Cuff Pressures

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Introduction

- **Cuff Pressures associated with:**
  - Tracheal damage
  - VAP
- **VAP in ICU associated with:**
  - high mortality and morbidity
  - increased LOS
  - increased costs (antibiotics, ▲LOS)
- **ICU patients ventilated more than 24 hours:**
  - risk of developing VAP increases 6-21 times

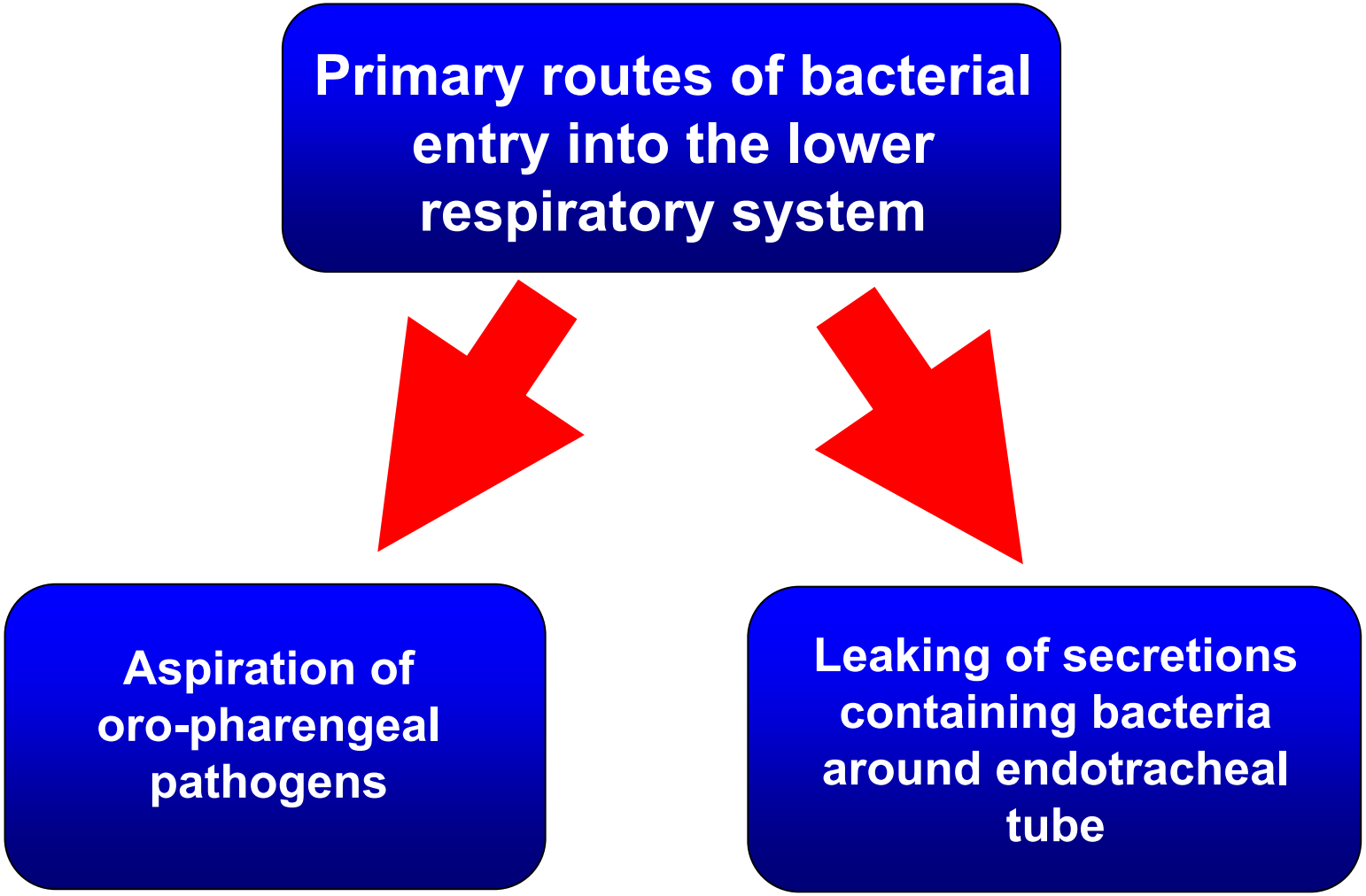
  … THEREFORE …
- **Prevention of VAP must be regarded as one of the most important aims in ICU**

