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The Victorian Newborn Resuscitation Project

Pedi-Cap™ CO_2 detector

Presentation redeveloped for this program by Rosemarie Boland
from an original presentation by Johnston, Adams & Stewart, (2006)

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Background

- Clinical methods of endotracheal tube placement have not been systematically evaluated in neonates

- End tidal CO_2 detectors identify oesophageal intubation faster than clinical assessment (Mean 8.1 seconds versus 39.7 seconds)

(Garey, et al., 2008)

Clinical verification of ETT position

Tracheal intubation is likely if:

- The ETT is visualized passing through the vocal cords
- The heart rate rises above 100 bpm soon after intubation & commencing positive pressure ventilation
- Breath sounds are auscultated in both axillae
- Condensation is seen on the inside of the endotracheal tube during expiration
- The infant's chest rises & falls with each inflation

(Australian Resuscitation Council, 2006)

ARC recommendation

"An end tidal CO_2 detector attached to the outside end of the endotracheal tube is recommended for verification of correct tube placement"

(Australian Resuscitation Council, 2006, Guideline 13.5)

Benefits of using a Pedi-Cap

- Quick confirmation of correct ETT placement in the trachea
- Easy to use
- Inserts quickly into the circuit
- Inexpensive
- Portable
- Risk management strategy

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How does the Pedi-Cap work?

- The Pedi-Cap is a semi-quantitative, non invasive colorimetric end tidal CO_2 ($ETCO_2$) detector
- The device starts at a base line colour when minimal CO_2 is present & undergoes gradual colour change as the concentration of exhaled CO_2 increases with each positive pressure breath delivered to the infant
- $ETCO_2$ is a reflection of ventilation, cardiac output, pulmonary blood flow & metabolism

The effect of pulmonary perfusion on $ETCO_2$

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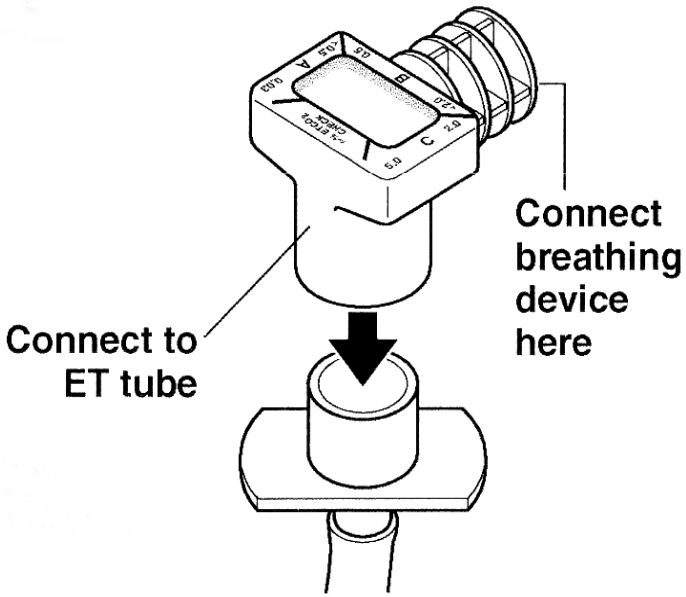
- If perfusion is adequate, $ETCO_2$ represents the partial pressure of CO_2 in circulating blood. This will be demonstrated breath-to-breath on the Pedi-Cap after successful intubation

- Inadequate cardiac output & decreased pulmonary perfusion (e.g. during cardiac-respiratory arrest) will lead to negligible $ETCO_2$ detection as CO_2 is not being delivered to the lungs

(Garey, et al., 2008)

Connecting the Pedi-Cap

- The Pedi-Cap is inserted between the outer end of the endotracheal tube and the manual ventilation device (e.g. Neopuff™ or self inflating bag)

