Cricoid pressure: useful or dangerous?

Francis VEYCKEMANS
Cliniques Universitaires Saint Luc
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Controversial issue

- Can J Anaesth 1997 JR Brimacombe
- Pediatr Anesth 2002 JG Brock-Utne
- Curr Opin Anaesthesiol 2007 M Jöhr
- Can J Anesth 2007 DT Neilipovitz
- Ann Emerg Med 2007 DY Ellis
- Anaesthesist 2007 M Weiss
- Pediatr Anesth 2008, M Weiss
Rapid sequence induction: definition

- preoxygenation
  - fixed dose of a hypnotic agent
  - cricoid pressure (CP)
  - succinylcholine
    - 60 sec apnea, no ventilation
      - tracheal intubation
        - release of CP after confirming intubation

Rapid sequence induction

- a cornerstone of GA since the 1960’s
- to prevent inhalation of gastric contents in at risk situations
- contributed to improving safety of GA but hemodynamics?
  hypoxemia?
  awareness?
- based more on hypothesis and dogma than on a scientific basis
In clinical practice...

- less than 50% of British pediatric anesthesiologists use it in emergency cases!
  \[\textit{Paediatr Anaesth} 2001; 11: 147\]
- large variation in the use of RSI by British non-pediatric anesthesiologists in non-fasted patients (\textit{Pediatr Anesth} 2007; 17: 235)

Outline

- risk and incidence of inhalation
- preoxygenation
- fixed dose of the hypnotic agent
- cricoid pressure: pro & con
- succinylcholine?
- apnea
- modified RSI's
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Preoperative risk factors for inhalation

- emergencies: gastric contents
  - time interval between trauma and last food?
  - full vs distended stomach?
- increased abdominal pressure: ascitis, tumor
- low conscious level
- GO reflux disease?
Inhalation in children: a rare event

- Borland *J Clin Anesth* 1998; 10: 95
  \[ n = 52/50,880 \Rightarrow 0.1\% \]
  41 during induction

- Warner *Anesthesiology* 1999; 90: 66
  \[ n = 24/58,136 = 1/2632 \Rightarrow 0.04\% \]
  7 in elective cases
  1/373 emergency vs 1/4544 elective
  21 during induction

- Murat *Pediatr Anesth* 2004; 14: 158
  \[ n = 19/24,165 = 0.08\% \]
  50% in PACU!
- Pediatric Closed claims 1990-2000
  *Anesthesiology* 2007; 104: 147
  \[ n = 6/? \]
  5 after adenoidectomy/tonsillectomy

- no (published) mortality
Inhalation during induction (Warner)

n = 21 - 2 (aspirated before induction)
- RSI used in 9 with preoperative risk factors
- RSI not used in 10 others
  ✐ 3 difficult intubations
* all cases of inhalation gagged or coughed during airway manipulation
* CP difficult to apply in less than 3 y old

➢ 15 no signs symptoms within 2 h
➢ 9 symptomatic : 5 PICU ⇒ 3 ventilated > 48h

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Preoxygenation in children

- risk of hypoxemia as age decreases:
  - increased $O_2$ consumption
  - lower $O_2$ stock (FRC)
* preO$_2$ more rapid if < 1 y
* following effective preO$_2$,
  mean apnea time $\Rightarrow$ SpO$_2 \leq 90\%$
  96 sec if 2d - 6 months
  118 sec if 7mo - 2y
  160 sec if 2 - 5 y
  210 sec if 6 - 10 y


Effective preoxygenation?

- difficult to achieve in awake infants and children
  - acceptance of facemask
  - good seal around the face
- can produce agitation
- duration?
  - monitoring $E_T O_2$: OK if > 90% of FiO$_2$
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Fixed dose of a hypnotic agent

- thiopentone vs propofol vs etomidate vs ketamine + midazolam
- laryngoscopy and intubation are stressful maneuvers: no analgesia!
  = no blunting of stress reaction
- no titration of dose
  - risk of overdosing: collapse
  - risk of underdosing: ↑ BP, awareness

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Cricoid pressure: theory

- used in 1774 by Munro to prevent the passage of air into the stomach
- described by Sellick (1961) in a few patients
- position:
  hyperextension of the neck, no pillow
  (> sniffing position used nowadays)
- «during cricoid pressure the lungs may be ventilated by ippv without risk of gastric distension» (Lancet 1961)
Cricoid pressure in children

