

# Cuffed vs. Uncuffed ETT

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# 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*

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# 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 CJL, 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

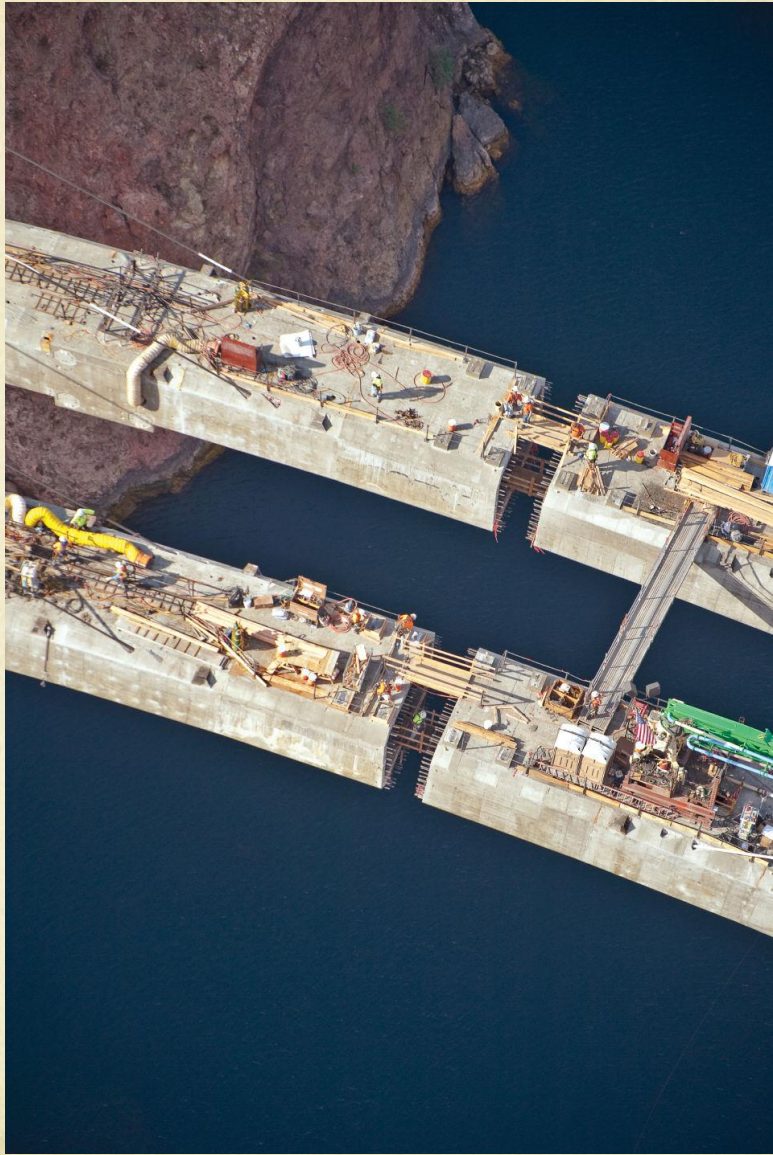
- Evaluating new Microcuff cuffed ETT and ETT size selection
- 350 patients birth to 5 years
- Incidence of stridor 2.3%
- Treated for stridor 0.9%

# 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 H<sub>2</sub>O
- 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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- Flynn PE et al. The use of cuffed tracheal tubes for paediatric tracheal intubation, a survey of specialist practice in the United Kingdom. *European Journal of Anaesthesiology*. 2008

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- Silva MJ et al. Ischemic subglottic damage following a short-time intubation. European Journal of Emergency Medicine. 2008
- Aker J. An emerging clinical paradigm: the cuffed pediatric endotracheal tube. AANA Journal. 2008
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- 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

