

AIRWAY MANAGEMENT

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AIRWAY MANAGEMENT

- AIRWAY EXAMINATIONS
- AIRWAY MANEUVER
- VENTILATION
- INTUBATION
- DIFFICULT AIRWAY MANAGEMENT

History Findings

That Suggest Difficult Airway Management

Finding

Dry cough

Easy bleeding

Gastroesophageal reflux

Long-standing diabetes mellitus

Loud snoring

Major trauma

Radiation to neck

Recent temporal craniotomy

Smoking

Undigested food returning to mouth

Implication

Possible tracheobronchial compression

Epistaxis risk

Aspiration risk

Limited cervical mobility

Prone to soft-tissue obstruction

Unstable neck, limiting safe mobility

Fibrosis, immobility

Limited mandibular motility

Salivation, cough, laryngospasm

Aspiration risk from pharyngeal pouch

Congenital Syndromes Associated with Difficult Endotracheal Intubation

Syndrome	Description
Trisomy 21	Large tongue, small mouth make laryngoscopy difficult Small subglottic diameter possible Laryngospasm is common
Goldenhar (oculoauriculovertebral anomalies)	Mandibular hypoplasia and cervical spine abnormality make laryngoscopy difficult
Klippel-Feil	Neck rigidity because of cervical vertebral fusion
Pierre Robin	Small mouth, large tongue, mandibular anomaly
Treacher Collins (mandibular dysostosis)	Laryngoscopy is difficult
Turner	High likelihood of difficult tracheal intubation

Growth failure
Mental retardation

Flat back of head

Abnormal ears

Many "loops"
on fingertips

Palm crease

Special skin
ridge patterns

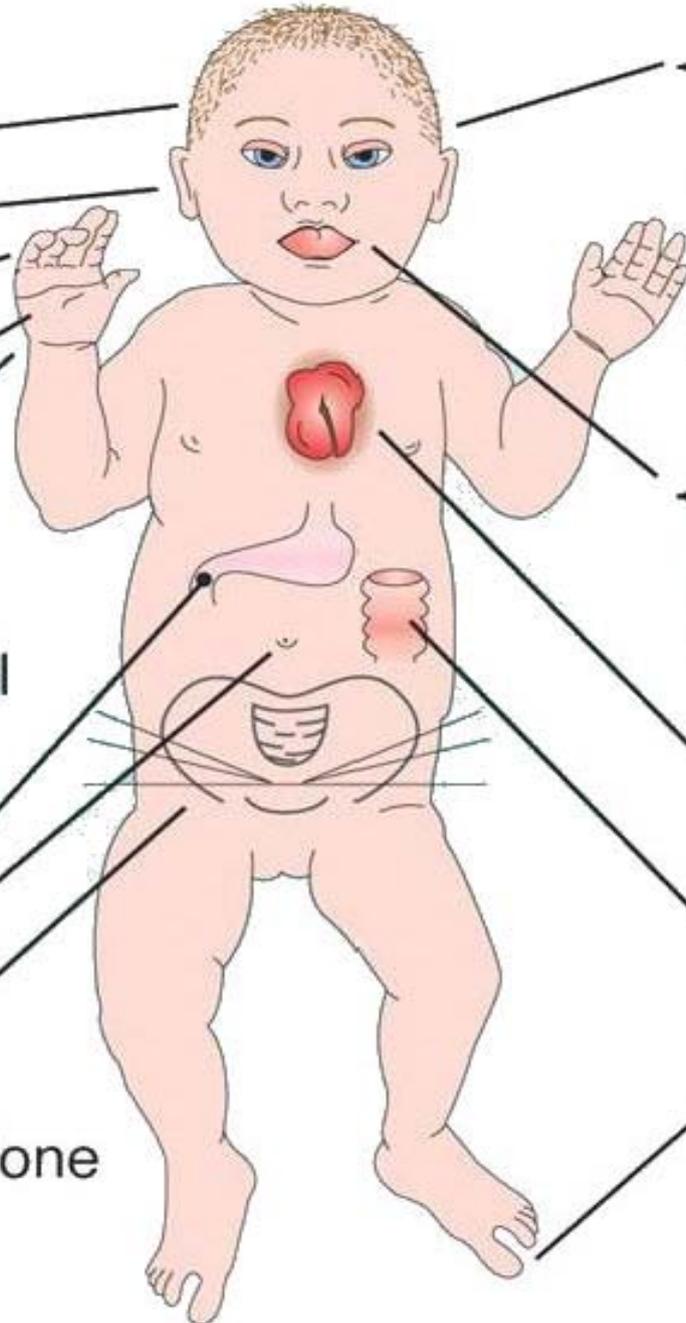
Unilateral or bilateral
absence of one rib

Intestinal blockage

Umbilical hernia

Abnormal pelvis

Diminished muscle tone



Broad flat face
Slanting eyes
Epicanthic eye fold
Short nose

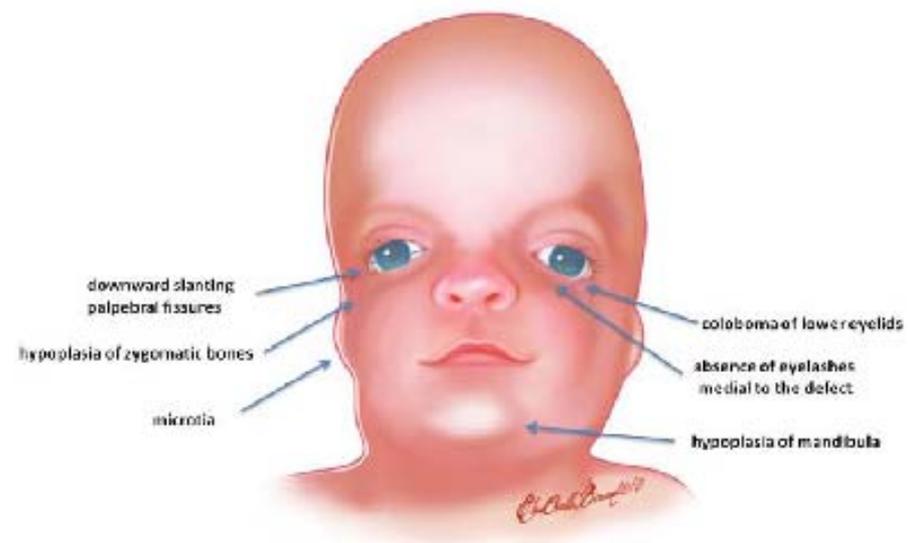
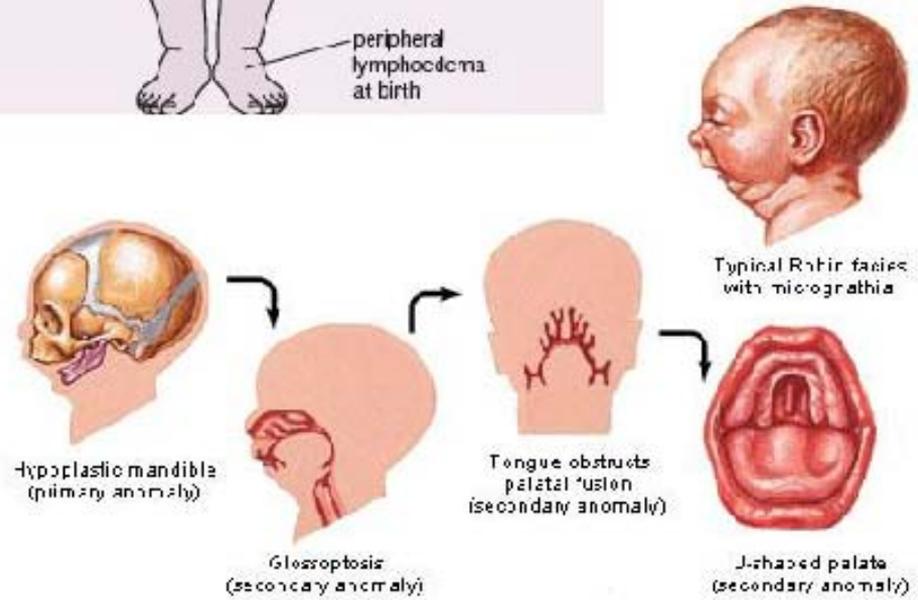
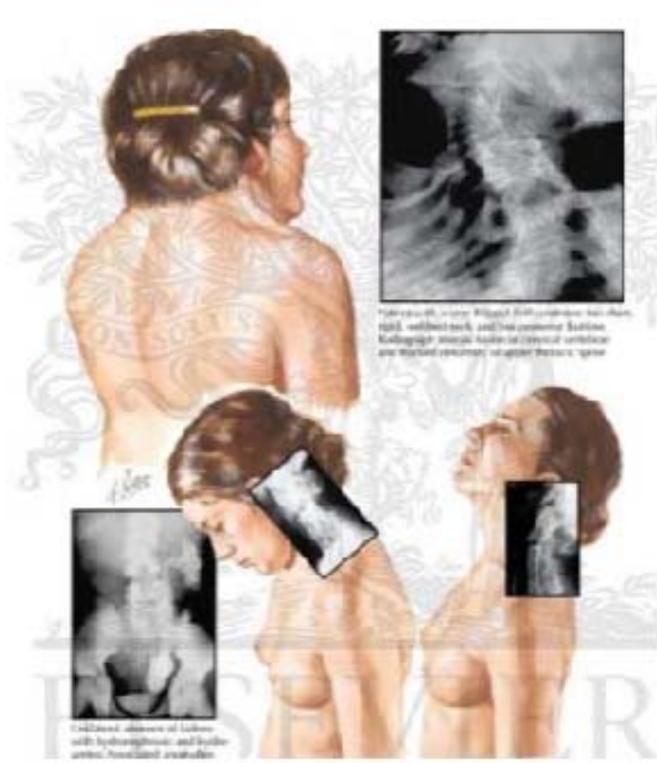
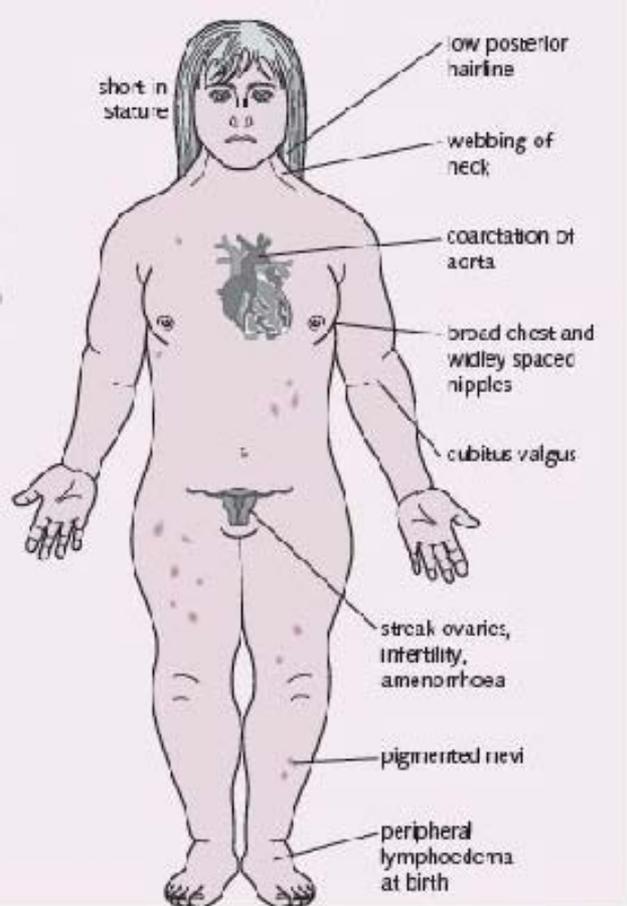
Short and
broad hands

Small and
arched palate
Big, wrinkled
tongue
Dental anomalies

Congenital heart
disease

Enlarged colon

Big toes widely
spaced



OSA screening questionnaire: STOP-Bang questionnaire

STOP questionnaire

- S Snoring: Do you snore loud enough to be heard behind closed doors?
 - T Tiredness: Do you feel tired or sleepy during the daytime?
 - O Observed: Has anyone observed that you stop breathing during sleep?
 - P Pressure: Do you have or are being treated for High Blood Pressure?
 - B BMI: $> 35 \text{ kg/m}^2$?
 - A Age: > 50 years?
 - N Neck circumference: $> 40 \text{ cm}$?
 - G Gender: Are you male?
-

Risk of OSA	if Yes
Low	< 3
Moderate	3-4
High	≥ 5

Physical Findings That Suggest Difficult Airway Management

Finding	Implication
Obesity	Easily obstructed airway, aspiration risk, diminished chest wall compliance, difficult laryngoscopy because of macroglossia and immobile head
Pregnancy	All the problems associated with obesity, especially aspiration risk; large breasts impair laryngoscope insertion; swollen mucosa bleed easily
Ascites	Aspiration risk, diminished chest wall compliance
Whiskers, flat nasal bridge, large face	Difficult mask seal
Mouth opens less than 40 mm	Glottic exposure blocked by maxillary teeth
Cervicooccipital extension limited to an angle at the hyoid less than 160°	Difficult to align mouth and pharynx for glottic exposure
Short, thick, muscular neck	Prone to soft tissue obstruction, difficult to extend neck for intubation or mask ventilation
Thyromental distance less than 60 mm, receding chin	Difficult to mobilize tongue for glottic exposure, glottis too anterior to visualize
Maxillary gap from missing incisors with other teeth present to the right	Laryngoscope fits into gap while adjacent teeth, lip, or gums block view of glottis and passage of tracheal tube





Physical Findings That Suggest Difficult Airway Management

Edentulous with atrophic mandible

Small face and furrowed cheeks impair mask fit, tongue and soft palate block exhalation

Prominent or protruding maxillary incisors

Teeth block view of glottis

Advanced caries, loose teeth, caps, bridges

Dentition can be damaged or aspirated, rough edges can tear tube cuff

Stridor, retractions
Hoarseness

Risk of insurmountable airway obstruction
Chance of vocal cord dysfunction or airway masses

“Underwater” voice

Vallecular or epiglottic cysts

Nasogastric tube in situ

Difficult to seal mask

Poorly visualized soft palate and fauces in upright patient with mouth fully open (Mallampati sign)

Difficult to expose glottis with rigid laryngoscopy

Large goiter or immobile tumor displacing trachea

Difficult to expose glottis, airway obstruction, or tracheal collapse

Tracheostomy scar

Possible tracheal stenosis

MOANS : difficult mask ventilation (DMV)

- M** Mask seal difficult to achieve with the presence of abundant facial hair, encrusted blood, or lower facial abnormalities
- O** Obesity, near-term parturients and patients with upper airway obstruction or abscesses, angioedema, or epiglottitis
- A** Age over 57 → due to loss of muscle and tissue tone in the upper airway
- N** No teeth
- S** Snores or stiff: Sleep apnea

LEMON : difficult laryngoscopy & intubation

- L** Look externally: small or large mandible, short neck, bull neck, lower facial disruption, large breasts
- E** Evaluate 3-3-2: → assessment of the upper airway geometry
 - 3 -three fingers breadths into mouth (adequacy of oral access)
 - 3 -three fingers breadths between tip of mentum & mandible-neck junction (capacity to accommodate the tongue on laryngoscopy)
 - 2 -fit two fingers breadths between mandible-neck junction & thyroid notch (optimal distance of the larynx to the base of tongue)
- M** Mallampati class
- O** Obstruction: three cardinal signs; muffled voice, difficulty swallowing secretions, and stridor
- N** Neck mobility: Cervical flexion and head extension

- Mouth open: 3 fingers
 - ◆ Allows insertion of tube, laryngoscope
- Mentum to hyoid: 3 fingers
 - ◆ Predicts ability to lift tongue into mandible
- Floor of mouth to thyroid cartilage: 2 fingers
 - ◆ If high larynx, airway tucked under base of tongue, hard to visualize

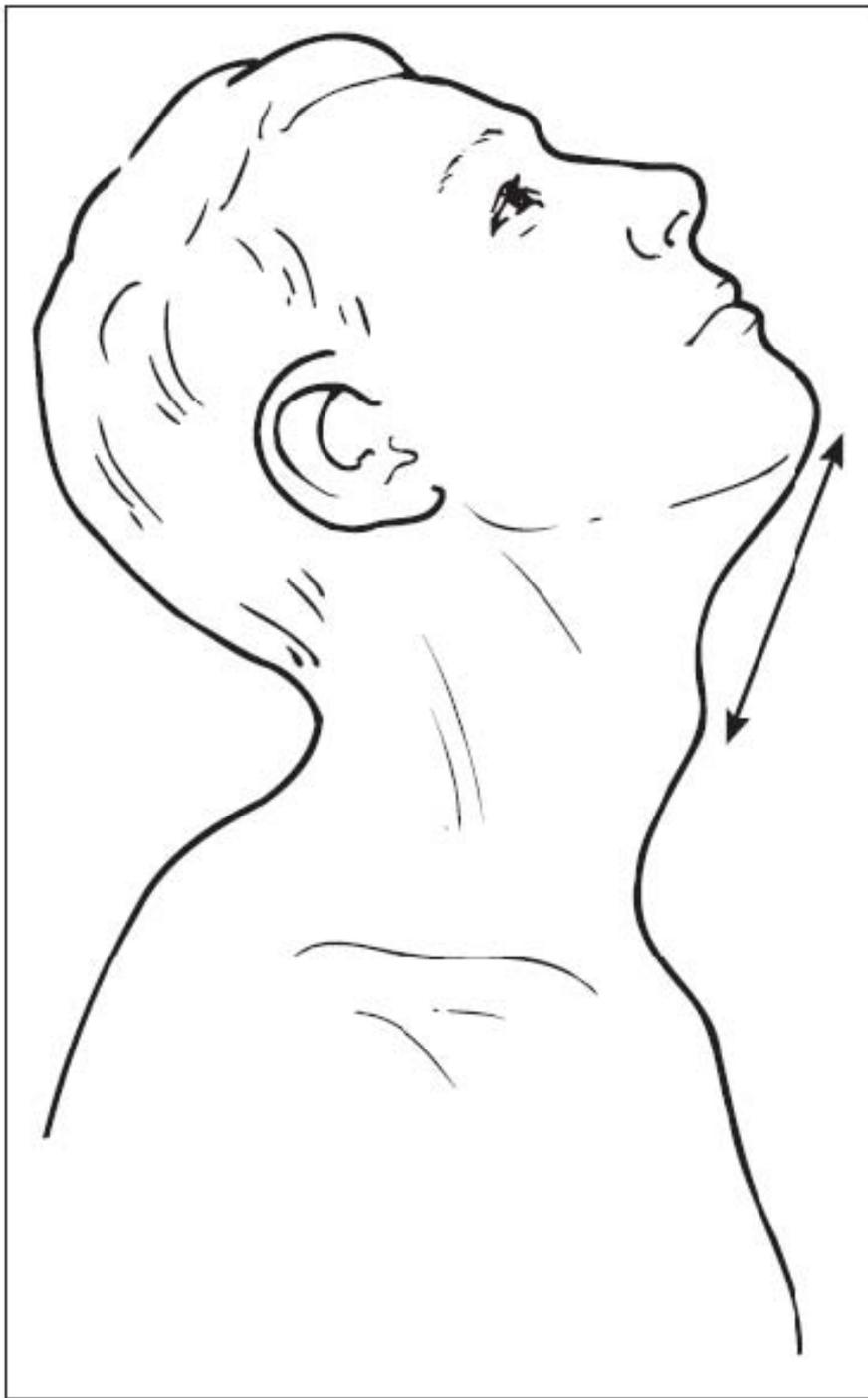
Assess the Airway

Structured Approach to Airway Management

<u>Component</u>	<u>Description</u>	<u>Assessment Activities</u>
Mandible	Length & subluxation	Measure hyomental distance & anterior displacement of mandible
Opening	Base, symmetry, range	Assess & measure mouth opening in cms
Uvula	Visibility	Assess pharyngeal structures & classify
Teeth	Dentition	Assess for presence of loose teeth & dental appliances
Head	Flexion, extension, rotation of head/neck & cervical spine	Assess all ranges & movement
Silhouette	Upper body abnormalities, both anterior & posterior	Identify potential impact on control of airway of <i>large breasts, buffalo hump, kyphosis</i>

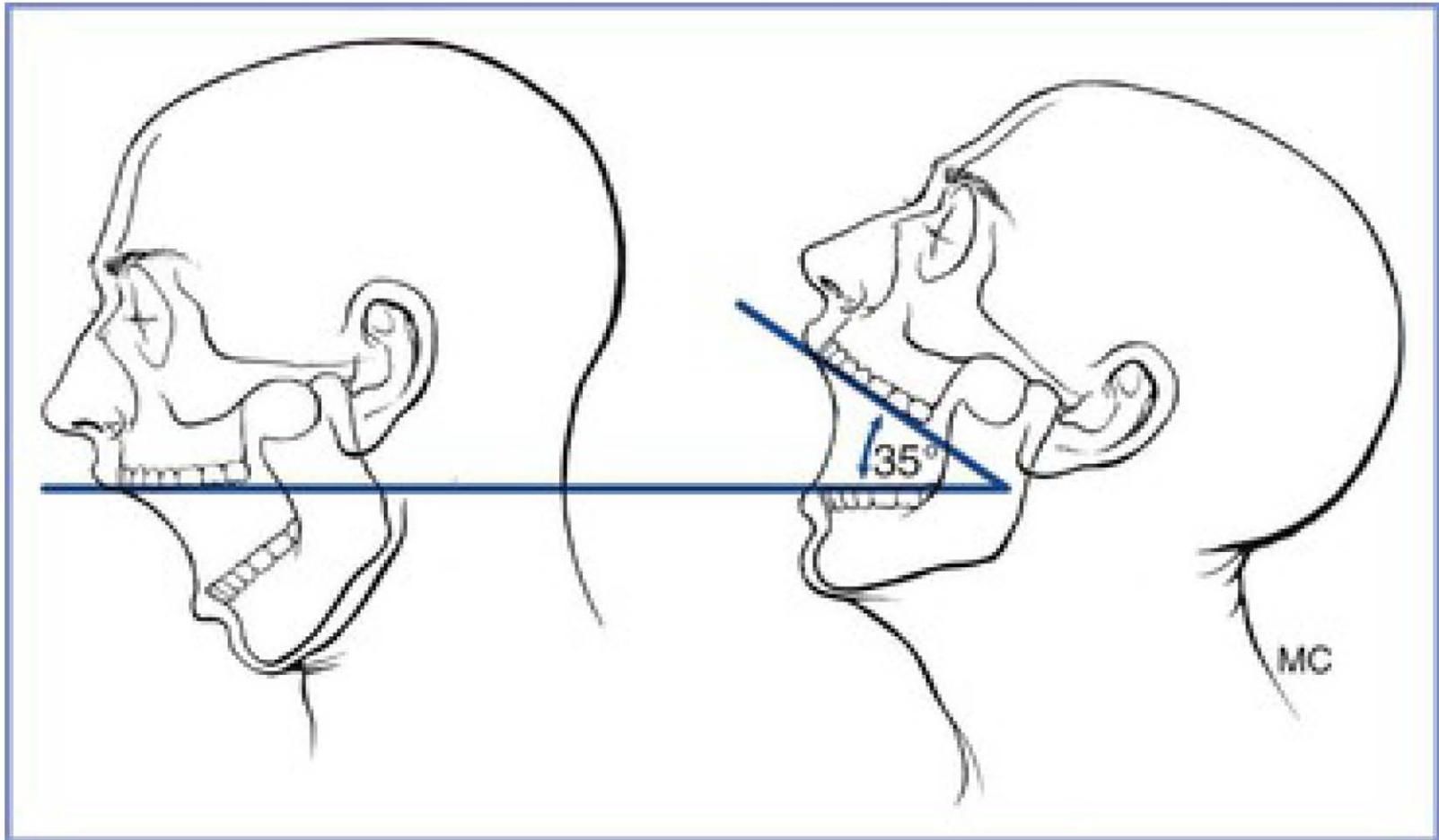
AIRWAY EXAMINATIONS

PREOP. EXAMINATION	ACCEPTABLE ENDPOINT	SIGNIFICANCE OF ENDPOINT
Length of upper incisors	Short	Long → Blade cephalad direction
Intercisor distance	> 3 cms.	2 cms. → blade insert between teeth
Oropharyngeal class	≤ Class II	Tongue = Oral cavity
Upper Lip Bite Test	≤ Class II	Mandibular motility
Thyromental distance	≥ 5 cms. Or ≥ 3 FB	Larynx posterior to upper airway structure
ROM of head & neck	Sniff position = Neck flex 35* Head extend 80*	Line of sight in OA, PA, LA

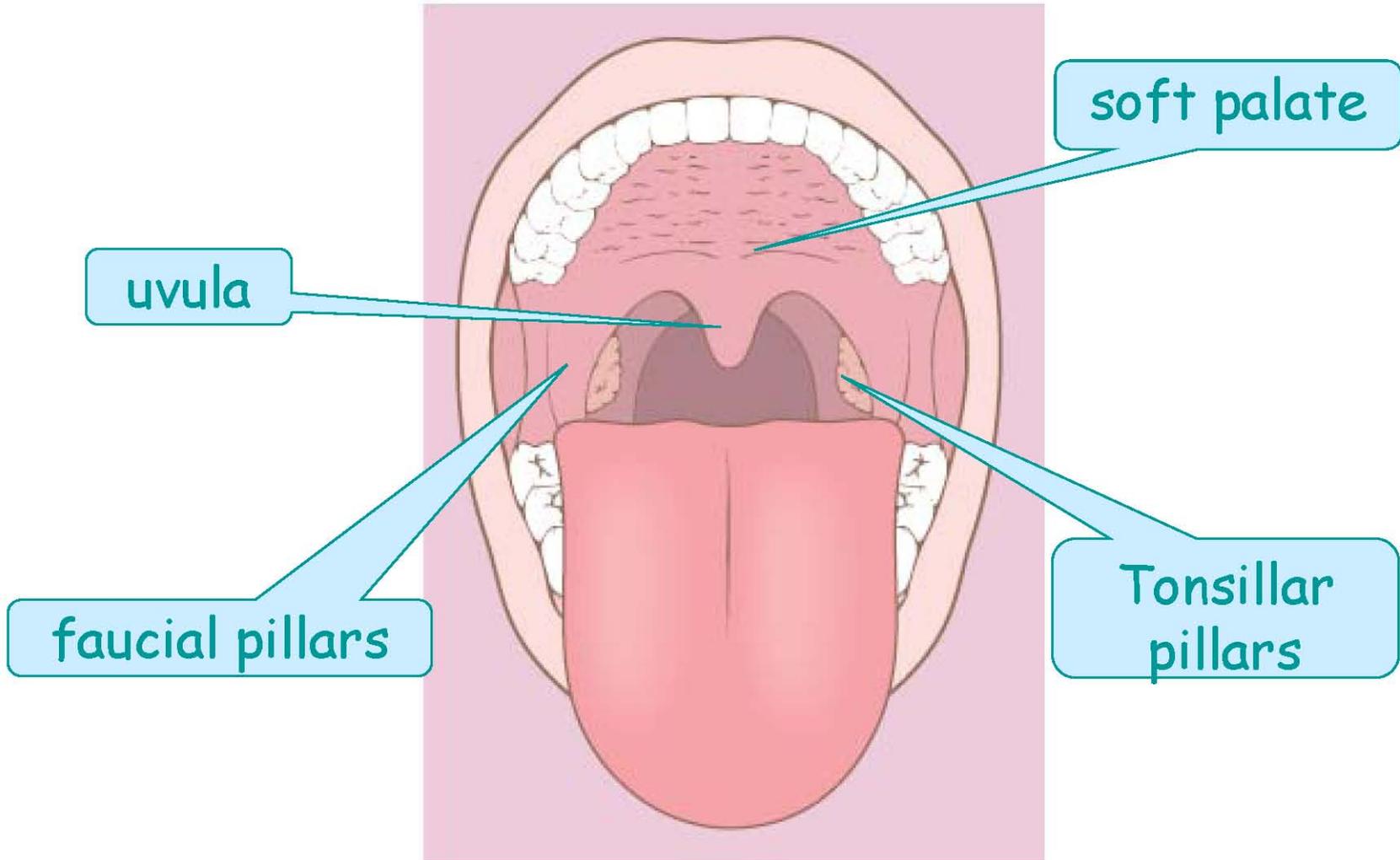


Thyromental distance

Atlanto-occipital angle



Mallampati



Mallampati Classification



Grade I



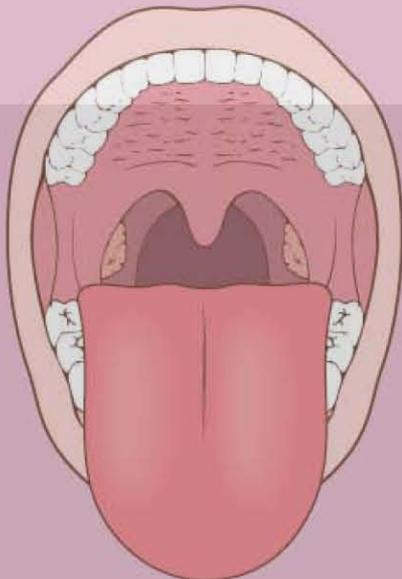
Grade II



Grade III



Grade IV



Class I



Class II



Class III



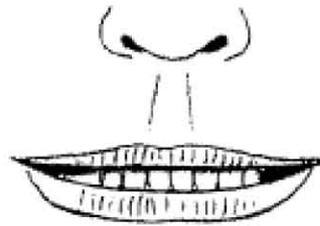
Class IV

Upper Lip Bite Test

Frontal view



Class I

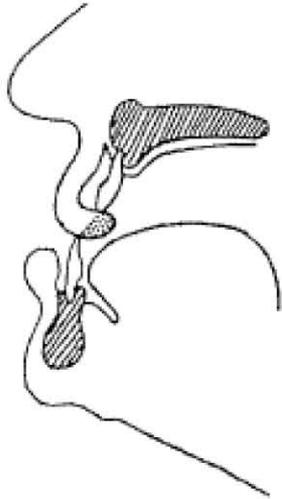


Class II

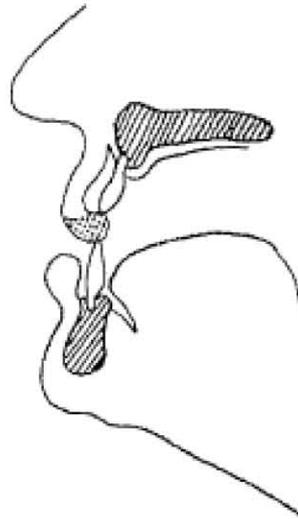


Class III

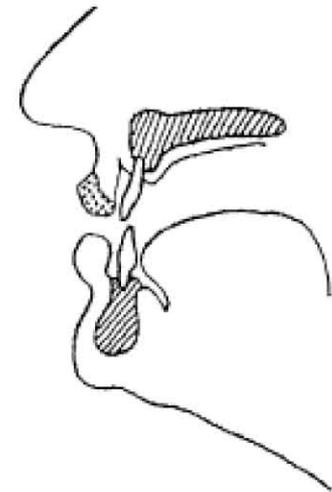
Lateral view



Class I



Class II



Class III

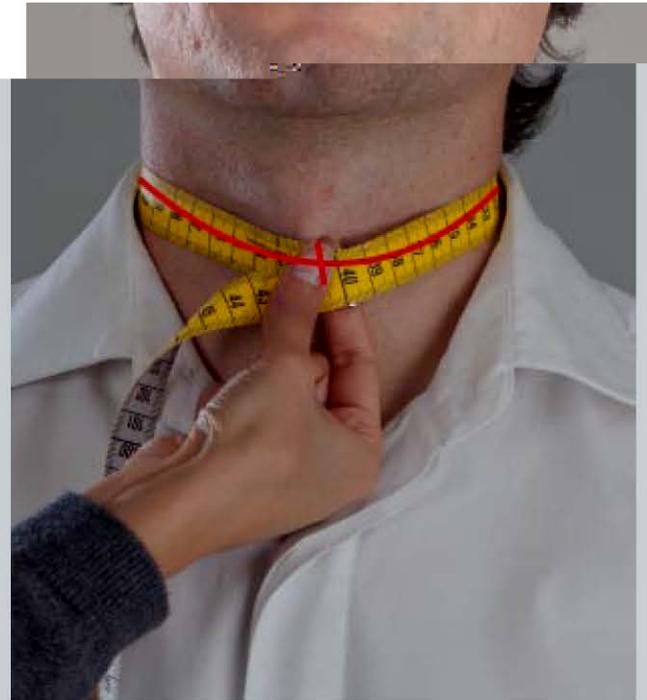
Mallampati & Upper Lip Bite Test

Predicting test	Laryngoscopic view	
	I and II	III and IV
Modified Mallampati		
Classes I and II	189	3
Classes III and IV	94	14
Upper lip bite		
Classes I and II	251	4
Class III	32	13

AIRWAY EXAMINATIONS

Neck Circumference = Weight (Kg) / 2 in Cms

If Neck circumference > 13% → 40 Cms = Difficult intubation



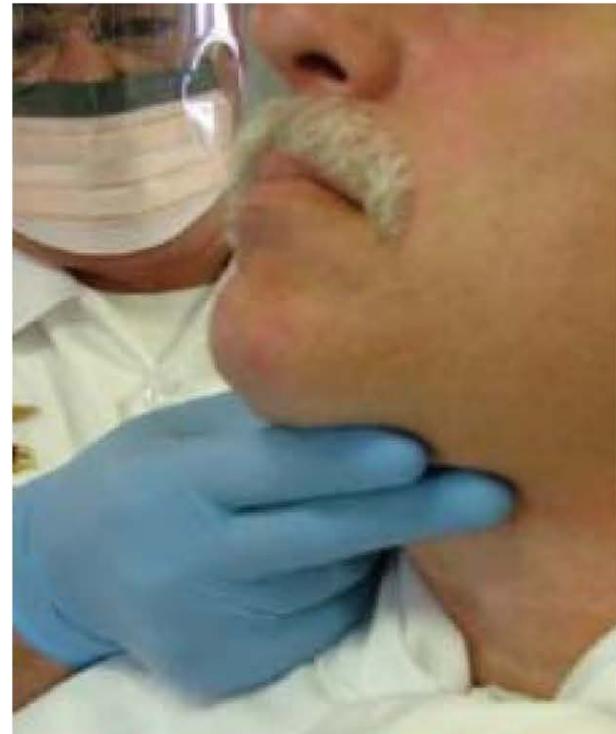
AIRWAY EXAMINATIONS

Hyo-Mental Distance

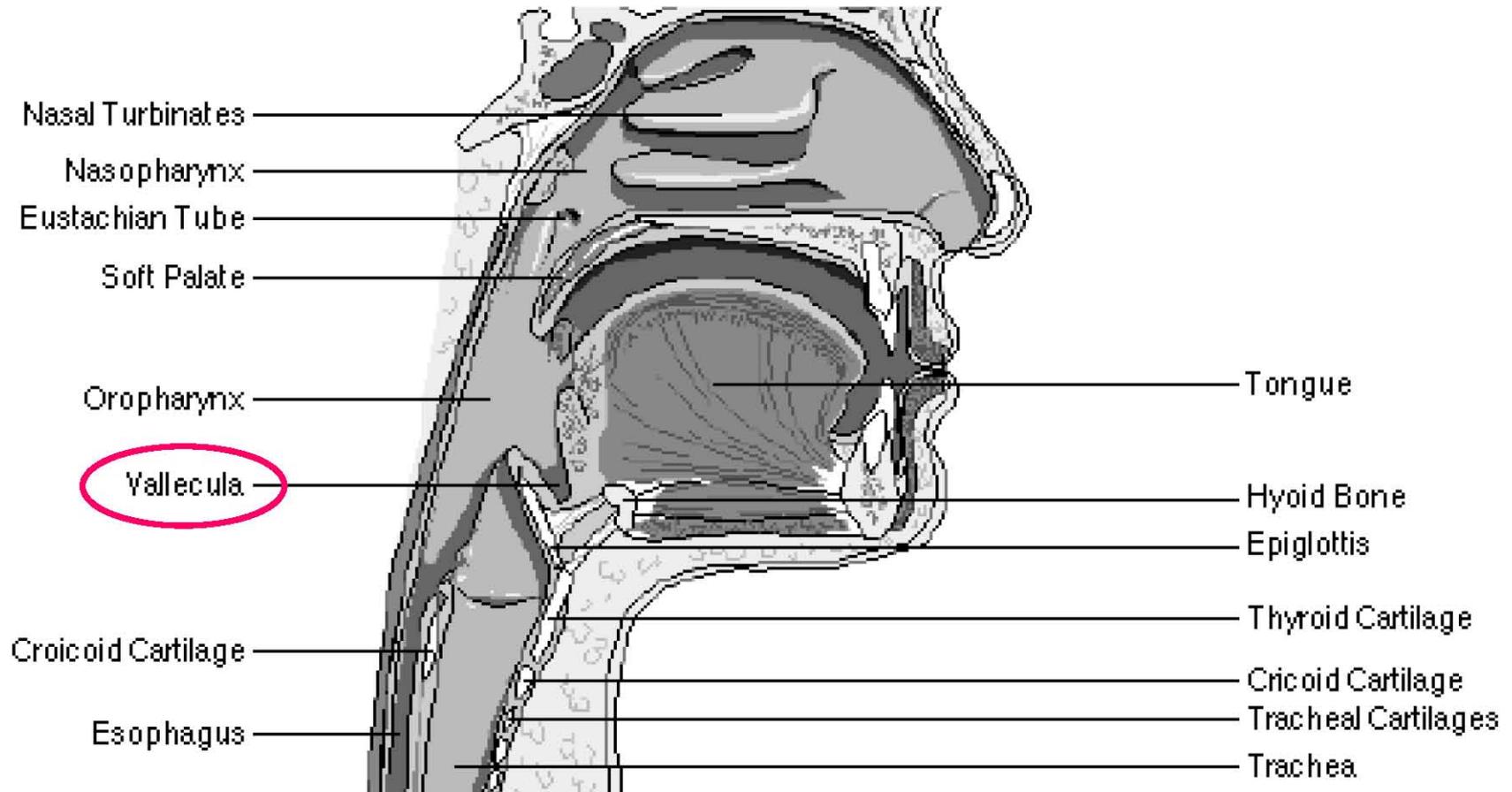
Grade 1 : > 6 cm

Grade 2 : 4-6 cm

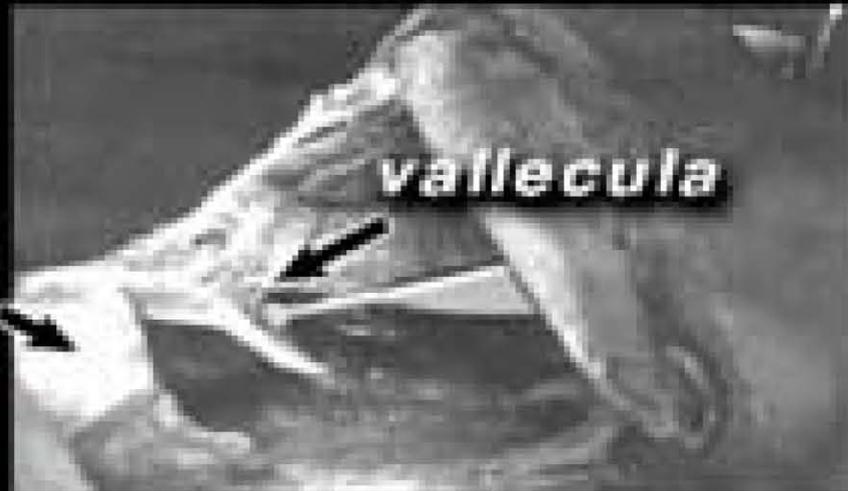
Grade 3 : < 4 cm \rightarrow Difficult intubation