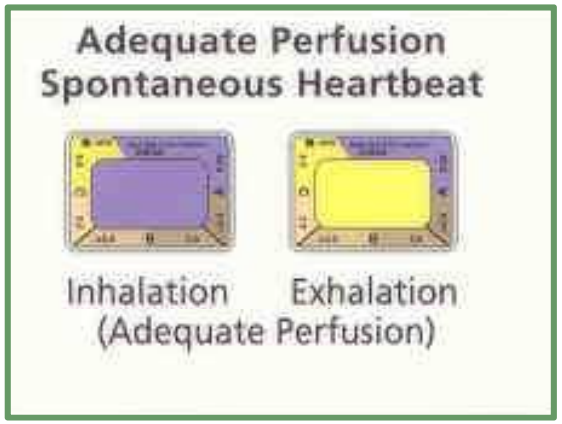


Interpreting the results

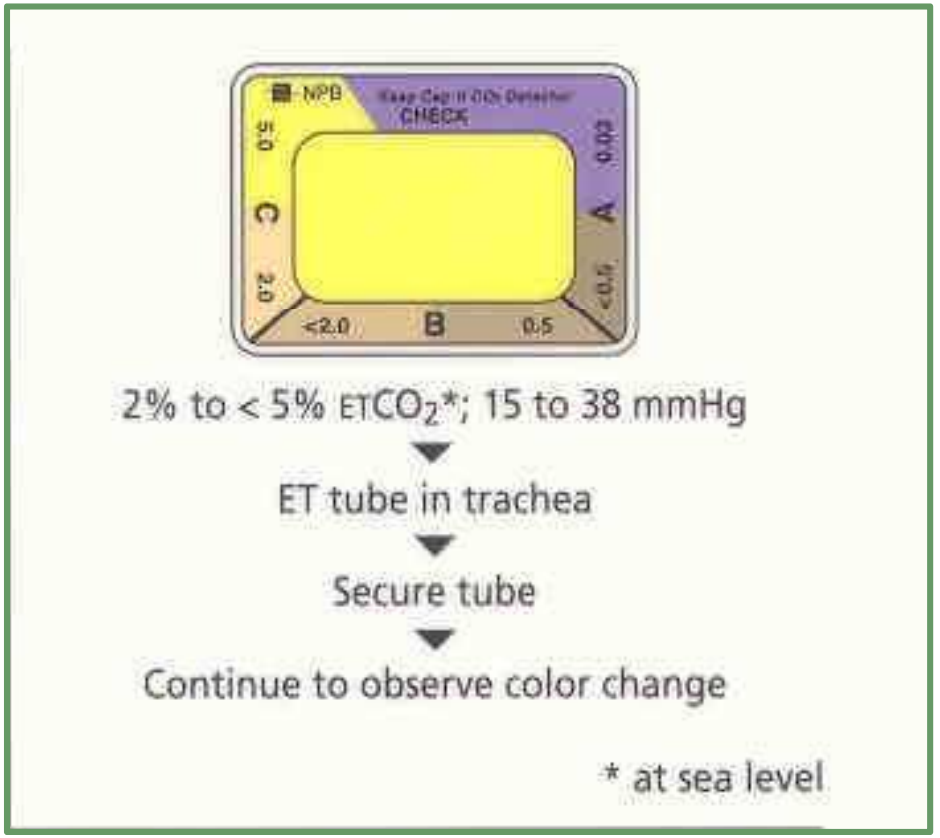
- After 6 effective positive pressure breaths, evaluate the colour of the window on expiration
- Successful tracheal intubation is confirmed if the Pedi-Cap window changes from purple (on inspiration) to yellow (on expiration) with every positive pressure breath delivered to the infant

The following slides describe all the colour changes that may be seen and their meaning

