Acute Respiratory Failure

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Acute Respiratory Failure

Recognition
Etiology
Airway assessment and management
RSI/induction agents
Alternate devices

Dx Acute Resp Failure

"Difficult to define but I know it when I see it"
Very subjective diagnosis

Signs and Symptoms

subjective feeling of shortness of breath
tachypnea
using accessory muscles of respiration
paradoxical abdominal movements with breathing
inability to talk w/o gasping for air
cyanosis (mucus membranes, nail beds)
skin mottling
decreased mental status
unstable vital signs
abnormal lung sounds
cough and purulent sputum

Important Signs and Symptoms

tachypnea
using accessory muscles of respiration
paradoxical abdominal movements with breathing
inability to talk w/o gasping for air

Stages of ABG's

	pH	pCO_2	pO_2	
Stage 0	7.40	40	100	normal
Stage 1	7.53	20	100	
Stage 2	7.53	20	70	
Stage 3	7.44	37	70	
Stage 4	7.20	60	50	

Stages of ABG's

	pH	pCO_2	pO_2	RR
Stage 0	7.40	40	100	16
Stage 1	7.53	20	100	30
Stage 2	7.53	20	70	30
Stage 3	7.44	37	70	30
Stage 4	7.20	60	50	20 - 40

ABG Stages in COPD

	pH	pCO_2	pO_2	
Stage 0	7.36	50	60	baseline
Stage 1	7.48	40	60	
Stage 2	7.48	40	50	
Stage 3	7.36	50	50	
Stage 4	7.00	150	30	

Etiology Resp Failure

Lung Parenchymal Disease	Hypoventilation
COPD	Drug overdose
Pneumonia	Head injury
CHF	Neuromuscular disease
Sepsis	
Pulmonary	Embolism

Pulmonary Pathophysiology

- CO_2 diffuses across the alveolar membrane 200 x better than O_2
- Hypoxia with normal pO_2 is always lung parenchymal disease
- Hypoxia with an elevated pCO_2 could be primary hypoventilation or could be severe lung parenchymal disease
- Hypoxic resp failure vs Hypercapnic resp failure

A-a gradient

Alveolar to arterial oxygen gradient
A is estimated from a formula
a is from the ABG

A is estimated from the following formula:

$A = FiO_2(Pb - PH_2O) - pCO_2/RQ$

$A = FiO_2(760 - 47) - pCO_2/RQ$

$A = FiO_2(713) - pCO_2/RQ$

$A = FiO_2(700) - pCO_2$

A-a gradient = $FiO_2(700) - pCO_2 - pO_2$

In the normal individual breathing room air with a normal pO_2 of 100 and a pCO_2 of 40

A = 0.21(700) - 40

A = (147) - 40

A = 107

A-a gradient = 107 - 100 = 7

The normal A-a gradient is < 10

FORMULAS TO REMEMBER

A-a on room air

= 150 - pCO_2- pO_2

A-a on oxygen

= (FiO_2 x 700) - pCO_2 - pO_2

Resp Failure Differential Diagnosis

	A-a	inc FiO_2	Etiology
hypoventilation	nl	PaO_2 inc	Drugs, head injury
dead space	inc	PaO_2 inc	COPD
shunt fraction	inc	PaO_2 not inc	pneumonia, CHF, PE

Resp Failure Differential Diagnosis

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Really only applies at high FiO2 levels > 60 %

100 % oxygenation FiO2 challenge and calculate the change in the pF ratio (pO2/FiO2)

Pulmonary Embolism

Yes, in autopsy series there are some missed PEs

In the real world, common things happen commonly

If your patients presents with a good explanation for their resp failure there is no reason to add PE to the list

Pulmonary Embolism

D-dimer only helpful when negative

negative means no PE

positive means nothing

a very high D-dimer still means nothing

Not all D-dimers are created equal

know which one your hospital uses

Use a prediction score

Wells score

Wells Criteria

Clinical symptoms of DVT (leg swelling, pain with palpation) 3.0
Other diagnosis less likely than pulmonary embolism 3.0
Heart rate >100 1.5
Immobilization (≥3 days) or surgery in the previous four weeks 1.5
Previous DVT/PE 1.5
Hemoptysis 1.0
Malignancy 1.0

Probability	Score
High	>6.0
Moderate	2.0 to 6.0
Low	<2.0

Data needed to make decisions

History
- Acute—HPI
- Chronic—Past Med Hx

Exam
- Vital signs
- General assessment "How do they look"
- Lung sounds

ABG

CXR

Do they need mechanical support

In shock?

