AIRWAY MANAGEMENT 101

MANAGEMENT OF THE "ROUTINE" PEDIATRIC AIRWAY

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BROWN
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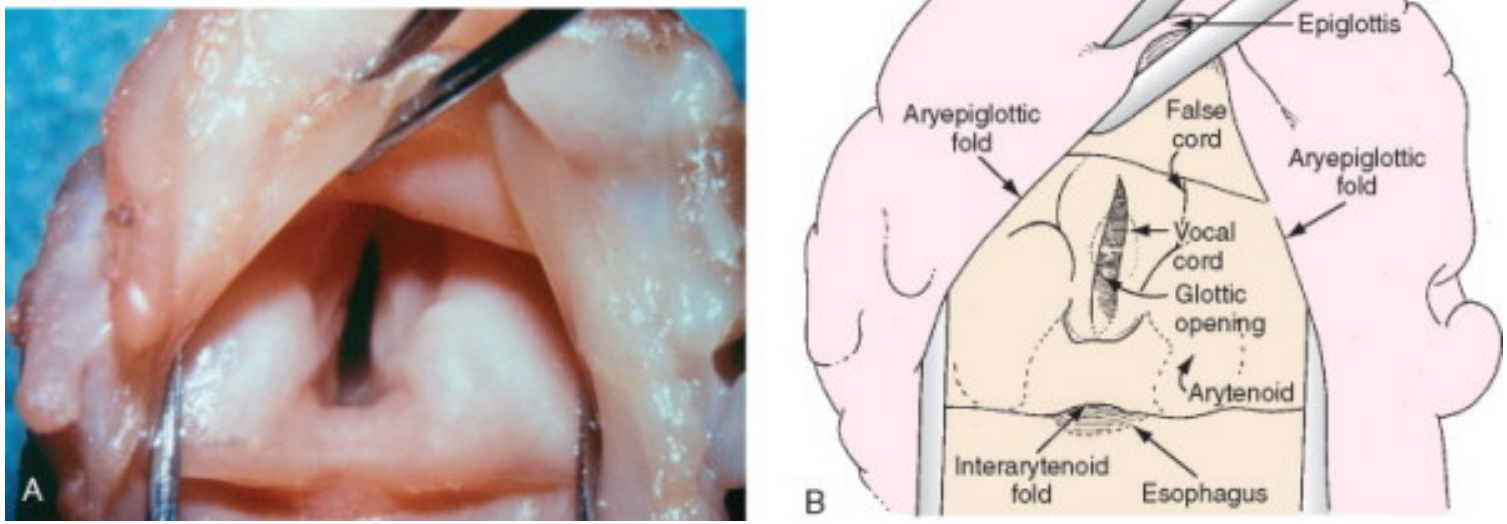
LARYNGEAL ANATOMY