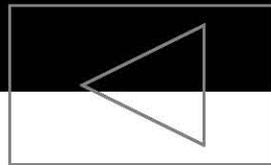
Airway assessment



*thyroid
cartilage*



*external
laryngeal
manipulation*



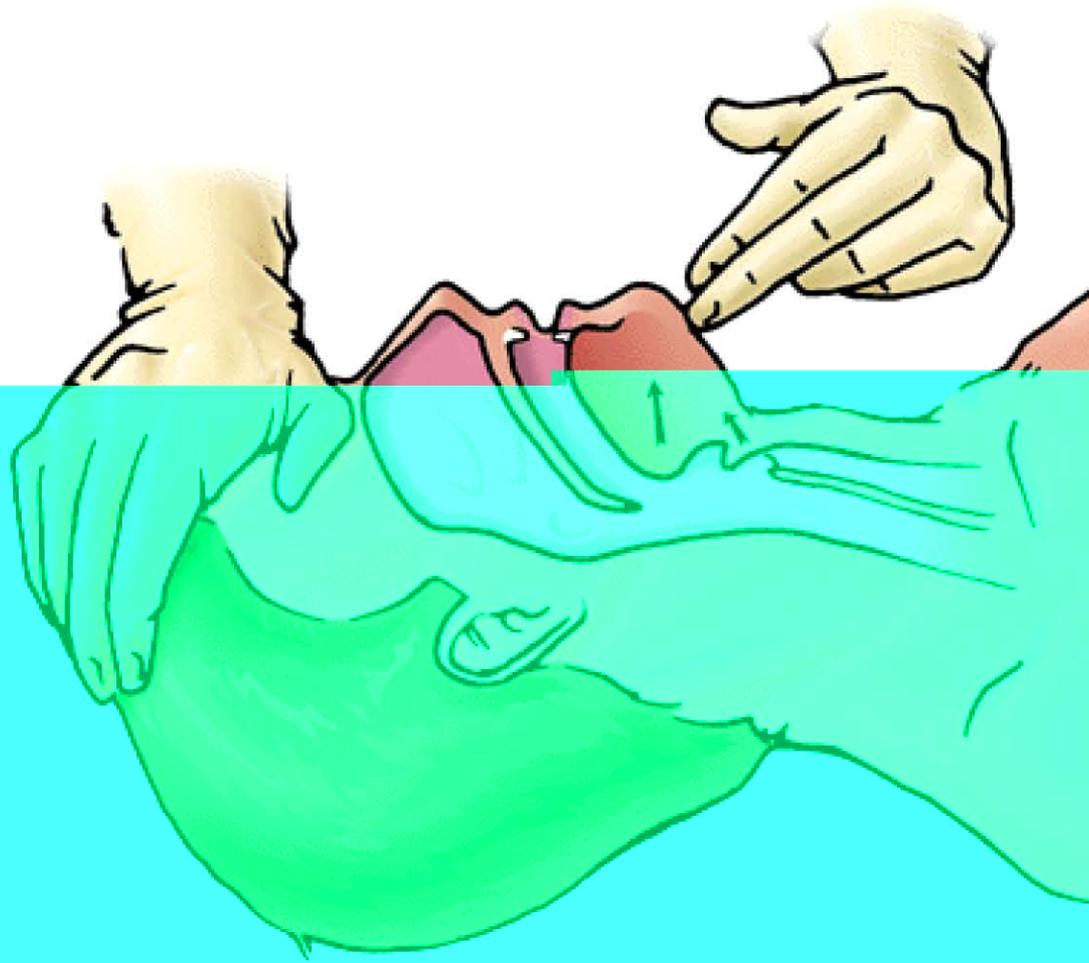
Three basic decisions needed before induction of anesthesia

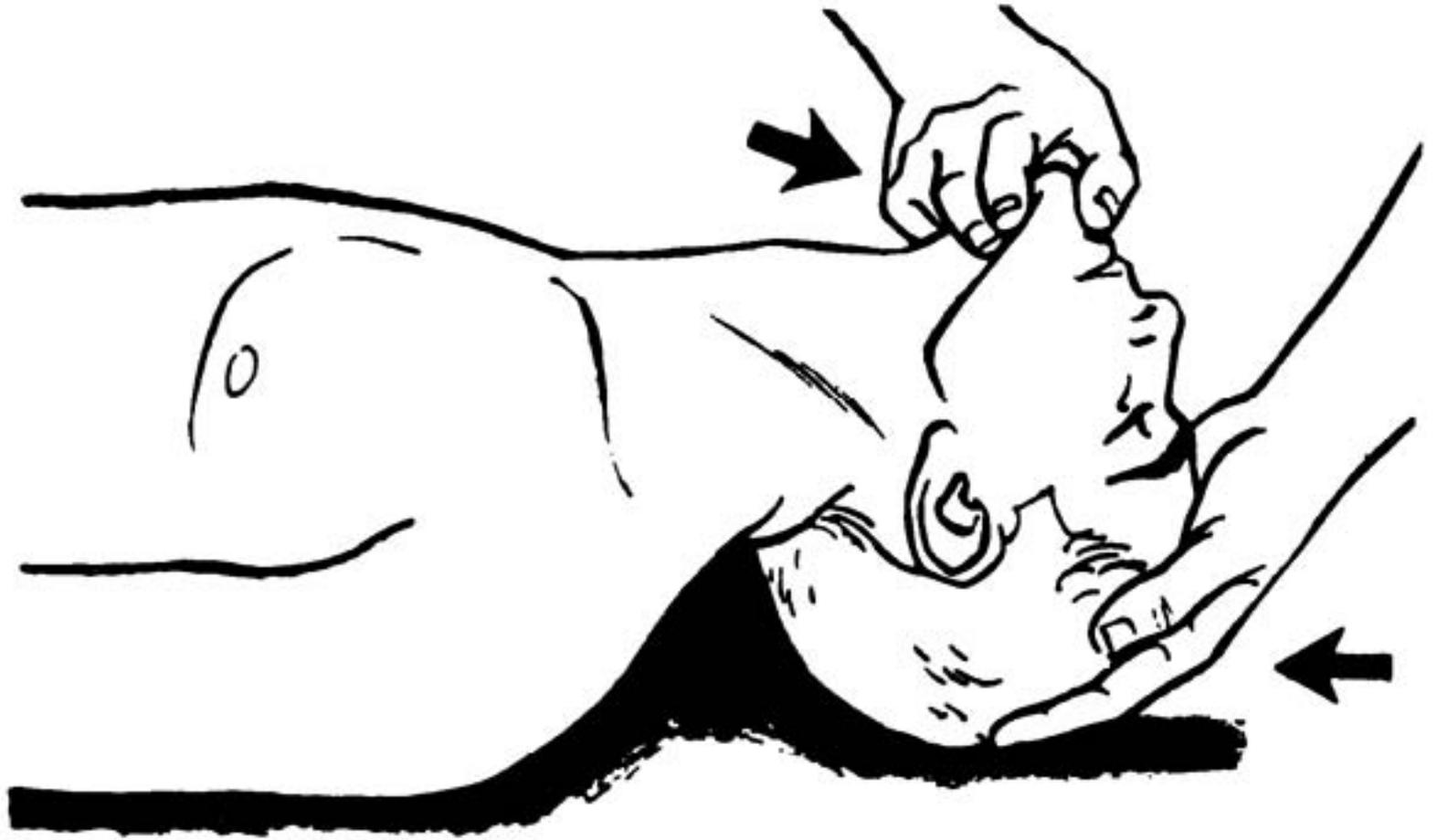
- To use awake endotracheal intubation
- To use a percutaneous technique
- To maintain spontaneous ventilation

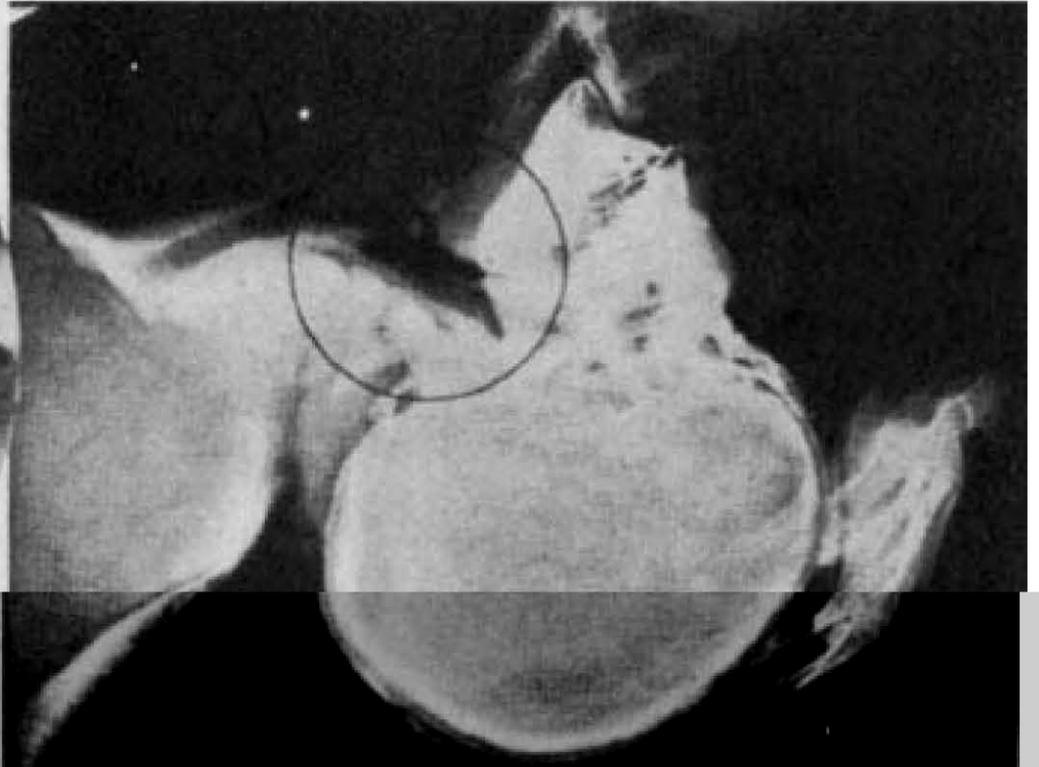
AIRWAY MANEUVER

- HEAD TILT - CHIN LIFT
- JAW THRUST (C-spine injury)
- Tripplle Airway Maneuver

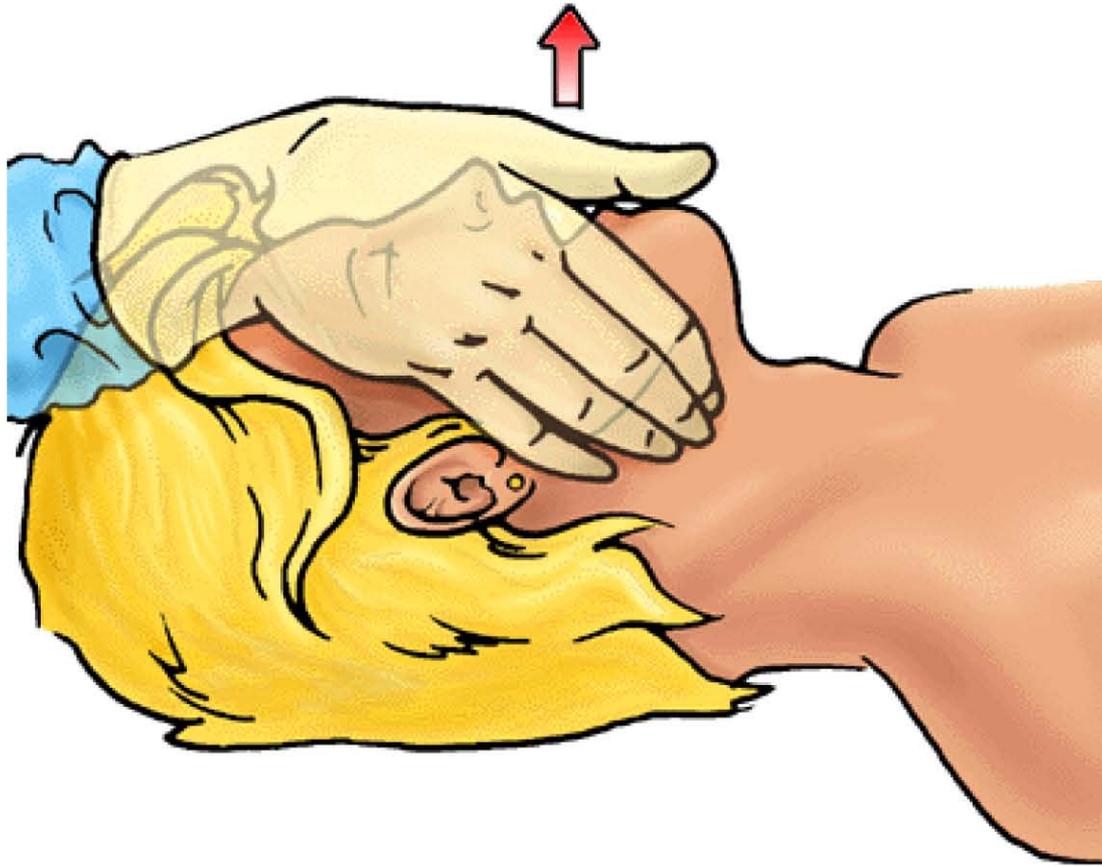
HEAD TILT - CHIN LIFT



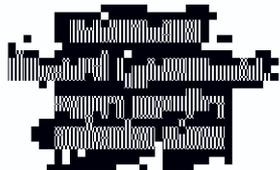
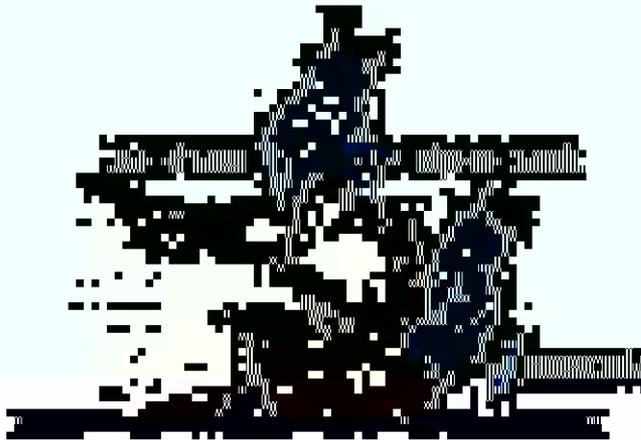
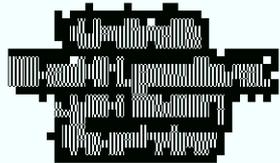
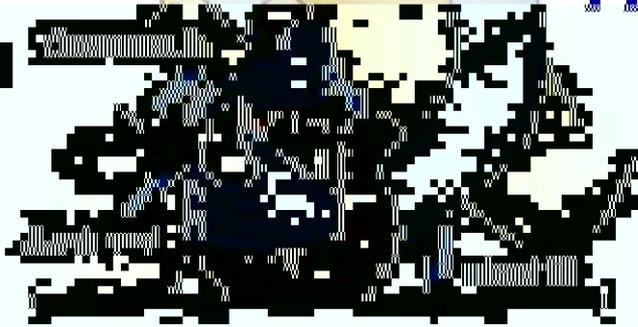
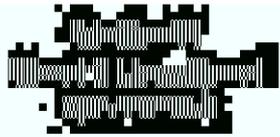




JAW THRUST



Tripble Airway Maneuver



AIRWAY OBSTRUCTION

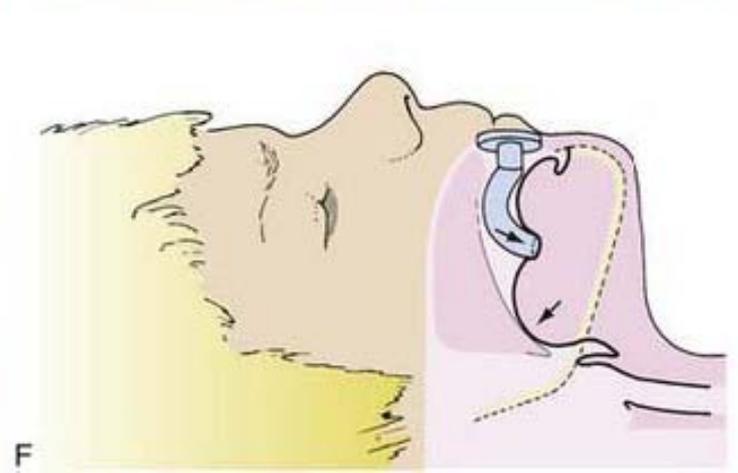
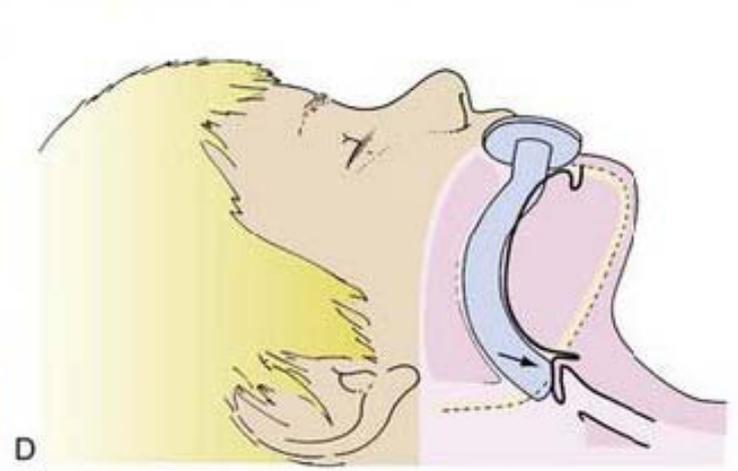
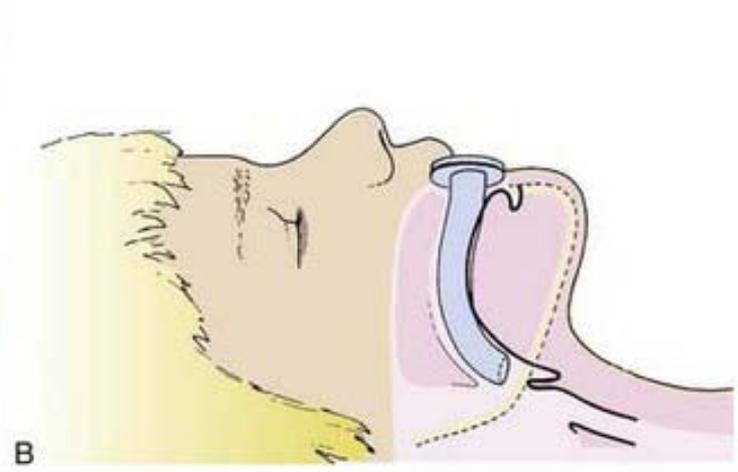


Oral - Nasal airway

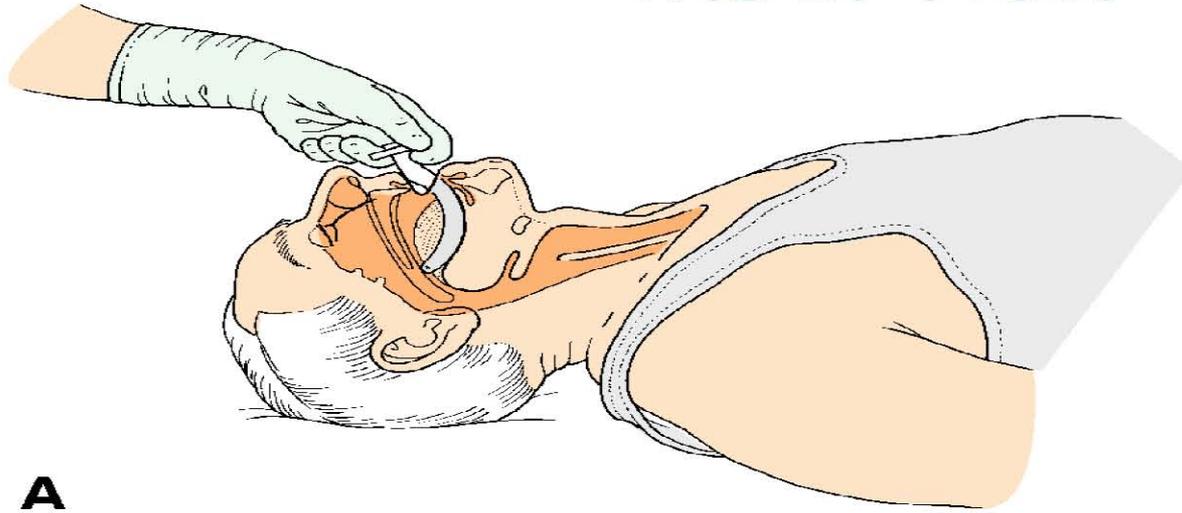


Sizing an oropharyngeal airway

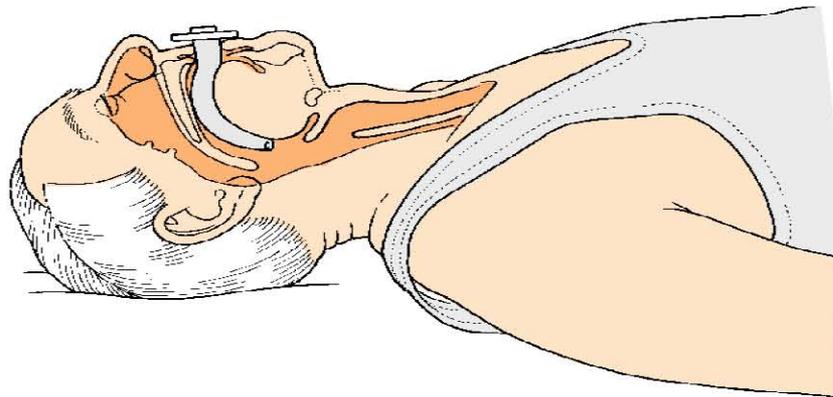




Oropharyngeal airway insertion

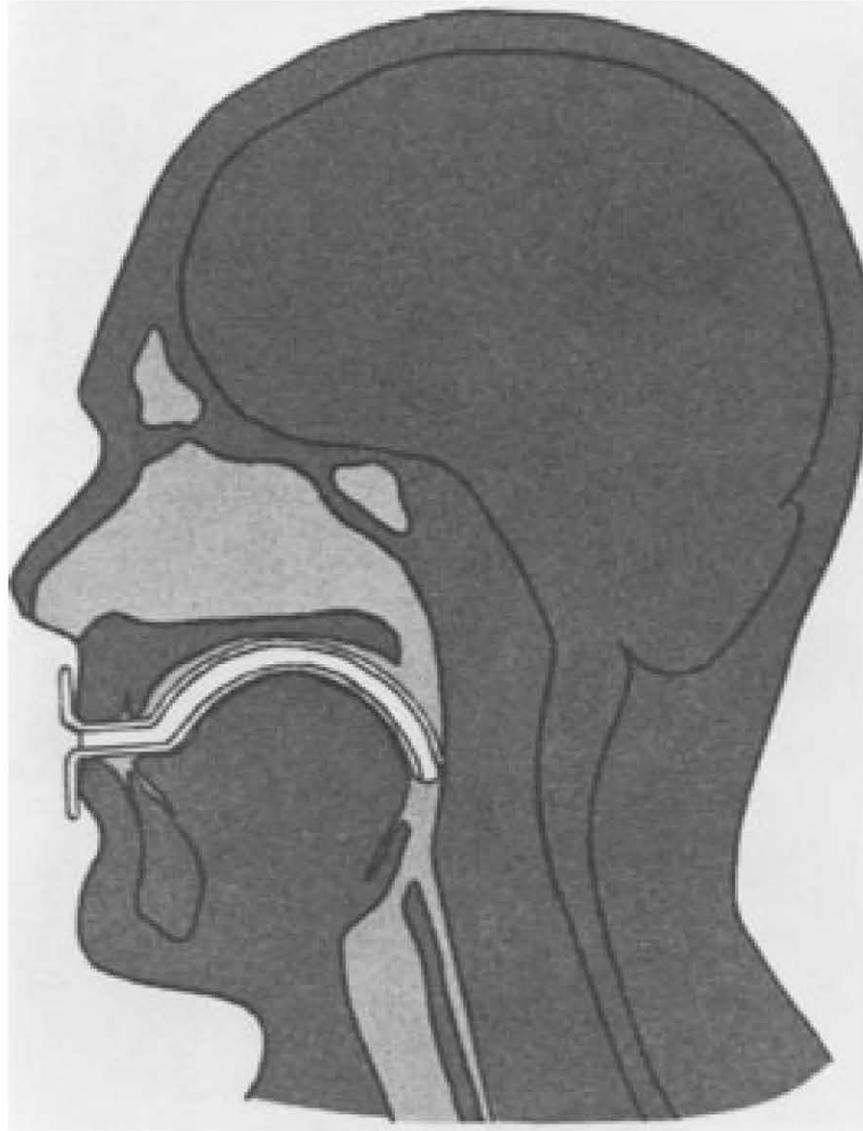


A

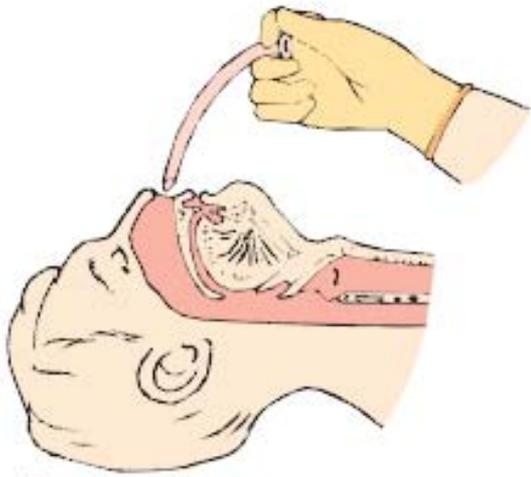


B

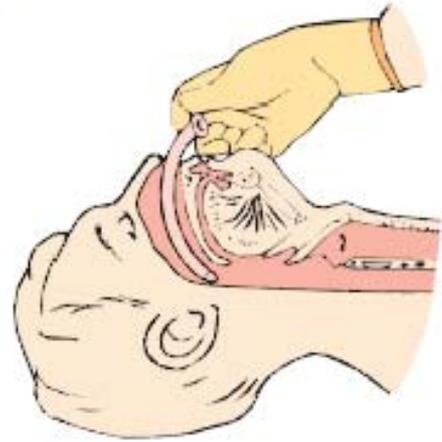
OROPHARYNGEAL AIRWAY



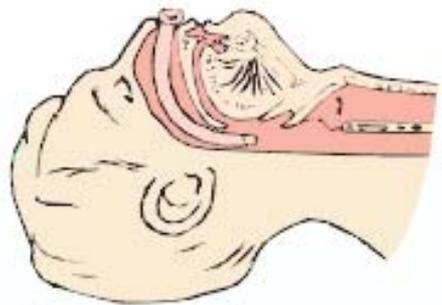
Nasopharyngeal airway insertion



(a)

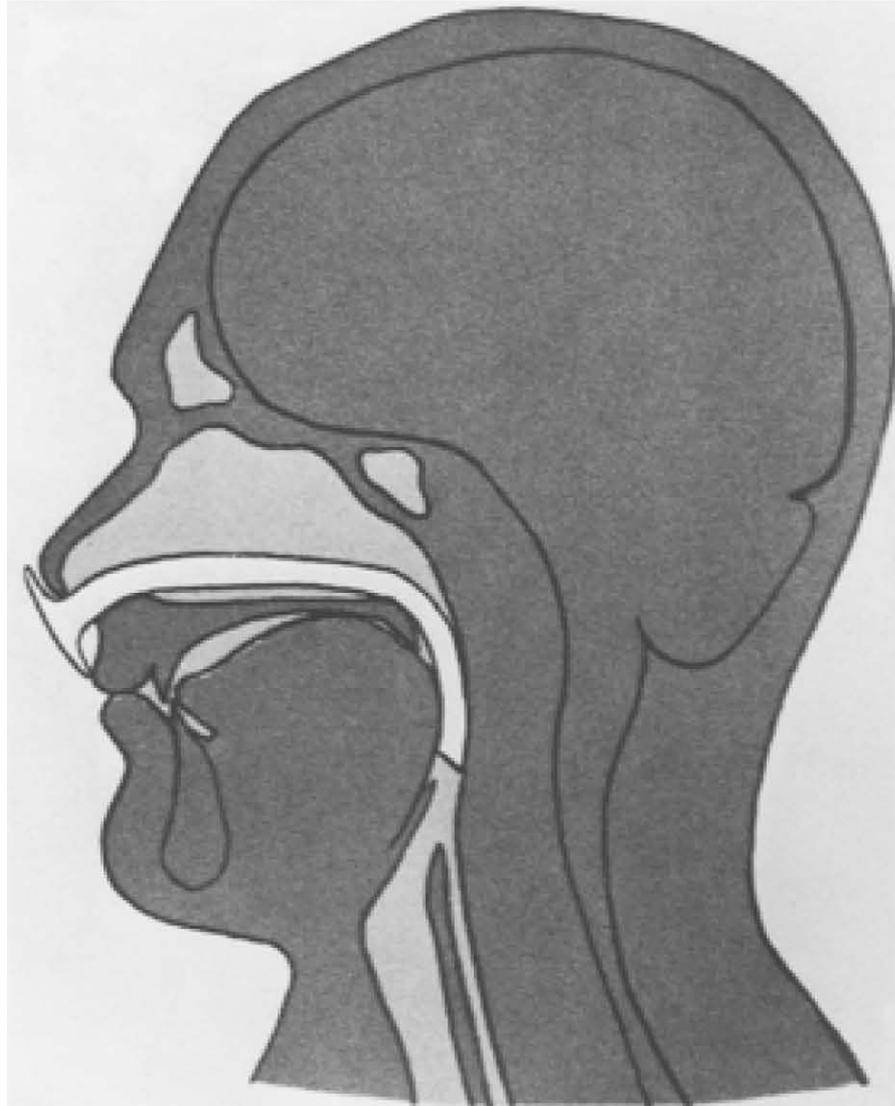


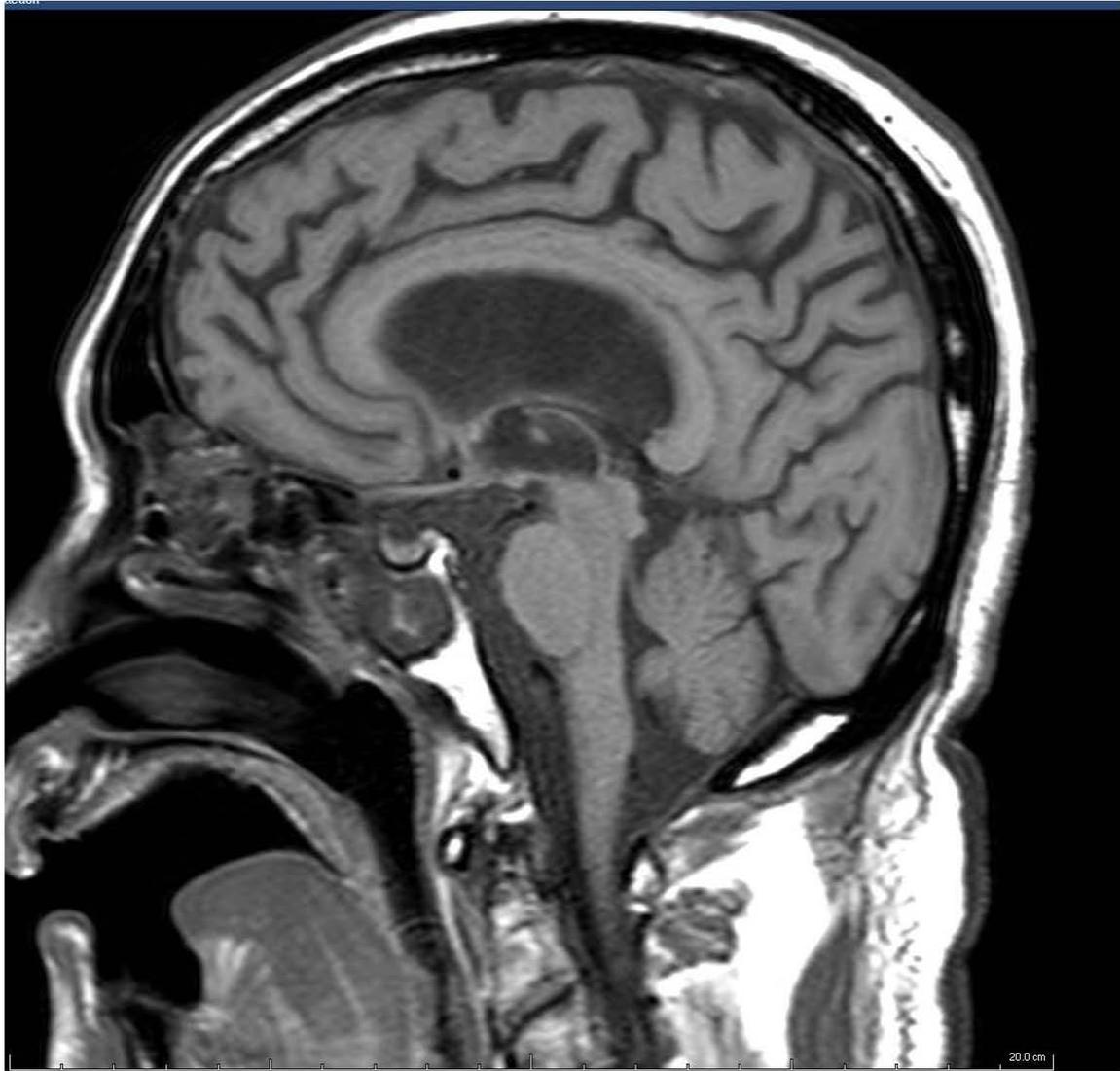
(b)



(c)

NASOPHARYNGEAL AIRWAY





VENTILATION

Some causes of Difficult Ventilation;

- Anatomical features
 - ◆ Short-muscular neck, Limit neck motility, Whiskers, Flat nasal bridge, Large face
- Pathological states ;
 - ◆ Edema, Ankylosis, Congenital Dz, Obesity, Infection, Masses, Scar, Tumor
- Technical & Mechanical factors ;
 - ◆ Cast, Collar, FB, Halo fixation, NG, Edentulous
Inexperience

PREDICTORS OF DIFFICULT FACEMASK VENTILATION

- age older than 55 years
- a body mass index greater than 26 kg/m²
- a beard
- lack of teeth
- a history of snoring
- repeated attempts at laryngoscopy
- Mallampati class III to IV
- neck radiation
- male gender
- limited ability to protrude the mandible















MASK VENTILATION ; ONE HAND

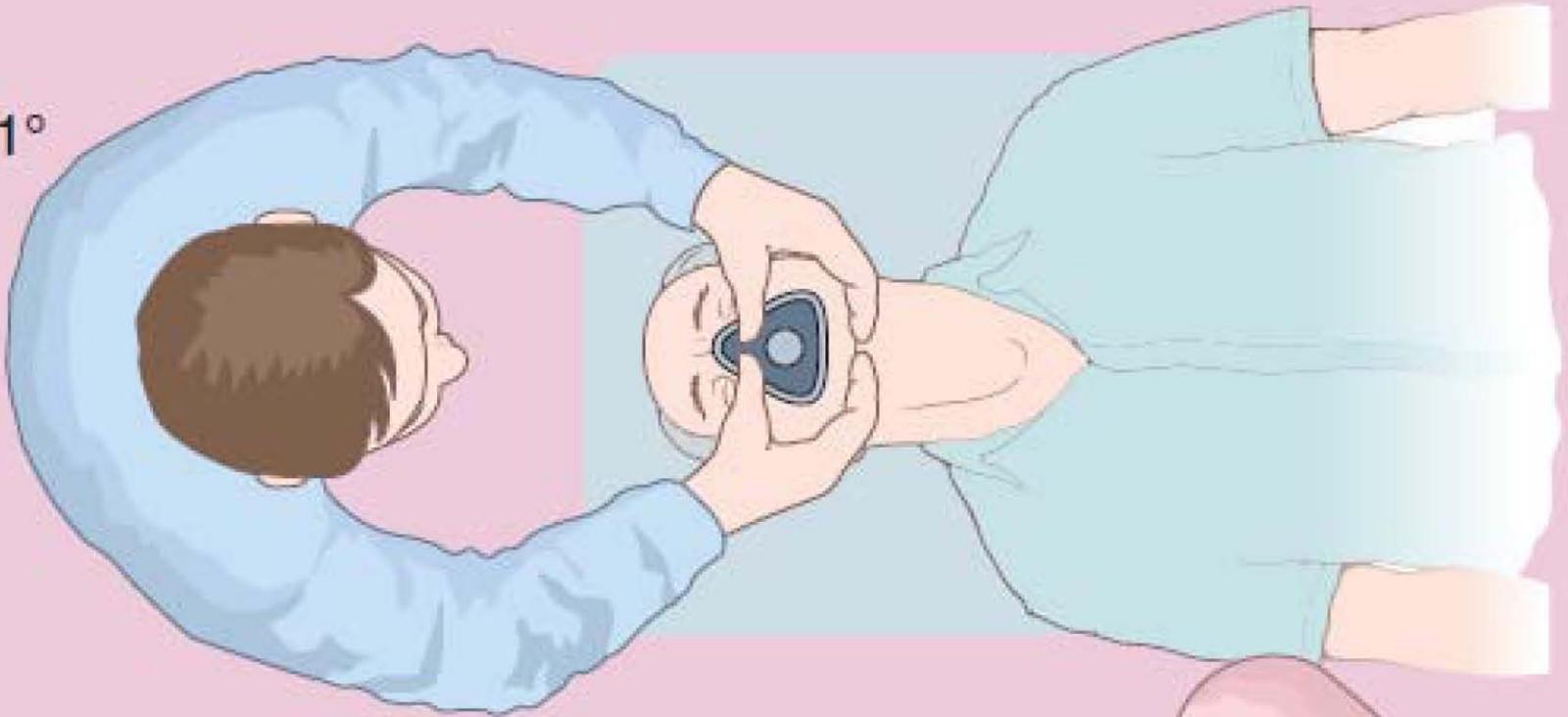


MASK VENTILATION ; TWO HAND





1°



2°



B

Suggestion for Inadequate Ventilation

- Stridor, Phonation, Snoring
- Motionless subcostal
- Upper chest retraction during subcostal expansion
- Supraclavicular retraction
- Depleted reservoir bag
- Reduce TV measure
- SpO₂ < 95 %
- Tachycardia, Bradycardia, Dysrhythmias, Hypotension, Hypertension, Tachypnea