Hsieh & Tuite. Crit Care Nurse Q. 2006. 25: 205-208

Introduction

- **Many of the prevention strategies for VAP are:**
  - nurse specific
  - can be applied during daily nursing care
- **This presentation will focus on the monitoring and management of:**
  - endotracheal
  - tracheotomy tube cuffs

Why?



American Thoracic Society. Am J Respir Crit Care Med. 2005. 171: 338-416

Function of Cuffs

- **The purpose is two-fold:**
  - to allow application of positive pressure ventilation without loss of tidal volume
  - to prevent aspiration of oral/gastric secretions
- **TAKE NOTE:**
  - anchoring the tube in the trachea is **NOT** a function of the cuff

Pierce. Management of mechanically ventilated patient. 2007. 91-98

Valencia et al. Crit Care Med. 2007. 35: 1543-1549

Function of Cuffs

- **For the cuff to perform these functions, it must exert some pressure against the tracheal wall**
- **This cuff-to-tracheal wall pressure should be:**
  - low enough to prevent excessive pressure on tracheal wall
  - high enough to prevent air leak and aspiration

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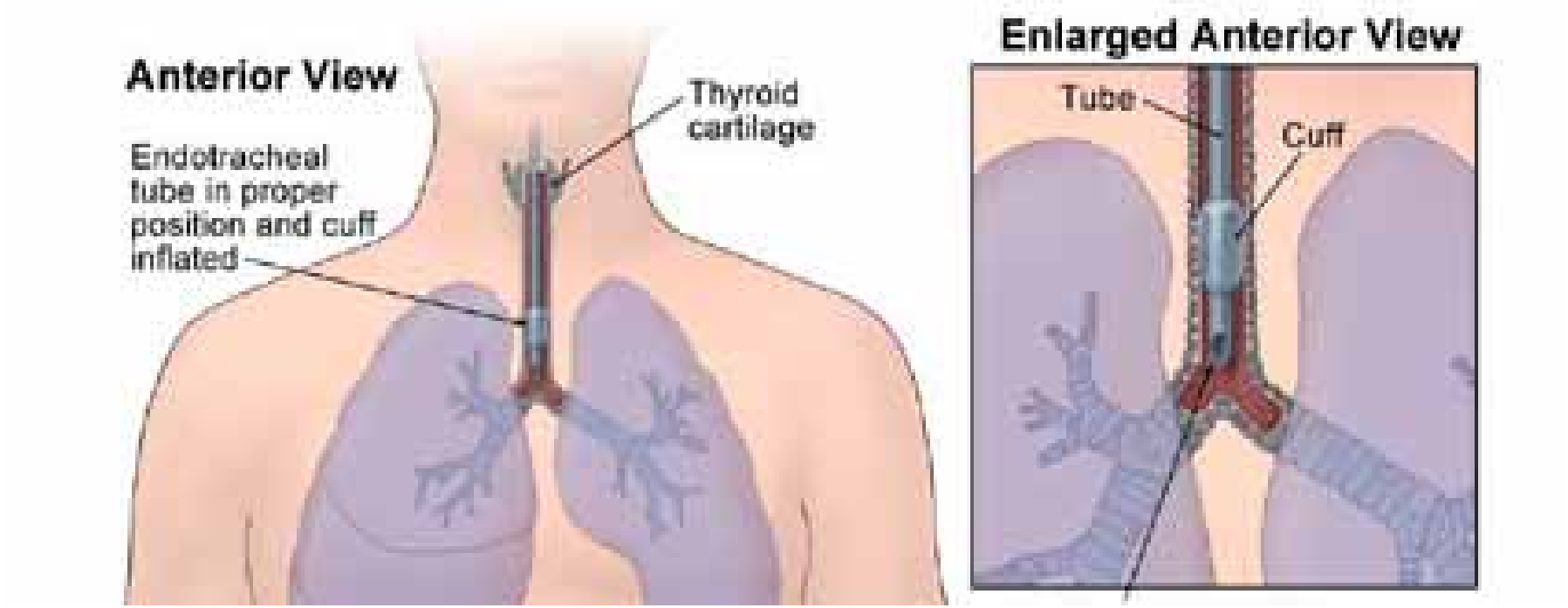
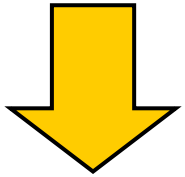
Valencia et al. Crit Care Med. 2007. 35: 1543-1549