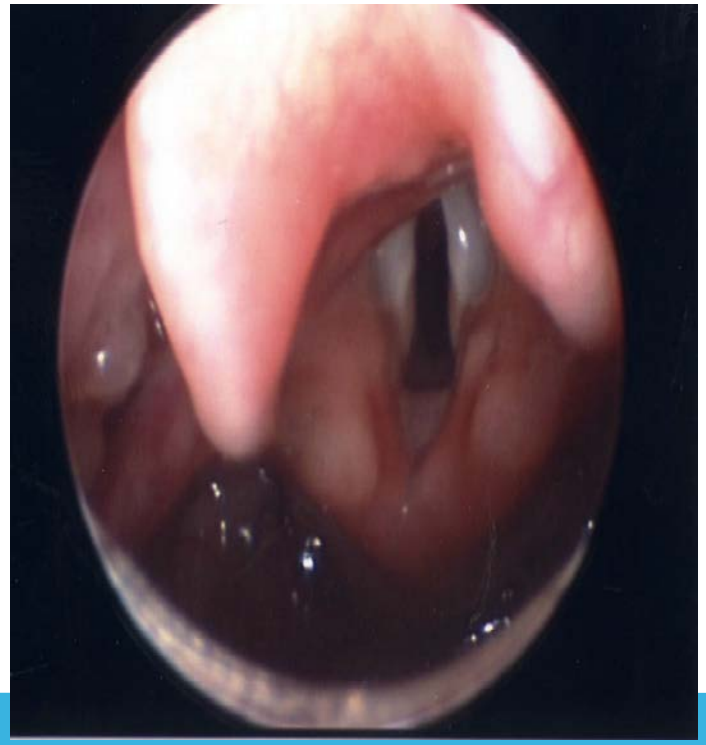


Neonatal larynx and schematic

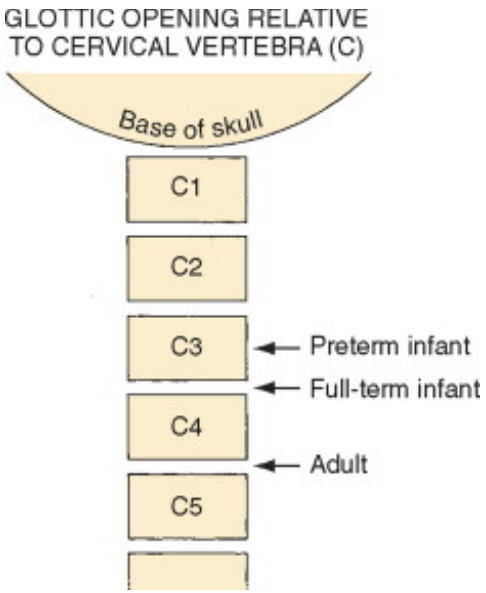
DEVELOPMENTAL ANATOMY OF THE LARYNX (I)

in infants…..

- tongue proportionally larger
- occiput proportionally larger
- larynx more cephalad
- epiglottis angled from trachea
- short, omega-shaped epiglottis
- vocal folds angled
- narrowing of cricoid ring