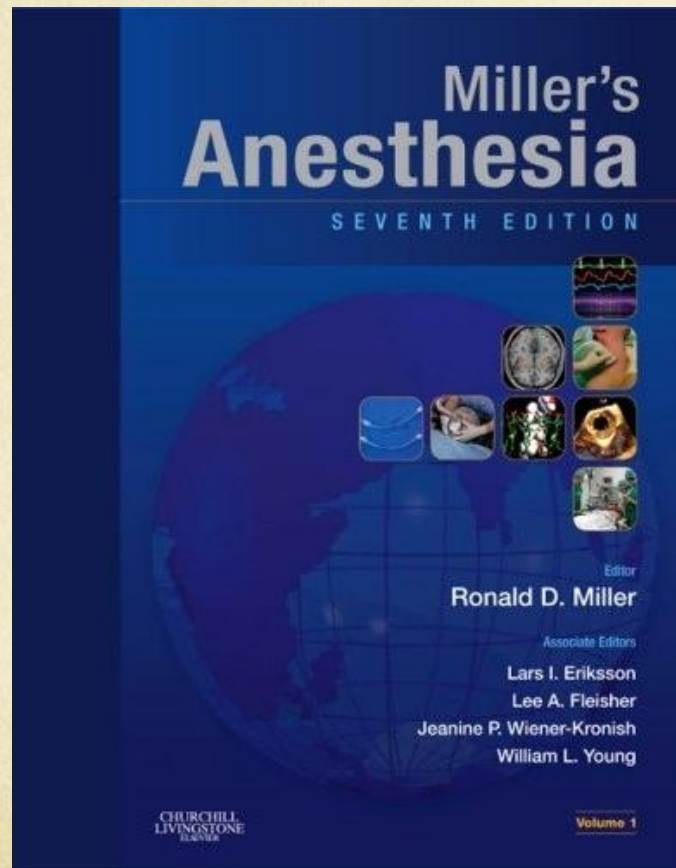
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- Fine G et al. The future of the cuffed endotracheal tube. *Paediatric Anaesthesia*. 2004
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- Dillier CM et al. Laryngeal damage due to an unexpectedly large and inappropriately designed cuffed pediatric tracheal tube in a 13-month-old child. *Canadian Journal of Anaesthesia*. 2004

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

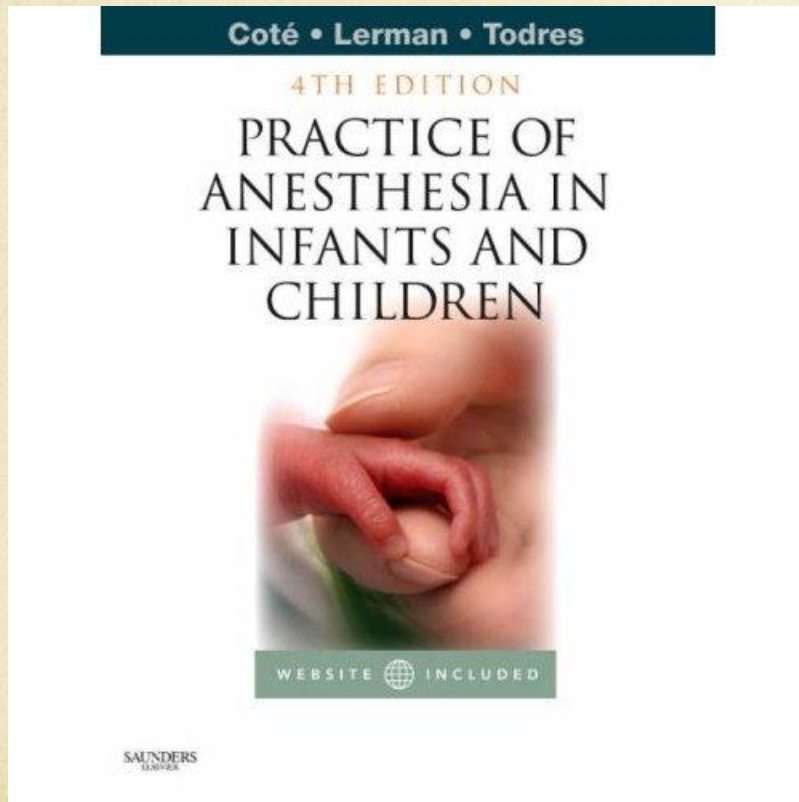
- Felten M et al. Endotracheal tube cuff pressure is unpredictable in children. *Anesthesia & Analgesia*. 2003
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- Ho A et al. The margin of safety associated with the use of cuffed paediatric tracheal tubes. *Anaesthesia*. 2002
- Orliaguet GA et al. 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
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# Textbook recommendations