Correct position of the cuff



History of cuffs

- **Past 4 decades, cuff designs have evolved from:**
  - high pressure, low volume rigid rubber structures to



  - high volume, low pressure cuffs that conform to the tracheal contours at low pressure
- **More recently**
  - 3rd generation polyurethane membrane cuffs have been developed
  - these cuffs enable better prevention of aspiration while maintaining low cuff pressures

Rose & Redl. ICCN. 2008. 24: 359-365
Crimlisk et al. Heart & Lung. 1996. 25: 225-235

Choice of endotracheal tubes

- **Longitudinal folds develop within the cuff on inflation in the trachea**
  - this is a source of contamination of the lower airway where secretions above the cuff leak past the cuff
- **Second generation endotracheal tubes have PVC cuffs**
  - more prone to development of longitudinal folds
- **Third generation endotracheal tubes have polyurethane cuffs**
  - less development of longitudinal folds
  - less leakage of secretions past the cuff

Lucanglo et al. Crit Care Med. 2008. 36: 409-413

Pathophysiology of tracheal injury

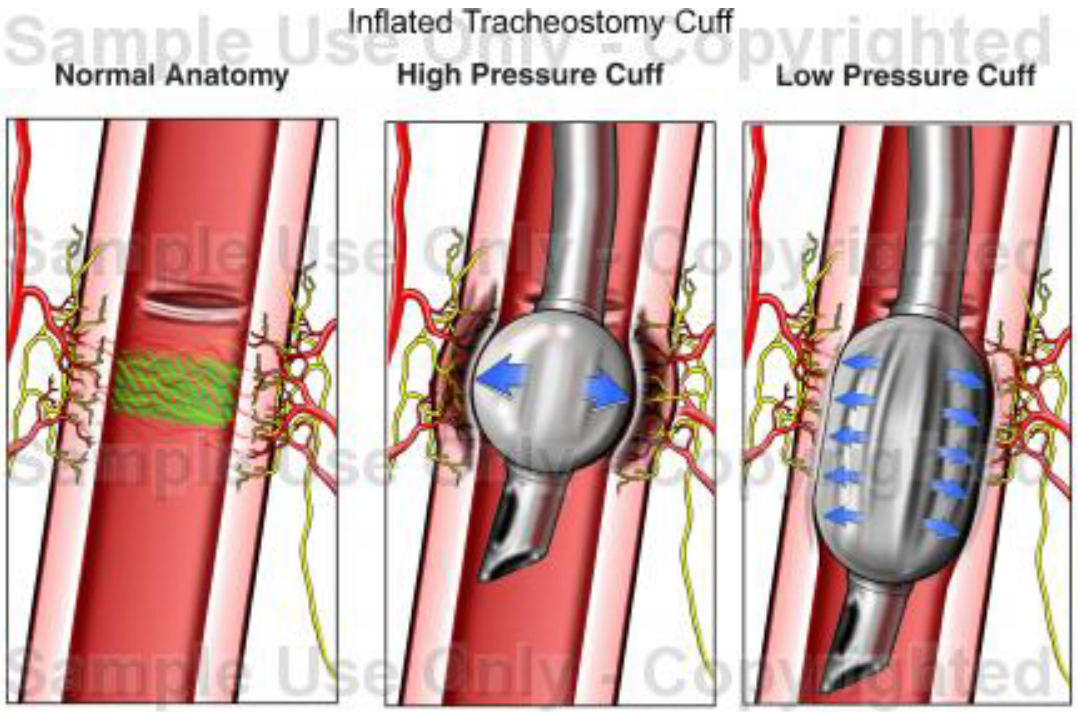
- **Tracheal capillary perfusion pressure is:**

