

Cuffed vs. Uncuffed ETT

Patrick Ross, MD

The view you see



Depends on where you stand



Landmark Description of the Pediatric Airway

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SOME ANATOMIC CONSIDERATIONS OF THE INFANT LARYNX INFLUENCING ENDOTRACHEAL ANESTHESIA*

JAMES E. ECKENHOFF, M.D.

Philadelphia, Pennsylvania

Received for publication October 10, 1950

Landmark Description of the Pediatric Airway

- The infant larynx is more cephalad
- The epiglottis is longer, stiff, U shaped
- The cricoid ring is the narrowest portion of the airway
- “A tube that cannot be advanced through the cricoid ring should not be left in situ but should be replaced with a smaller tube or the anesthesia completed without an endotracheal tube”

The History

- Initially there was no cuff and red rubber tubes caused mucosal irritation
- The first cuffs were high pressure
- High-compliance low pressure cuffs were developed in the 1970's
- Size appropriate tubes are available from many manufacturers
- 2nd generation cuffed tubes with softer polyurethane are now available

Possible Advantages with CTT

- Fewer DLs due to sizing issues
- Less pollution with anesthetic gas
- Decreased gas use
- Decreased risk of aspiration
- Able to precisely control ventilation
- Able to guarantee PEEP
- Monitoring of respiratory function
- Able to adjust for change in compliance (burns)

A few arguments against cuffed tubes

- The presence of a leak ensures the tube is not compressing the tracheal mucosa against the nondistensible cricoid ring
- Extra care required for correct placement
- Cuffs cause trauma to the trachea
- Cuff pressure must be monitored
- Using a smaller tube limits the ability to suction or ventilate

What's the Research

- Deakers TW, et al. Cuffed endotracheal tubes in pediatric intensive care. The Journal of Pediatrics. 1994
- Khine HH, et al. Comparison of cuffed and uncuffed endotracheal tubes in young children during general anesthesia. Anesthesiology 1997
- Newth C JL, et al. The use of cuffed versus uncuffed endotracheal tubes in pediatric intensive care. The Journal of Pediatrics. 2004
- Salgo B, et al. Evaluation of a new recommendation for improved cuffed tracheal tube size selection in infants and small children. Acta Anesthesiologica Scandinavica 2006

What's the Research

- Weiss M, et al and the European Paediatric Endotracheal Intubation Study Group. British Journal of Anaesthesia
 - Prospective randomized controlled multi-centre trial of cuffed or uncuffed endotracheal tubes in small children
 - December 2009

Deakers TW et al. 1994

- Prospective, 243 Pts, 282 intubations
- Outcomes: Stridor, reintubation
- Pt with cuffed tubes older 8 vs. 2.5 yr
- Pt with cuff intubated longer 6.1 vs. 3.7d
- Incidence of stridor 14.9%
 - No difference between groups
- 2 cuffed and 4 uncuffed reintubated
 - No Difference between groups

Khine HH et al. 1997

- Prospective, 488 Pts, randomized
- Outcomes: Tube changes, Gas Flow, Nitrous Oxide contamination, # Tx for croup Sx
- Duration of intubation 1 hour

Khine HH et al. Outcome

	Cuffed	Uncuffed	P
# Tube Change	3 (1.2%)	54 (23%)	<0.001
# > 2 lpm gas	3 (1.2%)	26 (11%)	<0.001
# Tx croup	3 (1.2%)	3 (1.3%)	>0.5
# Admit croup	1 (0.4%)	1 (0.4%)	>0.5

Khine HH et al. Outcome

Nitrous Oxide Concentration (ppm)

	<10	11-25	26-299	>300
Uncuffed ETT	19	6	9	6
Cuffed ETT	39	0	0	0

Khine Formula for cuffed ETT

- Cuffed tube size (mm ID) = $(\text{age}/4) + 3$
- Other formulas available but may not be better
- Should have leak with cuff down