Successful tracheal intubation

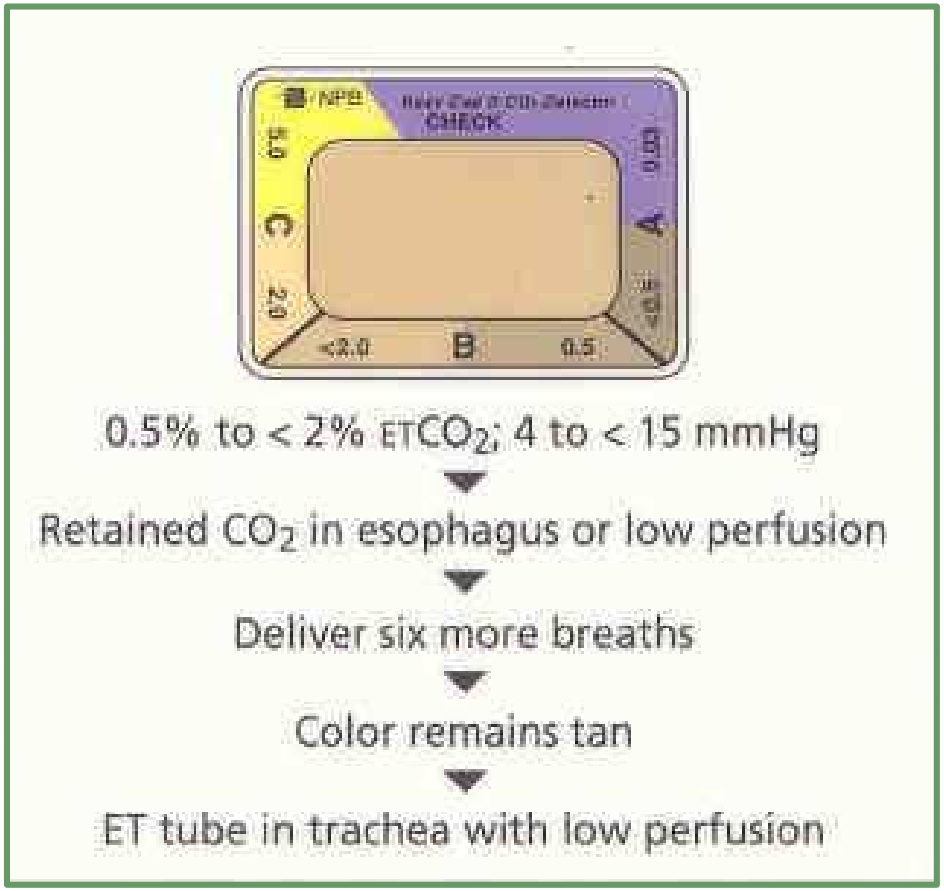


The Pedi-Cap window changes colour on expiration from purple to gold or mustard yellow