±22mm Hg

- **When cuff pressure exceeds tracheal perfusion pressure ► tracheal injury occurs**
- **Precise pressure at which tracheal mucosal blood flow is impaired depends on numerous factors, most importantly blood pressure**

Hoffman et al. Am J of Emergency Med. 2006. 24: 139-143

Stauffer. Resp Care. 1999. 44: 828-843



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Complications of Cuffs

- **Due to over-inflation of the cuff the following can occur:**
  - ischaemia and inflammation
  - necrosis, ulceration and haemorrhage
  - healing may result in granuloma and scar formation ► tracheal stenosis
  - tracheal cartilage affected ► tracheal dilation
  - tracheomalacia
  - tracheo-oesophageal fistula
  - tracheo-vascular fistula

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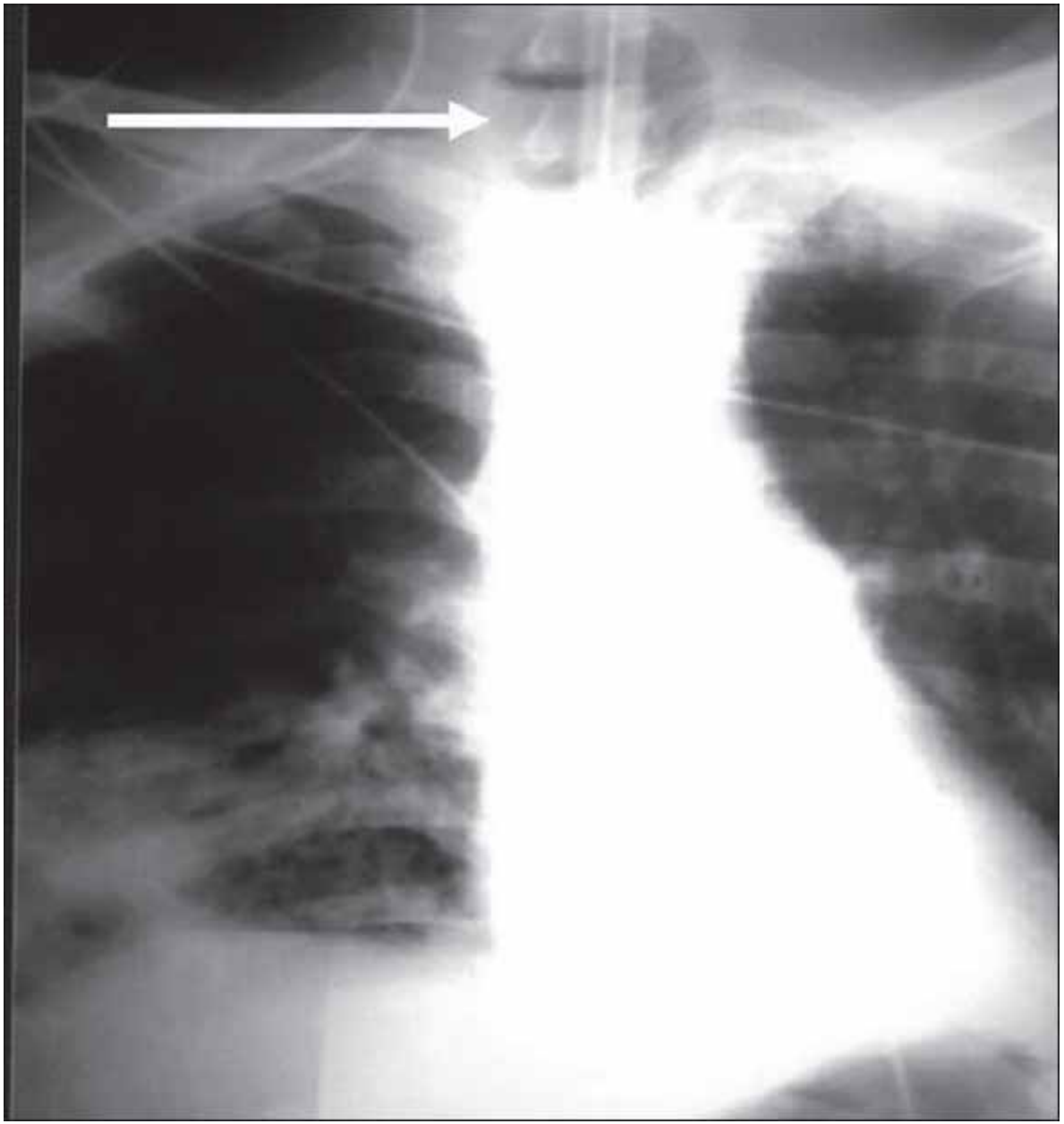