Newth CJL et al. 2004

- Prospective, 860 Pts
- 597 Pts < 5 yrs, 210 cuffed ETT
- Outcomes: Extubation success, racemic epi use, need for tracheostomy
- Pts under 2 years with cuff tube were intubated longer and had higher PRISM score
- No difference cuff vs. uncuffed for extubation success, # racemic Tx, # trached

Salgo B et al. 2006

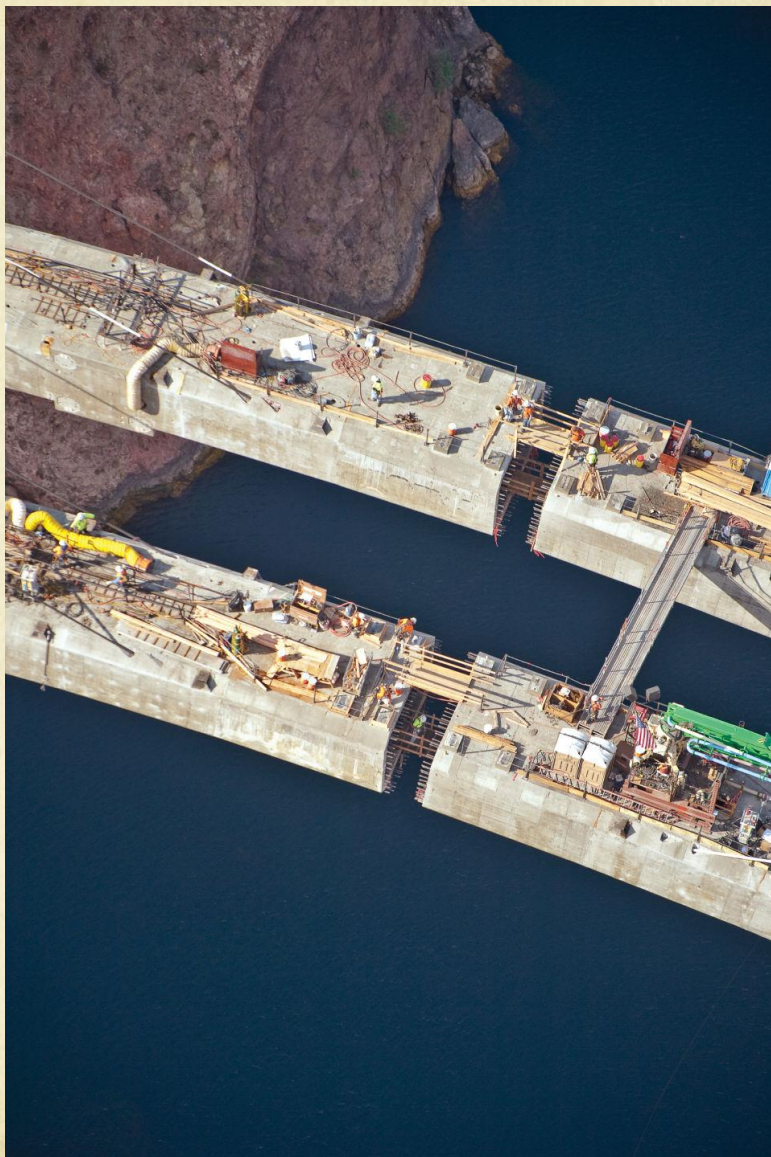
- Evaluating new Microcuff cuffed ETT and ETT size selection
- 350 patients birth to 5 years
- Incidence of stridor 2.3%
- Treated for stridor 0.9%

Weiss M. et al 2009

- Multi-center, randomized, age 0 to 5 yr
- 1119 Microcuff PET cuffed
- 1127 uncuffed
- Max cuff pressure limited at 20 cm H₂O
- Post-extubation stridor 4.4% cuffed and 4.7% uncuffed (p=0.54)
- Exchange rate 2.1% cuffed and 30.8% uncuffed (p<0.0001)