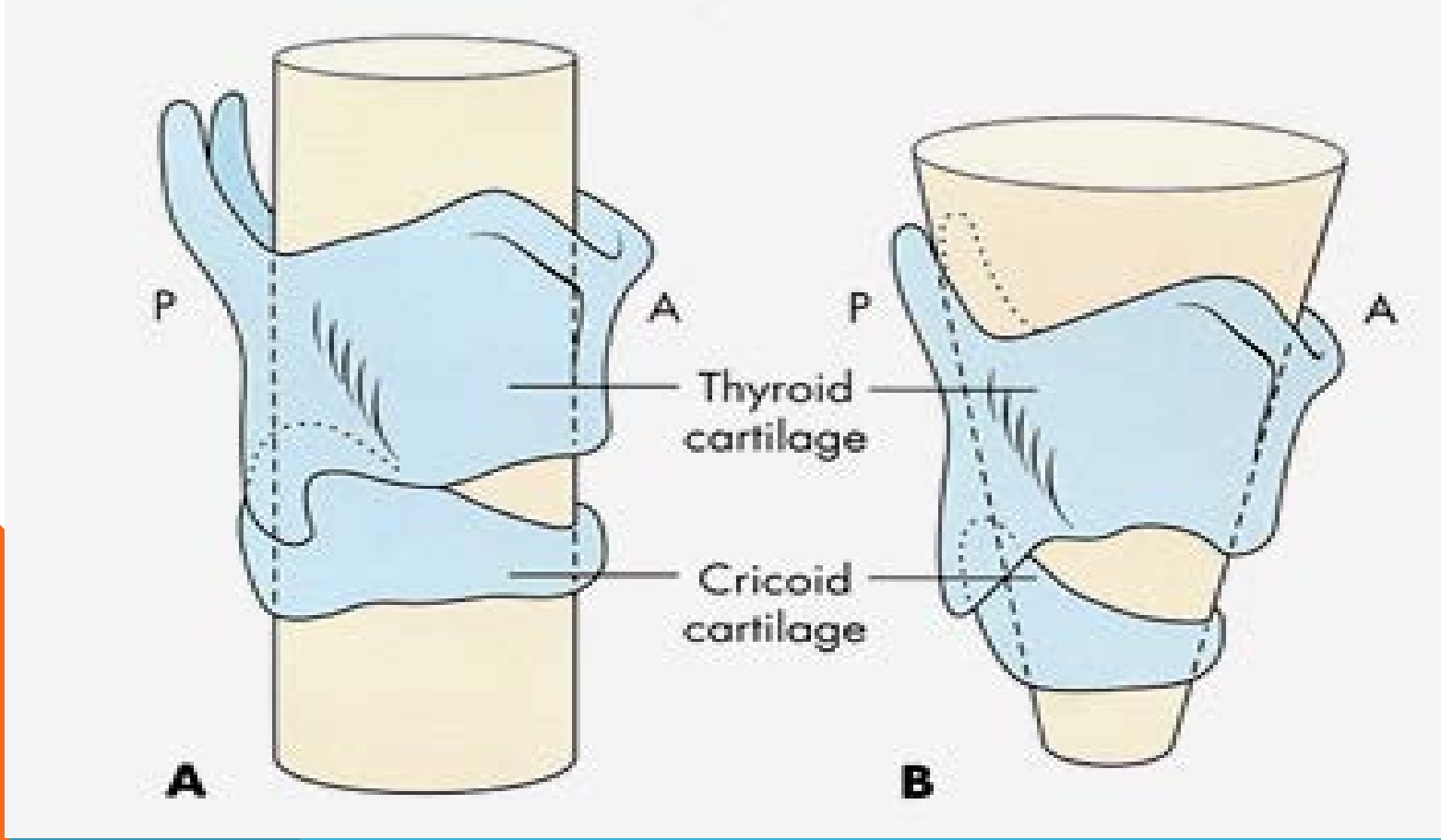


DEVELOPMENTAL ANATOMY OF LARYNX (II)



Larynx more cepahalad in infants

DEVELOPMENTAL ANATOMY OF LARYNX (III)



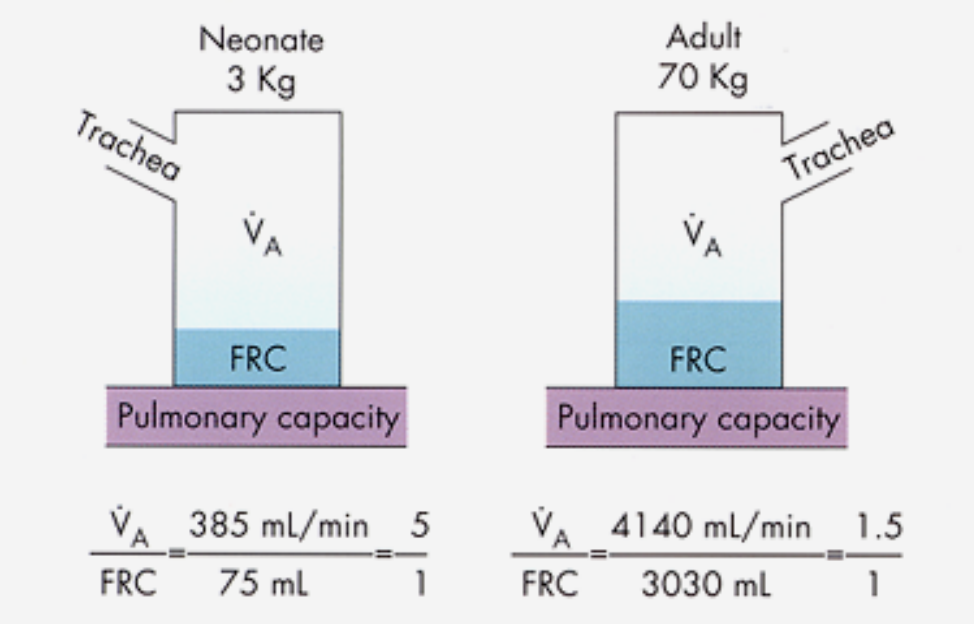
ADULT

INFANT

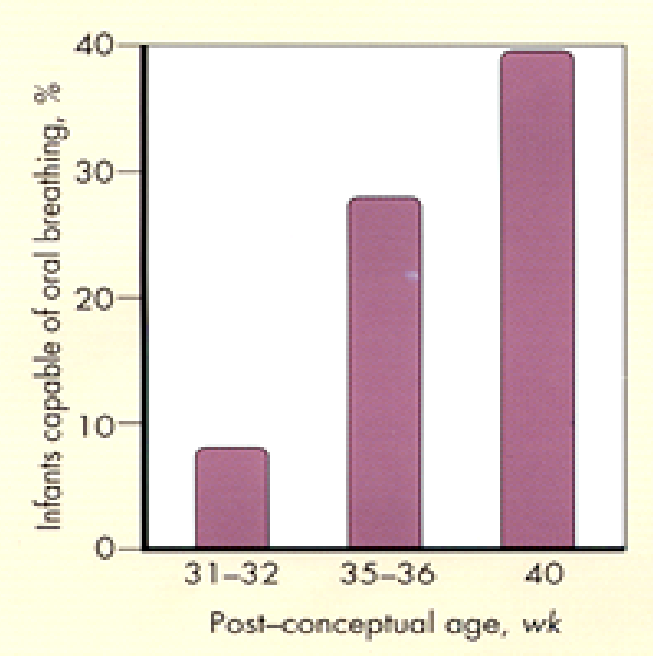
DEVELOPMENTAL PHYSIOLOGY OF THE AIRWAY (I)