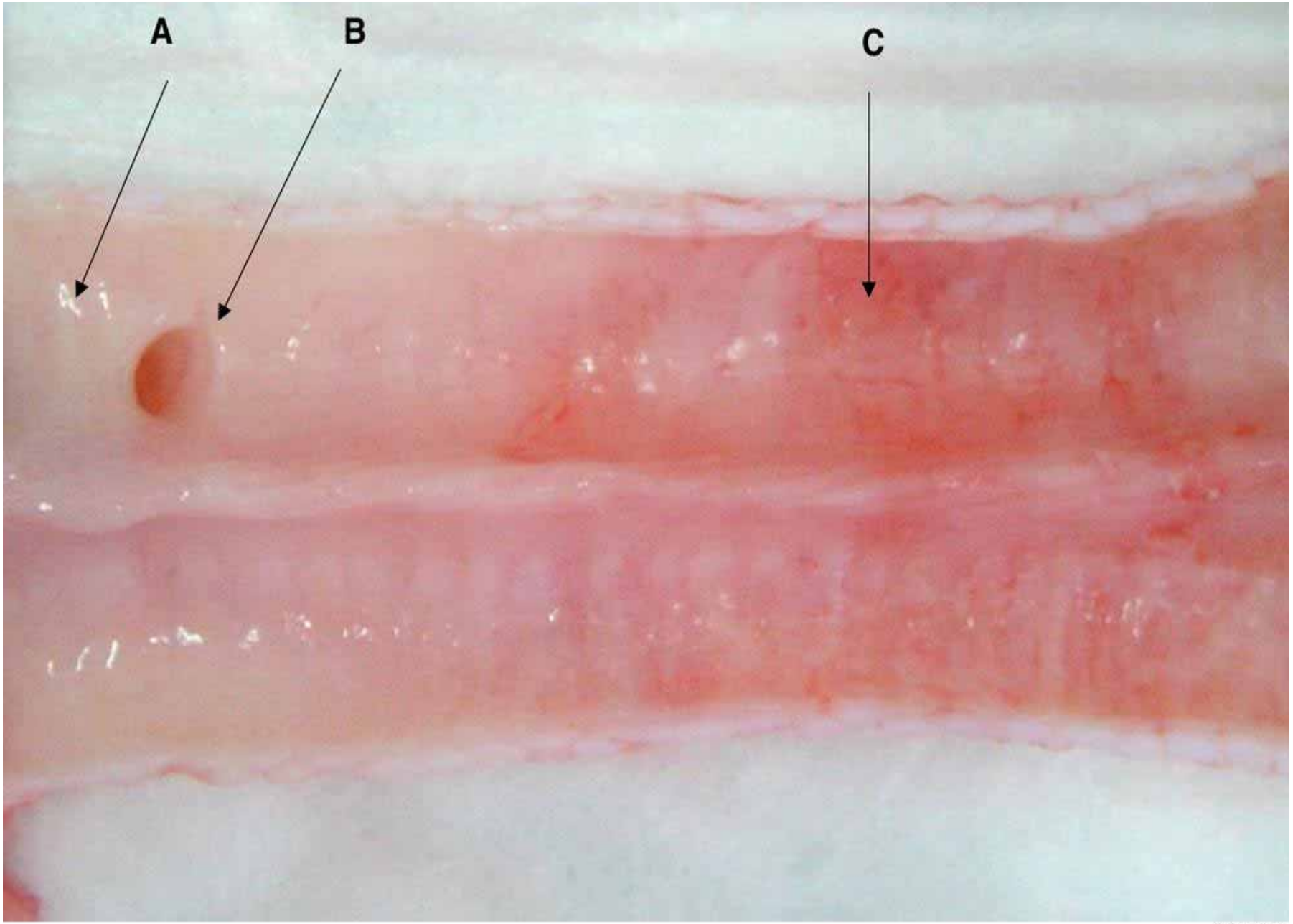

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Complications of Cuffs

- **Due to under-inflation:**
  - air leak with loss of tidal volume
  - aspiration ► VAP

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Cuff Pressure Measuring

- **The aim is to keep the cuff pressure**

18-22mm Hg
25-30cm H_2O

- **Measuring cuff pressure gives an approximation of cuff-tracheal wall pressure**

Stauffer. Resp Care. 1999. 44: 828-843

Cuff Pressure Measuring

- **Frequency of checking cuff pressure varies in the literature, but at least once per shift is generally recommended**
- **Cuff pressure should be measured:**
  - ASAP after intubation
  - After transfer from another hospital/ward
  - Following anaesthesia