Weiss M. et al 2009

- Cuffed tubes can be used with similar risk of post-op stridor
- Limitations
 - Only one brand of cuffed tube used
 - Short length of intubation relative to ICU
 - Outcome is stridor not injury



List of Editorials, Pro/Con Debates, Measurement and Case studies

- Leong L et al. The design of pediatric tracheal tubes. Paediatric Anaesthesia. 2009
- Holzki J et al. Stridor is not a scientifically valid outcome measure for assessing airway injury. Paediatric Anaesthesia. 2009
- Holzki J et al. Iatrogenic damage to the pediatric airway Mechanisms and scar development. Paediatric Anaesthesia. 2009
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List of Editorials, Pro/Con Debates, Measurement and Case studies

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- Aker J. An emerging clinical paradigm: the cuffed pediatric endotracheal tube. AANA Journal. 2008
- Moehrlen U et al. Scanning electron-microscopic evaluation of cuff shoulders in pediatric tracheal tubes. Paediatric Anaesthesia. 2008
- Weiss M et al. Cuffed tracheal tubes in children: past, present and future. Expert Review of Medical Devices. 2007
- Weiss M. et al. Comparison of cuffed and uncuffed preformed oral pediatric tracheal tubes. Paediatric Anaesthesia. 2006
- Weiss M et al. Cuffed tracheal tubes in children – things have changed. Paediatric Anaesthesia. 2006
- Ashtekar CS et al. Do cuffed endotracheal tubes increase the risk of airway mucosal injury and post-extubation stridor in children? Archives of Disease in Childhood. 2005

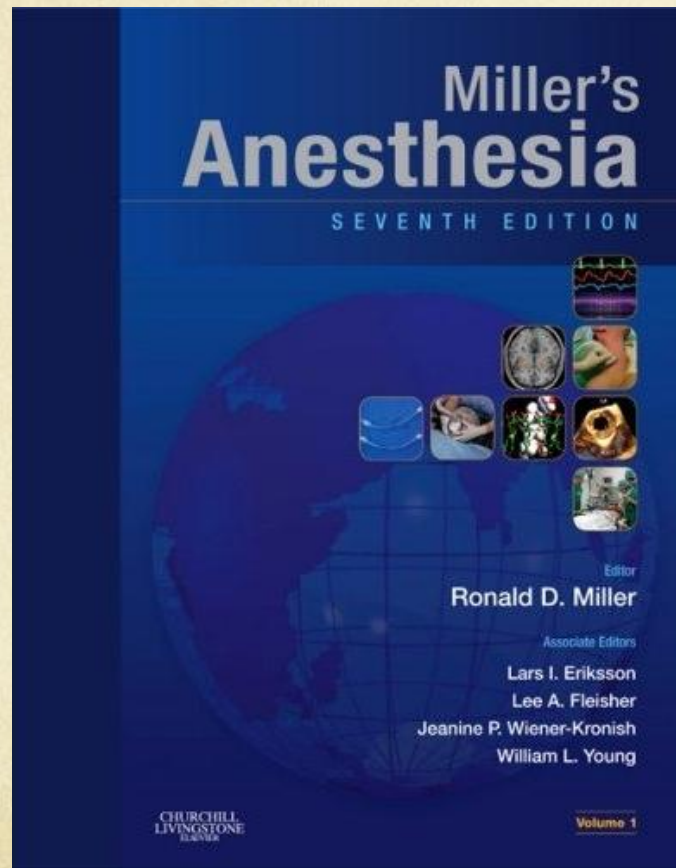
List of Editorials, Pro/Con Debates, Measurement and Case studies