- preponderance of type I muscle fibers
- obligatory nasal breathing
- low apneic threshold
- sensitivity genioglossus muscle to halothane (& presumably sevoflurane)

DEVELOPMENTAL PHYSIOLOGY OF THE AIRWAY (II)



apneic threshhold



obligate nasal breathing

AIRWAY PATENCY IN ANESTHETIZED CHILDREN

- immobile maxillary block
- mobile mandibular block obstructs
- loss of genioglossus tone (Motoyama)
- adenoidal hypertrophy
- non-invasive maneuvers / CPAP
- artificial airways

AIRWAY MANAGEMENT: SOAP

Suction

Oxygen

Airway Equipment

Pharmacology (monitoring)

COMPRESSED GAS CYLINDERS (I)

you open your E cylinder oxygen container by slowly turning the valve CCW until fully open. The pressure in the cylinder is 650 psi.

Assuming flow of 4 LPM, how many minutes of oxygen remain?

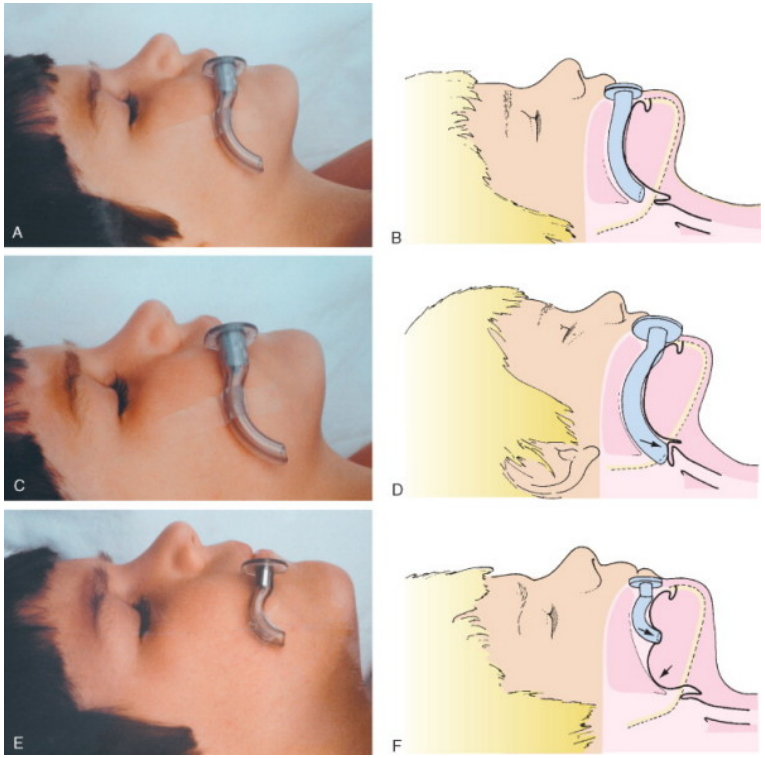
COMPRESSED GAS CYLINDERS (II)

- E cylinders contain ~ 660 liters
- working pressure ~ 2000 psi
- the tank is ~ 1/3 full (220 L)
- 45 minutes of oxygen remaining
- USA - oxygen tanks are green
- INTL - oxygen tanks are white

ROUTINE AIRWAY EQUIPMENT

- laryngoscope
- breathing bag
- oral airways
- suction catheter
- tonsil-tip suction
- endotracheal tubes
- stylets
- masks (± LMA)
- extra blades
- pharmacology

CORRECT PLACEMENT OF ORAL AIRWAYS



Tip just cepalad to angle of mandible - OPTIMAL

Tip posterior to angle of mandible - pushes epiglottis down & worsens obstruction

