2015
Outcome improved across all subgroups while response intervals, indications for initiating CPR, and bystander CPR rates were unchanged.
The Technology of Head Up CPR

An evolution
One Approach
Simple Wedge
One size does not fit all, hard to add automated CPR
Mechanical lift
Body and LUCAS slip
Current Prototype:
Weight without LUCAS backplate: 15 lbs

Meets major design specifications
MRS 525™ Patient Placement System in Supine Position with LUCAS 3 Attached

Meets specifications for reproducibility, stability, manual and automated CPR, optimal head and heart elevation
There’s hope yet
Summary of Science and Technology

- Animal studies have shown Head Up CPR lowers ICP, enhances blood flow to the brain, and improves coronary perfusion pressures.

- Head Up CPR requires CPR adjuncts that enhance circulation (e.g. an ITD) to be safe and effective.

- Specialized devices are needed to elevate the head and thorax to a specific manner to optimize benefit.

- Head Up CPR can be harmful when implemented poorly.
Conclusion

• Head Up CPR is a newly discovered way to improve brain blood flow and reduce the potential for brain injury during CPR.

• Head Up CPR requires new devices and systems designed to harness the benefits of gravity on CPR physiology.

• Head Up CPR has the potential to significantly increase survival rates with favorable brain function.