Crimlisk et al. Heart & Lung. 1996. 25: 225-235

Pierce. Management of mechanically ventilated patient. 2007. 91-98

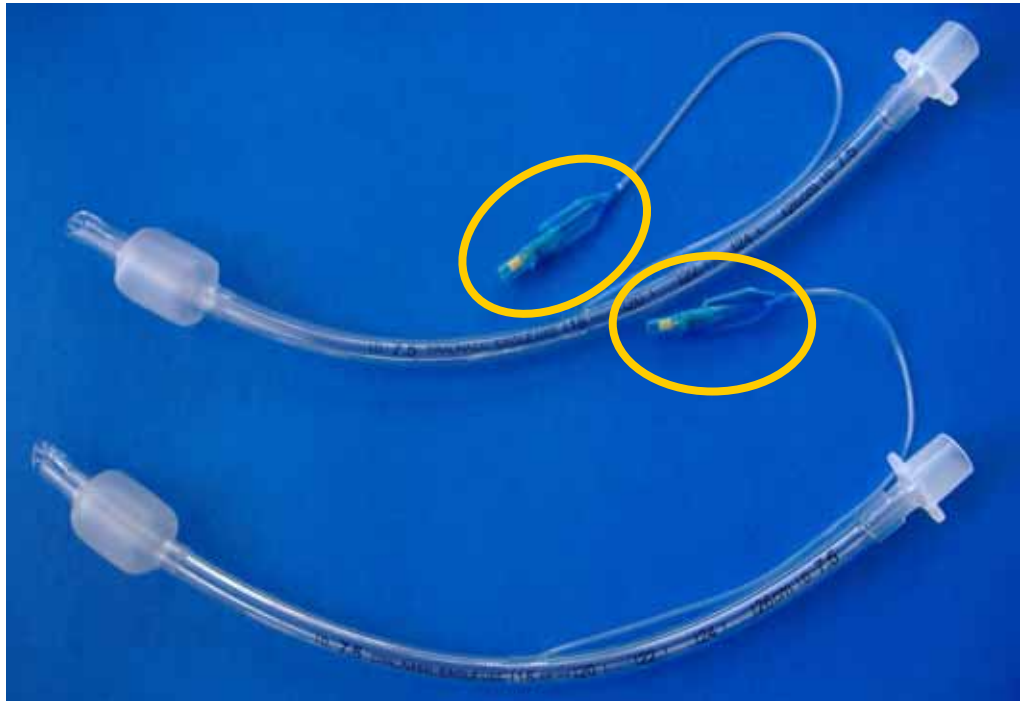
Cuff Pressure Measuring

- **Variety of methods are available including:**
  - palpation of cuff
  - minimal occlusion volume
  - minimum leak technique
  - aneroid pressure manometer
  - standard Baumanometer
  - automatic cuff pressure measuring devices

Cuff Pressure Measuring

- **Palpation of pilot balloon**
  - Subjective estimate and inaccurate
  - Not recommended

Hoffman et al. Am J of Emergency Med. 2006. 24: 139-143



Cuff Pressure Measuring

- **Minimal occlusion volume**
  - inflate the cuff until the airflow heard escaping around the cuff ceases during inspiration
- **Problems**
  - potential for tracheal wall trauma