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- Dullenkopf A et al. Fit and seal characteristics of a new paediatric tracheal tube with high volume-low pressure polyurethane cuff. *Acta Anaesthesiologica Scandinavica*. 2005
- Fine G et al. The future of the cuffed endotracheal tube. *Paediatric Anaesthesia*. 2004
- Bell C. Endotracheal tube cuff pressure is unpredictable in children. *Survey of Anesthesiology*. 2004
- Devys JM et al. Cuff compliance of pediatric and adult cuffed tracheal tubes: an experimental study. *Paediatric Anaesthesia*. 2004
- Dillier CM et al. Laryngeal damage due to an unexpectedly large and inappropriately designed cuffed pediatric tracheal tube in a 13-month-old child. *Canadian Journal of Anaesthesia*. 2004

List of Editorials, Pro/Con Debates, Measurement and Case studies

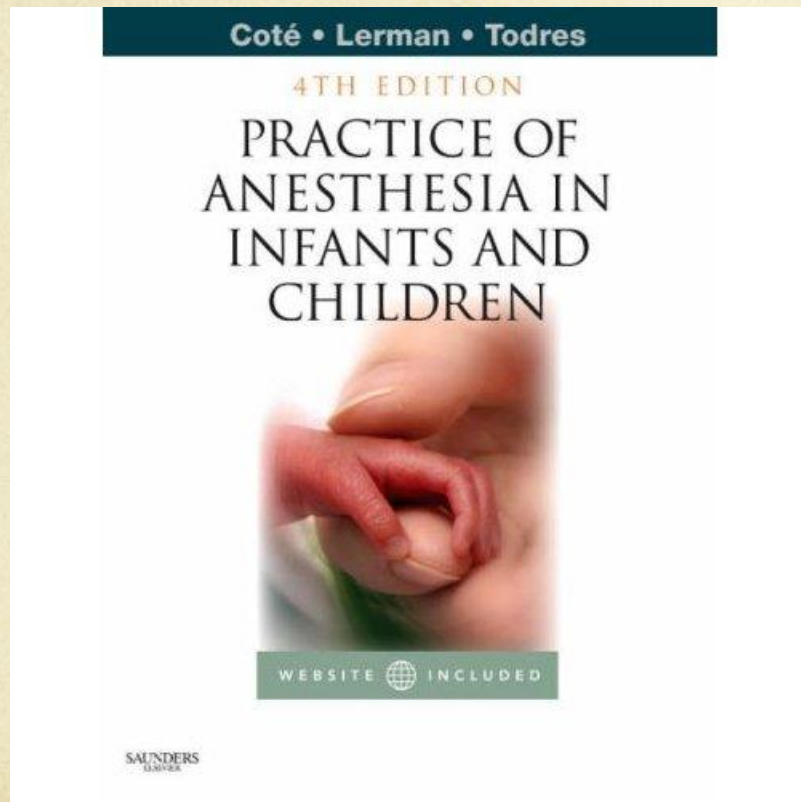
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- Mhanna MJ et al. The “air leak” test around the endotracheal tube, as a predictor of postextubation stridor, is age dependent in children. *Critical Care Medicine*. 2002
- Ho A et al. The margin of safety associated with the use of cuffed paediatric tracheal tubes. *Anaesthesia*. 2002
- Orliaguet GA et al. Postal survey of cuffed or uncuffed tracheal tubes used for paediatric tracheal intubation. *Paediatric Anaesthesia*. 2001
- James I. Cuffed tubes in children. *Paediatric Anaesthesia*. 2001
- Murat I. Cuffed tubes in children: a 3-year experience in a single institution. *Paediatric Anaesthesia*. 2001
- Reyes G et al. International survey on the use of cuffed vs uncuffed endotracheal tubes. *Pediatrics*. 1999

Textbook recommendations



- 5th 2000
 - Uncuffed < 10 years
- 6th 2005
 - Uncuffed < 6 years
- 7th 2009
 - Cuffed OK even in infants