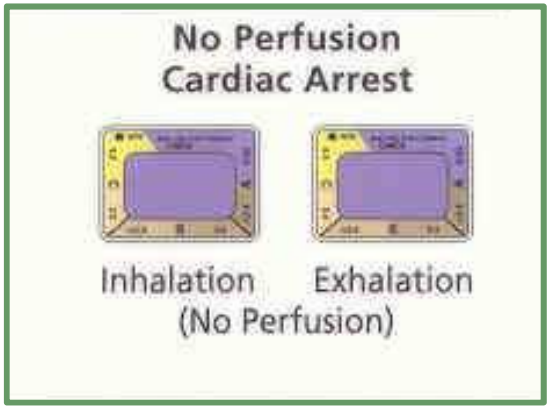


Poor perfusion or insufficient tidal volume (V_T) is being delivered

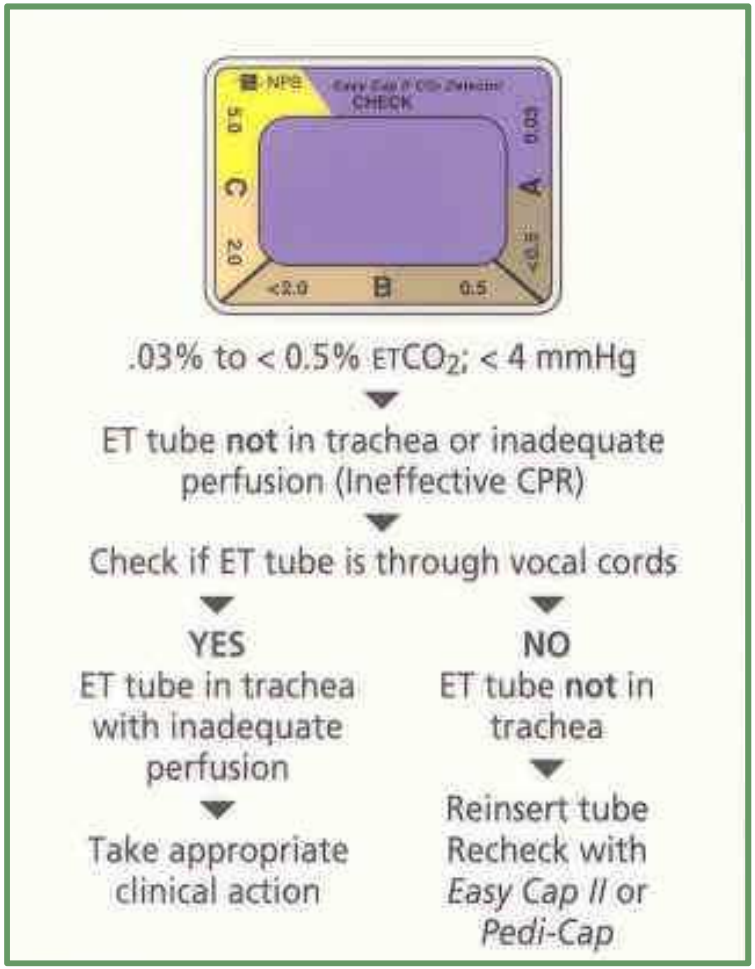
The Pedi-Cap window changes colour on expiration to light or dark tan if perfusion is poor or insufficient V_T is being delivered



No perfusion, cardiac arrest or oesophageal intubation

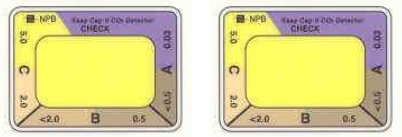


The Pedi-Cap window stays purple or dark grey on expiration if there is no perfusion or the ET tube is in the oesophagus



Damaged Pedi-Cap

Damaged Pedi-Cap



Inhalation Exhalation

The Pedi-Cap window stays yellow on both inspiration & expiration, indicating a damaged Pedi-Cap

Reasons for damage

- Contamination with Adrenaline
- Contamination with surfactant
- Exposure to gastric juices
- Prolonged exposure to high humidity

Caution when using a Pedi-Cap

- Misinterpretation of the result is possible if:
  - Insufficient breaths are delivered
  - Insufficient tidal volume is delivered
  - There is significant air leak around the endotracheal tube
  - The infant is in full circulatory arrest

Management during cardiac arrest

- In cardiac arrest, re-establishment of cardiac output and pulmonary perfusion by adequate CPR is necessary to increase end tidal CO_2 to a level detectable by the Pedi-Cap
- Actions:
  - Continue ECC & positive pressure ventilation at 3:1
  - Check that the ETT can be visualized passing through the vocal cords: re-intubate if it is not
  - If the ETT is through the vocal cords, increase the PIP to ensure a sufficient tidal volume is being delivered

The very low birth weight infant

- The Pedi-Cap CO_2 detector is labeled for use in infants > 1kg birth weight

- Research has shown that the tidal volume of a viable (400 gram) infant is above the tidal volume threshold for the Pedi-Cap device, suggesting that a Pedi-Cap is appropriate for use on any neonate to confirm intubation

(Garey, et al., 2008)

Limitations of the Pedi-Cap

- A positive colour change will occur when the endotracheal tube is in any portion of the respiratory tree, such as the right main bronchus or oropharynx

- A chest X-ray remains the gold standard to confirm correct endotracheal tube position in any infant who requires ongoing ventilation in SCN or NICU after birth

Conclusion

- The Pedi-Cap can quickly verify endotracheal tube placement in the trachea
- It is easy to use
- It is easy to learn to use
- Caution is required in certain situations
- A Pedi-Cap should be standard equipment on newborn resuscitation cots

(Australian Resuscitation Council, 2006)

Pedi-Cap: Product details

- Weighs < 5 grams
- Dead space: 3 mL
- Resistance: 2.5 cm H_2O (+/- 0.5 cm) at 10 L/min flow
- Single patient use, but can be used intermittently or continuously on an infant for two hours

Supplier

Tyco Healthcare Pty Ltd

Telephone: 1800 252 467

Pedi-Cap™ Pediatric CO_2 Detector

Box of 6

References

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Acknowledgments

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Disclaimer

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