- **Advantages**
  - prevents loss of tidal volume
  - decreases risk of aspiration

Pierce. Management of mechanically ventilated patient. 2007. 91-98

Henneman et al. ACCN protocols for practice. 1999

Cuff Pressure Measuring

- **Minimum leak technique:**
  - inflate the cuff until any air leak stops
  - remove a small amount of air until a small air leak is heard on inspiration
- **Problems:**
  - loss of tidal volume
  - aspiration past cuff
- **Advantages:**
  - less potential for trauma to tracheal wall

Pierce. Management of mechanically ventilated patient. 2007. 91-98

Henneman et al. ACCN protocols for practice. 1999.

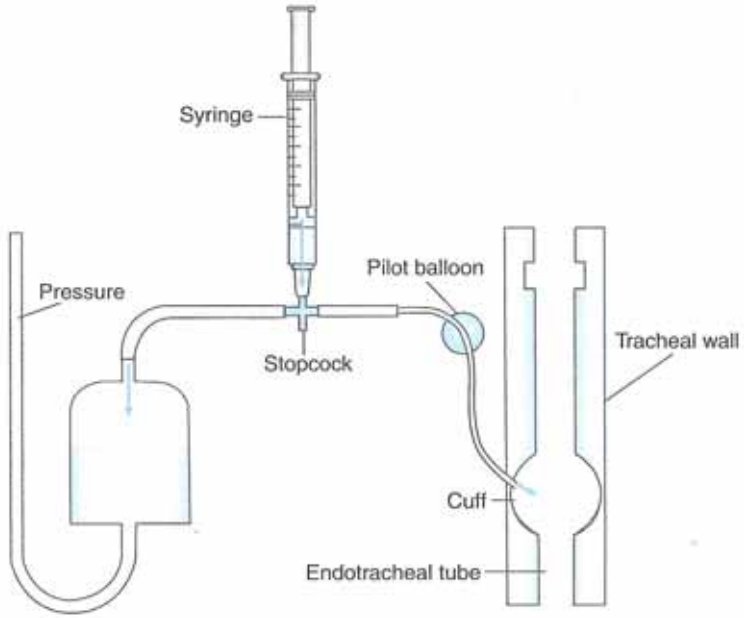
Cuff Pressure Measuring

- **Aneroid manometer**
  - objective measurement
  - reading in cm H_2O
  - inexpensive
  - easy to use