- effective to prevent aspiration of gastric contents, even in the presence of a nasogastric tube (Salem, Br J Anaesth 1972)

- effective to prevent gastric insufflation in infants and children ventilated by mask with PIP up to 40 cmH$_2$O w/wo muscle relaxation (Moynihan Anesthesiology 1993)

NB: appropriate CP = no clinically notable increase in airway resistance

But cricoid pressure

😊 lowers LOS tone
in awake & anesthetized adults

😊 can distort the upper airway anatomy
« release it if ventilation/intubation difficult »

😊 is not easy to perform correctly:
- 1 or 2 hands? 2 or 3 fingers?
- which force? soft pediatric trachea!
- when? → retching if before induction

😊 interferes with positioning of a LMA
LOSP and cricoid pressure

- 29%

Fasting
No GER!
But no effect of sedation with propofol and/or remifentanil!

(Anesth Analg 2005; 100: 1200)

Force applied: 30 N?

- 50 mL syringe filled with air
- Pressure with 2 fingers down to 38 mL mark = 30N
Anatomic basis of CP?

MRI in 19 awake adults, head in neutral position:
* esophagus displaced lateral to cricoid and vertebral body in 52.6% (mainly to the left)
* cricopharyngeal muscle between cricoid and vertebral body in 95%

- with CP:
  * esophageal displacement in 90.5%
    13 ⇒ left    4 ⇒ right
  * compression of airway in 81%
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Succinylcholine

(+): quick onset: 60 sec
(+): perceived short duration of action
   in case of failed intubation
   😎 in fact: 4 to 8 min!
(-): possible side-effects

- other muscle relaxants are presently available
- rapid reversal of rocuronium block with sugammadex
No ventilation

based upon

«stomach is readily distended with gas if ventilation with bag & mask is attempted» (Leigh & Belton 1960)

- it is indeed a risk despite cricoid pressure: gentle ventilation !!
- $O_2$ reserve is lost during apnea
  ➔ hypoxemia not unusual
  usually diagnosed after intubation

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Summary

- CP does not prevent inhalation
  - false sense of safety
- CP prevents gastric inflation (mask ventilation)
- preoxygenation is difficult
  - risk of hypoxemia
- risk of ↑↓ blood pressure
- risk of awareness
- need for quick intubation
  - traumatic?

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Alternative technique(s)

1) if intestinal obstruction, distension: 
   nasogastric tube to aspirate gastric content (decompression)
2) it should be left in place, open to atmosphere (blow-off valve)
   BUT
   - seal of facemask more difficult
   - increased risk of esophageal intubation because tracheal tube tends to follow it

The future?

3) any emergency:
   - gastric ultrasound!
     eg, young adults with acute appendicitis
     full stomach in 5/7 fasting < 8h
     6/10 fasting 8-12h
     11/43 fasting > 12h
Alternative technique(s)

4) preoxygenation ... as feasible
   suspect concealed hypovolemia
5) small dose of opiate
6) titration of a hypnotic
   o propofol neonate
   cyanotic cardiac disease
   cough if quick injection!
   o etomidate if unstable hemodynamics
   steroid suppression
   o ketamine +midazolam

Alternative technique(s)

7) gentle trial mask ventilation (CP ?)
   * if OK ⇒ + muscle relaxant
   * if mask ventilation difficult :
     - check depth of GA
     - still difficult: LMA Proseal® / classic Laryngeal tube®

8) gentle mask ventilation
   = just enough to rise the upper thorax
   ie, PIP < 15 cmH₂O
Alternative technique(s)

9) when muscle relaxation OK:
- atraumatic intubation with cuffed tube at depth of anesthesia!

10) if cough or gagging at any time before intubation is complete:
- add some hypnotic and intubate

The intubator’s apnea!
Suspected difficult intubation: inhalation induction!!

Conclusion (1)

1) another way to achieve safely tracheal intubation in patients at risk for inhalation while providing
- oxygenation
- analgesia and anesthesia
- more stable hemodynamic conditions
- better conditions for intubation

RSI ≠ rapid sequence intubation!
Conclusion (2)

2) training is needed to achieve it safely

3) assessment of safety :
   very large multicentric studies

4) research on cricoid pressure

Thank you