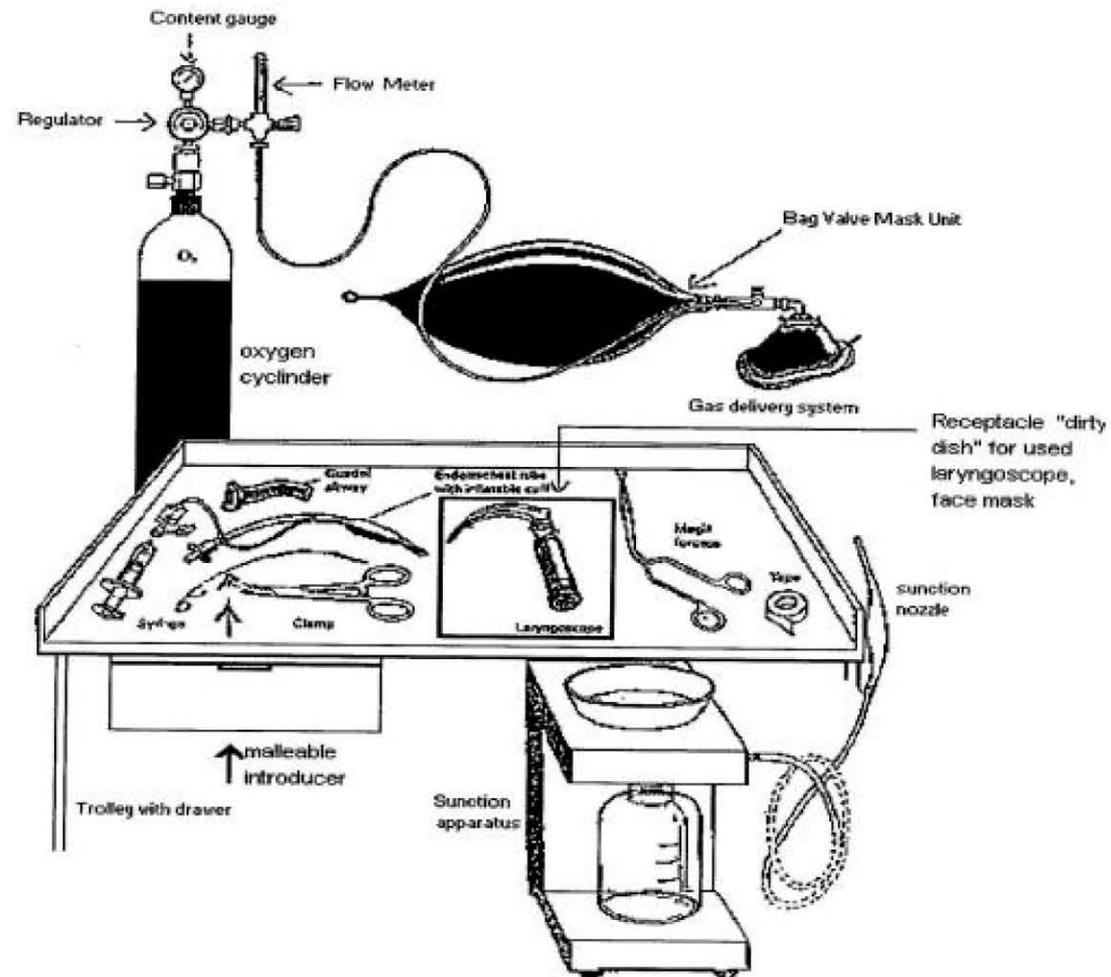


INTUBATION

- Indications
- Contraindication
- Equipments
- การเตรียมผู้ป่วยและสิ่งอุปกรณ์
- Complications

Indication ET intubation

S secretion retention
O obstruction relieve
A aspirate prevention
P positive pressure



ข้อบ่งชี้ในการใส่ท่อช่วยหายใจ

- ช่วยหายใจในผู้ป่วยที่หยุดหายใจหรือมีภาวะหายใจล้มเหลว (Positive pressure ventilation)
- ป้องกันการสำลักอาหาร (Aspiration)
- เพื่อดูดเสมหะ (Suction secretion)

หายใจ (Prevent airway obstruction)

ได้เช่น ขวางการผ่าตัด ขากรรไกรค้ำ

ifficult

■ ป้องกันและรักษาการอุดตันทางเดิน

■ ไม่สามารถใส่ท่อหลอดลมคอทางปาก

■ Airway maintenance with mask or

■ Disease involving upper airway

Indications for tracheal intubation

Surgical and Anesthetic Indications

- Surgical requirement for neuromuscular blocking drugs, e.g., abdominal surgery
- Airway access shared with the surgeon, including ear, nose, and throat surgery
- Patient position in which access to the airway is restricted or precludes rapid tracheal intubation, e.g., lateral, prone
- Predicted difficult airway
- Risk of aspiration of gastric contents or blood, e.g., upper gastrointestinal obstruction or sepsis, facial trauma, bleeding into the respiratory tract from any cause
- Surgery that impairs gas exchange
- Prolonged surgery
- Other airway techniques ineffective

Critical Illness

- Inability to protect the airway, e.g., coma from any cause
- Impaired respiratory function (hypoxemia or hypercapnia) unresponsive to noninvasive management
- Prevention of hypercapnia, e.g., raised intracranial pressure

Three basic decisions needed before induction of anesthesia

- To use awake endotracheal intubation
- To use a percutaneous technique
- To maintain spontaneous ventilation

ข้อห้ามและข้อควรระวัง

- Aspiration จากภาวะ Full stomach
- ภาวะที่มีอันตรายต่อ Laryngotrachea, Maxillofacial injury
- มีการอุดตันทางเดินหายใจเช่น เนื้องอก สิ่งแปลกปลอม
- Coagulopathy

การเตรียมอุปกรณ์ใส่ท่อช่วยหายใจ

- Bag-valve-mask (BVM) resuscitator
- Reservoir bag
- อุปกรณ์ให้ออกซิเจน
- อุปกรณ์เฝ้าระวัง EKG, Oxygen saturation
- อุปกรณ์ในการดูดเสมหะ
- Laryngoscope & Blade
- Endotracheal tubes
- Stylet
- Syringe 10 ml

- พลาสเตอร์ยึดท่อช่วยหายใจ
- Stethoscope
- KY jelly
- ยาชาชนิดพ่น Topical
- Magill forcep
- Endotracheal tubes ส่วนใหญ่เลือกขนาดที่ใส่เล็กกว่าใส่ทางปาก 0.5 mm
 - ☞ ผู้ชาย ใช้ขนาด 7.5 - 8
 - ☞ ผู้หญิง ใช้ขนาด 7 - 7.5

การเตรียมผู้ป่วยและสิ่งอุปกรณ์

- ติดอุปกรณ์ไฟระวัง EKG, Oxygen saturation
- ตรวจสอบเช็คอุปกรณ์ต่างๆพร้อมใช้ เช่น ET cuff ว่าไม่มีรั่ว, ไฟ Laryngoscope & Bladeส่องสว่างดี, อุปกรณ์ในการดูดเสมหะพร้อมใช้งาน
- เลือกขนาดท่อหลอดลมคอที่เหมาะสม โดยคำนวณจากสูตร
$$\text{ETT Size} = \text{อายุ (ปี)} / 4 + 4$$
- ประเมินทางเดินหายใจผู้ป่วย เช่น ช่องปาก ฟัน การเคลื่อนไหวของคอ ถ้าประเมินว่าอาจใส่ท่อหลอดลมคอลำบากให้ใส่ Stylet พร้อมทั้งใส่เจลหล่อลื่นในท่อให้เรียบร้อย
- จัดผู้ป่วยในท่านอนหงาย หนุนหมอนบริเวณท้ายทอยสูงประมาณ 8 - 10 ซม. กรณี C spine injury ห้ามขยับคอผู้ป่วย ห้าม Hyperextension
- ดูดเสมหะ, เลือดและกำจัดสิ่งแปลกปลอมในทางเดินหายใจผู้ป่วย
- ให้ผู้ป่วยสูดดมออกซิเจน 100 % นานอย่างน้อย 2-3 นาที

Pre-oxygenation

- Healthy adults breathing **room air** will develop oxygen desaturation ($SpO_2 < 90\%$) with 2 minutes of apnea
- Preoxygenation with 100% oxygen can maintain oxygen saturation above 90% for more than 6 minutes
- 4 vital-capacity breaths in 30 seconds or 8 vital capacity breaths in 60 seconds provide adequate pre-oxygenation

Recommended tube sizes in children

Age	Weight (kg)	Size (id)	Length (cm)	
			Oral	Nasal
Neonate	2–4	2.5–3.5	10–12	15
1–6 months	4–6	3.5–4	12–14	15
6–12 months	6–10	3.5–4.0	14–16	15
1–3 years	10–15	4.0–4.5	16–18	16
4–6 years	15–20	4.5–5.5	18–20	17
7–10 years	25–35	5.5–6.0	20–22	18–20

Below 8–10 years uncuffed tubes should be used.

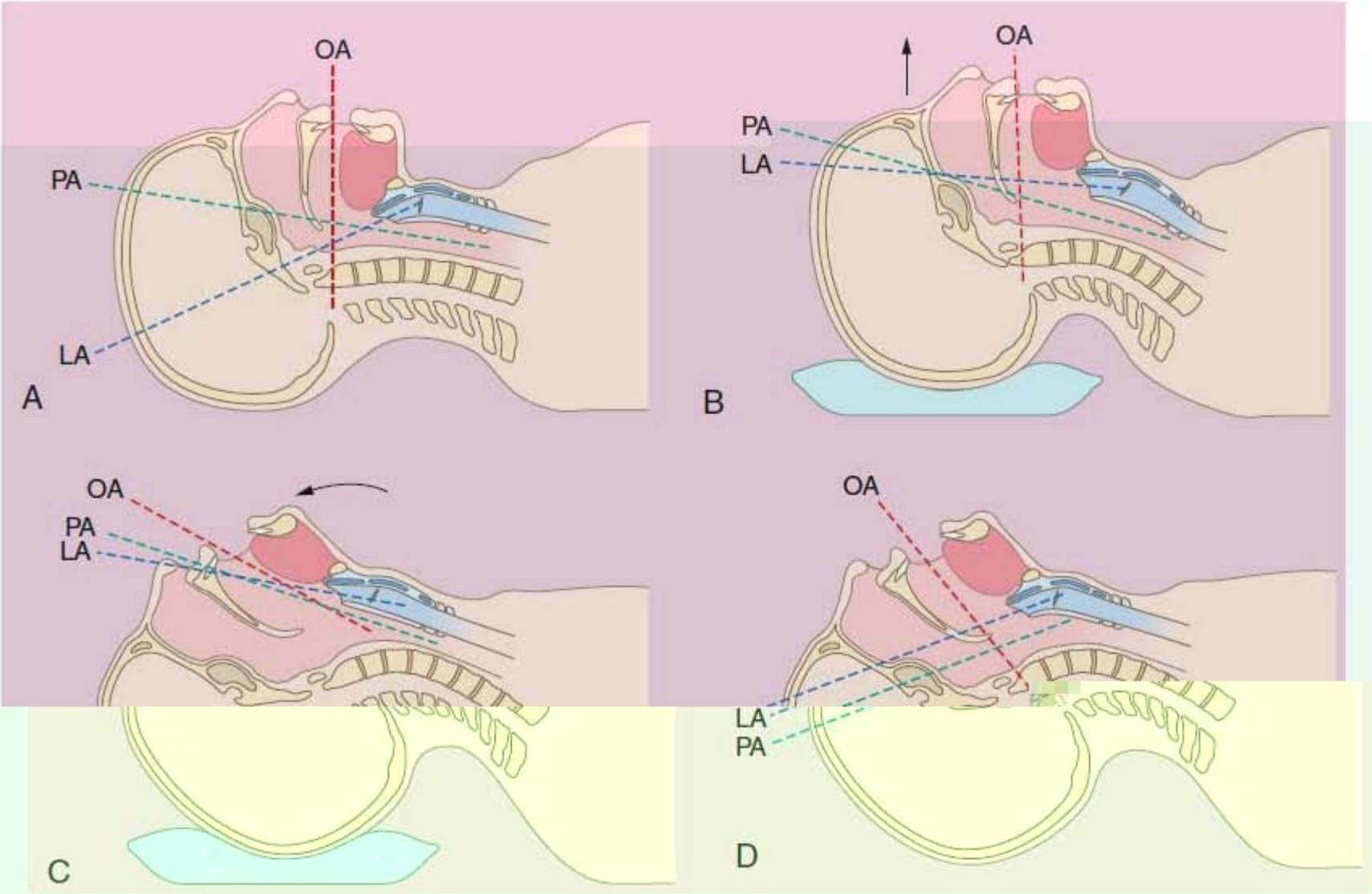
Tube size (internal diameter (id)) in children = $\frac{\text{Age in years}}{2} + 2\frac{1}{2}$ or $\frac{\text{age in years}}{4} + 4$

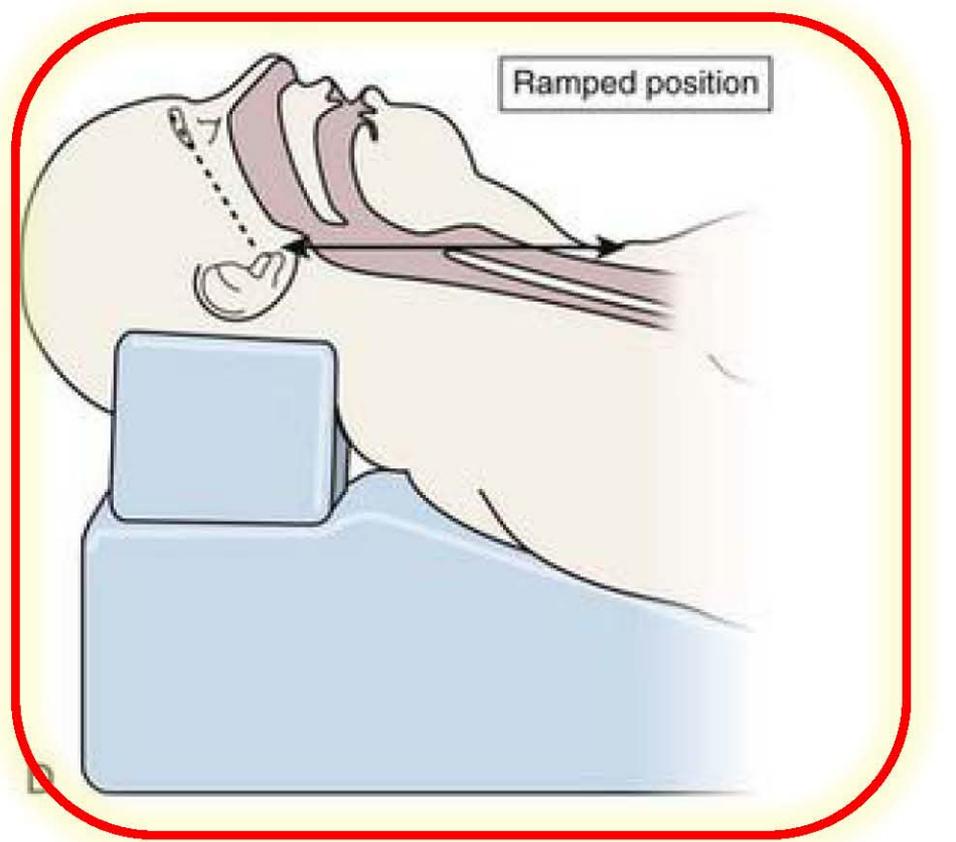
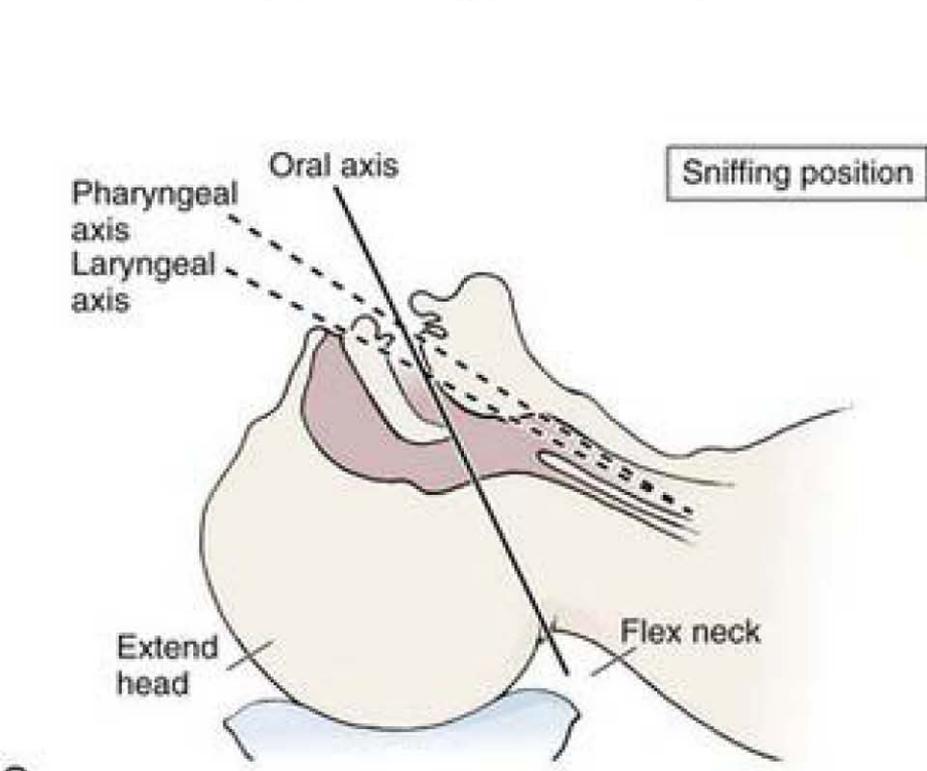
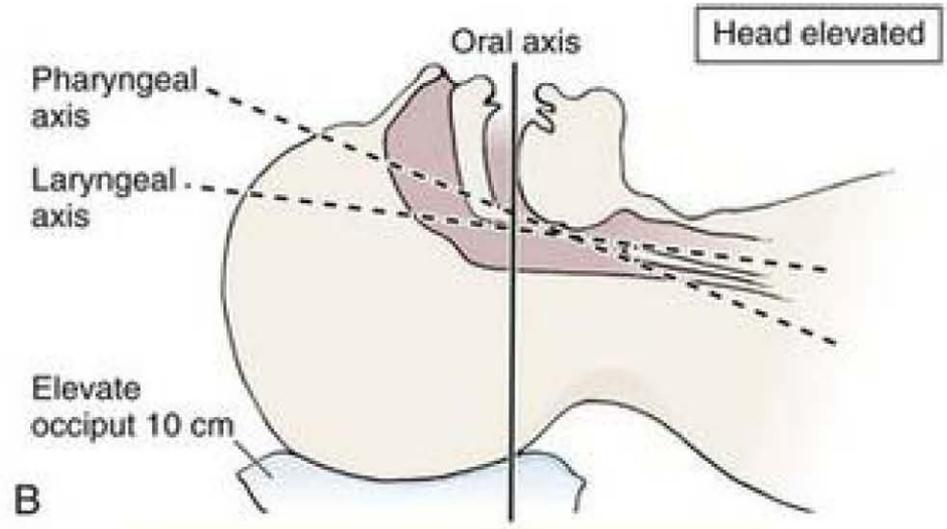
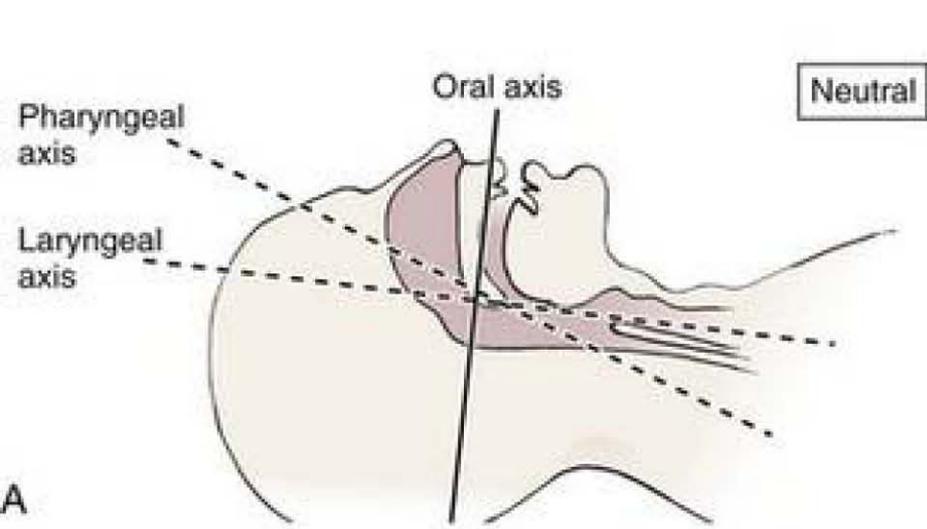
Oral tube length (cm) = $12 + \frac{\text{Age in years}}{2}$

Nasal tube length (cm) = $15 + \frac{\text{Age in years}}{2}$

Sniff position







Positioning in special situations



1

C-Spine Precautions [Manual in-line stabilization](#)

2

Ramped position

3

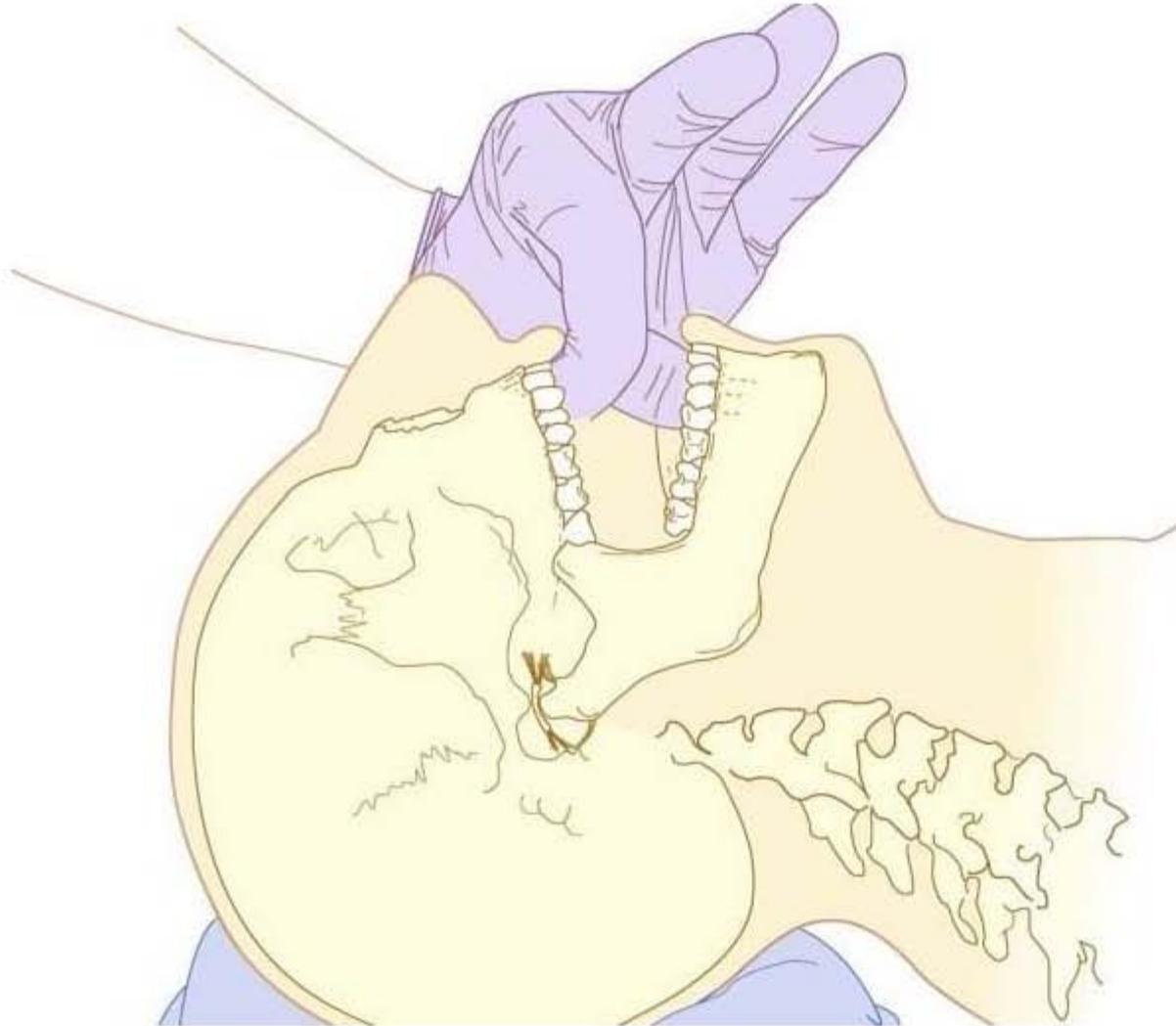
Sitting position

4

LUD position

5

Scissors maneuver



Maneuvers Used to Optimize the View at Direct Laryngoscopy

Maximum head extension

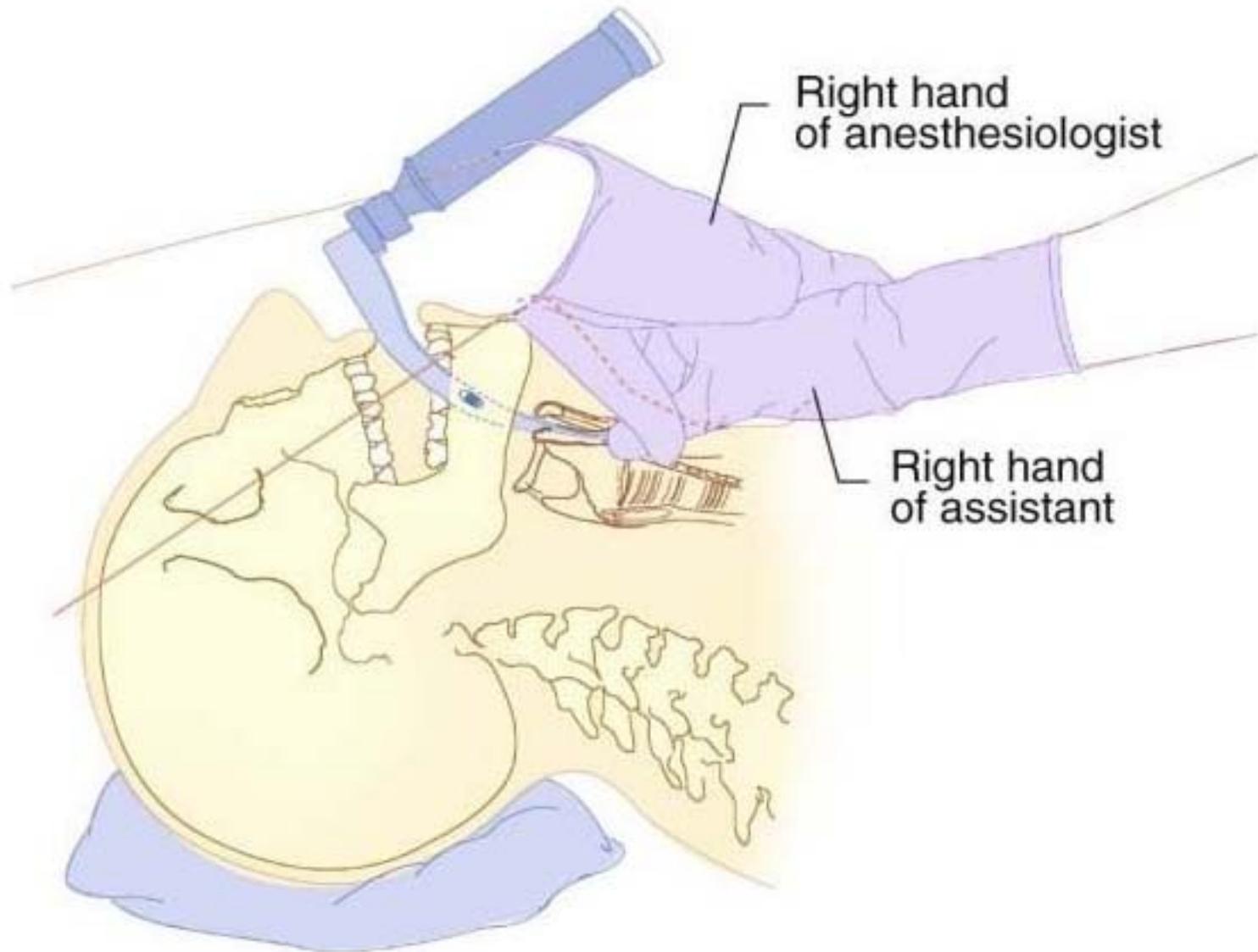
Tongue entirely to the left of the laryngoscope

Optimal depth of insertion of the laryngoscope

Strong lifting force applied in the correct direction to the laryngoscope

External laryngeal manipulation—applied initially with the right hand of the anesthesiologist

Bimanual laryngoscopy (external laryngeal manipulation)



BURP Maneuver

คือ **technique** ในการทำ **laryngeal manipulation** เพื่อช่วย
ให้เห็น **vocal cord** คีจิ้น

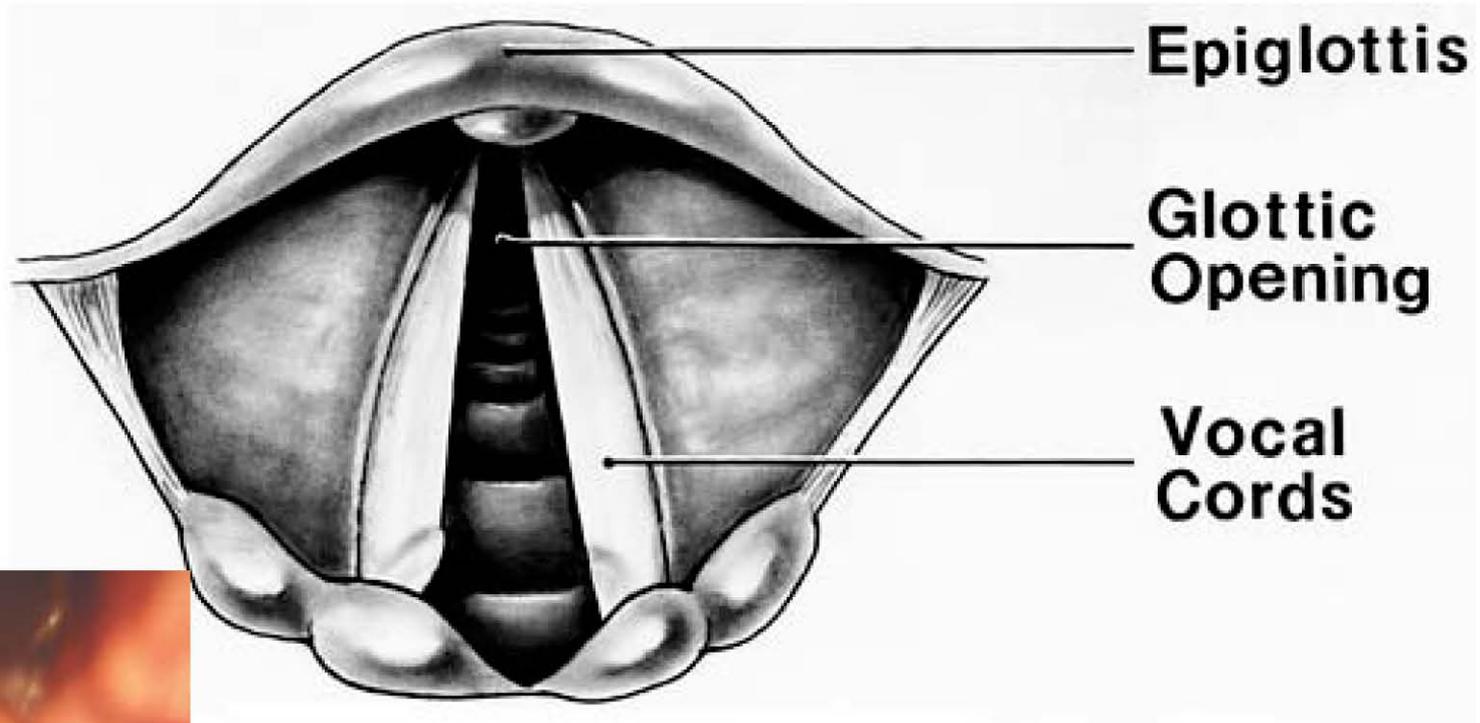
B → Backward

U → Upward

RP → Rightward Pressure



Laryngoscopic view

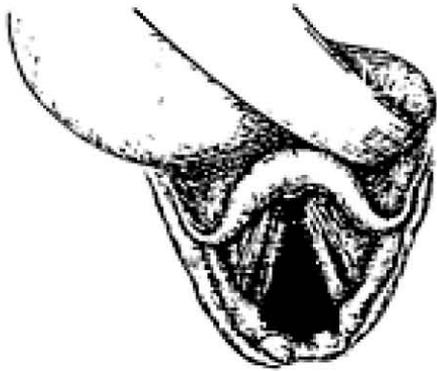


Laryngoscopic view

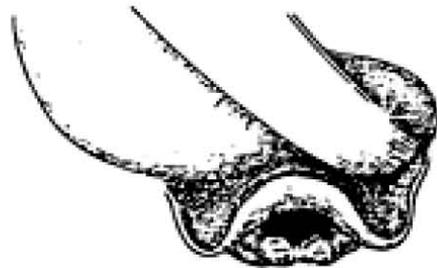
Cormack and Lehane.