Pierce. Management of mechanically ventilated patient. 2007. 91-98

Cuff Pressure Measuring

- **Baumanometer**



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Cuff Pressure Measuring

- **Baumanometer**
  - Cumbersome procedure
  - Need to adjust for dead space in tubing
  - Baumanometers are being replaced by automatic blood pressure machines

Pierce. Management of mechanically ventilated patient. 2007. 91-98

Cuff Pressure Measuring

- **Remember**
  - when measuring cuff pressure using a Baumanometer, the measurement is in **mm Hg**
  - when measuring cuff pressure using an aneroid manometer, the measurement is in **cm H_2O**

mm Hg x 1.36 = cm H_2O

Cuff Pressure Measuring

- **The two most common techniques for checking cuff pressure are:**
  - minimum occlusion volume
  - minimum leak technique
- **However, given the availability of inexpensive, simple-to-use devices for measuring cuff pressures objectively, the use of an aneroid manometer to measure cuff pressures should be mandatory**

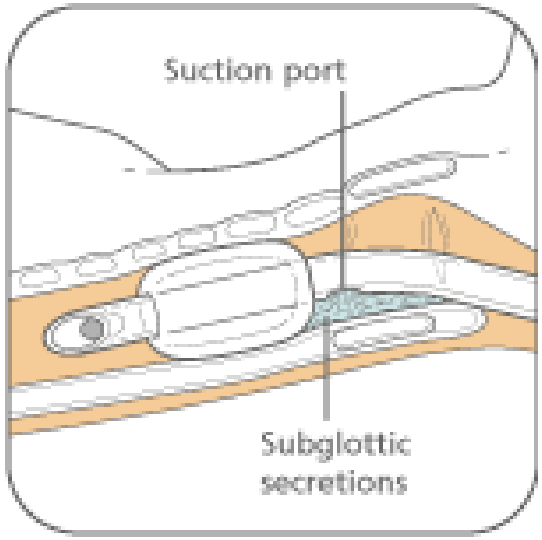
Valencia et al. Crit Care Med. 2007. 35: 1543-1549

Cuff Pressure Measuring

- **Automated**
  - not commercially available, designed by ICU practitioners
    - “home made”
  - not frequently used
  - suggested advantages
    - nursing workload decrease
    - protect against excessive cuff inflation
    - easy to use

Cuff Pressure Measuring

- **To prevent aspiration, it is recommended that, prior to cuff deflation:**
  - the oro-pharynx first be suctioned to remove secretions
  - secretions can be removed:
    - suctioning above the cuff with a thin flexible suction catheter
    - subglotic secretion drainage



  - positive pressure be delivered to prevent aspiration of secretions

McHail & Carlson. AACN procedure manual for critical care. 2001. 49-55

Lucanglo et al. Crit Care Med. 2008. 36: 409-413

Cuff Pressure Measuring

- **Deflating cuff for 5 minutes every 4 to 8 hours**
  - used with older more rigid cuffs to prevent tracheal wall trauma
  - not recommended with new cuffs

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Managing Cuff Leaks

- **Possible sources of air leaks include:**
  - around the cuff when patient changes position
  - leak from cuff itself
  - faulty one-way valve on pilot balloon
  - cracked/broken air inflation line
  - displacement of tube into larynx

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Managing Cuff Leaks

- **Points regarding management of air leaks:**
  - if determined that leak is caused by head position, reposition patient's head
  - leak from cuff itself – patient will need to be re-intubated
  - faulty one-way valve on pilot balloon – attach 3-way stopcock, inflate balloon, turn stopcock to closed position
  - cracked/broken air inflation line – cut air inflation line below fault and carefully insert 19-20 gauge needle attached to 3-way stopcock, inflate balloon and turn stopcock to closed position
  - displacement of tube into larynx – reposition tube remembering to suction above cuff and to maintain positive pressure while cuff is deflated

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Conclusions

- **Cuffs may be very small but are VERY important**

- **We, as nurses, have the ability to decrease patient morbidity and possibly even mortality by competently carrying out what should be considered basic nursing care**