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

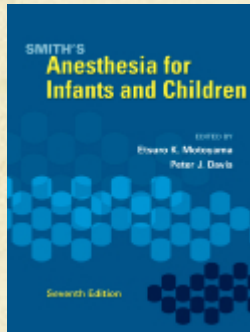
# Textbook recommendations



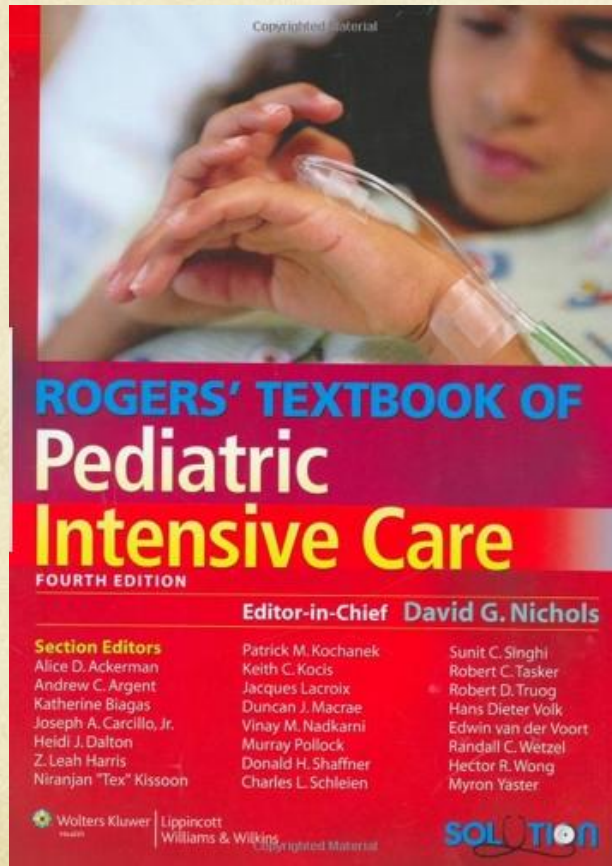
- 3<sup>rd</sup> 2001
  - Uncuffed < 8 years
- 4<sup>th</sup> 2009
  - Traditional teaching...Uncuffed < 8 years
  - Recent data ...