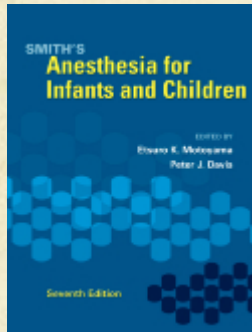
Textbook recommendations



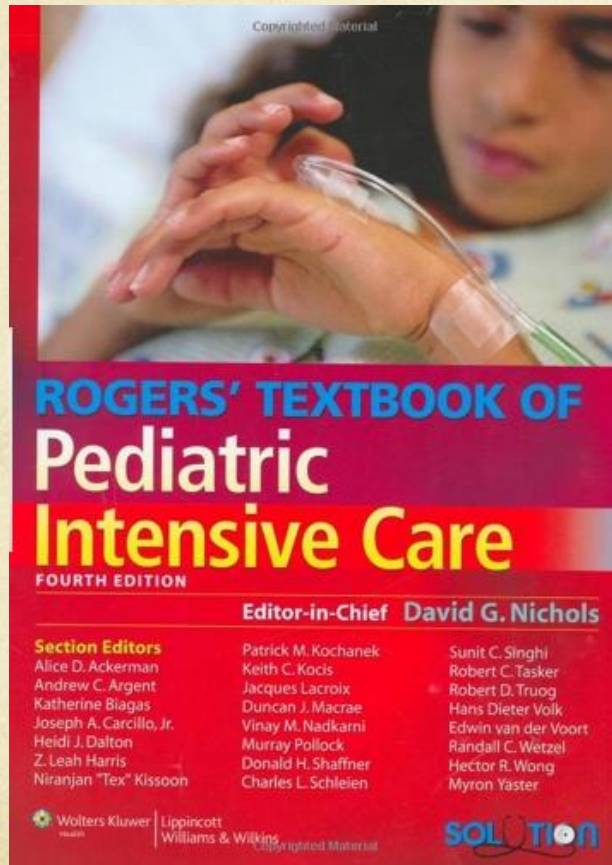
- 3rd 2001
 - Uncuffed < 8 years
- 4th 2009
 - Traditional teaching...Uncuffed < 8 years
 - Recent data ...