Tip above angle of mandible - kinks the tongue

THE LARYNGEAL MASK AIRWAY

- one of the supraglottic devices
- steep learning curve
- doesn't "seal" airway
- may provide temporizing ventilation in "cannot intubate"
- adjunct for intubation ± FOB

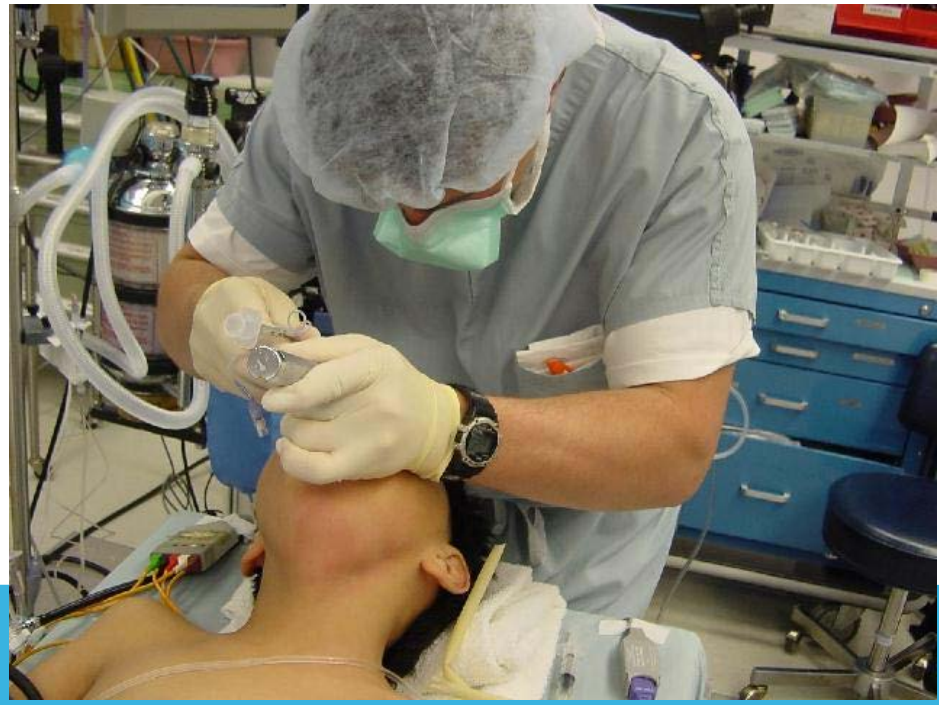
Patient weight (kg)	LMA size	Cuff volume (ml)
< 5	1	4
5-10	1.5	7
10-20	2	10
20-30	2.5	14
30-50	3	20
50-70	4	30
70-100	5	40

ENDOTRACHEAL INTUBATION

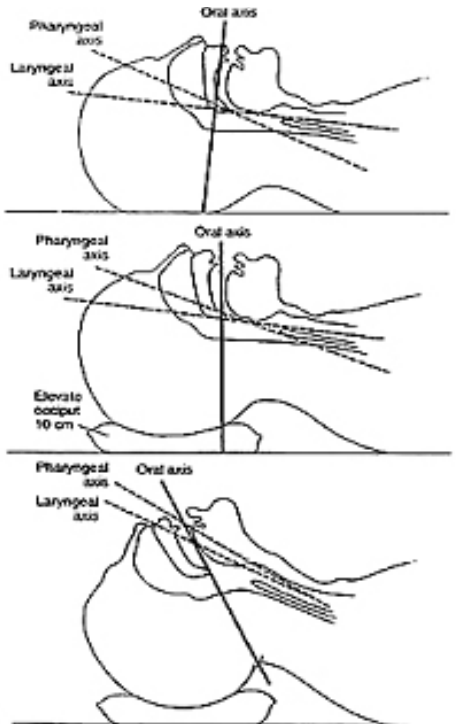
- ensures airway patency
- airway protection
- pulmonary toilet
- IPPB with FiO2 of 1.0
- positioning other than supine (±)

KEYS TO SUCCESSFUL ENDOTRACHEAL INTUBATION

- adequate SOAP prep
- optimize patient position
- adequate mouth opening
- tongue well swept to left
- control of epiglottis
- external manipulation larynx
- watch through the cords