# Textbook recommendations

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

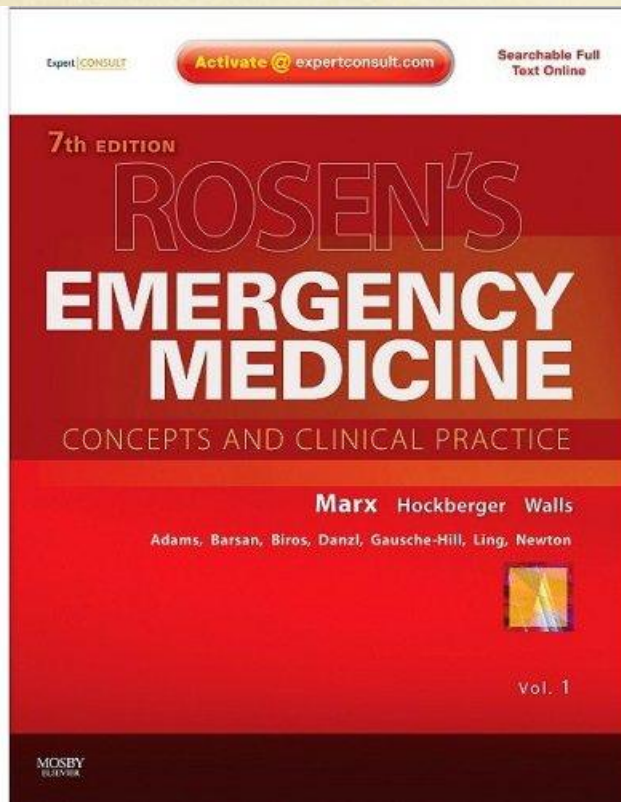


# Textbook recommendations



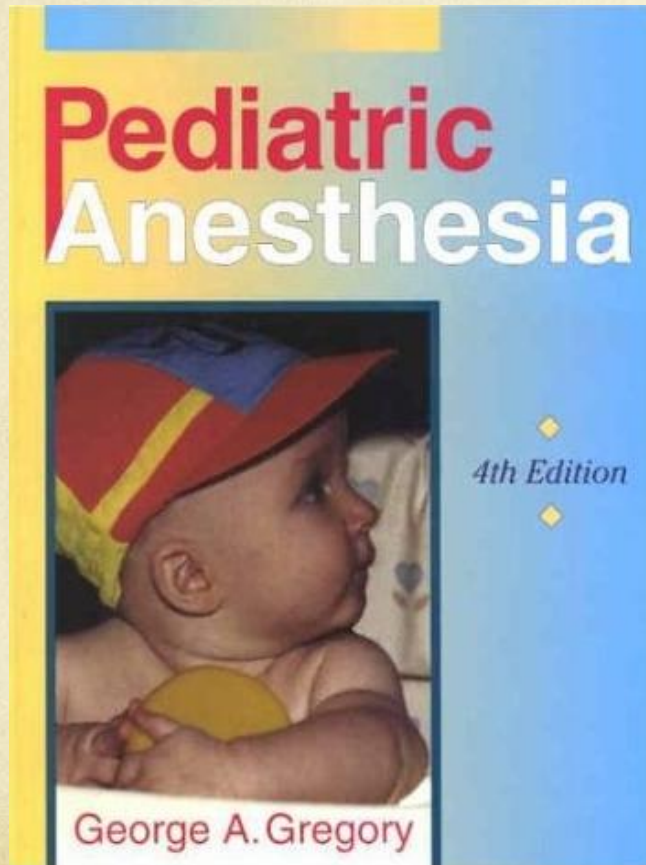
- 3<sup>rd</sup> 1996
  - Uncuffed < 8 years
- 4<sup>th</sup> 2008
  - No mention in text
  - Charts indicate cuffed OK down to 2 years

# Textbook recommendations



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

# Excellent Insight

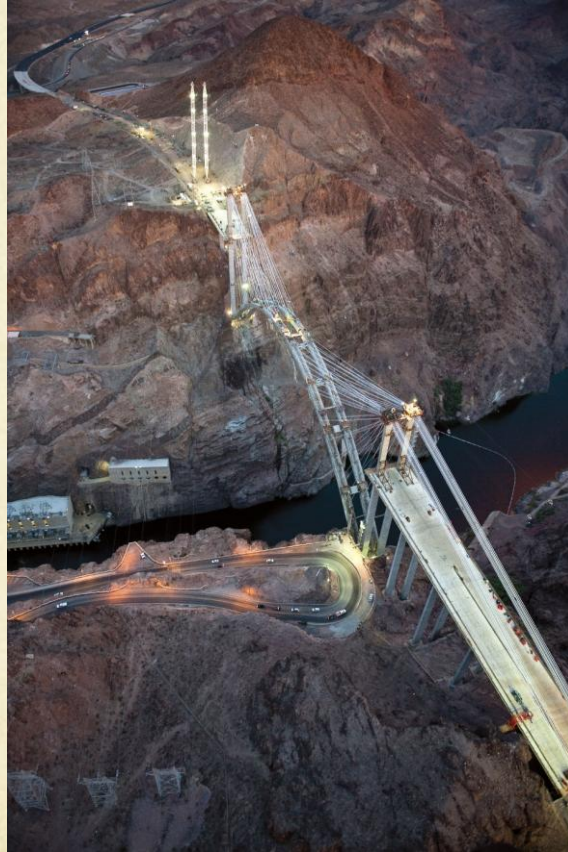


- As far back as the 3<sup>rd</sup> Edition in 1994 the use of cuffed tubes is considered.
- Chapter by Dennis Fisher, MD

## Gregory's Pediatric Anesthesia 3<sup>rd</sup> 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