Entire glottis seen

Grade 1

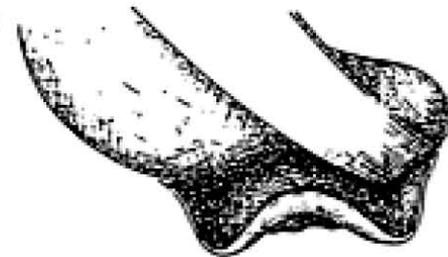


Grade 2



Only posterior glottis seen

Grade 3



Only epiglottis seen

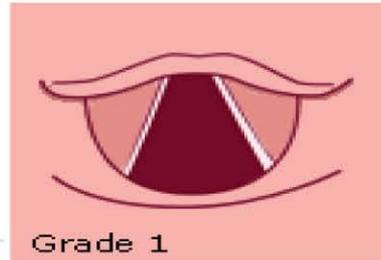
Grade 4



Even glottis not seen

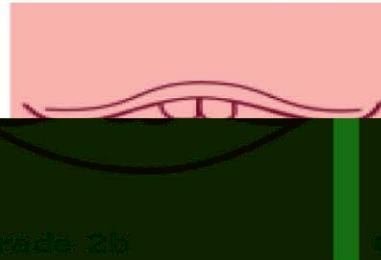
Easy

Views require no adjuncts



Restricted

Views require a gum elastic bougie



Difficult

Views require advanced techniques



Cook's modified laryngeal classification

grade 1 : most of the cords visible

grade 2a : posterior cord visible

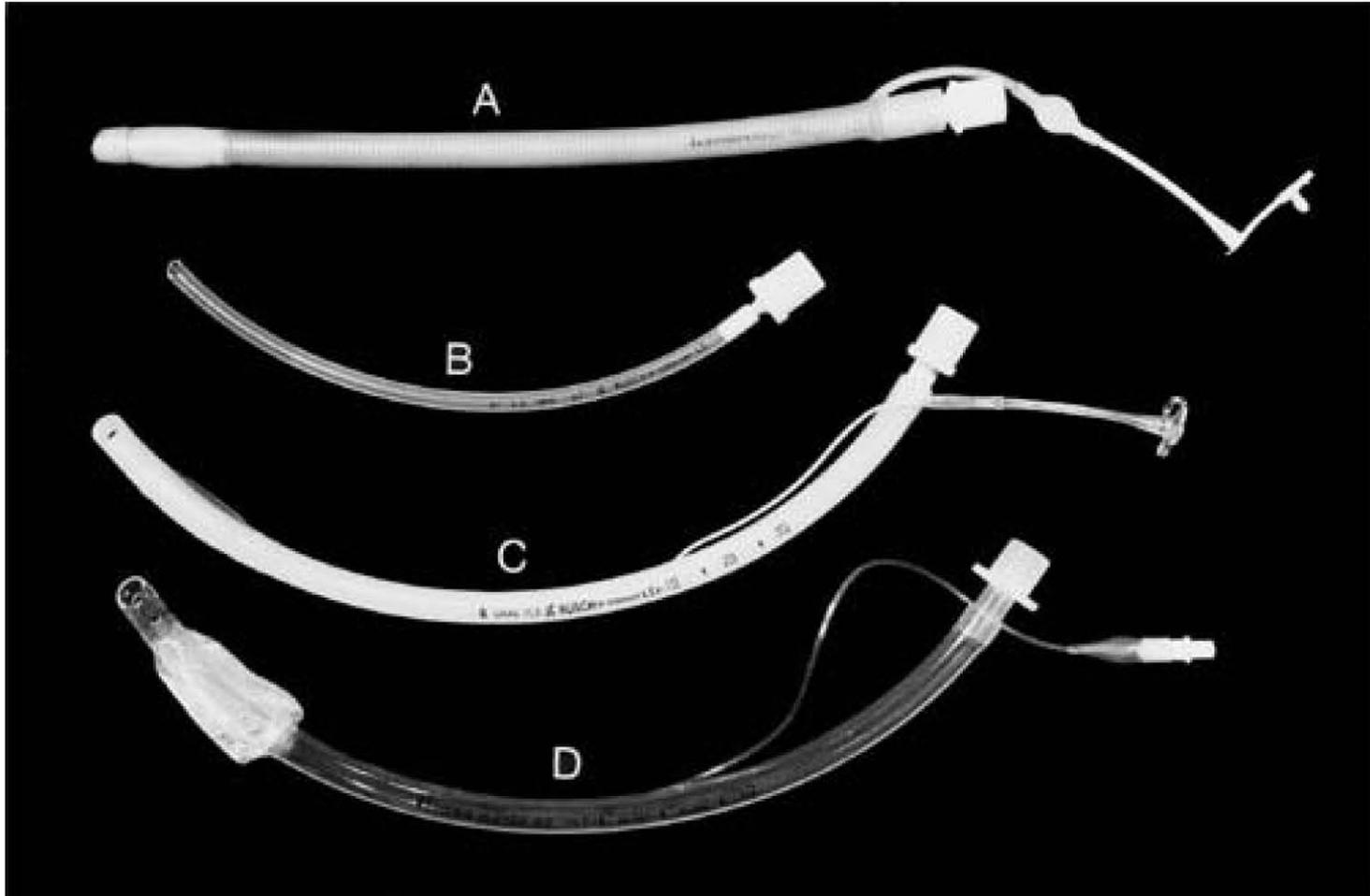
grade 2b : only the arytenoids or the very posterior origin of the cords visible

grade 3a : epiglottis visible and liftable

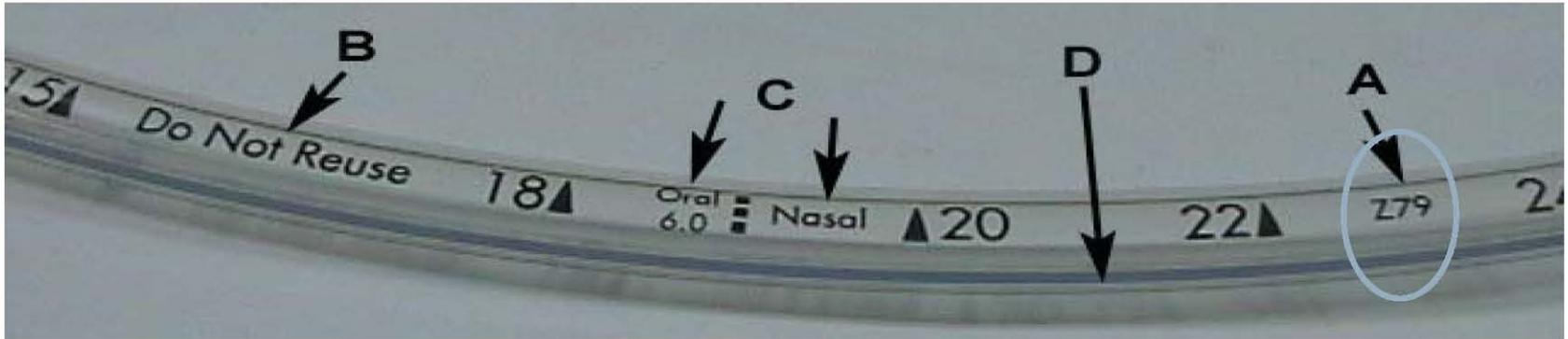
grade 3b : epiglottis adherent to pharynx

grade 4 : no laryngeal structures seen

OROTRACHEAL TUBE



Tube markings

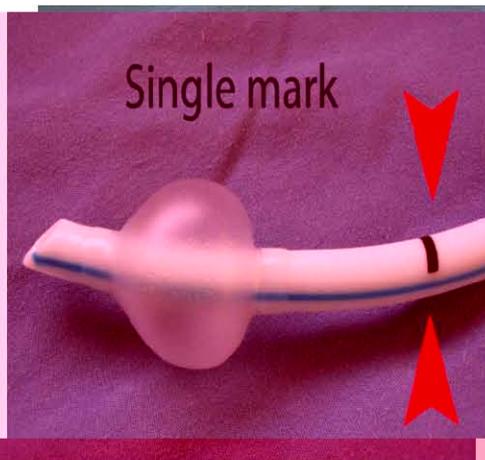


A = Z-79 , IT (implant tested in rabbit muscle for tissue compatibility)

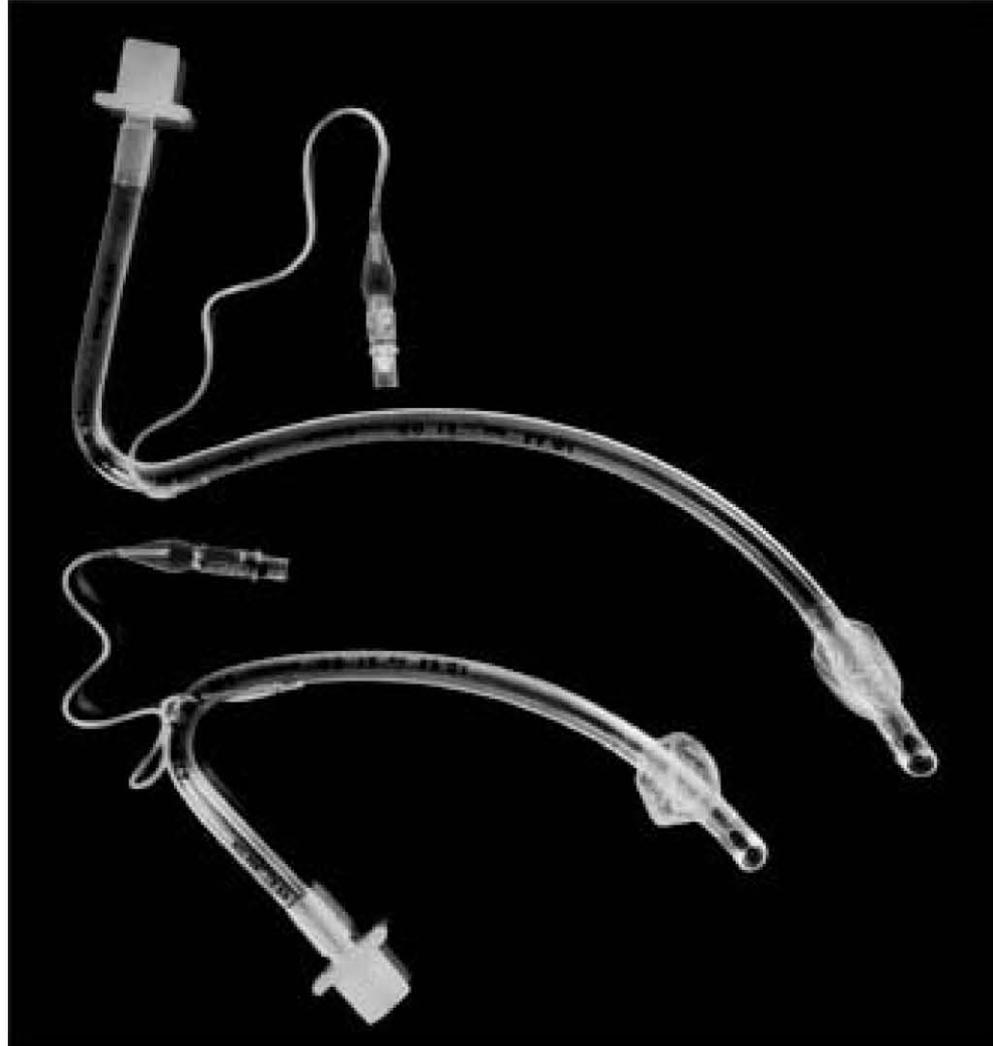
B = Disposable (Do not reuse)

C = Oral/ Nasal

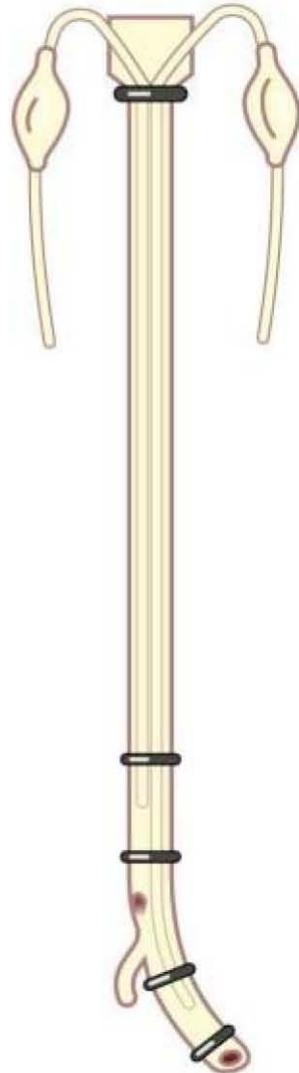
D = Radiopaque marker



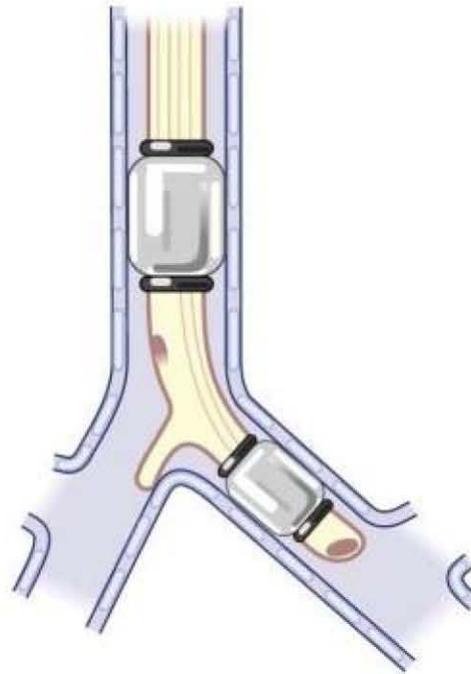
RAE TUBE



Carlens red rubber double-lumen



A. Carlens tube



B. Placement at the carina

Endobronchial tube



Double lumen tube



Indications for One-Lung Ventilation

■ *Absolute*

- Isolation of one lung from another to prevent spillage or contamination (infection, massive hemorrhage)
- Control of distribution of ventilation
 - Bronchopleural fistula
 - Surgical opening of major conducting airway
- Unilateral bronchopulmonary lavage
 - Ex: pulmonary alveolar proteinosis

■ *Relative*

- Surgical exposure- high priority
 - Thoracic aortic aneurysm
 - Pneumonectomy
 - Upper lobectomy
- Surgical exposure- lower priority
 - Middle lobe lobectomies
 - Esophageal resection
 - Thoracoscopy
 - Thoracic spine procedures
- Post-removal of totally-occluding chronic unilateral pulmonary emboli

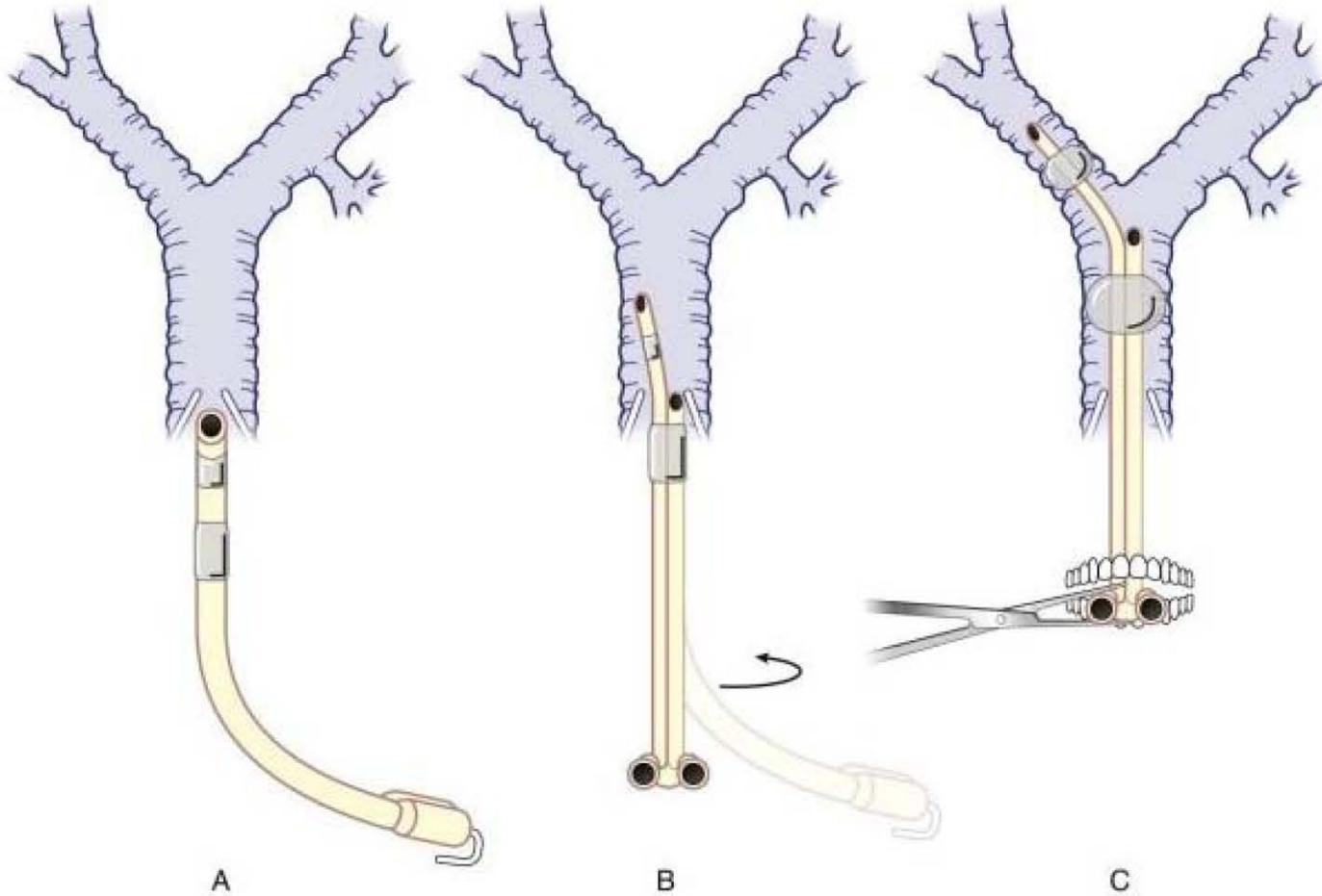
Selection of Double-Lumen Tube Size

Sex	Height (cm)	Size (Fr)
Female	<160 (63 in.) *	35
Female	>160	37
Male	<170 (67 in.) †	39
Male	>170	41

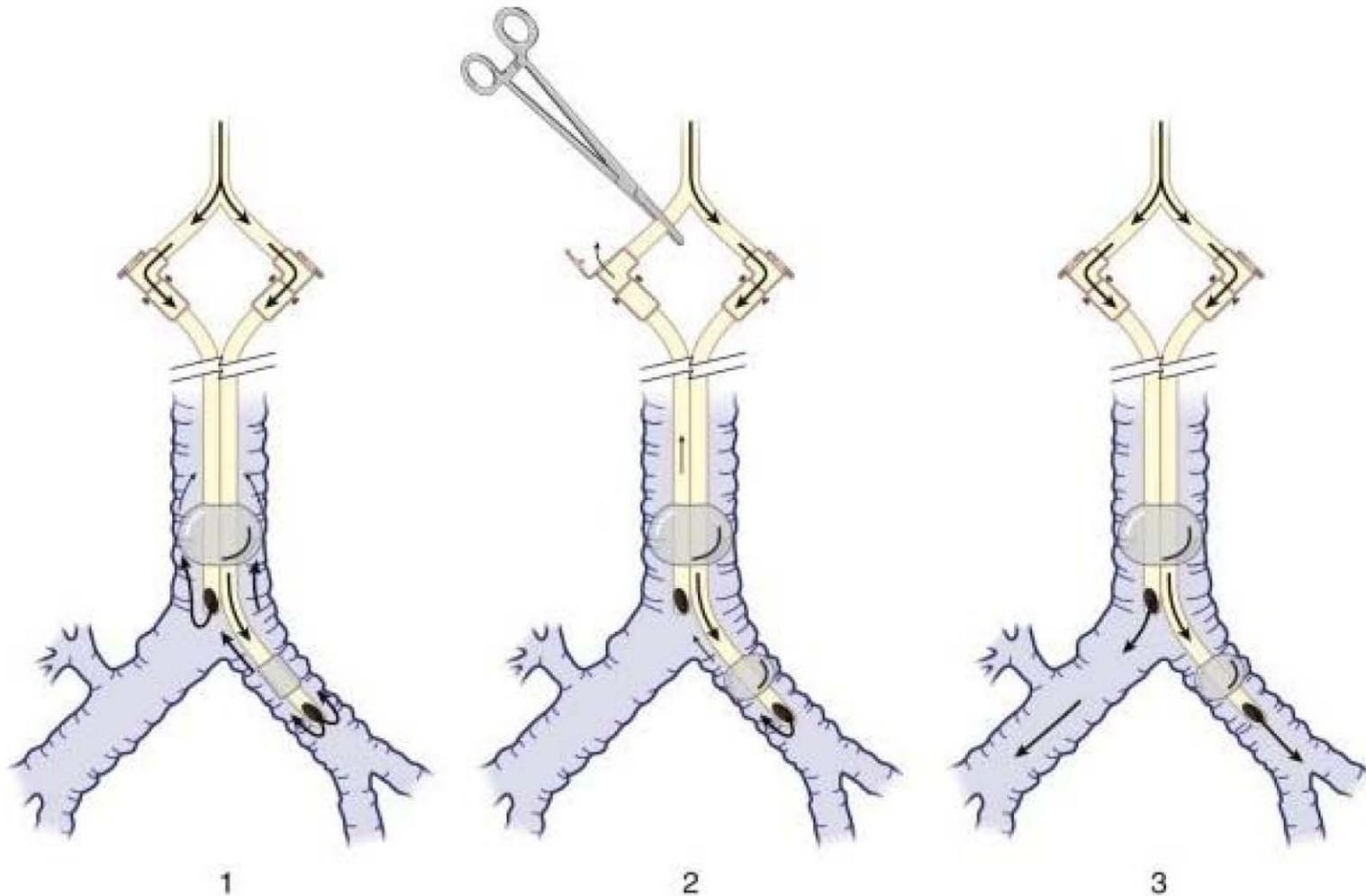
For females < 152 cm → consider 32 Fr.
For males <160 cm → consider 37 Fr.

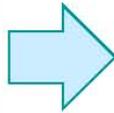
Depth (for a properly positioned DLT) = $12 + (\text{Height}/10)$ cm

Methods of Insertion DLT



"three-step" method to confirm position of a left DLT by auscultation



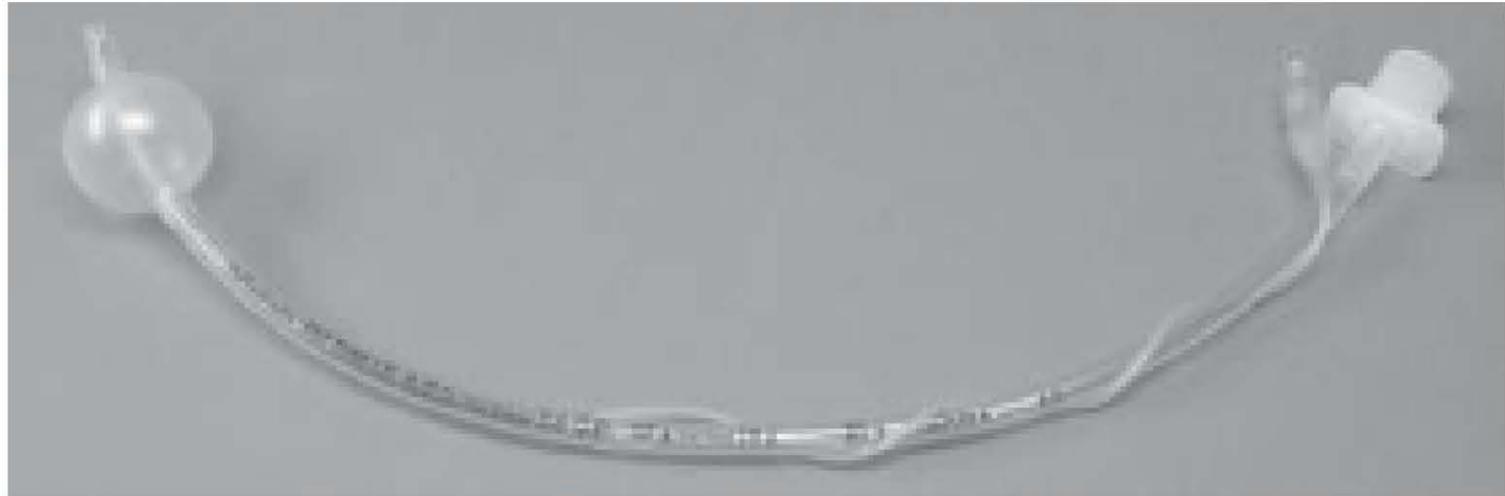


Laser tubes

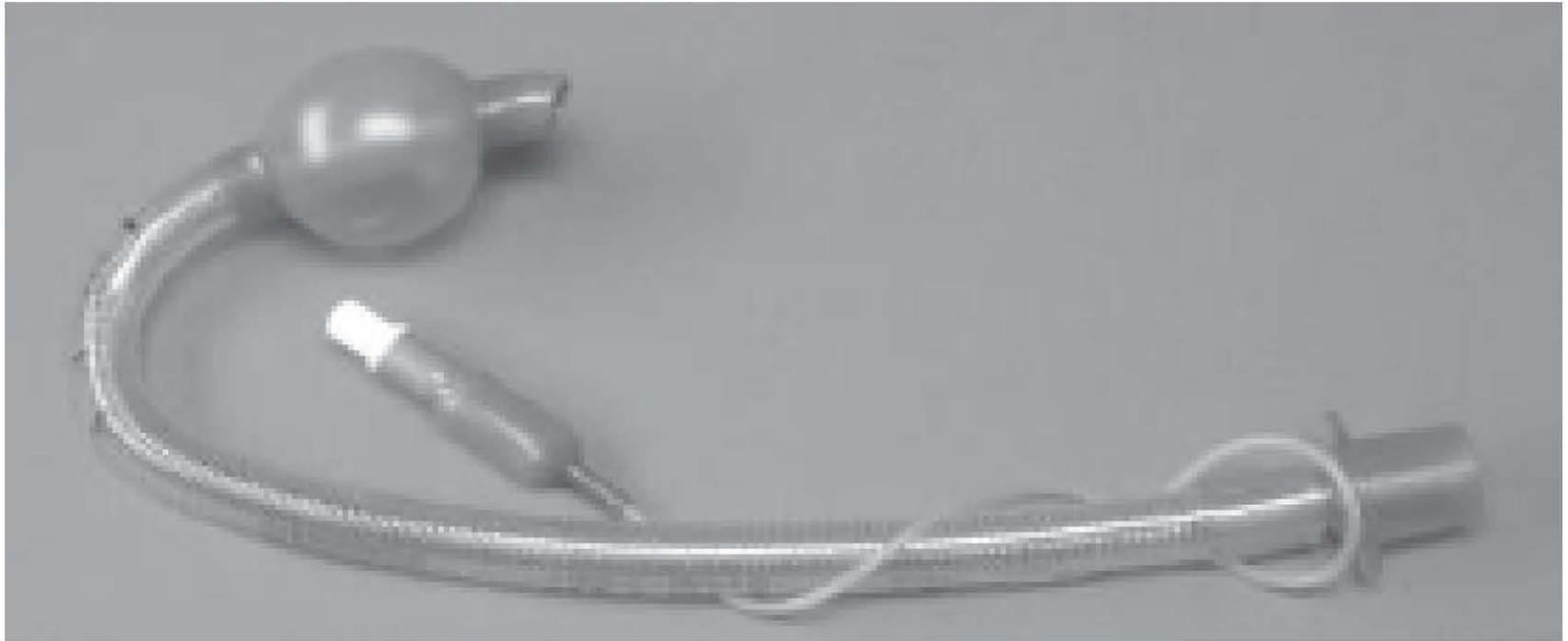


Ian Calder, Core topics in airway management, 1 st ed, 2005.

Microlaryngeal tube



Laryngectomy tube

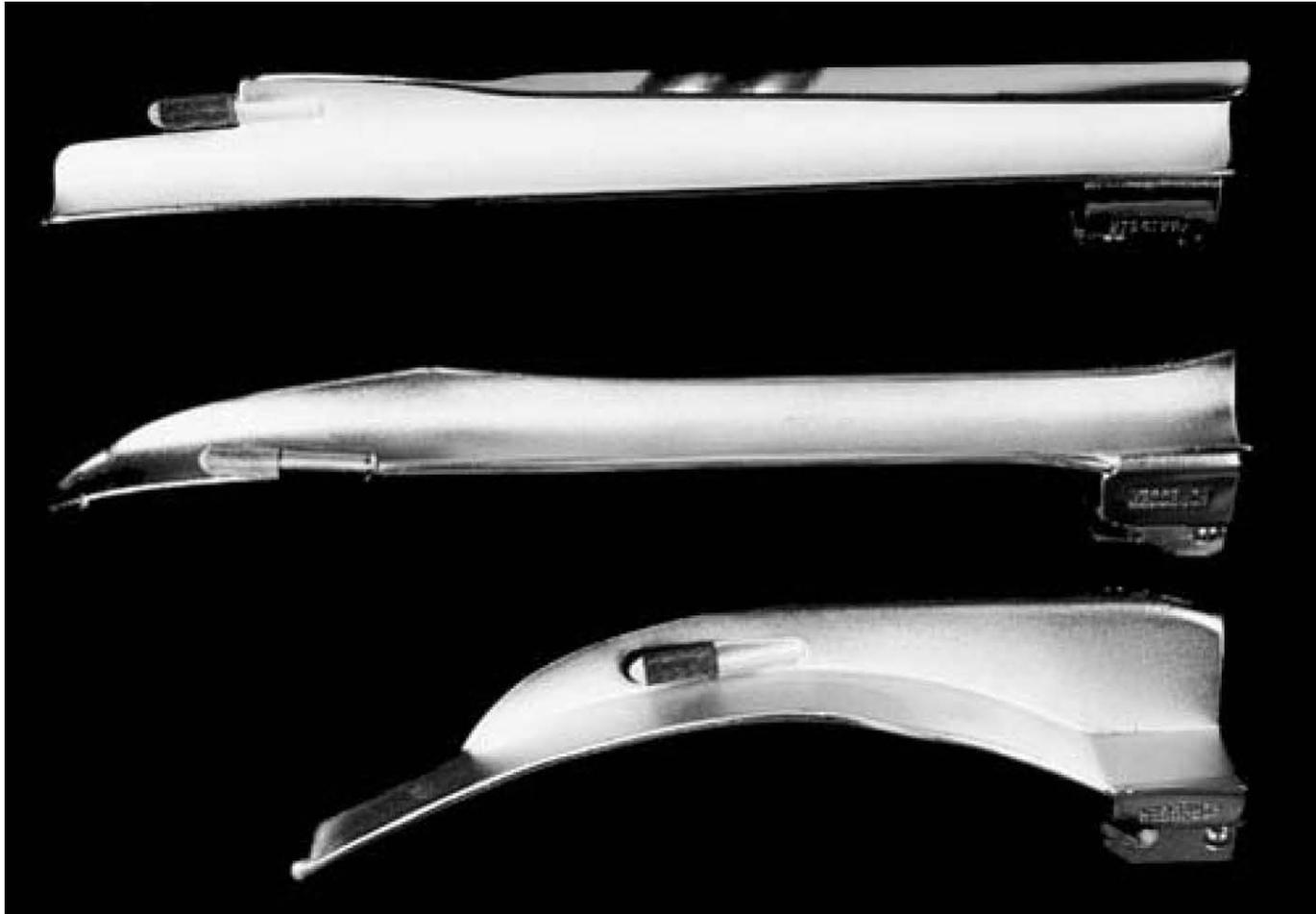


Microcuff endotracheal tube



Ronald D. Miller, *Airway management, Anesthesia*, 7 th ed, 2009.

LARYNGOSCOPIC BLADE



Oxyscope



Laryngoscope Blade

□ Blade ชนิดตรง (Miller)

- : วางปลาย **blade** ใต้ต่อ **epiglottis**
- : นิยมใช้ในเด็กเล็ก

□ Blade ชนิดโค้ง (Macintosh)

- : วางปลาย **blade** บริเวณ **vallecular** หน้าที่ต่อ **epiglottis**
- : นิยมใช้ในผู้ใหญ่

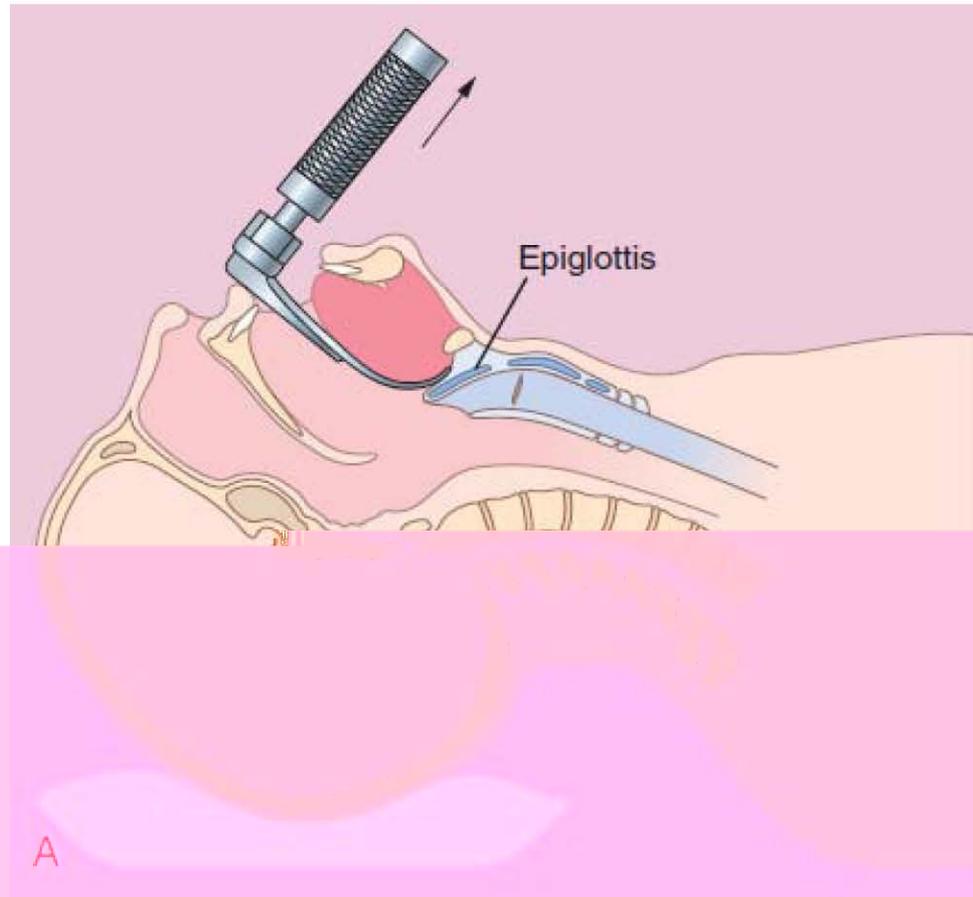
Macintosh blade



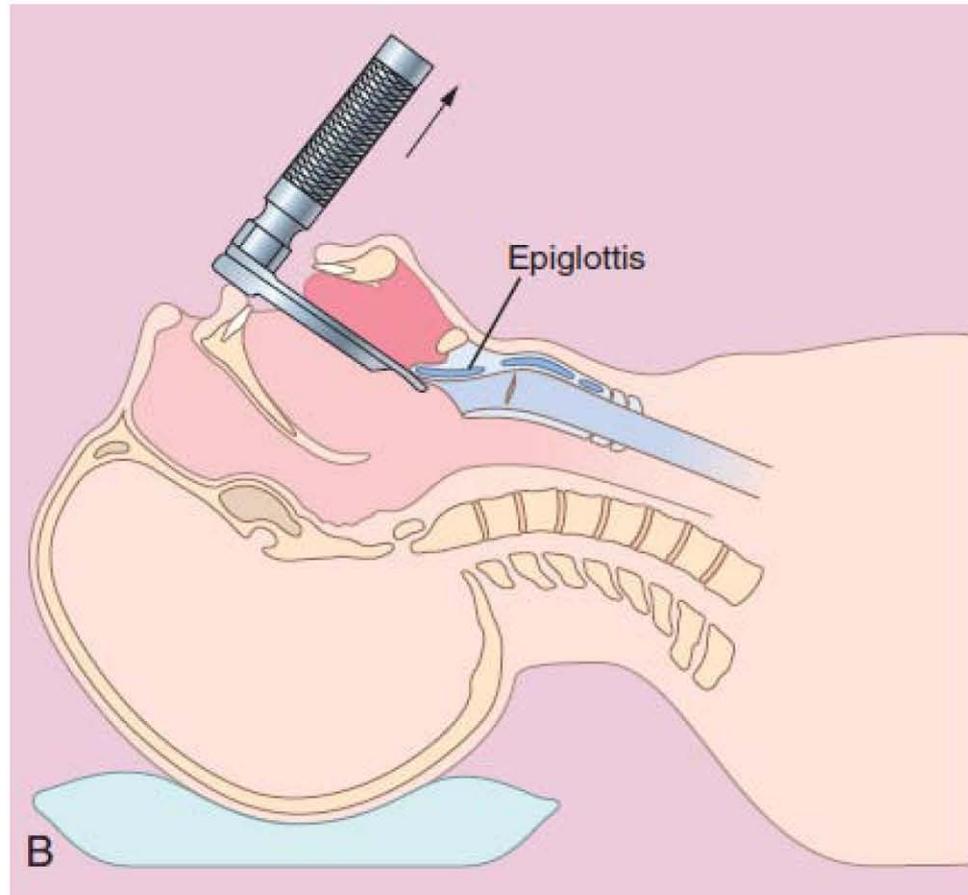
Miller blade

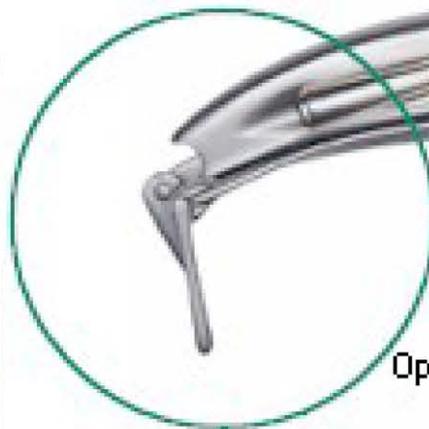
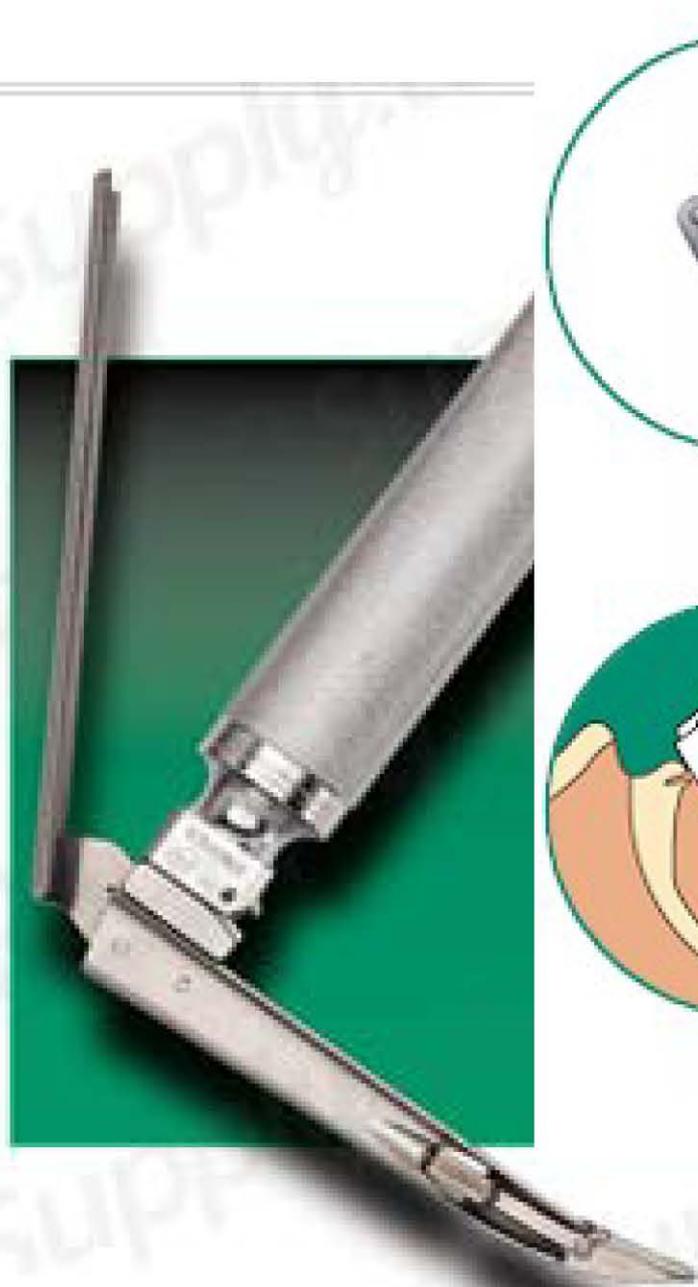


