Gastric carbon dioxide concentration following bag and mask ventilation in children

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Background and Goals of Study:

Unrecognized placement of an endotracheal tube (ETT) in the oesophagus is a potentially life threatening complication of tracheal intubation. Correct ETT position is confirmed by presence of carbon dioxide (CO₂) in exhaled gas. Following bag-mask ventilation in children a high and deceptive level of end tidal (ET) CO₂ can be present in the expired gas following inadvertent oesophageal intubation. We sampled gastric gas CO₂ levels in anaesthetized children following bag-mask ventilation at induction to demonstrate this possibility.

Materials and Methods:

Twenty-one children were recruited. Anaesthesia was induced and child bag-mask ventilated using a Jackson-Rees T-piece circuit. Intravenous lines were inserted and the trachea intubated. The airway management provider was usually a resident supervised by senior. After securing the airway mechanical ventilation was started and a size 10 suction catheter was passed into the stomach via mouth. The ETCO₂ monitoring line was disconnected and attached to the open end of the suction catheter. Gastric gas was sampled for 10-seconds and displayed. The level of gastric CO₂ was measured from the ETCO₂ trace (Fig.).

Results and Discussion:

Median (range) age was 14(0-60) months, and weight was 9(3-25) kg. Children were bag-mask ventilated for 4(1-20) minutes with fresh gas flow rate of 6(3-18) L/min. Gastric gas could be sampled in all cases. The mean (range) level of gastric CO₂ detected was 29 (12-52) mmHg. The child with highest level of gastric CO₂ was bag-mask ventilated for 10 minutes.

Significant levels of CO₂ are found in the stomach following bag-mask ventilation in young children. These levels are sufficiently high to cause confusion when using the ETCO₂ trace as evidence of successful tracheal intubation. Holding a face mask and ventilating using a Jackson-Rees circuit can result alveolar gas rich in CO₂ entering the stomach. Presence of volatile agent in the gas was consistence with an alveolar origin (Fig.). The longer and more difficult the period of manual ventilation the greater the amount that accumulates.

Table showing data from those cases with the highest gastric CO₂ levels. (* difficult ventilation / gastric distention)

Type of Surgery	Age (months)	Weight (kg)	Gastric CO ₂ (mmHg)	Duration bag-mask	Method of induction
Supracondylar #	48	17	30	5 min	IV*
Lap. Hernia repair	4	8	33	8 min	gas
Umbilical Cyst	36	16	34	7 min	gas*
Rectal pull throw	32	12	35	6 min	gas
Lap. Hernia repair	17	9	36	7 min	gas*
Hypospadias	15	12	44	4 min	IV
Duplex kidney	31	16	45	5 min	IV
Digit transplant	36	15	50	14 min	gas
Cystoscopy	4	7	52	15 min	gas*

Conclusion:

Significant amounts of CO₂ often in excess of 30 mmHg may be initially detected following oesophageal intubation in children as a result of bag-mask ventilation. Therefore presence of CO₂ to confirm correct ETT position is not totally reliable in children and the ETCO₂ trace should be confirmed over several ventilator cycles.