OPTIMIZING PATIENT POSITION



- first described by Jackson 1913
- Bannister & Macbeth “sniffing” 1944
  - slight neck flexion & extend a-o joint
- Adnet (2001) MRI criteria – sniffing no better than simple extension – both better than neutral
  - axes are **not** aligned in sniffing position (as depicted by the “classic”diagram above)

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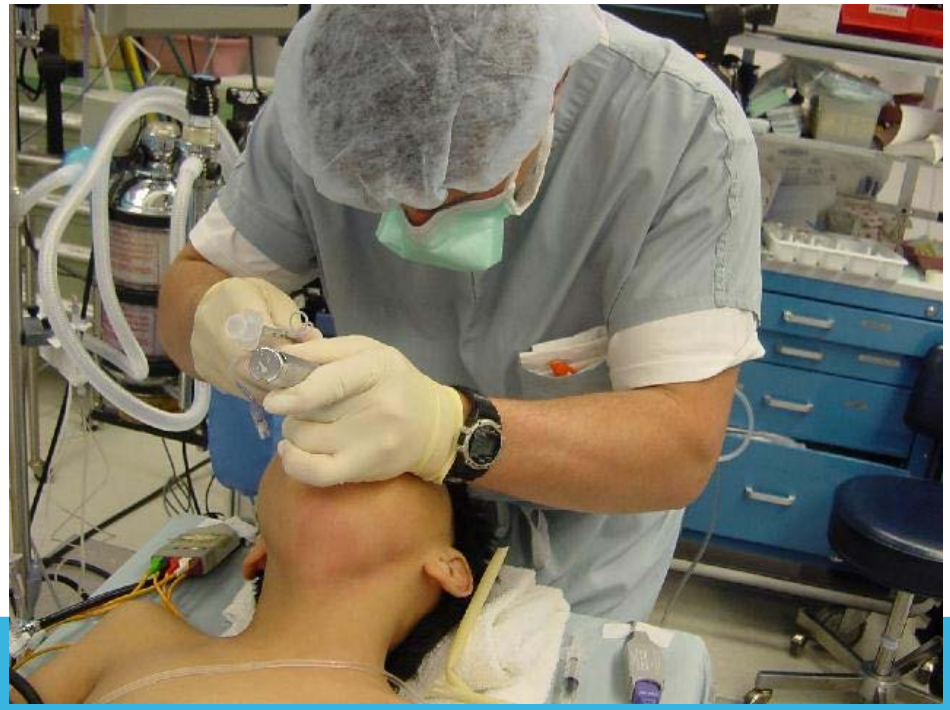
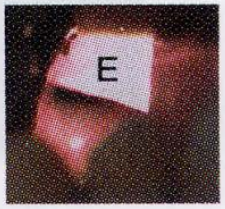
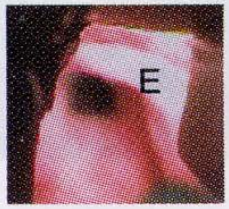
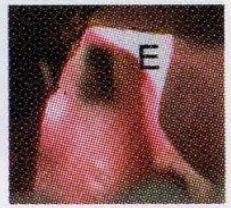


MANDIBULAR ADVANCEMENT & LARYNGEAL VIEW

TAMURA M ET AL. *ANESTHESIOLOGY* 100:598;2004

Procedures	C	M	B	BM
Laryngeal view				
Cormack-Lehane	III	II	II	I
Rating score	4	3	2	1

BURP (backward upward pressure) better view than mandibular advancement – best view with BOTH