ENDOTRACHEAL INTUBATION



ENDOTRACHEAL INTUBATION





2960.175.20
Optima Eclipse VM Macintosh
Tilting Tip Blade
Adult No.3 (130x18mm)

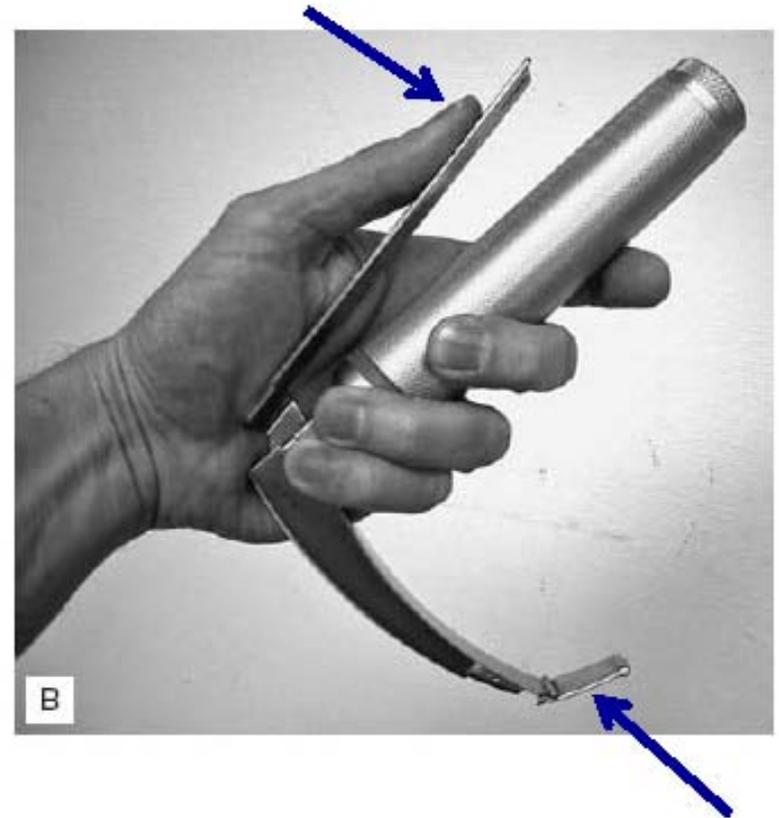


- Tilting tip for elevation of the epiglottis
- Increased view of larynx
- Less force required to intubate
- Unique design
- Less risk of patient trauma
- Ideal for difficult intubations

McCoy laryngoscope

McCooy blade

ใช้กระดูกตรงปลายเพื่อช่วยยก epiglottis



Video Laryngoscope



Video Laryngoscope



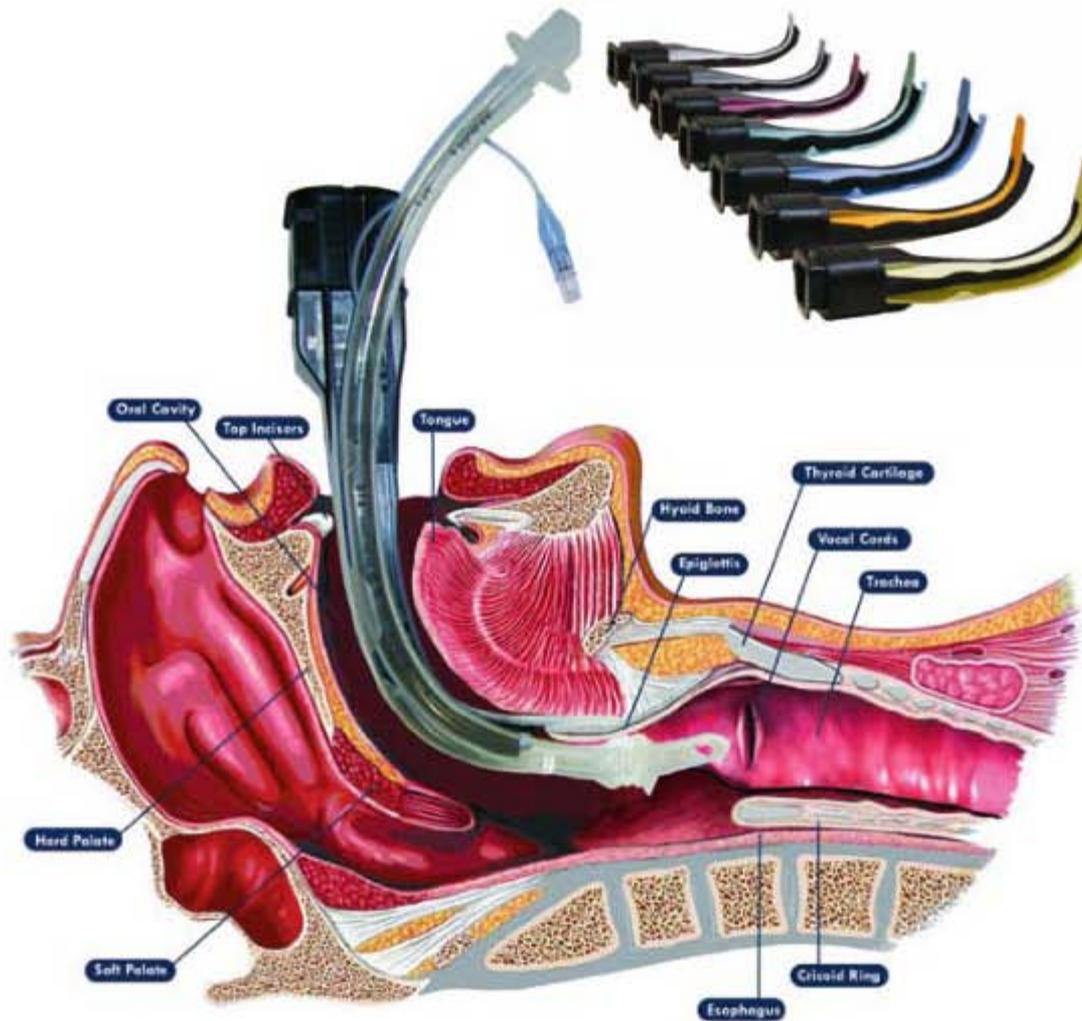
Videolaryngoscopy



GlideScope



Airtraq

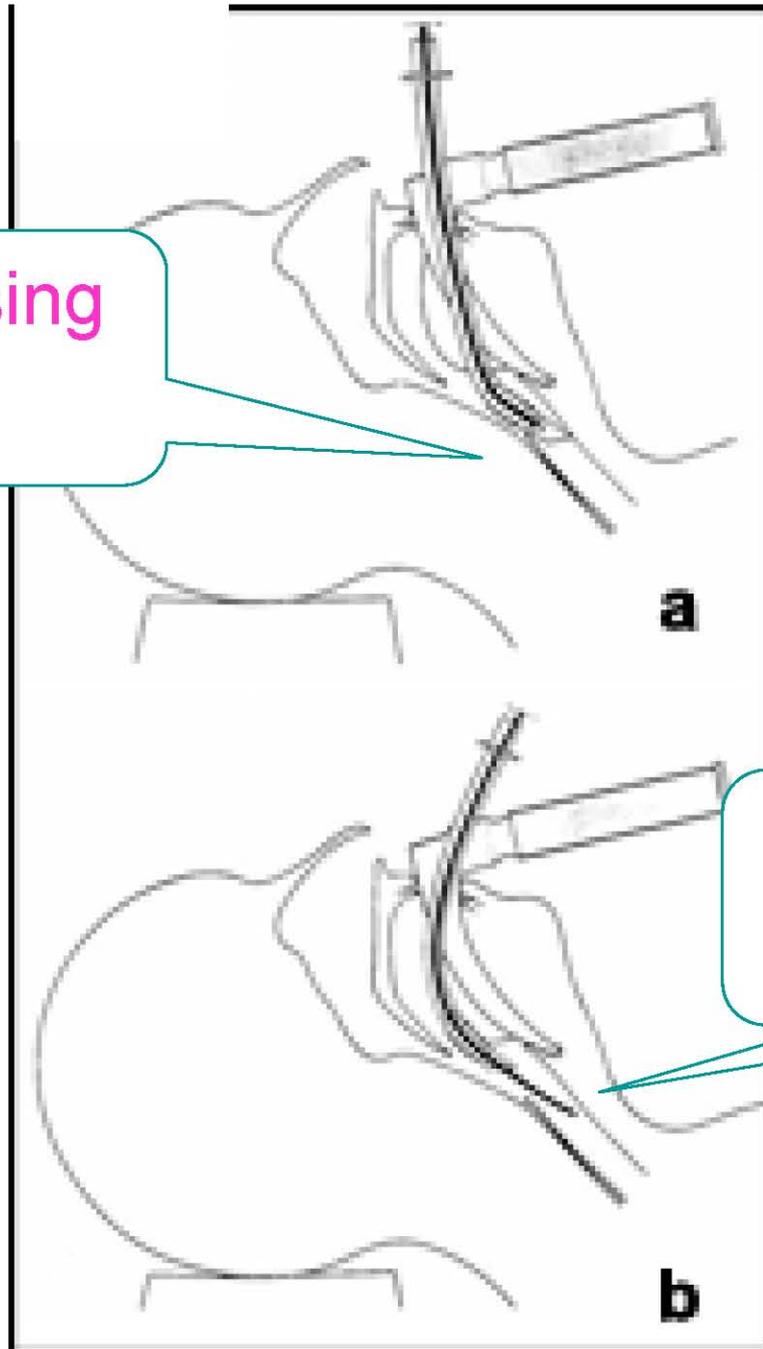


Airtraq intubation

- ✓ Fully Disposable
- ✓ Portable, All-In-One
- ✓ Ready to use

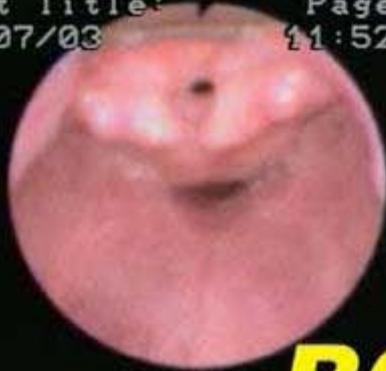


Intubation using
stylet



Intubation using
a bougie

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BOUGIE

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Frova



Portex intracuff pressure monitor



Confirming ETT Location

■ Fail Safe (Gold standard)

◆ Direct visualization ;

- ETT visualized between cord
- Fiberoptic visualized cartilaginous rings of trachea

◆ Continuous CO_2 monitoring or capnometry

- Must have at least 3 continuous readings without declining CO_2

■ Near Fail Safe

◆ CO_2 detection



◆ Rapid inflation of Esophageal detection device (EDD)

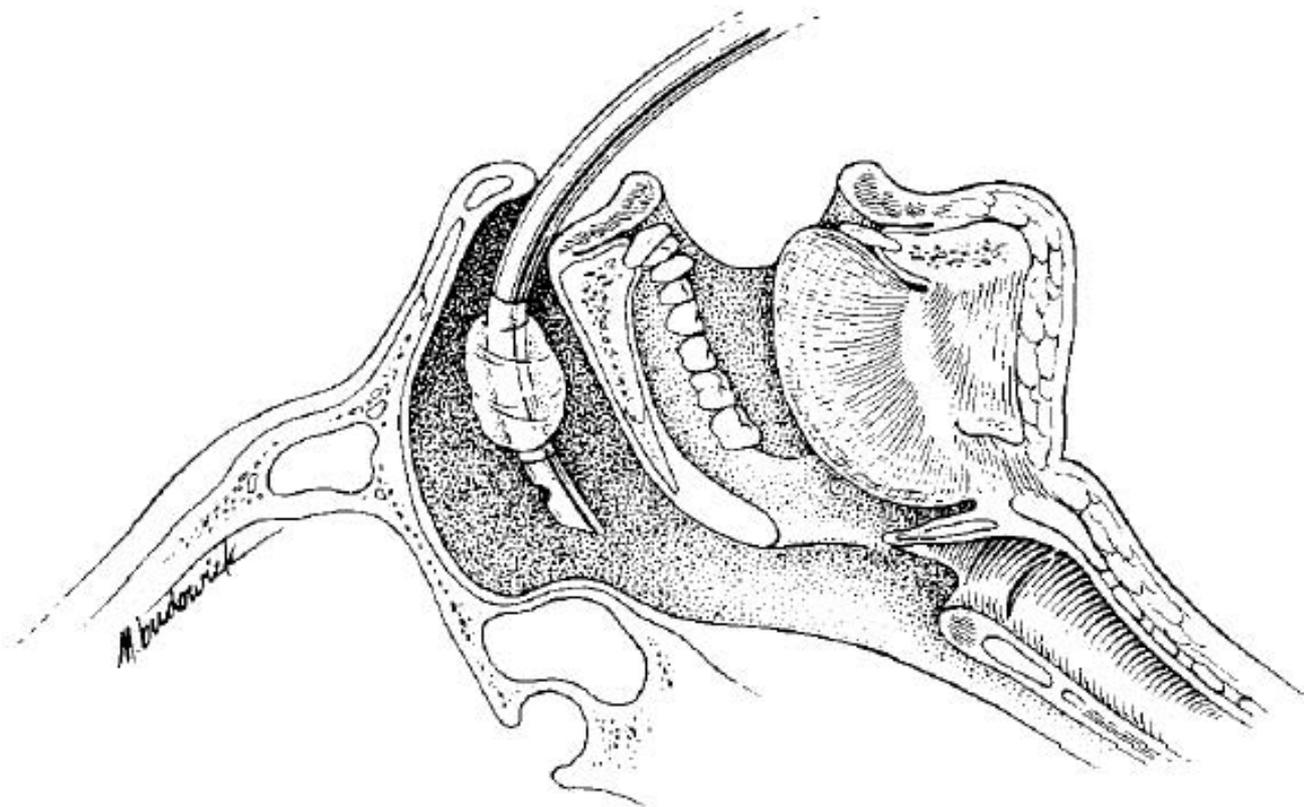
■ Non-Fail Safe

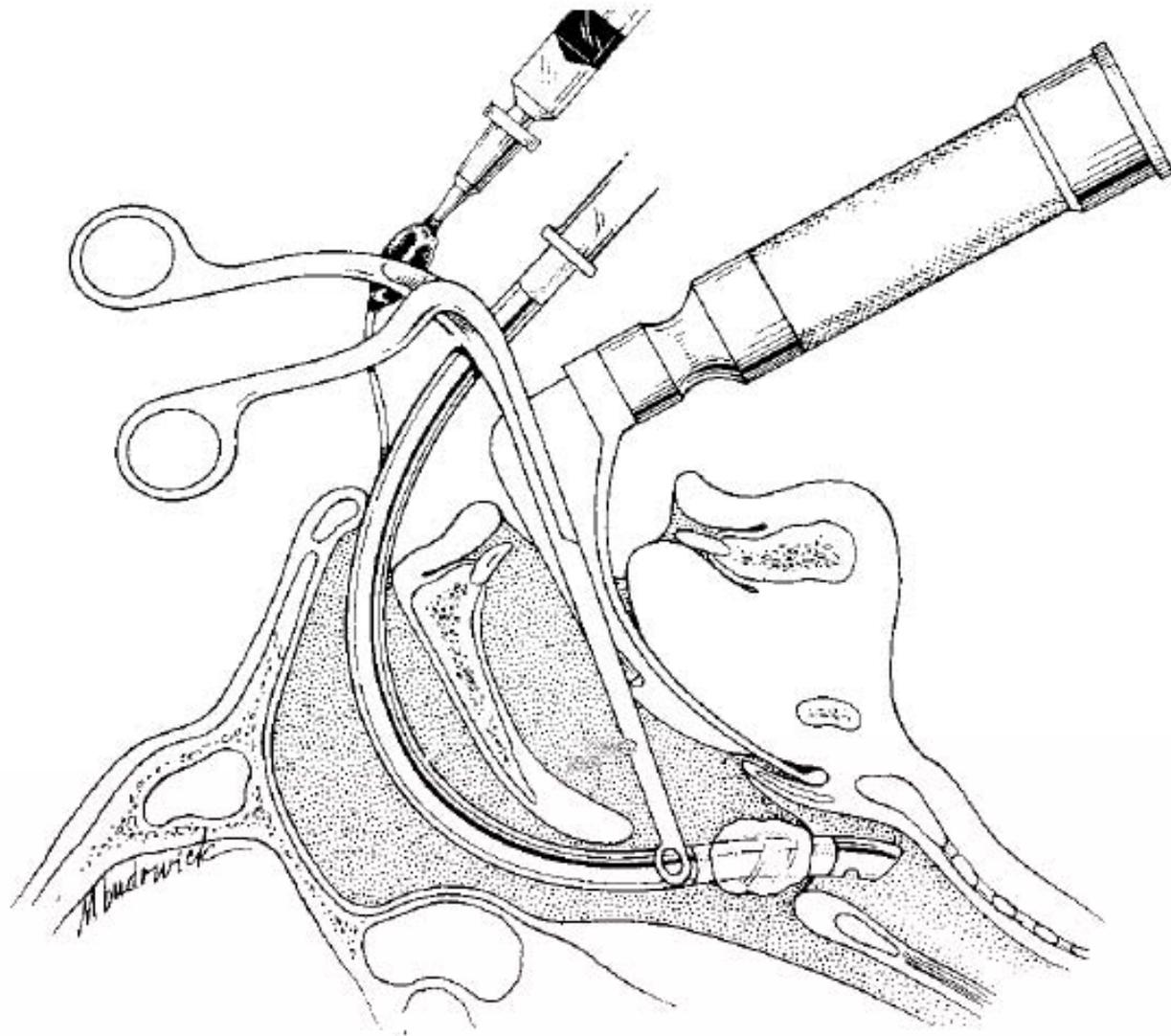


Non-Fail safe

- Presence of breath sounds
 - Absence of epigastric sounds
 - Absence of gastric distention
 - Chest Rise & Fall
 - Large Spontaneous Exhaled Tidal Volumes
-
- Condensation in tube disappearing & reappearing with respiration
 - Air exiting tube with chest compression
 - Bag Valve Mask having the appropriate compliance
 - Pressure on suprasternal notch associated with pilot balloon pressure

Nasotracheal intubation





Nasotracheal intubation with Magill forceps

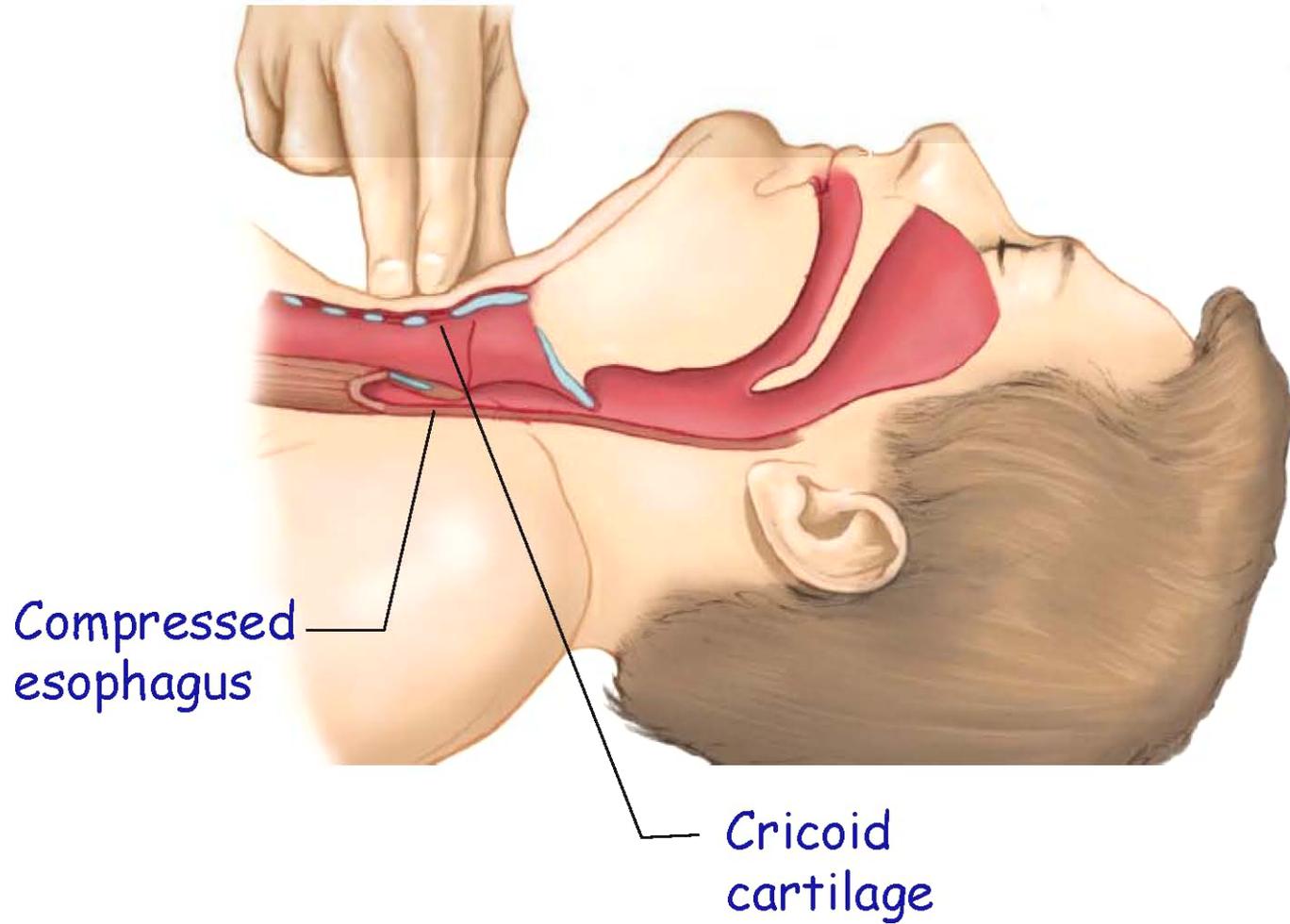
Flexion of cervical spine facilitates nasotracheal intubation



Awake intubation



Sellick maneuver



Indications for Awake Intubation

- Risk for aspiration
- May be difficult mask ventilation

Airway Techniques

That Can Be Performed Under Topical Anesthesia in an Awake Patient

"Supraglottic airway device insertion

Direct laryngoscopy and intubation

Blind nasal intubation

Retrograde intubation

Flexible fiberoptic laryngoscopy and intubation

Rigid indirect optical devices and intubation

Tracheotomy/Cricothyrotomy"

Techniques of Airway Anesthesia

Nebulizers—entire airway

Topical sprays and gels—upper airway

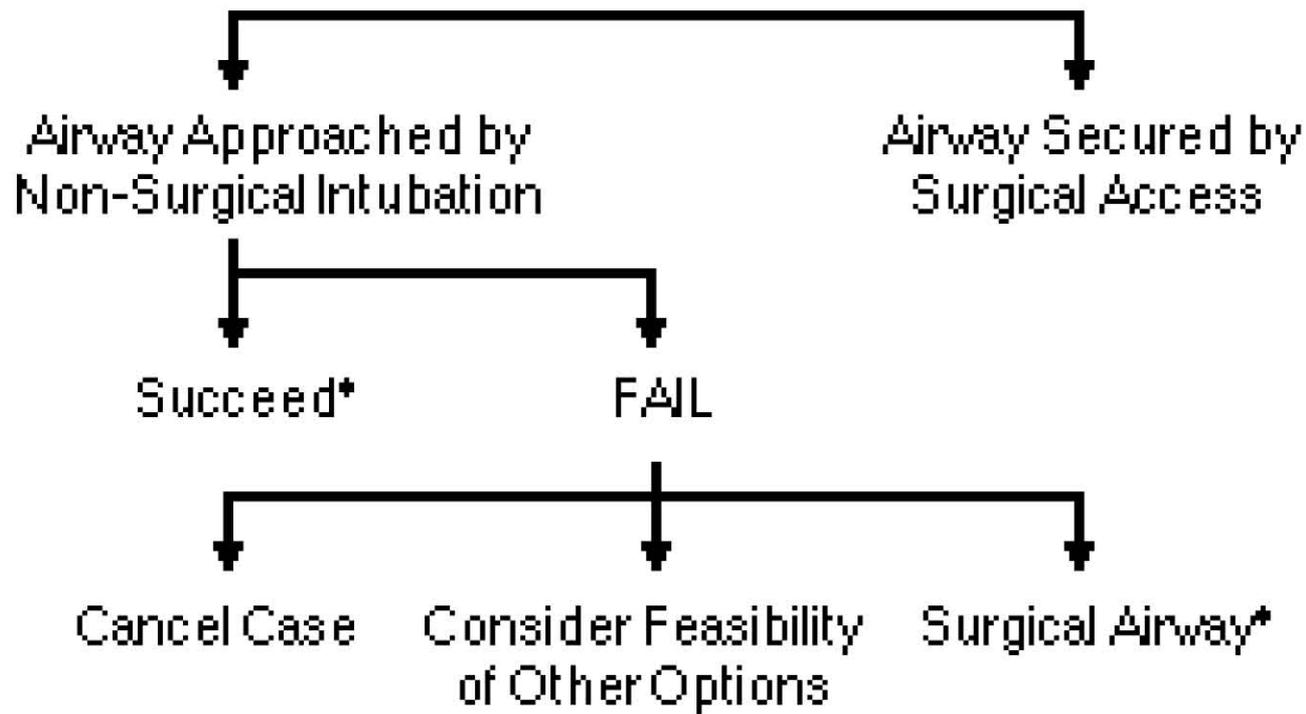
Transtracheal injection—larynx and trachea

“Spray as you go”—larynx and trachea

Nerve blocks—distribution of the nerve supply

Combinations of the above

AWAKE INTUBATION



***Confirm intubation with exhaled CO₂.**

High flow O2 mask with bag

Induction & Succinyl & Cricoid Pressure

Intubation

Inflating cuff

Breath sound checking

Off Cricoid pressure



0

3

Rapid Sequence Induction with Cricoid pressure

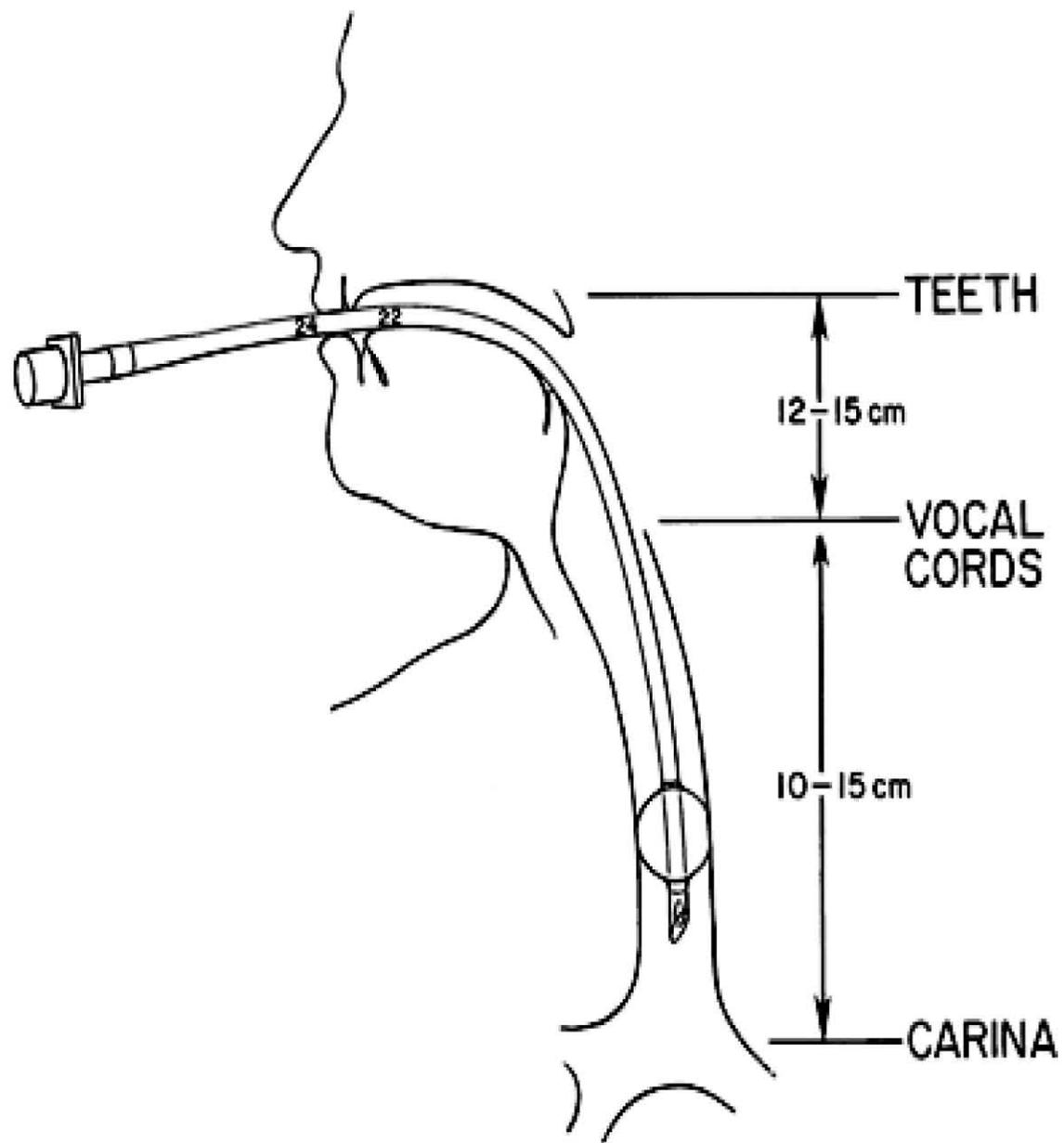
7 Steps to a Successful RSI

RSI 7 p's:

- ◆ Preparation
- ◆ Preoxygenate
- ◆ Pretreatment
- ◆ Paralysis
- ◆ Protection
- ◆ Placement
- ◆ Post intubation management

Topical local anesthetic agent





ภาวะแทรกซ้อนจากการใส่ท่อช่วยหายใจ

- Hypoxemia
- Hypercarbia
- Aspiration
- ใส่ท่อช่วยหายใจเข้าหลอดอาหาร (Esophageal intubation)
- ใส่ท่อช่วยหายใจเข้าปอดขวา (Endobronchial intubation)
- หัวใจเต้นผิดจังหวะ
- เพิ่มความดันในกระโหลกศีรษะ
- อันตรายต่อฟันเช่น โยก หัก
- Hypertension
- Arytenoid cartilage displacement
- อันตรายต่อ C spine injury มากขึ้น



Complications of Tracheal Intubation

During Direct Laryngoscopy and Tracheal Intubation

Dental and oral soft tissue trauma
Systemic hypertension and tachycardia
Cardiac dysrhythmias
Myocardial ischemia
Inhalation (aspiration) of gastric contents

While the Tracheal Tube Is in Place

Tracheal tube obstruction
Endobronchial intubation
Esophageal intubation
Tracheal tube cuff leak
Pulmonary barotrauma

Neurogastric distention

Accidental disconnection from the anesthesia breathing circuit
Tracheal mucosa ischemia
Accidental extubation

Immediate and Delayed Complications after Tracheal Extubation

Laryngospasm
Inhalation (aspiration) of gastric contents
Pharyngitis (sore throat)
Laryngitis
Laryngeal or subglottic edema
Laryngeal ulceration with or without granuloma formation
Tracheitis
Tracheal stenosis
Vocal cord paralysis
Arytenoid cartilage dislocation

Risk factors for difficult intubation

Risk factor	LG	Sensitivity (%)	Specificity (%)
Mouth opening <4 cm	≥III	26.3	94.8
	IV	46.7	93.9
Thyromental distance <6.0 cm	≥III	7.0	99.2
	IV	16.8	99.0
Mallampati class III	≥III	44.7	89.0
	IV	59.8	87.4
Neck movement <80°	≥III	10.4	98.4
	IV	16.8	97.9
Inability to prognath	≥III	16.5	95.8
	IV	26.2	95.3
Body weight >110 kg	≥III	11.1	94.6
	IV	13.1	94.3
Positive history of difficult intubation	≥III	4.5	99.8
	IV	9.3	99.7

Difficult Airway Algorithm

1. Assess the likelihood and clinical impact of basic management problems.
 - A. Difficult ventilation
 - B. Difficult intubation
 - C. Difficulty with patient cooperation or consent
 - D. Difficult tracheostomy
2. Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management.
3. Consider the relative merits and feasibility of basic management choices:

A.

Awake intubation

vs.

Intubation attempts after induction of general anesthesia

B.

Noninvasive technique for initial approach to intubation

vs.

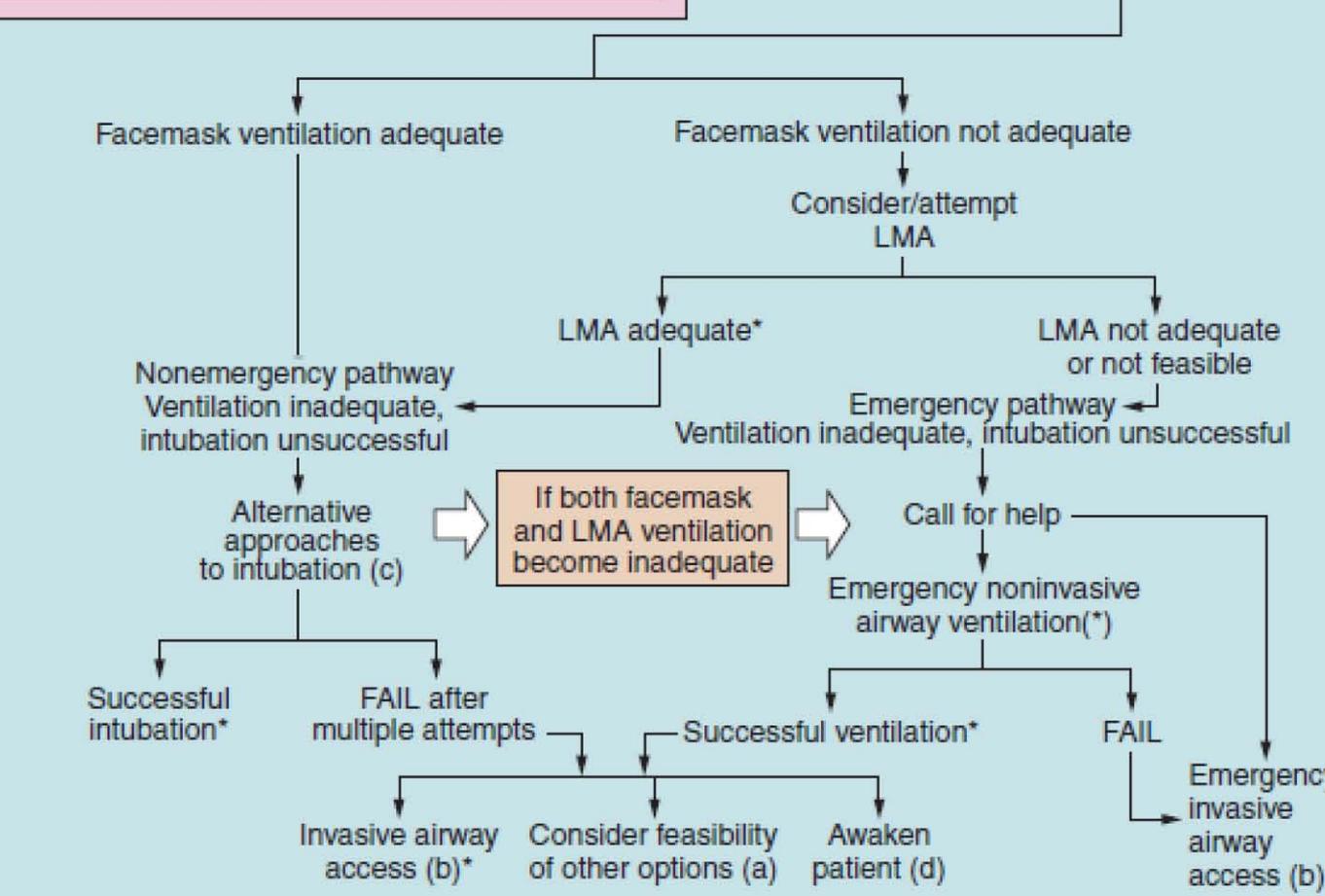
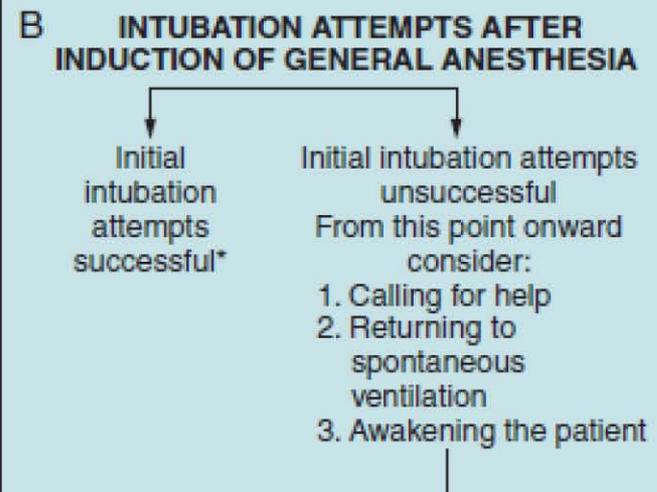
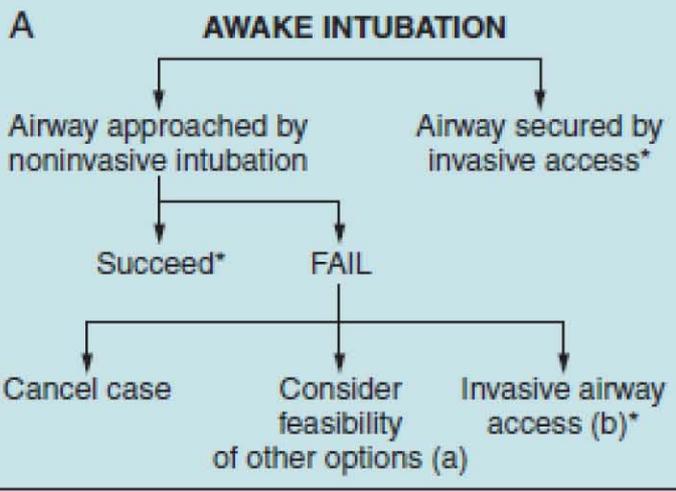
Invasive technique for initial approach to intubation

C.

Preservation of spontaneous ventilation

vs.