Textbook recommendations

- 6th 1996
 - Uncuffed < 8 years
- 7th 2006
 - Uncuffed tubes may be OK

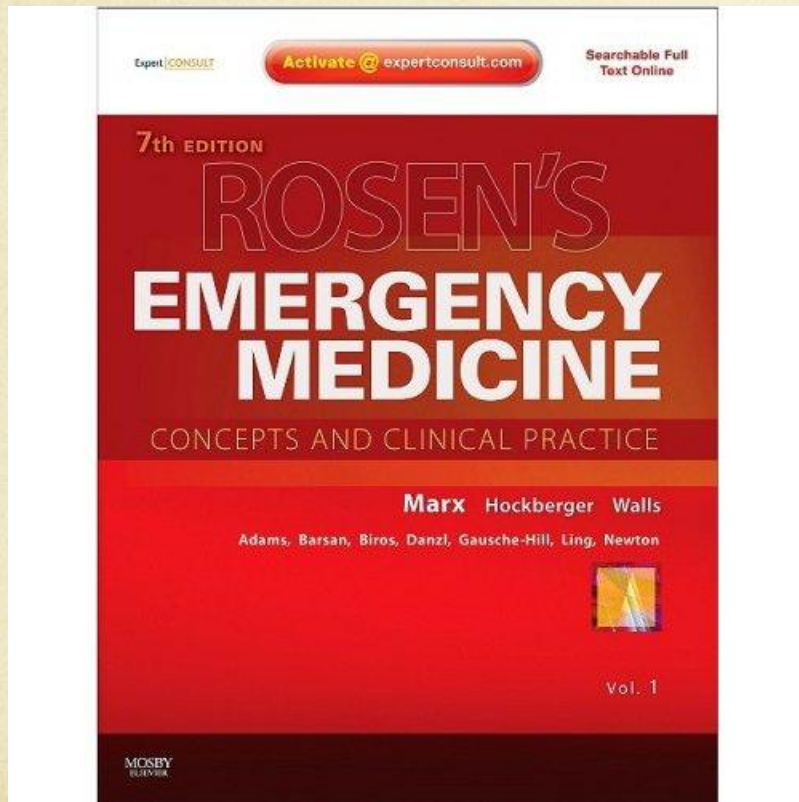


Textbook recommendations



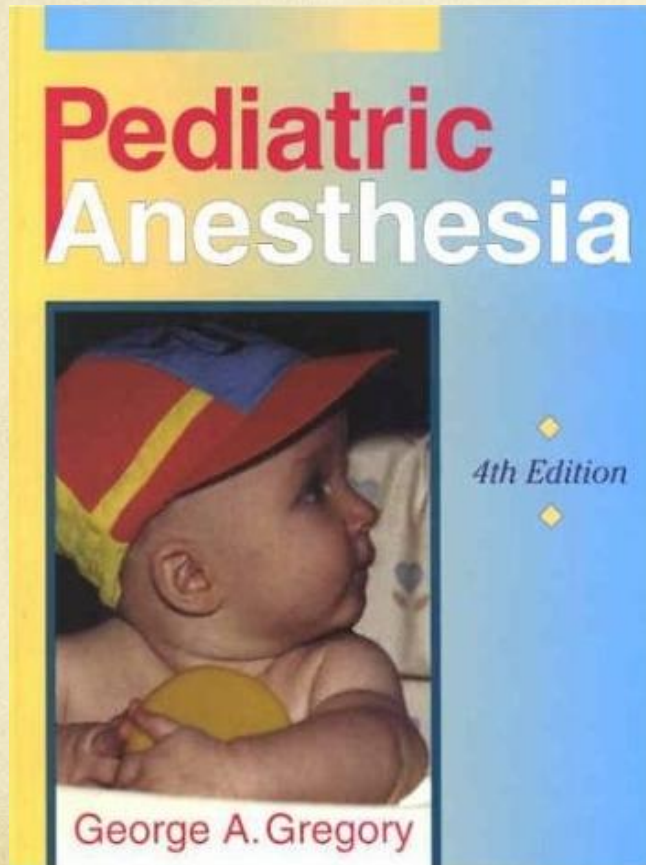
- 3rd 1996
 - Uncuffed < 8 years
- 4th 2008
 - No mention in text
 - Charts indicate cuffed OK down to 2 years

Textbook recommendations



- 5th 2002
 - Uncuffed < 6 – 8 yrs
- 6th 2006
 - Uncuffed < 6 – 8 yrs
- 7th 2010
 - Recent evidence ...
safe for all ages

Excellent Insight



- As far back as the 3rd Edition in 1994 the use of cuffed tubes is considered.
- Chapter by Dennis Fisher, MD

Gregory's Pediatric Anesthesia 3rd Edition 1994

- “Until recently I routinely used uncuffed ETTs for all patients less than 6 years of age. However, in many instances I found myself replacing tubes that leaked at low pressure. . . I now frequently insert a cuffed endotracheal tube, and measure the leak with the cuff deflated. If the leak pressure is appropriate I leave the tube in place and check periodically that the cuff has not inflated during administration of nitrous oxide.” Dennis Fisher MD

Where do we stand now?



- The use of cuffed ETTs in young children increases the responsibility of the whole team
- Meticulous care with size, tube position, stabilization, sedation
- Cuff pressure should be monitored

In the OR

- Cuffed tubes will reduce the number of reintubations and contamination from anesthetic gases
- Incidence of post-extubation stridor should not be greater with appropriate sized tubes
- May still consider uncuffed tubes in infants

Where I Stand

- I have been encouraged to take a stand
- If they are coming to the ICU, If they may be difficult to ventilate, If I only want to intubate once I use a cuffed tube
- For short cases in infants I still use uncuffed tubes

Thanks