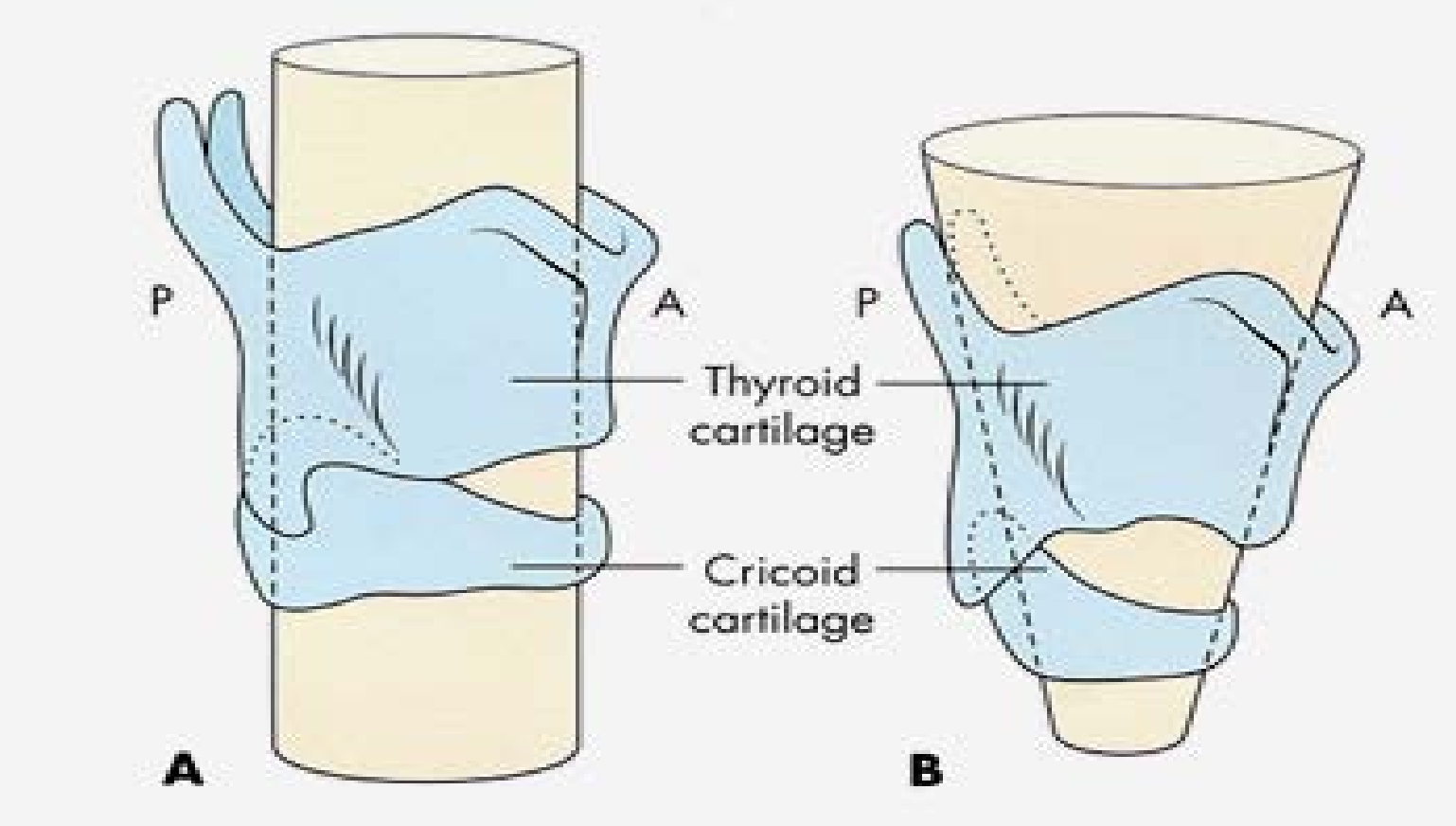
SUGGESTED LARYNGOSCOPE BLADES

AGE	MILLER	MAC	WIS-HIPPLE
premie	0		
neonate	0-1		1
newborn – 18 months	1		1
18 months- 5 years			1.5
5-12 years	2	2	
> 12 years	2-3	3	

SUGGESTED ETT SIZE BY AGE

AGE	SIZE (ID mm)	DEPTH (cm)
premie	2.5 – 3.0	7
term < 6 months	3.0 – 3.5	9
6 – 9 months	3.5 – 4.0	10
9 - 18 months	4.0 – 4.5	11
18 – 24 months	4.5	12
3 years	4.5 – 5.0	13
5 years	5.0 – 5.5	15
10 years	6.0 ± cuff	17
14 years	6.5 - 7.0 cuff	18 - 20

RATIONALE FOR UNCUFFED ETT IN CHILDREN



ADULT

INFANT

COMPARISON OF CUFFED AND UNCUFFED ENDOTRACHEAL TUBES IN YOUNG CHILDREN

KHINE HH ET AL. *ANESTHESIOLOGY* 86:627, 1997

- 488 pts < 8 years undergoing GETA
  - uncuffed size (mm ID) = (age + 16) / 4
  - cuffed size(mm ID) = (age/4) + 3
- appropriate in 99% (vs. 77%) $p < 0.001$
- advantages - ↓ laryngoscopies, ↓ FGF, ↓ OR anesthetic
- incidence of croup 1.2% vs. 1.3% (ND)

CONFIRMING PLACEMENT OF ETT

ARE WE IN?