Ablation of spontaneous ventilation



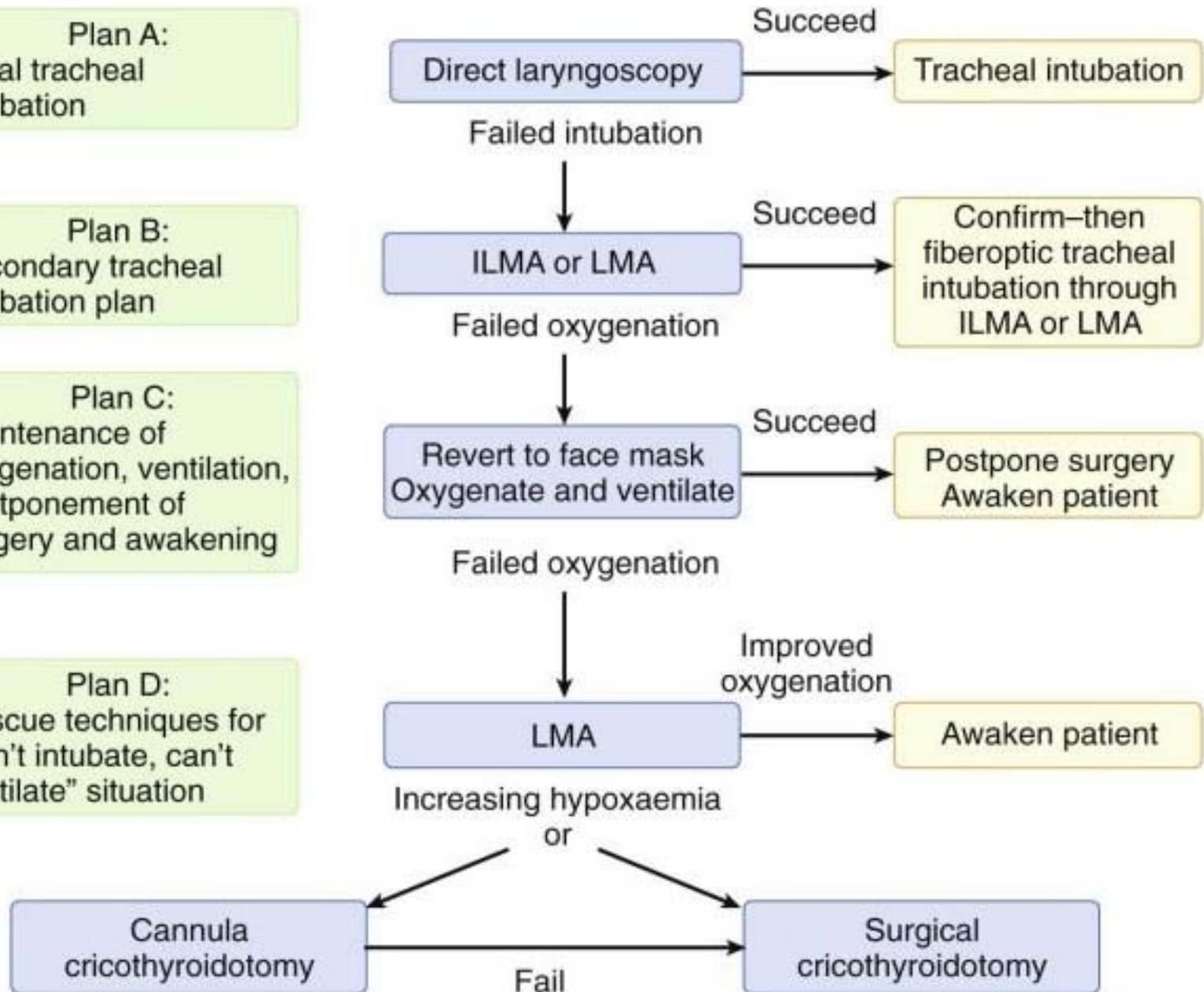
Basic algorithm of the Difficult Airway Society (DAS) guidelines

Plan A:
Initial tracheal intubation

Plan B:
Secondary tracheal intubation plan

Plan C:
Maintenance of oxygenation, ventilation, postponement of surgery and awakening

Plan D:
Rescue techniques for "can't intubate, can't ventilate" situation



Airway Management A-B-C

Start with Plan **A**

If plan A fails-

Go to plan **B**

If plan B fails-

Go to plan **C**

Plan “A”: (ALTERNATE)

- Different Length of blade
- Different Type of Blade
- Different Position
- Different Equipment

Plan “B”: (BVM & Blind Intubation Techniques)

- Mask Ventilation
- Bougie
- Combi-Tube?
- LMA an Option?
- Fiberoptic?

Plan-C : Can't Intubate.. Can't Ventilate

- Needle Cricothyrotomy
- Transtracheal Jet Ventilation
- Retrograde Wire Intubation

Techniques for Difficult Airway Management

Techniques for Difficult Intubation

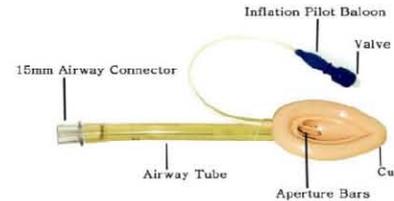
Alternative laryngoscope blades
Awake intubation
Blind intubation (oral or nasal)
Fiberoptic intubation
Intubating stylet or tube changer
Laryngeal mask airway as an intubating conduit
Light wand
Retrograde intubation
Invasive airway access

Techniques for Difficult Ventilation

Esophageal tracheal Combitube
Intratracheal jet stylet
Laryngeal mask airway
Oral and nasopharyngeal airways
Rigid ventilating bronchoscope
Invasive airway access
Transtracheal jet ventilation
Two-person mask ventilation

Supraglottic airway

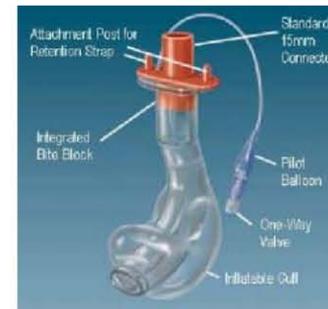
- Laryngeal mask airway



- i-gel



- COPA (Cuffed Oropharyngeal Airway)



- Combitube



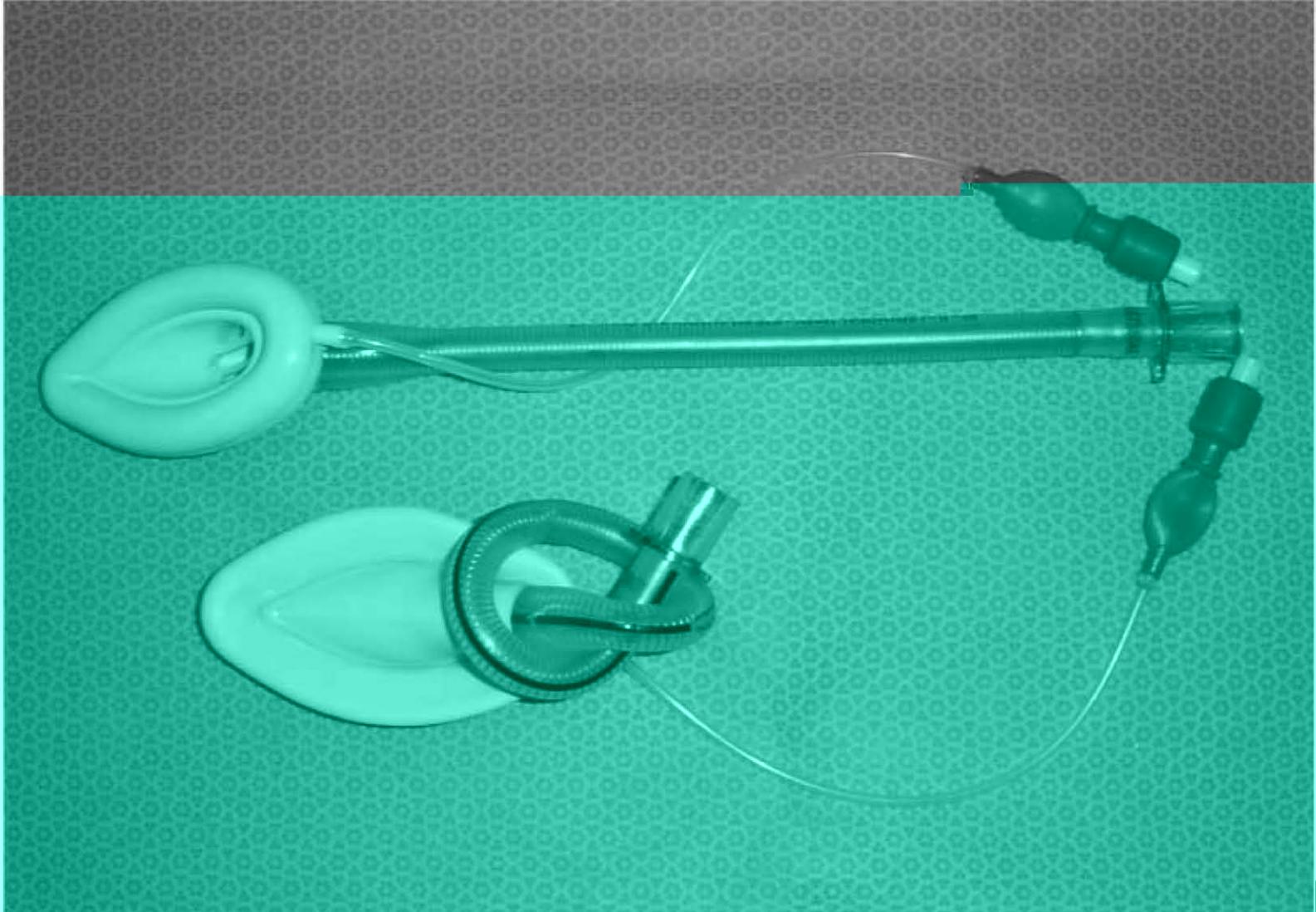
- Laryngeal Tube Airway



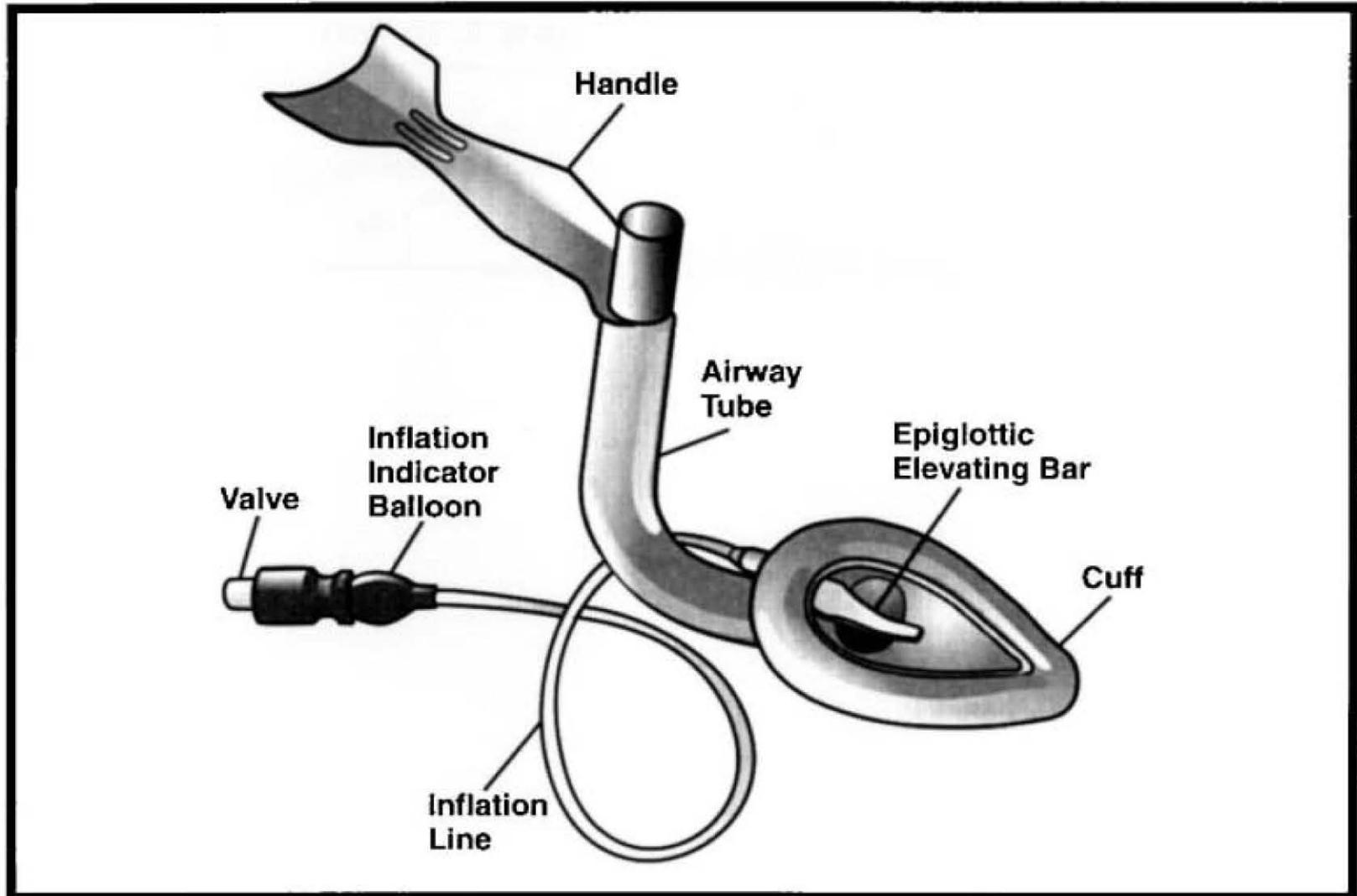
LMAs

- LMA-Flexible
- LMA-Fastrach
- LMA-Proseal
- LMA

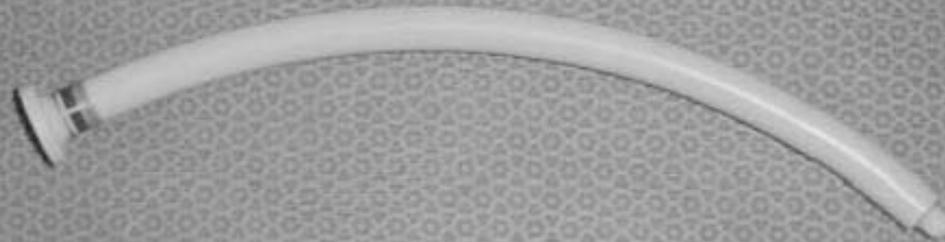
LMA-Flexible



LMA-Fastrach



endotracheal tube



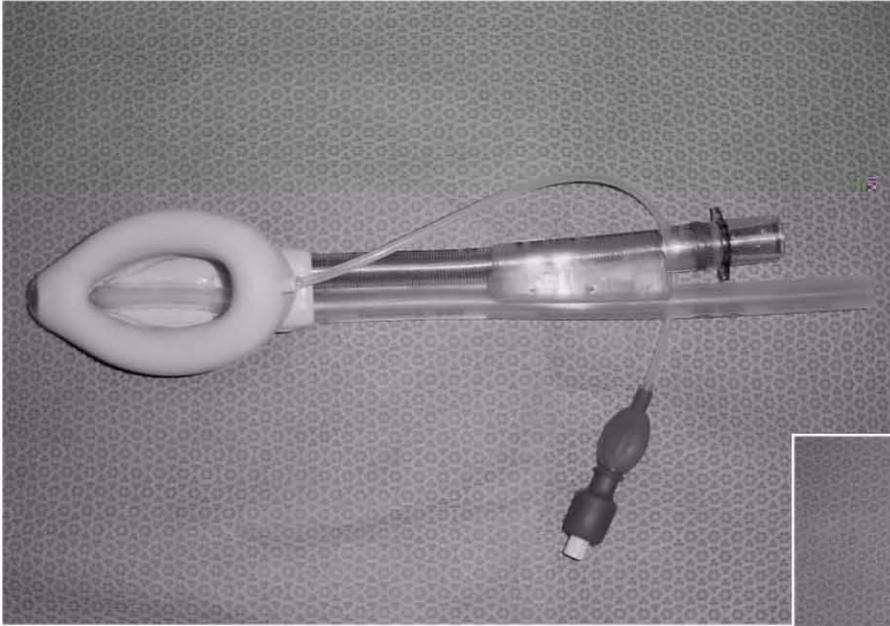
stabilizing rod



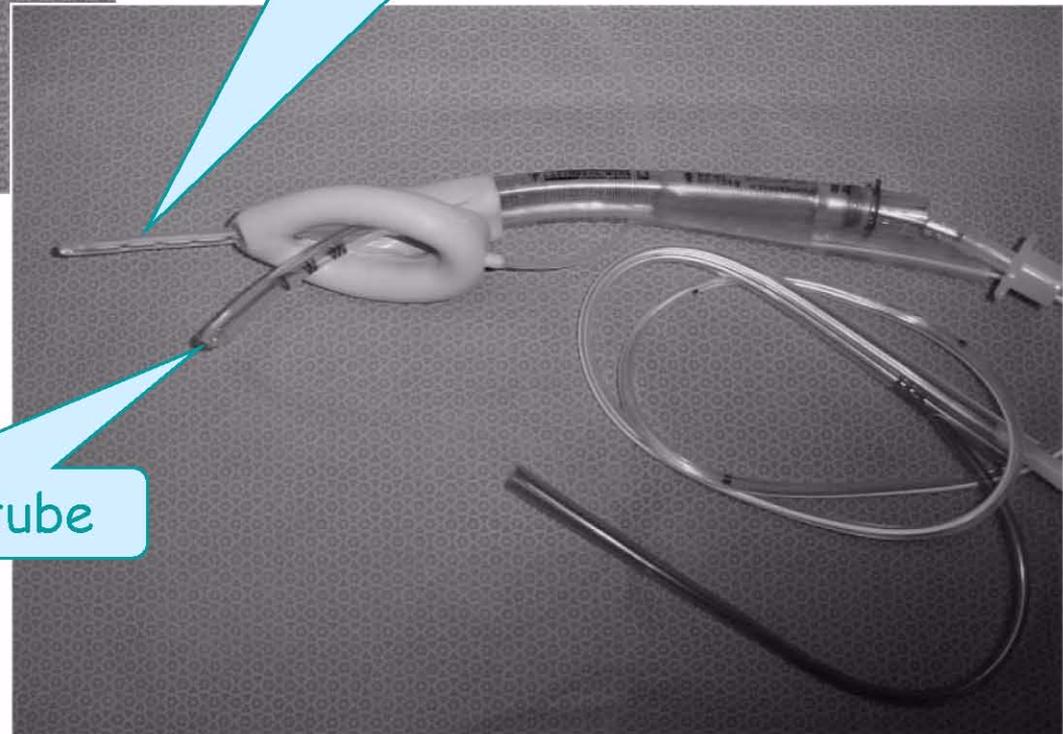
LMA-Fastrach



LMA-Proseal

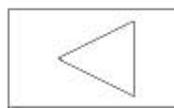


gastric sump tube

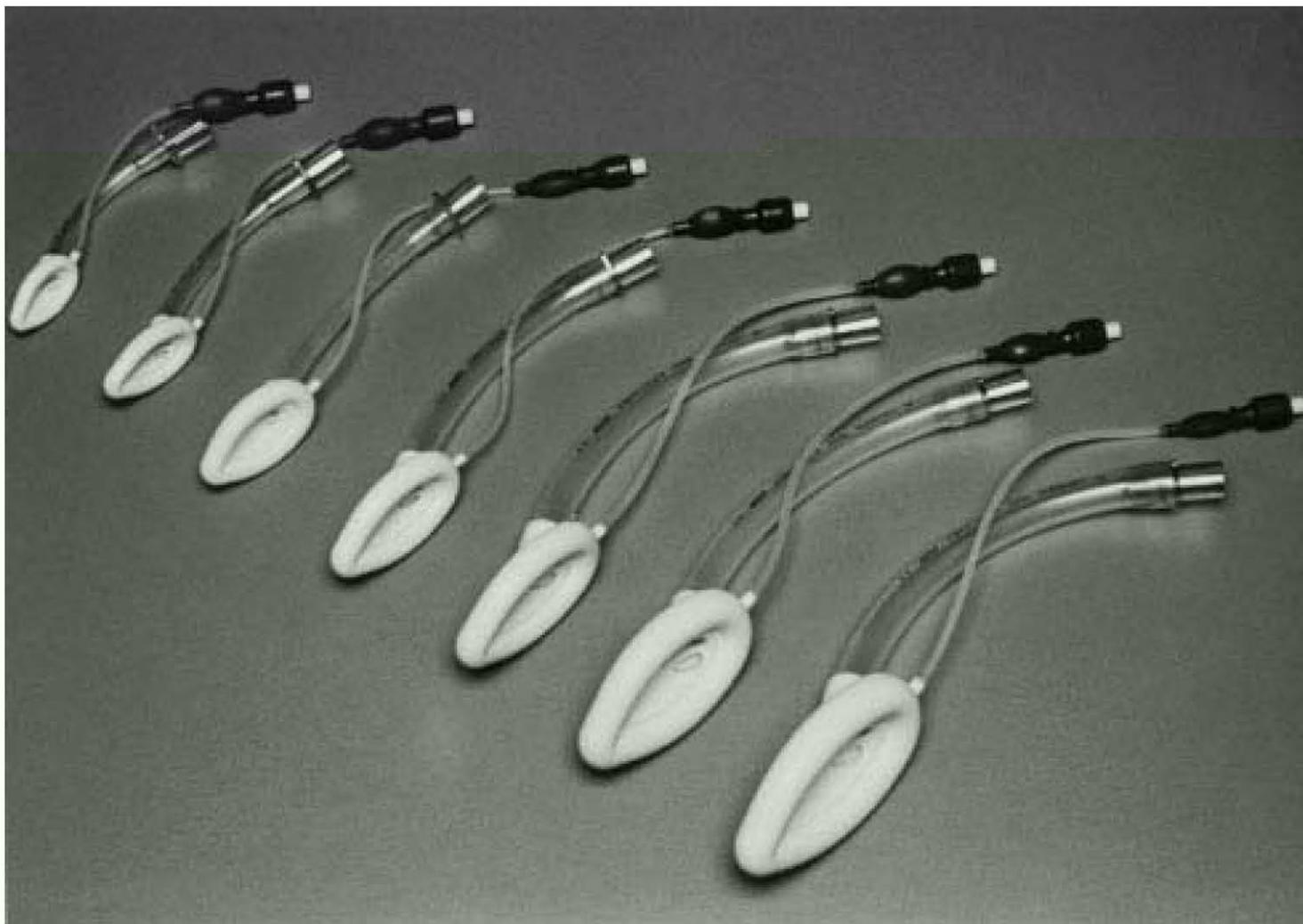


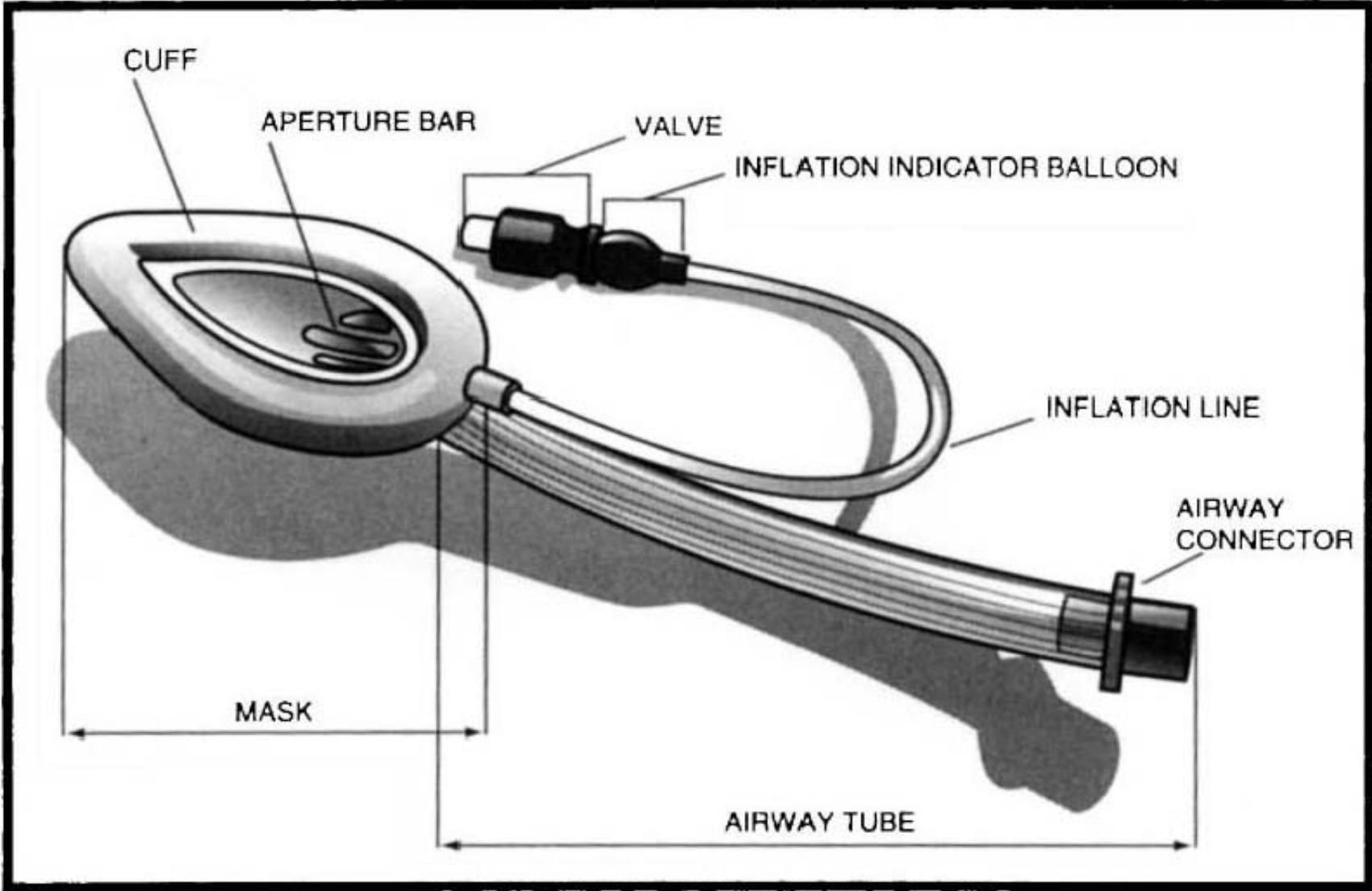
endotracheal tube

Proseal Size	Gastric Drain Salem Sump	Breathing Tube Internal Diameter	ETT Size (maximum)
#3 and #4	14–16 Fr	9.0 mm	5 mm uncuffed
#5	16–18 Fr	10.0 mm	5 mm cuffed



LMA



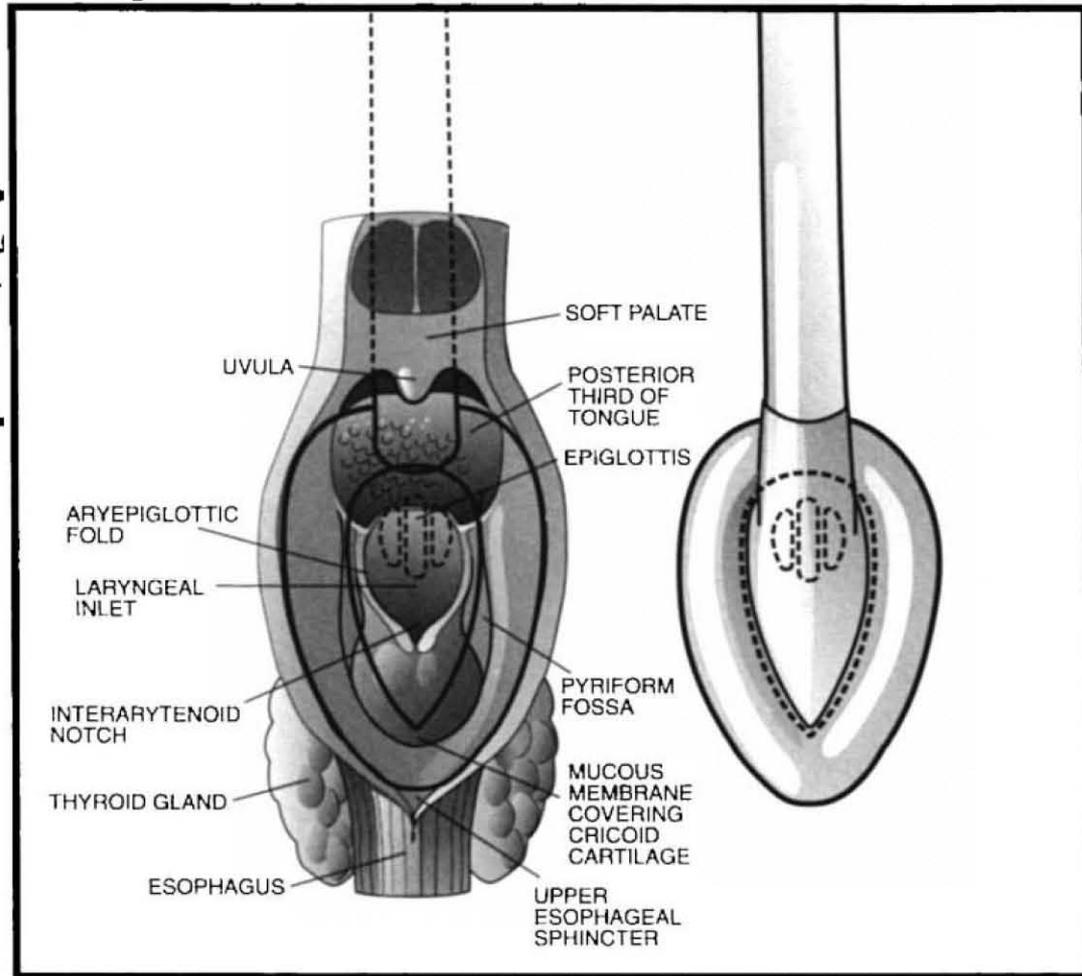
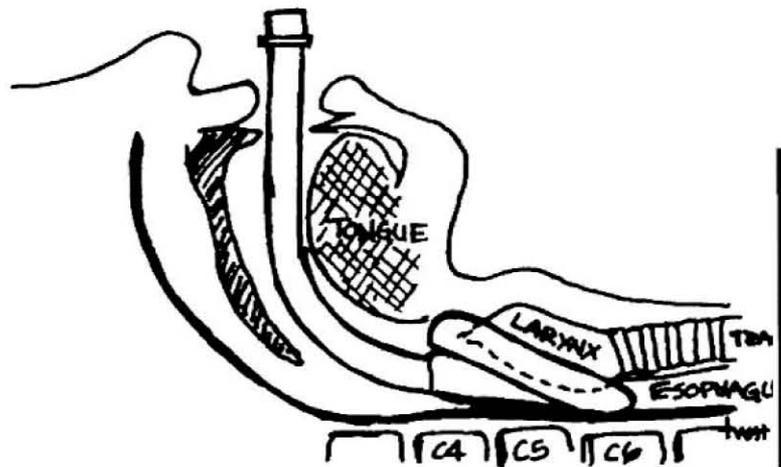


LMA Size & Patient Weight

LMA Size	Patient Weight (kg)	Cuff Volume (mL) (maximum recommended)
1	Up to 5	4
1.5	5–10	7
2	10–20	10
2.5	20–30	14
3	30–50	20
4	50–80 (female)	30
5	80 kg/>72" (male)	40
6	>100	50

LMA Size	LMA Tube Internal Diameter (mm)	LMA Tube Length (cm)	Maximum Cuff Volume (mL)	Largest ETT Internal Diameter (mm)	FOB Size (mm)
1	5.25	11.5	4	3.5	2.7
1.5	6.1	13.5	7	4	3
2	7	15.5	10	4.5	3.5
2.5	8.4	17.5	14	5	4
3	10	22	20	6 cuffed	5
4	10	22	30	6 cuffed	5
5	11.5	23.5	40	7 cuffed	5

End-to-end relationship of LMA to natural airway structures

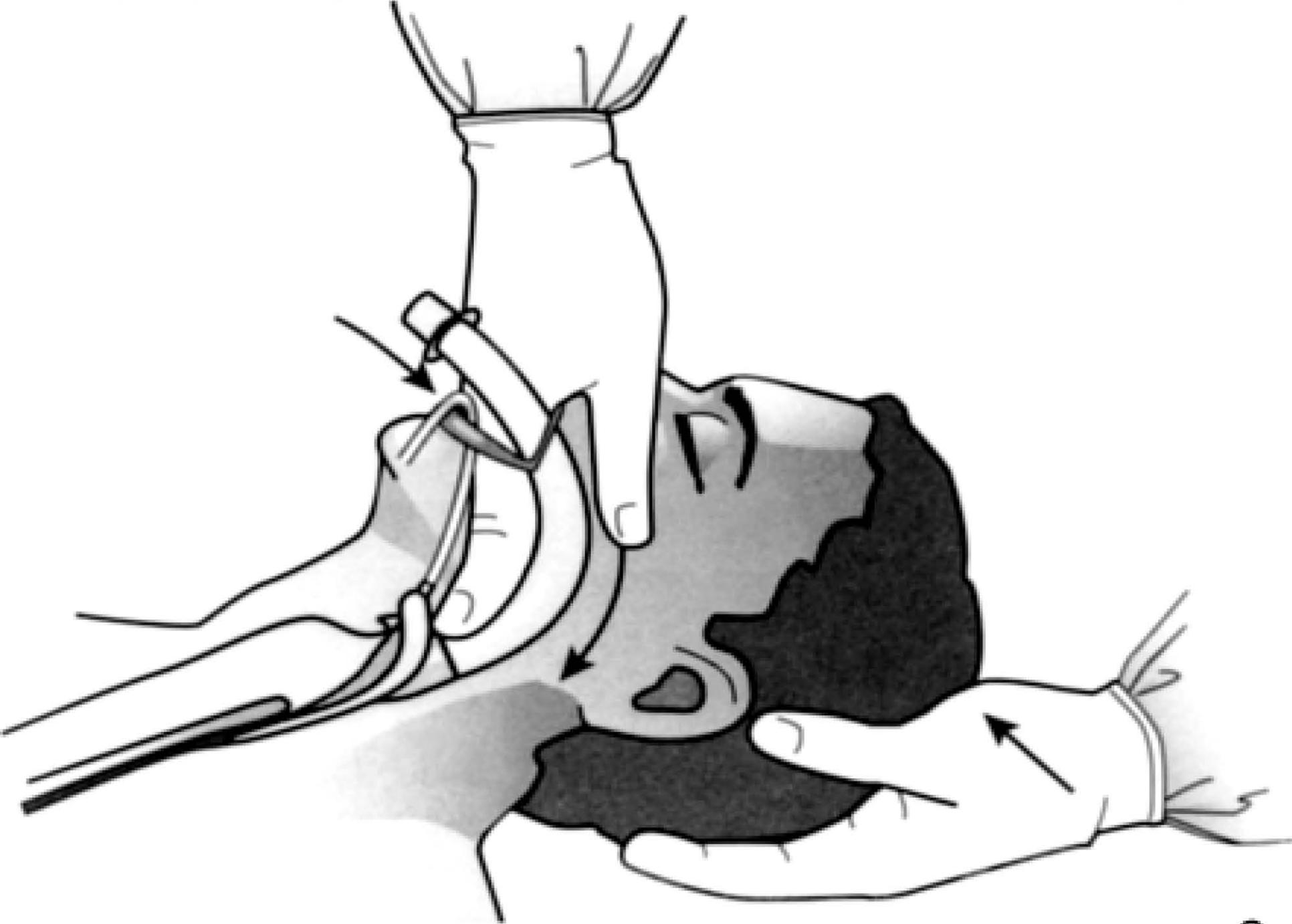


Contraindications LMA

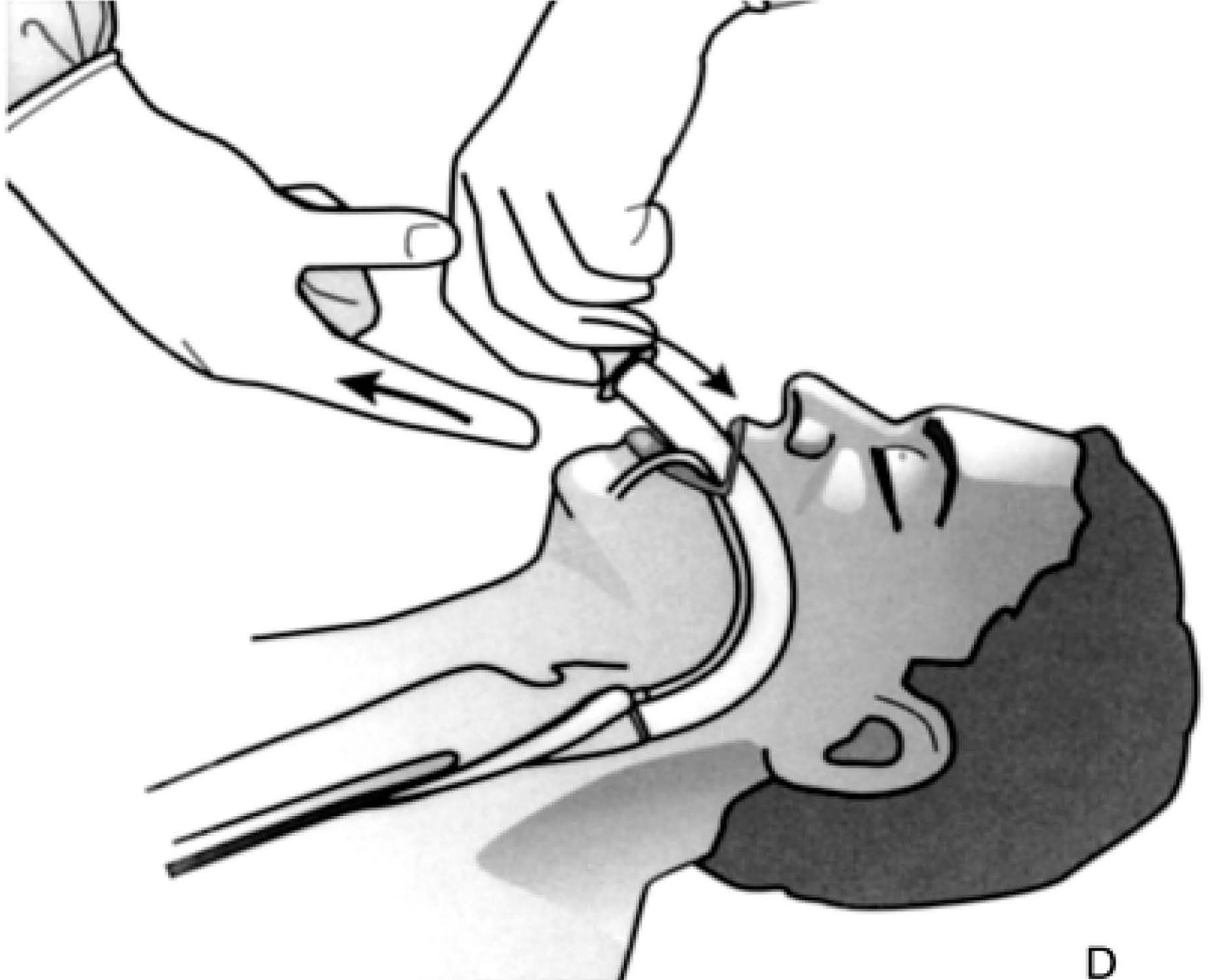
1. Risk of pulmonary aspiration of gastric contents (full stomach patient)
2. Hiatal hernia with significant GER
3. Morbid obesity
4. Intestinal obstruction
5. Delayed gastric emptying
6. Poor pulmonary compliance
7. Increased airway resistance
8. Glottic or subglottic airway obstruction
9. Limited mouth opening (<1.5 cm)



