Incorporating Waveform Capnography into Resuscitation Practice: Why & How!

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Objectives

- Discuss the 2010 Guidelines incorporating waveform capnography (PETCO₂) into Resuscitation practice
- Discuss barriers to implementation of waveform capnography (PETCO₂)
- Discuss training and education prior to implementation
2010 AHA ACLS Guidelines

- Bigger emphasis on compressions
- Early defibrillation
- Post resuscitation algorithm
- Waveform Capnography
**Waveform Capnography** is Level 1A Recommendation in the 2010 AHA ACLS Guidelines.
Normal values:

- PetCO₂: 35 - 40 mmHg
- PaCO₂: 40 - 45 mmHg

10 Adult Cardiac Arrest Guidelines

CPR Quality
- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If PetCO₂ <10 mm Hg, attempt to improve CPR quality
  - If relaxation phase pressure, pressure ≤ 20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in PetCO₂ (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Shock Energy
- Biphasic: Manufacturer recommendation (120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- Monophasic: 360 J

Drug Therapy
- Epinephrine IV/I/O Dose: 1 mg every 3-5 minutes
- Vasopressin IV/I/O Dose: 40 units can replace first or second dose of epinephrine
- Amiodarone IV/I/O Dose: First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway
- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

Reversible Causes
- Hypovolemia
- Hypoxia
- Hypertension (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

Consider Advanced Airway
Quantitative waveform capnography

Monitor CPR Quality

Drug Therapy
- IV/I/O access
- Epinephrine every 3-5 minutes
- Amiodarone for refractory VF/VT
Why use waveform capnography?

- The main determinant of PetCO₂ during resuscitation is perfusion to the lungs.
- Quality indicator of compressions.
- Surrogate marker for perfusion.
- Correlates with cardiac output & myocardial blood flow during resuscitation.
- It may help with prevent over-ventilation.
  - Most devices display the ventilation rate.
- If it is persistently low, it suggests ROSC is unlikely.
- If it abruptly increases, it may suggest ROSC.
When to use waveform apnography

- When an endotracheal tube is placed
- Gold standard for endotracheal tube placement
- Intra-arrest
  - Quality marker of compressions
  - Information helpful to determine cessation of resuscitation efforts - esp. in asystole
- Post arrest
What’s in the waveform?

Measure the CO₂ concentration at the end of expiration

Devices should display a value & the waveform
Do we need all this fancy stuff?

- It helps!
- How do you currently evaluate quality of compressions?
- With ineffective compressions CO\(_2\) remains in the tissues
- CO\(_2\) is not making it to the heart to be eliminated by the lungs
- If we improve compressions, the CO\(_2\) is picked up and eliminated with assisted ventilation
Other adjuncts

- **Coronary Perfusion Pressure (CPP)**
  - Diastolic pressure
  - Goal > 20 mmHg

- **Central venous saturation**
  - ScvO₂ - normal 60 – 80%
  - Goal > 30%
  - If < 30%, assess quality of compressions
Special considerations

- **Pulmonary embolus**
  - May have a consistently low PetCO$_2$

- **Endotracheal tube dislodgement**
  - PetCO$_2$ reads zero

- **Termination of efforts**
  - PetCO$_2$ never above 10 mm Hg
It can be especially helpful to monitor PetCO₂ post arrest!

Downward trends could signify perfusion & re-arrest.
Waveform Capnography during ROSC

- Abrupt increase over 40
- Education PERLS - wait until the end of the 2 minute cycle
How to monitor Capnography

- Central Monitors
- Defibrillators
- Portable devices
- ***Should display a waveform***
Education - common pitfalls

- Lack of understanding of the use of Waveform Capnography
- Review of basics
  - Confusion between ventilation & perfusion
  - Hypercapnia during arrest
- Case studies & application
- Critical thinking
- Hands-on practice with the equipment
- Designated person to be in charge of PetCO₂
- Establish guidelines around communication of PetCO₂ values
The “What If’s”:

- What if the PetCO₂ is below 10 mmHg & the compressor looks tired?
- What if the PetCO₂ is never above 10 mmHg?
- What if the PetCO₂ abruptly increases to 45 mmHg?
- What if the ABG results show a PaCO₂ of 80? Should we increase ventilation during resuscitation?
Who should be trained?

Minimum:
- Team Leader
- Respiratory Therapist
- Nurse code responders
- Recorder

- Designated person responsible for Set-up, monitoring

**AND**

Communicating the values

**Code Blue Response Team & Response**

- **Anesthesiologist**
  - Stands at the head of the bed
  - Establishes artificial airway
  - May assist with vascular access

- **Respiratory Therapist**
  - Stands at the head
  - Secures airway
  - Provides ventilation
  - Transports patient

- **ICU Nurse or STAT Nurse (acute care)**
  - Stands at bedside closest to IVs
  - Administers medications
  - Inserts IO line (Peds ICU RN or STAT RN only)

- **MCICU Nurse**
  - Stands on side of bed
  - Defibrillation
  - Inserts IO line

- **Pharmacist**
  - Stands at crash cart
  - Prepares medications
  - Calculates medication IV dosages

- **Bedside**
  - Stands at bedside
  - Provides ventilation

- **Attending or Senior MICU Resident**
  - Stands at foot of bed
  - Directs the resuscitation
  - Signs the resuscitation form
  - Delegates tasks as needed

- **1st Year Resident**
  - Observes the resident
  - Takes on roles

- **Other Code Blue Team Members:**
  - Lab: Performs blood gas analysis ensures the team is aware of the results
  - Spiritual Care: Stays with the patient during resuscitation
  - Nursing Supervision: Ensures adequate staff on unit, assigns ICU beds
Barriers to Implementation

- Lack of buy-in from leaders/administration
- Lack of equipment
- Cost
- Education
- System barriers
- Documentation
ow do you make it stick?

- Practice!
- Incorporate into mock codes
- Case reviews of codes
- Feedback to staff
In conclusion

- Waveform Capnography is a Level 1A recommendation in the 2010 ACLS Guidelines
- It can be successfully implemented; it will take some planning!
- It will require education and training with follow up

THANK YOU!!!

Questions?