- auscultation of BS
- symmetrical chest movement
- listen over stomach
- detection of CO2

WELL POSITIONED?

- identify carina
- chest radiograph
- palpation of cuff

PHARMACOLOGY OF AIRWAY MANAGEMENT: INDICATIONS

- facilitate a/w management
- reduce a/w trauma
- blunt rises ICP /IOP /MAP
- diminish airway reactivity
- reduce “stress” response
- facilitate transport / procedures
- humane considerations

PHARMACOLOGY OF AIRWAY MANAGEMENT: CONTRA-INDICATIONS

- insufficient expertise
- insufficient monitoring / equipment
- insufficient personnel
- during CPR
- ± hemodynamic instability
- potential loss of airway

AIRWAY PHARMACOLOGY:
SEDATIVES AND ANALGESICS

DRUG	DOSE (mg/kg)	SIDE EFFECTS
fentanyl	0.001-0.003	n/v; hypoventilation
midazolam	0.05-0.15	hypoventilation, especially if combined with opioids
thiopental	1-6	apnea, hypotension
propofol	1-3	apnea, hypotension, painful injection
ketamine	0.5-2	apnea, secretions, ICP
lidocaine	1-1.5	

AIRWAY PHARMACOLOGY:
NEUROMUSCULAR BLOCKADE

DRUG	DOSE (mg/kg)	SIDE EFFECTS
succinylcholine	1-2	bradycardia, hyperkalemia in at-risk pts
rocuronium	0.8-1.2	pain, precipitation with TPL
vecuronium	0.1-0.3	slow onset unless higher dose
pancuronium	0.1	heart rate increase slow onset and offset
atracurium	0.3-0.6	histamine release slower onset

MANAGEMENT OF "FULL STOMACH"

- **risk factors**
  - ingestion (delayed pain, stress, opioids)
  - obesity, GERD
  - esophageal pathology
- **pharmacologic adjuncts**
- **airway management options**
  - awake intubation or tracheostomy
  - rapid sequence induction (RSI)

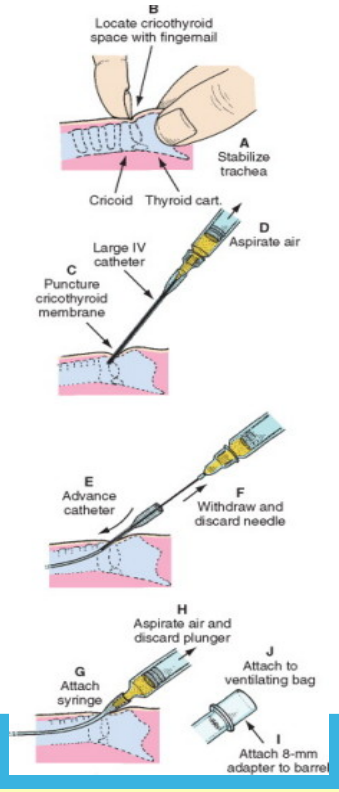
RAPID SEQUENCE INDUCTION *

- metoclopramide and/or H-2 blocker (if time)
- consider decompression gastric contents
- denitrogenation (FiO_2 1.0)
- rapid IV induction with rapid onset NMB
  - sux, rocuronium, high dose vecuronium
- Sellick's maneuver
- apneic oxygenation vs. gentle PPV
- cricoid maintained until successful intubation

** RSI COVERED MORE FULLY IN A SEPARATE POWERPOINT PRESENTATION*

CANNOT INTUBATE: BE PREPARED

- call for help
- “best” laryngoscopy
- multi-handed mask ventilation
- LMA
- emergency oxygenation
- definitive (surgical) airway



emergency cricothyrotomy

THE DIFFICULT AIRWAY: INTRODUCTION
IMPORTANCE OF RECOGNITION (RISK FACTORS)

- **access**
  - positioning (neck)
  - mouth opening
  - macroglossia
- **visualization**
  - micrognathia
- **target**
  - tumors, infection etc.