B



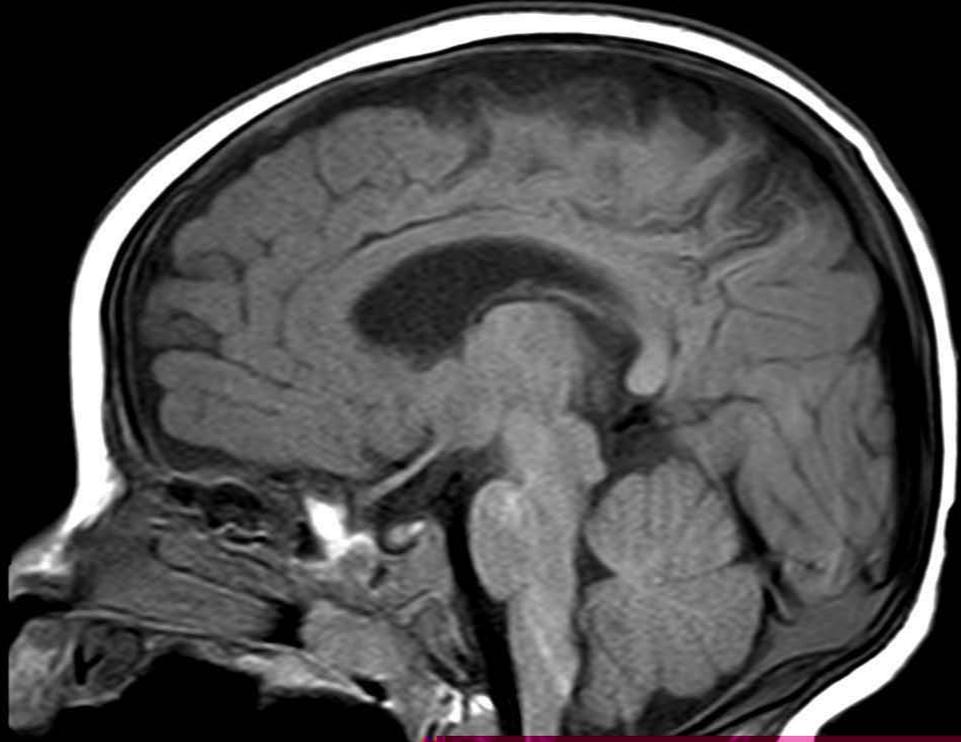
C



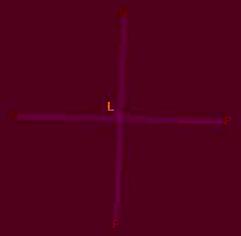
D

PANTHIRAK PHAKTHONG/5 Mo.
Sc 3.2/9
SE / SE/M [19]

Zoom 1.00



100.0cm



AP 7°
RL 2°
FH 5°
P 19 L 8 H 7

09:28:15
05-Jul-2011

20.0cm

Assessment of Function of the LMA

Observation of airway pressure and chest movement with a manual ventilation

Reservoir bag refill during expiration

Capnograph

Auscultation over the neck

Cuff leak pressure

Expired tidal volume and flow-volume loop

Examination with a flexible fiberoptic laryngoscope

การใส่ LMA-Fastrach









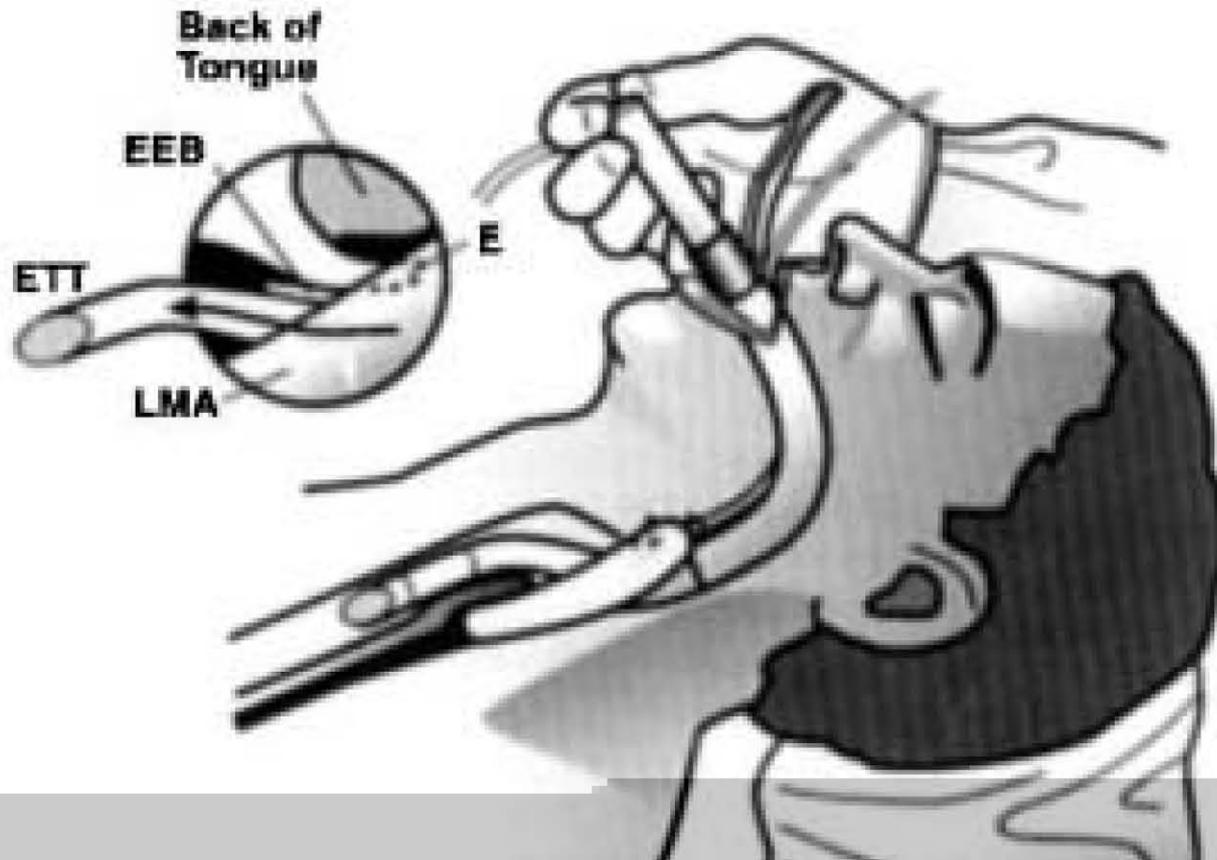
ETT depth marker

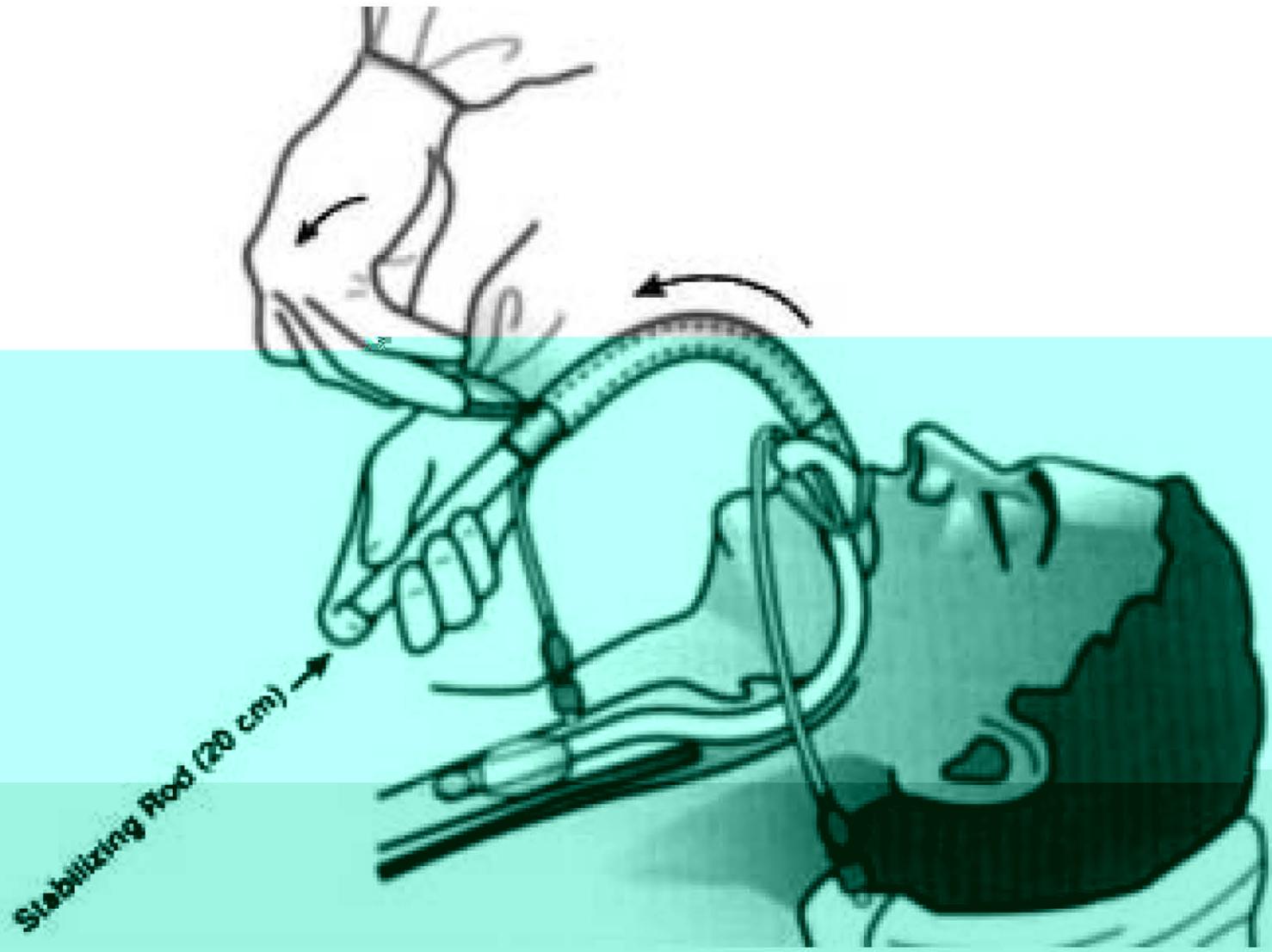


Epiglottic elevating bar lifts as endotracheal tube exits the bowl of the Fastrach

KEY

- E** Epiglottis
- EEB** Epiglottic Elevating Bar
- LMA** LMA-Fastrach
- ETT** Endotracheal Tube







Benefits of LMA

- Permit ventilation when mask ventilation & intubation have failed
- Permit lighter depth of anesthesia
- Facilitates blind or fiberoptic intubation
- Better airway for fiberoptic bronchoscopy
- Easier to learn

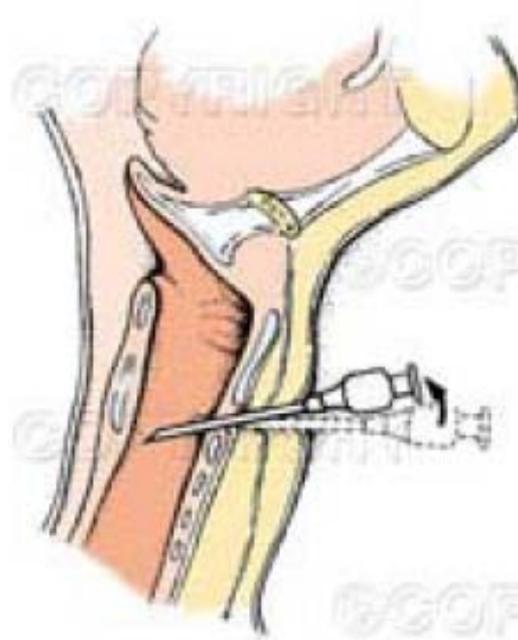
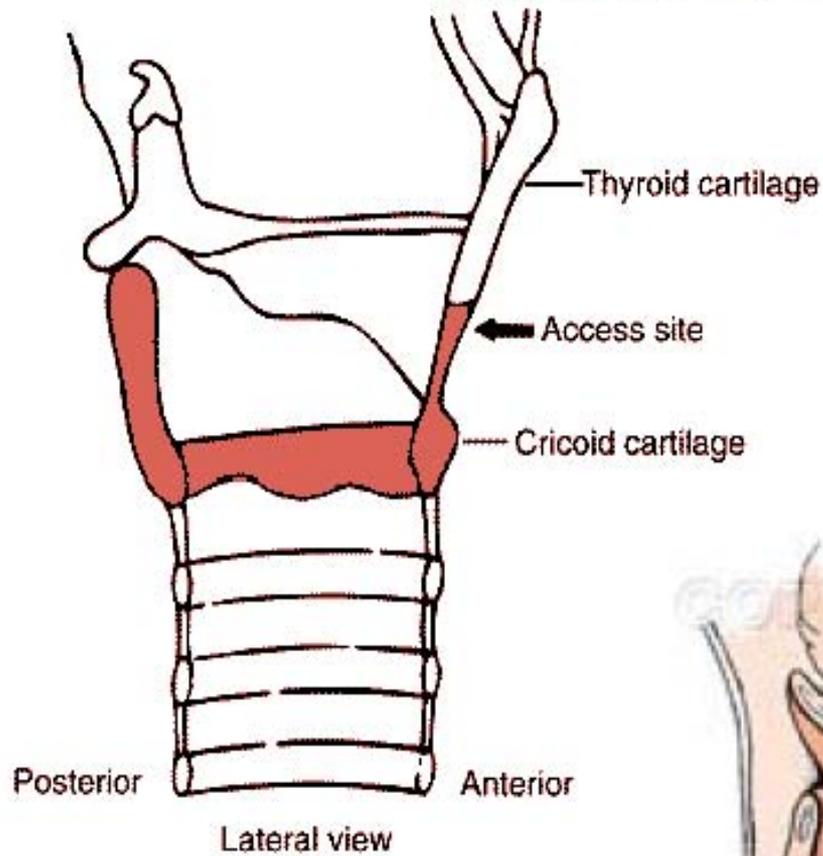
Limitations of LMA

- Difficult to achieve proper position LMA
- Gas leak when $AP > 20$ cmH₂O
- Spontaneous ventilation
- No protection against aspiration & laryngospasm

Complications with Use of the LMA

1. GER and aspiration
2. Laryngospasm
3. Coughing
4. Bronchospasm
5. Sore throat (less than tracheal intubation)
6. Transient changes in vocal cord function (possibly related to cuff overinflation during prolonged procedures)
7. Nerve injury (recurrent laryngeal, hypoglossal, lingual)

CRICOTHYROTOMY



Difficult Cricothyrotomy: SHORT

S: Surgery

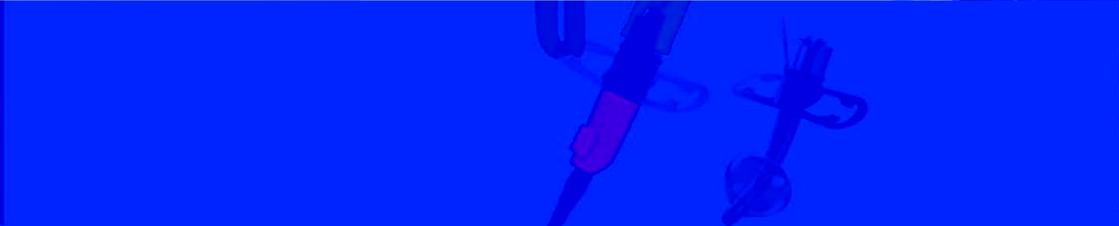
H: Hematoma

O: Obese

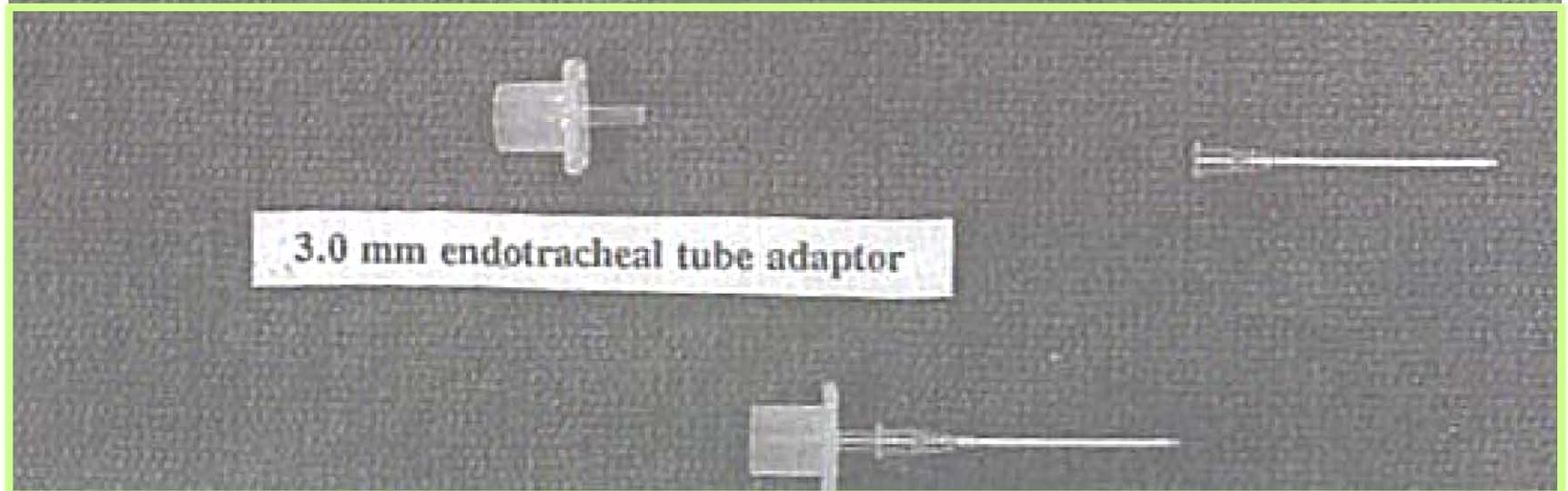
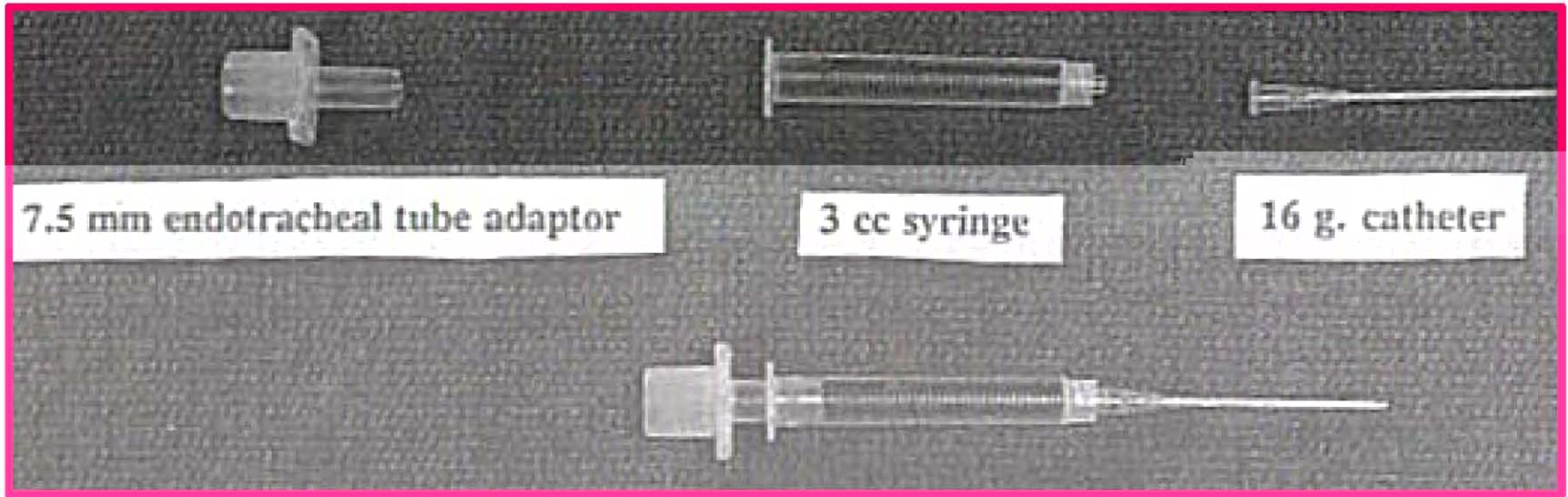
R: Radiation

T: Tumor

Cricothyrotomy set



Transtacheal needle ventilation



Surgical Cricothyrotomy



Surgical Cricothyrotomy



Surgical Cricothyrotomy



Surgical Cricothyrotomy



Surgical Cricothyrotomy



Surgical Cricothyrotomy

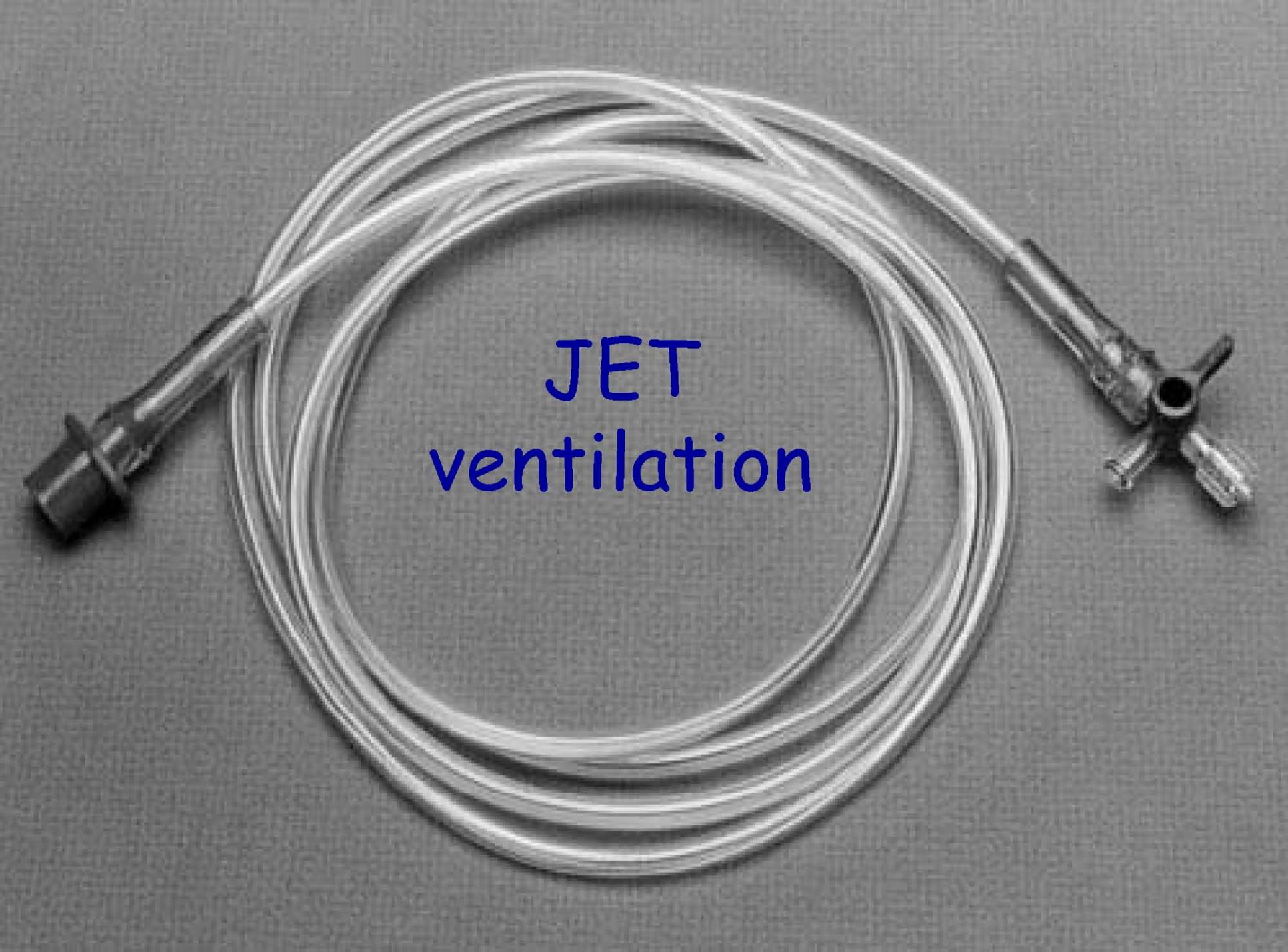


Surgical Cricothyrotomy



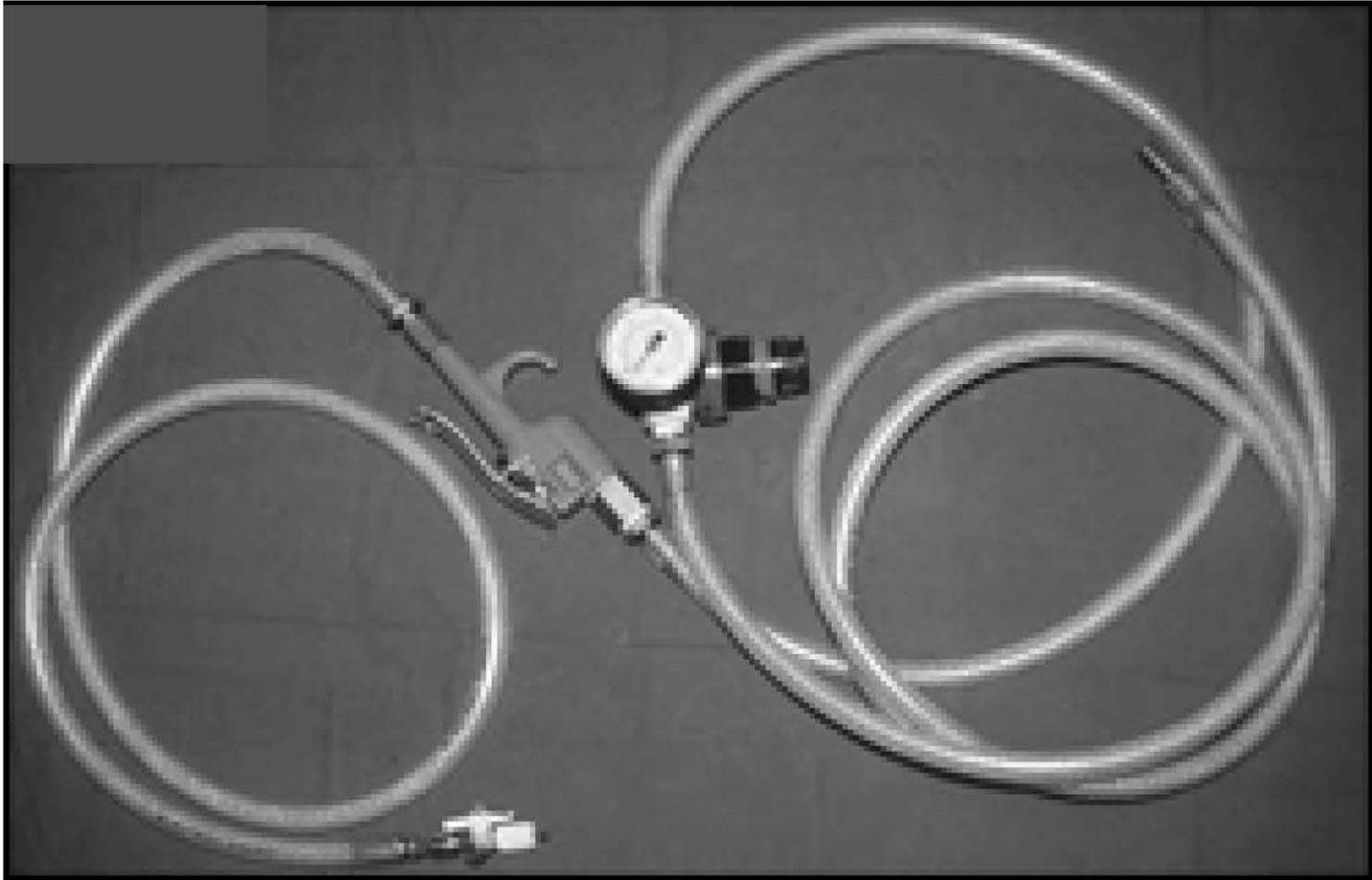
Surgical Cricothyrotomy



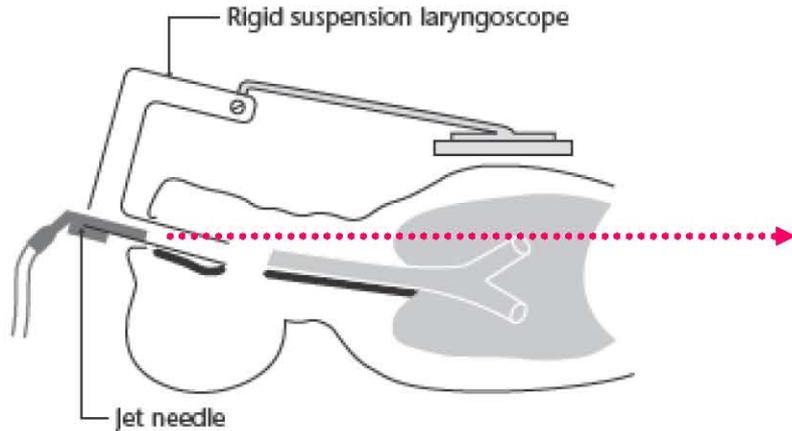


JET
ventilation

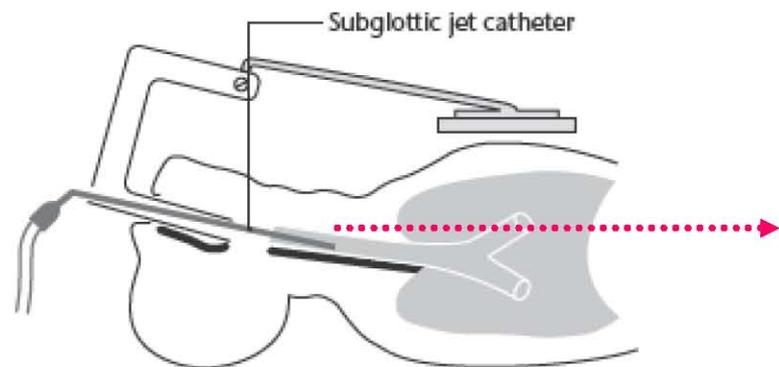
Jet ventilation



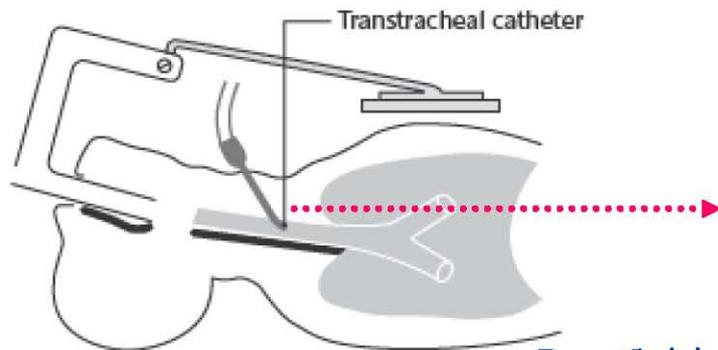
3 sites used for jet ventilation



supraglottic jet ventilation



subglottic jet ventilation



transtracheal jet ventilation

Combitube



Contraindications:

1. Esophageal obstruction or other abnormality
2. Ingestion of caustic agents
3. Upper airway foreign body or mass
4. Lower airway obstruction
5. Height < 120 cms
6. An intact gag reflex
7. Patients with latex allergy

Complications:

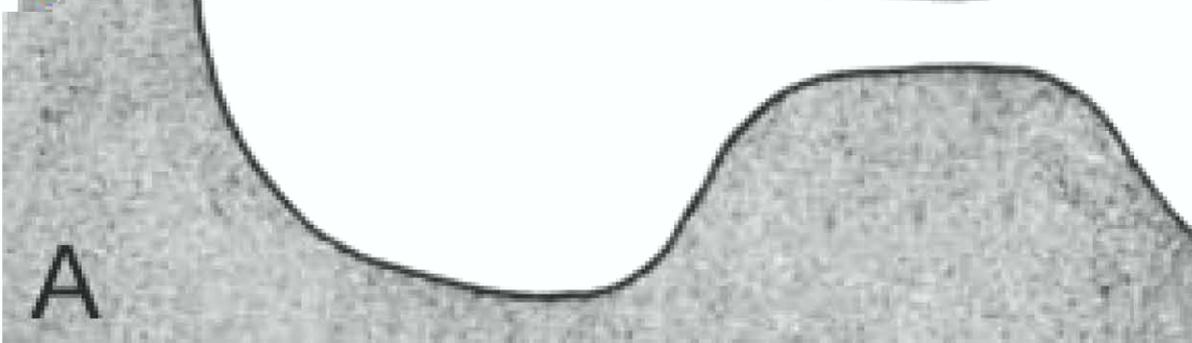
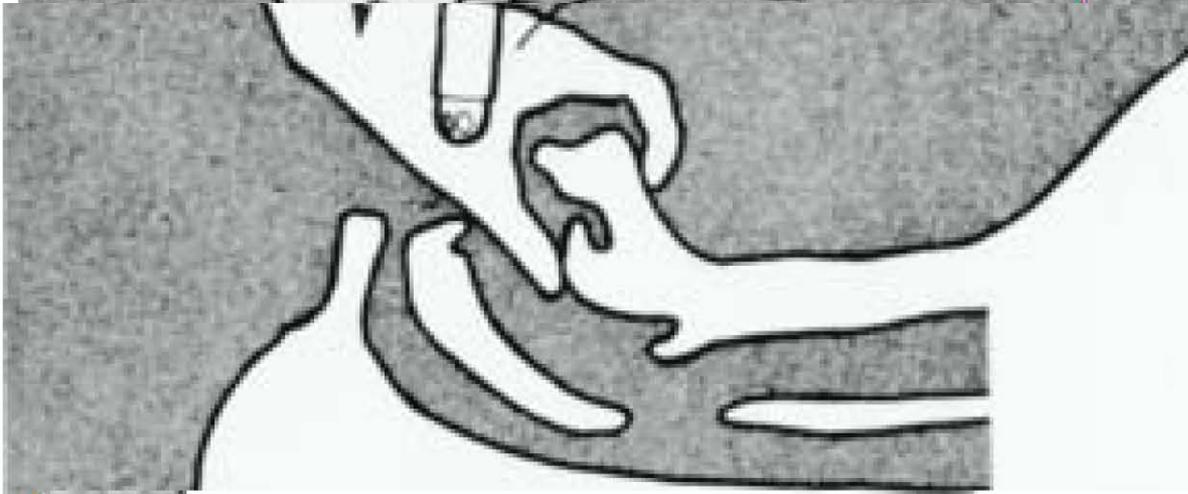
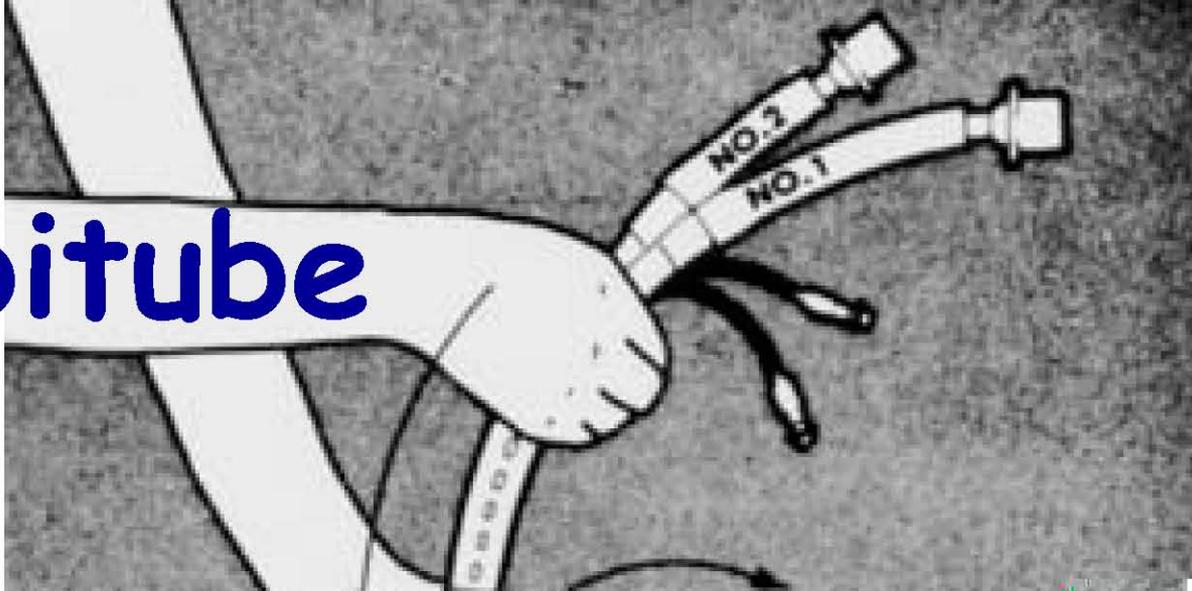
Lacerations to the pyriform sinus & esophageal wall

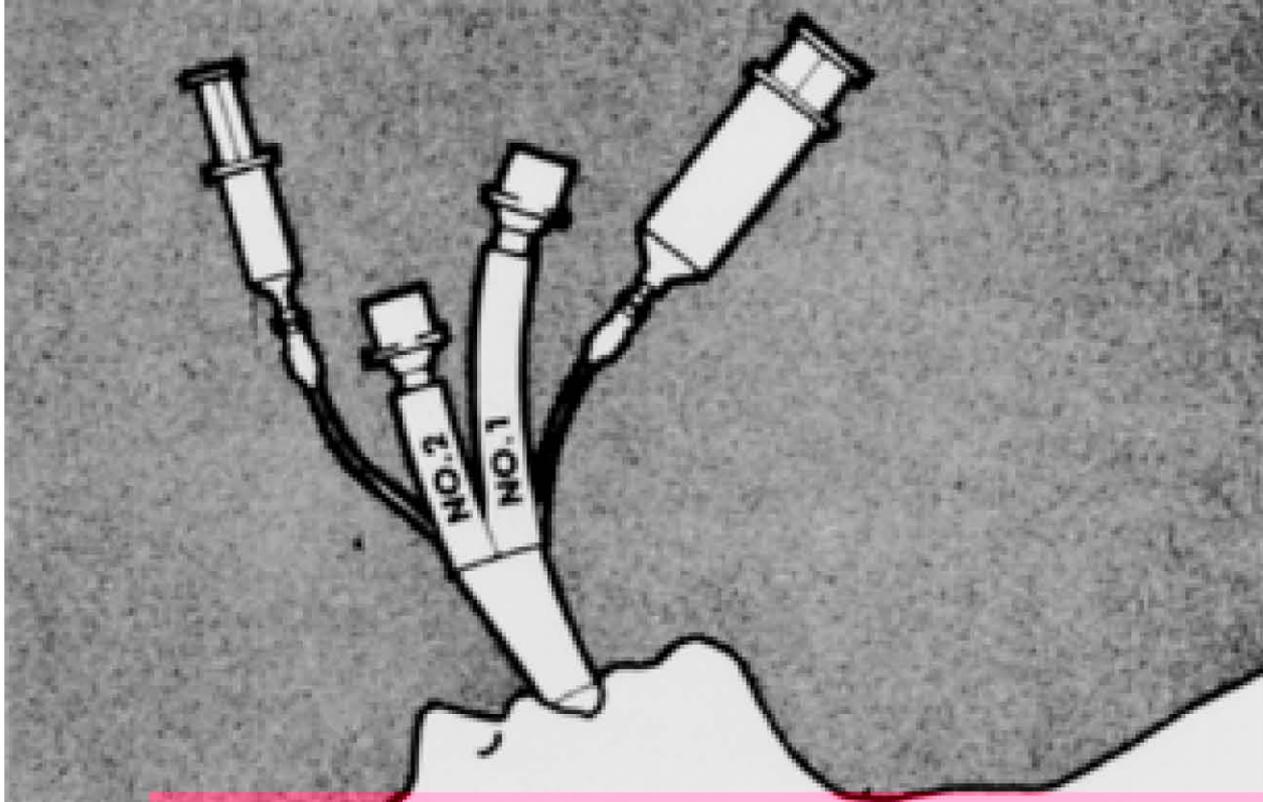


- Subcutaneous emphysema
- Pneumomediastinum
- Pneumoperitoneum
- Esophageal rupture

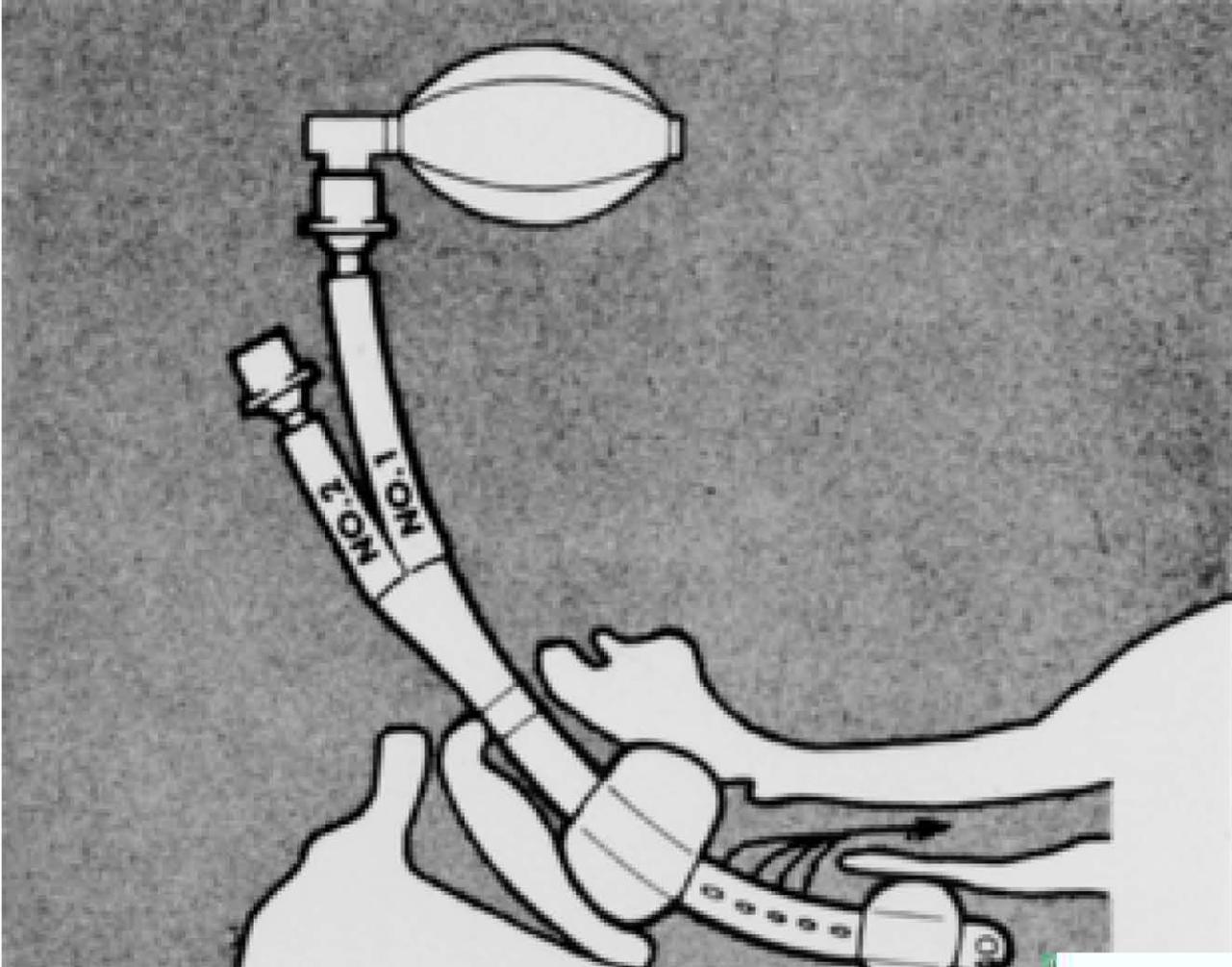
การใส่

Combitube

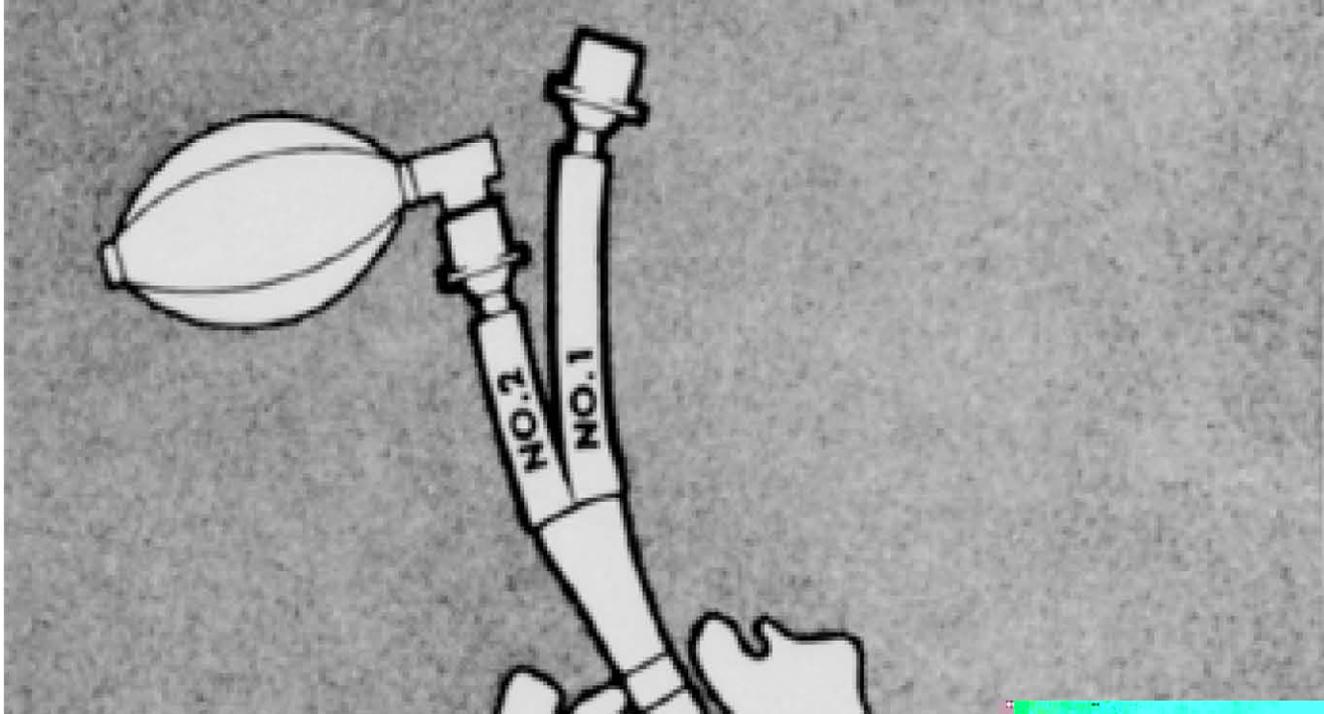




B



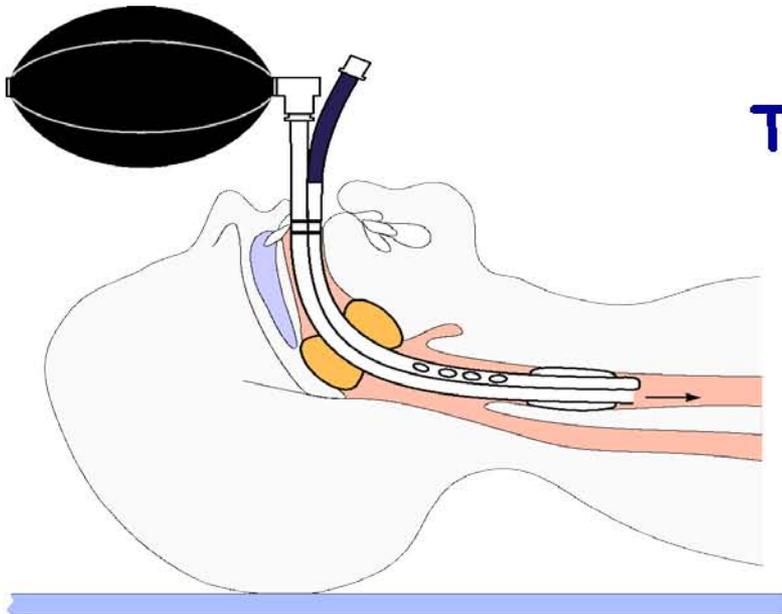
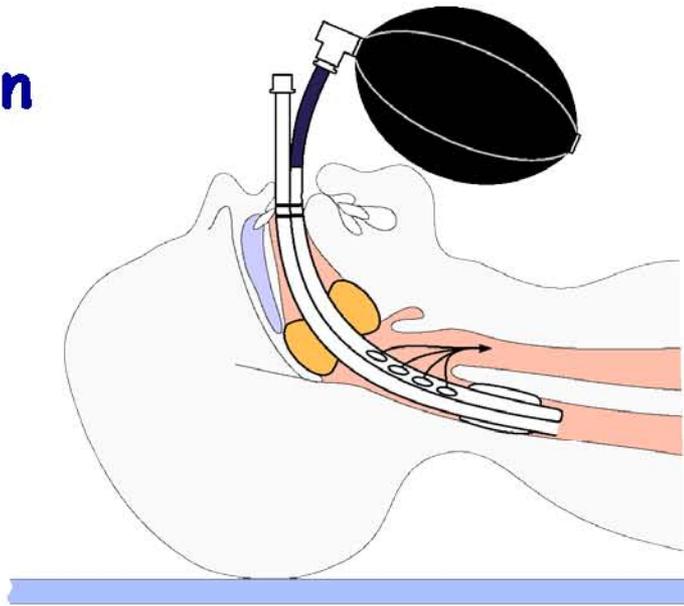
C



D

Esophageal position

Ventilation via longer
blue tube No. 1



Tracheal position

Ventilation via shorter clear
Tube No. 2

Benefits of Combitube

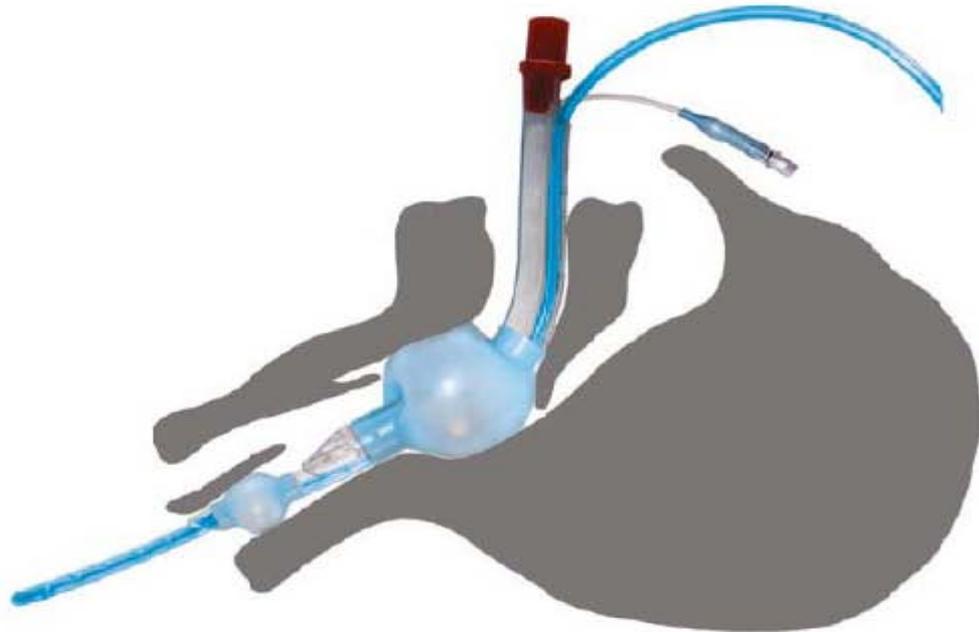
- Rapid placement esp. neutral position
- Protect against aspiration
- Easier to learn

Disadvantages of Combitube

- Inability to clear trachea by suction
- Inability to ventilate

Inability to clear trachea by suction

Laryngeal Tube Airway



Contraindications:

- Intact gag reflex (Conscious)
- Known esophageal disease
- Ingested caustic substance
- Does not protect the airway from regurgitation or aspiration

Lightwand



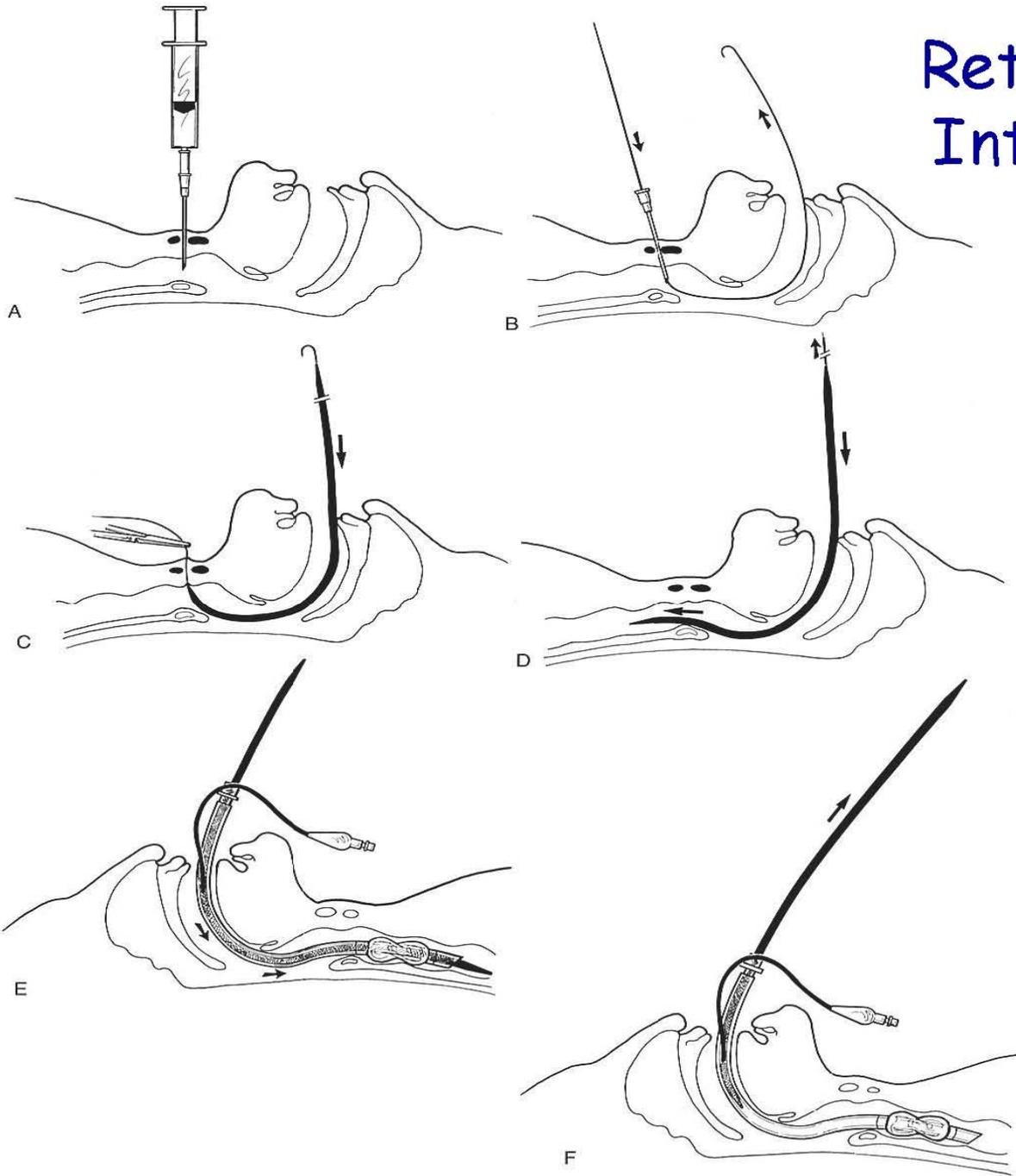


Tube Exchanger



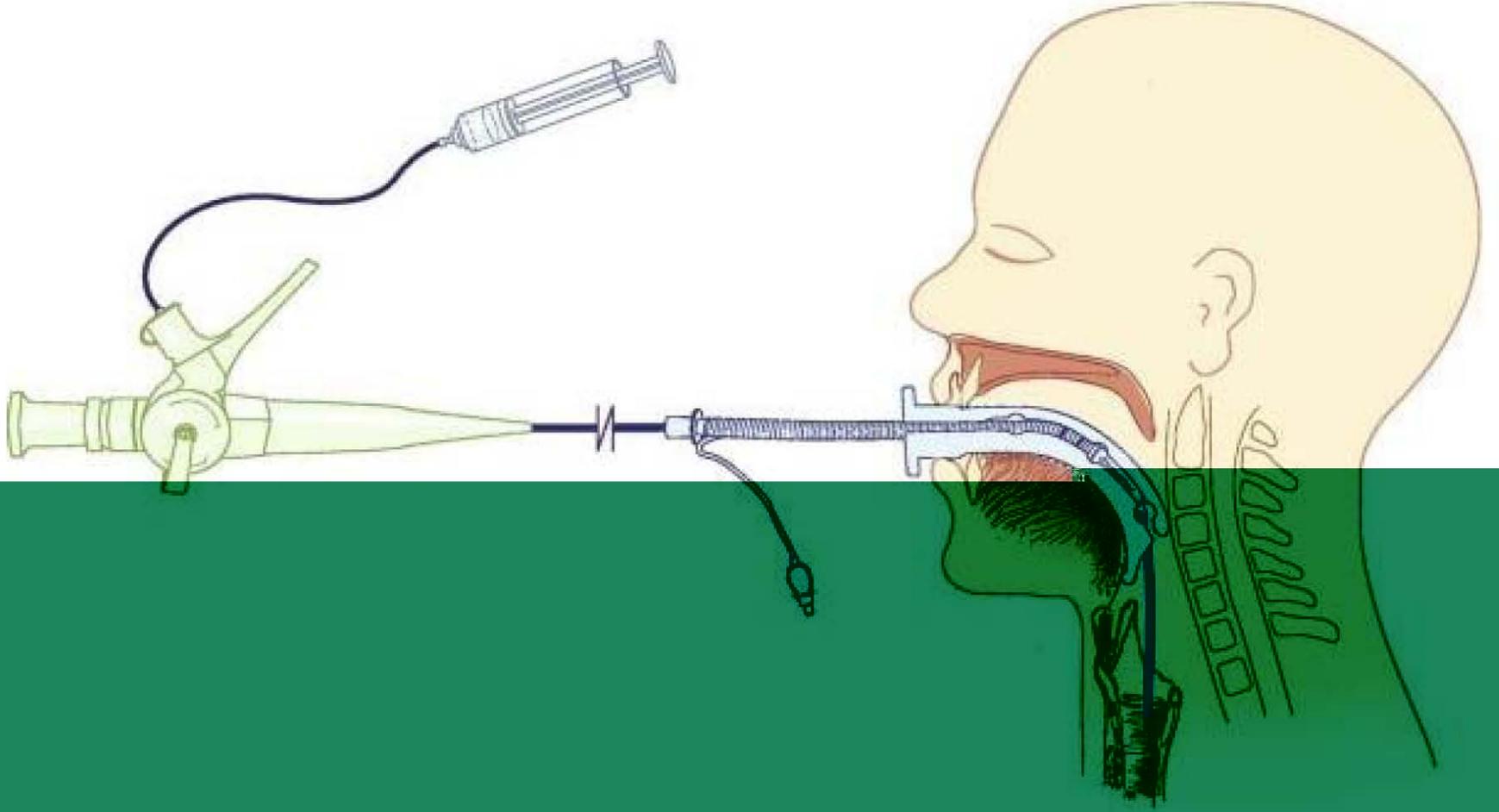
Cat No. Size	I. D(mm)	Lenght(cm)
0	2.5-4	56
2	4-6	81
4	6-8.5	81
6	7.5-10	81

Retrograde Intubation



Fiberoptic





Indications for Flexible Fiberoptic Laryngoscopy

Anticipated difficult tracheal *intubation*

Anticipated difficult mask *ventilation*, including seep apnea

Anticipated difficult *rescue* technique

Confirmation of tracheal tube position

Diagnosis of malfunction of a supraglottic airway device

Cervical spine instability (the rigid indirect laryngoscope is an alternative)

Positioning of a double-lumen tube and bronchial blocker

Assessment of swelling or trauma after difficulty with airway management

Tracheal tube change (between the nasal and oral routes)

Intensive care use, including aspiration of secretions and confirmation of the dilatational tracheotomy site

Flexible Fiberoptic Scope

Advantages

- Allows direct airway visualization
- Causes little hemodynamic stress
- Nasotracheal or orotracheal route
- Can be done in all age groups
- Requires minimal neck movement

Disadvantages

- Expensive
- Expertise requires practice
- Delicate equipment needs careful maintenance
- Visual field easily impaired by blood and secretions

Versatility of the Flexible Fiberoptic Laryngoscope

Flexible and steerable

Minimal tissue pressure and trauma

Continuous visualization

Oral or nasal route possible

Other intubating devices may facilitate combination techniques

Visual confirmation of the depth of intubation on withdrawal

Advantages of Awake Flexible Fiberoptic Laryngoscopy

Spontaneous breathing continues

Oxygenation and ventilation maintained

Intubation easier

Anatomy and muscle tone preserved

Phonation as a guide

Safety

Airway protection preserved

Options preserved

Flexible Fiberoptic Laryngoscopy Technique

Drying agent

Effective topical anesthetic

Equipment check: lenses clean and focused, antifog agent applied

Tracheal tube mounted

- On the flexible fiberoptic laryngoscope for the nasal route

- Within the oral airway for the oral route

Patient position: supine, semisitting, or sitting

Rapport: full explanation

Flexible fiberoptic laryngoscope technique

- Insertion cord kept straight and the scope maneuvered in three planes

- Tip flexion-extension, rotation, and advance-withdrawal

- Secretions aspirated

- White-out, red-out, or loss of target—withdraw, identify structures, readvance

- Targets (epiglottis, vocal cords, tracheal cartilages, carina) kept in the center of view as the flexible fiberoptic laryngoscope is advanced

- Advance to close to the carina

- Tracheal tube passed over the flexible fiberoptic laryngoscope

- Tube position confirmed and secured and anesthesia induced

Problems with the Flexible Fiberoptic Laryngoscope Technique in Unanticipated Difficult Intubation

High skill level needed for rapid control of the tip of the laryngoscope

Two skilled practitioners needed

Equipment often not ready (time)

Secretions, edema, and hemorrhage

Airway less open than when awake – get head awake, sedated, or paralyzed needed

Orbital pressure impeding entire procedure

Tracheal tube passage difficult

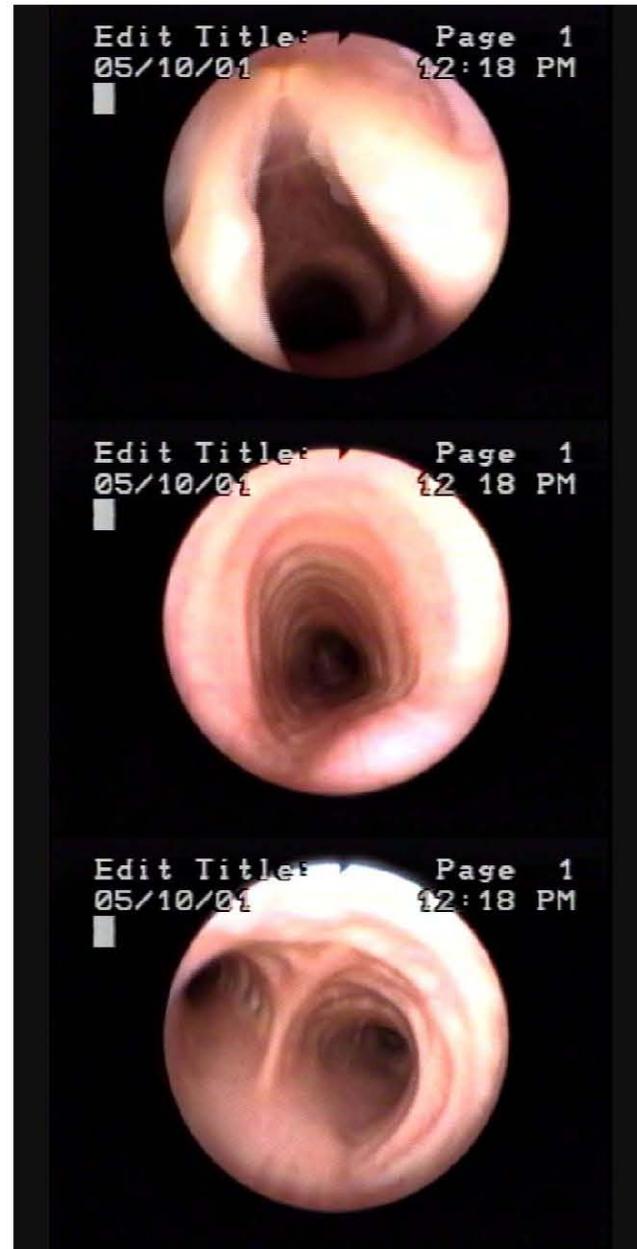
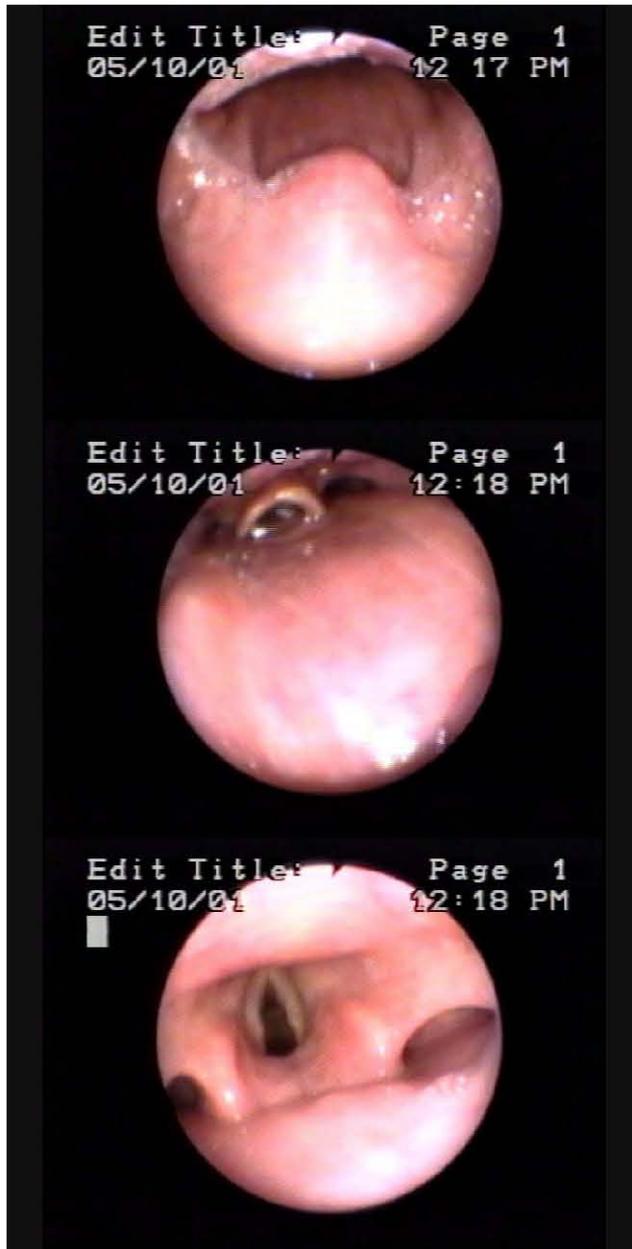
Patient risks: hypoxemia, hypoventilation, and pulmonary aspiration

• Patient anesthetized and paralyzed

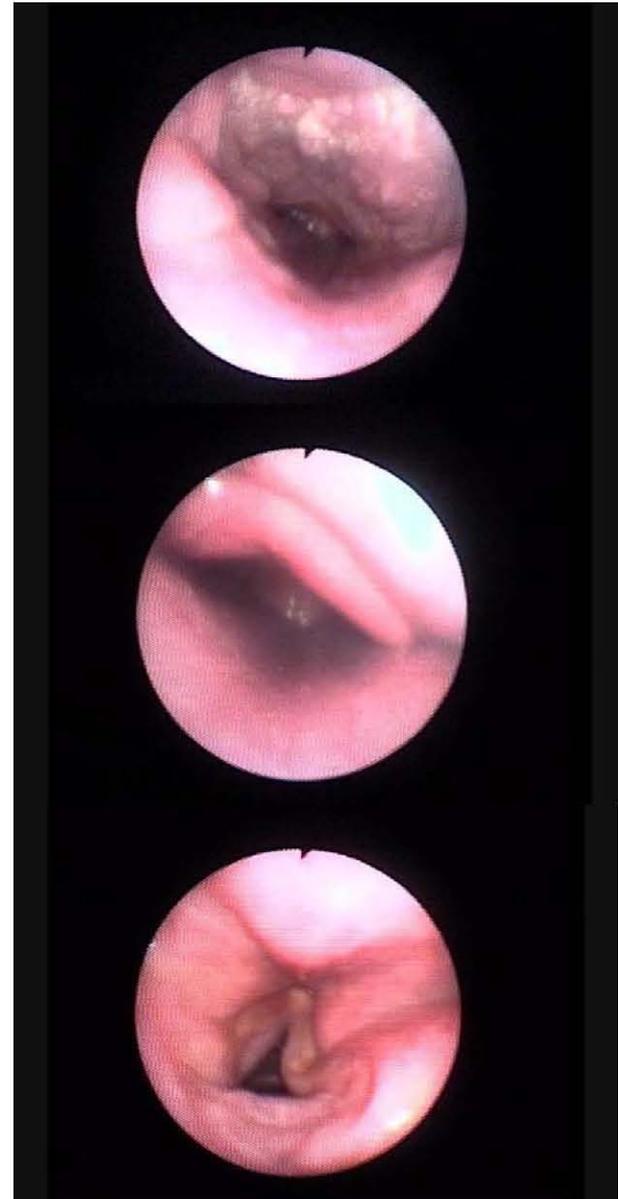
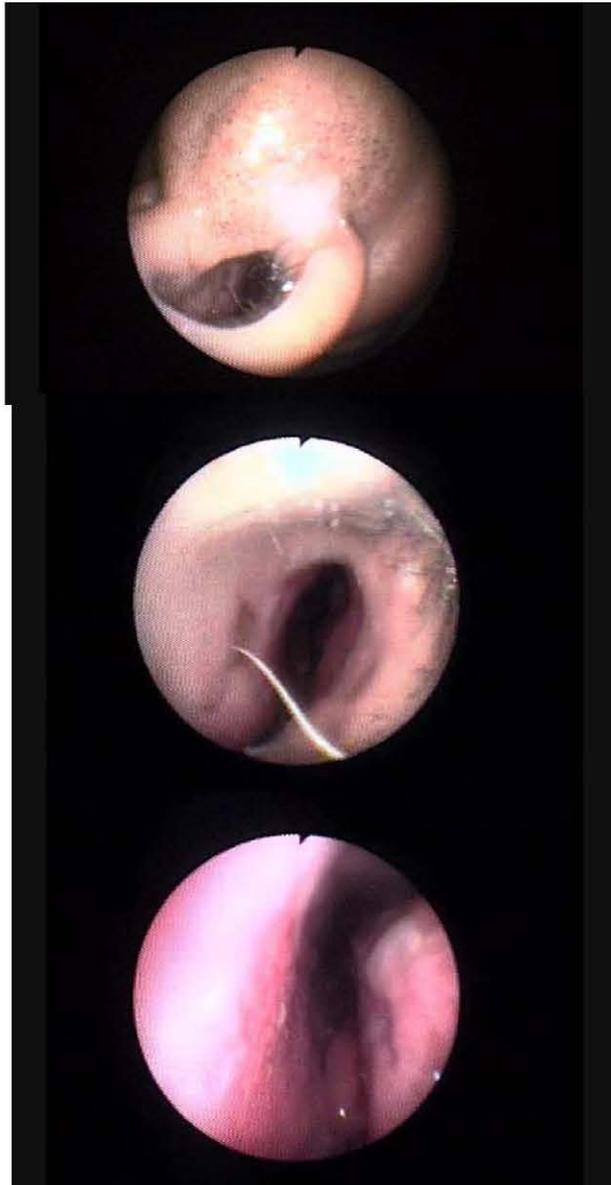
Oral Flexible Fiberoptic Laryngoscope



Oral Flexible Fiberoptic Laryngoscope



Nasal Flexible Fiberoptic Laryngoscope



Dexmedetomidine for fiberoptic bronchoscopy in spontaneously ventilating pt.

- α -2 agonist, 8 times more α -2 selective than clonidine
- Sedation effects on the locus coeruleus
- Analgesic effect occurs at the spinal cord
- Effects → anxiolysis, hypnosis, analgesia, amnesia, antisialagogue
- Dose:
 - ◆ Loading = 0.5-1mcg/kg IV given over 15 mins
 - ◆ Infusion = 0.5-0.7mcg/kg/h IV
- Side effects; bradycardia with at first hypotension and then hypertension

Application for Fiberoptic Bronchoscope

- Evaluate upper airway obstruction or pathology
- Evaluate VC motion
- Assess laryngotracheal injury after burn or prolong intubation
- Position endotracheal or endobronchial
- Change from Orotracheal to Nasotracheal tube

Criteria for extubation

- ◆ No indications for intubation
- ◆ Stable vital signs
- ◆ Awake & alert
- ◆ Adequated reversal muscle relaxant
- ◆ No effect of volatile or narcotic
- ◆ Protective airway reflexes
- ◆ Acceptable ABG; $\text{PaO}_2 > 80$, $\text{PaCO}_2 < 50$
- ◆ Acceptable respiratory mechanic;
 $\text{NIF} \sim 25\text{-}30 \text{ cm.H}_2\text{O}$, $\text{VC} > 10\text{-}15 \text{ ml/kg}$,
 $\text{TV} > 5\text{-}10 \text{ ml/kg}$

Preparation for Extubation

Initial Plan

"Deep" extubation

"Awake" extubation

Deep replacement of the tracheal tube with a laryngeal mask airway

Other Preparations

Patient position plan

Bite block in place

Throat pack removed

Preoxygenation

Secretions aspirated from the pharynx (the trachea also if indicated)

Complications at Extubation

Hypoventilation (residual effect of anesthetic drugs and neuromuscular blockade)

Upper airway obstruction

Laryngospasm and bronchospasm

Coughing (wound disruption)

Impaired laryngeal competence and pulmonary aspiration

Hypertension, tachycardia, dysrhythmias, myocardial ischemia

Conclusion

- Assess ;
 - ◆ Difficult ventilation
 - ◆ Difficult intubation
 - ◆ Difficult with patient cooperation or consent
 - ◆ Difficult tracheostomy
- 3 basic decisions needed before induction ;
 - ◆ use awake intubation
 - ◆ use a percutaneous technique
 - ◆ maintain spontaneous ventilation

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