Hypercapnic with complications?
- Hypotension ,hypoxia, widened QRS complex, etc.

Hypoxia not resolved with O2?

Look Bad?
- Increased work of breathing
- Decreased level of consciousness

What kind of mechanical support?

Non-Invasive Ventilation (NIV)
- BiPap or CPAP

Endotracheal intubation

Indications for NIV

Acute Respiratory Failure
intact mental status
airway protected
absence facial trauma
patient will tolerate

success rate 25 %

Non-Invasive Ventilation

Takes patience to initiate

Try several different masks to find right fit

Start with low settings and work up to full settings and mask fitting

May need some sedation
versed

How long to try

After get patient settled on NIV
15-20 minutes
Should look better in one hour
If not better consider intubation

Indications for intubation

Acute Respiratory Failure
failure of NIV
decreased mental status
unprotected airway
shock
emergencies
need high pressures

Transport Decisions

Complex question
Equipment and personnel available
Distance of transport

Intubation and Sedation

Please keep your patient comfortable post intubation
- Sedation and analgesia
- If hypotension develops then
  - More fluid
  - Early pressors

Avoid repeat doses of neuromuscular blockers for transport

Medications for Transport

Sedation
Analgesia
Isotonic fluids
Vasopressor

Paralytics rarely needed for transport

Airway Management

Endotracheal Intubation is by far and away the best, safest and preferred technique to management the acute respiratory failure patients airway

Novice

Intubation is perceived as scary

Reality is that is not that hard a skill to master

Frist resource for training should be on a dummy

one hour once in a lifetime sufficient

In OR do some elective intubations

repeat that every 1-2 years

RAPID SEQUENCE INTUBATION

"RSI is the standard of care in emergency airway management for intubations not anticipated to be difficult

simultaneous administration of a sedative and a neuromuscular blocking agent to render a patient rapidly unconscious and flaccid in order to facilitate emergent endotracheal intubation and to minimize the risk of aspiration.

Multiple studies confirm the high-success rate of RSI using the combination of a sedative and a paralytic drug"

Induction Agents

midazolam (Versed)

Propofol

Fentanyl

Ketamine

Etomidate

Neosphyenine

Fluids

midazolam (Versed)

Dose 2-4 mg

(induction dose is listed as 0.1-0.3 mg/kg)

Onset 1-5 minutes

Duration 5-30 minutes

Amnesic effect

Propofol

	60 kg	100 kg
Dose (1.5-3 mg/kg)	50 mg	100 mg
Onset seconds	15-45	
Duration minutes	5-10 minutes	

Reduces airway resistance, decreases ICP, good antiepileptic

Does vasodilate– cause hypotension

Fentanyl

Personal experience more than guidelines

	60 kg	100 kg
Dose 0.5 mcg/kg	60 mcg	100 mcg
Onset minutes	1	
Duration minutes	5-15	

Rocuronium

	60 kg	100 kg
Dose 0.6 mg/kg	35 mg	60 mg

Onset 1-2 minutes (typically faster)

Duration 5-15 minutes (typically quicker)

Nondepolarizing agent

Succinylcholine

	60 kg	100 kg
Dose 1.5 mg/kg	90 mg	150 mg
Onset seconds	45-60	
Duration minutes	6-10	

Depolarizing agent

Hyperkalemic cardiac arrest (Are defined risks groups but can occur in anyone)

No longer recommended in any patients

Etomidate

	60 kg	100 kg
Dose 0.3 mg/kg	20 mg	30 mg
Onset 0.5-1 minute		
Duration 3-5 minutes		

Causes less hypotension

Adrenal insufficiency, inc mortality in septic patients, no longer used in the ICU

Ketamine

	60 kg	100 kg
Dose 1-2 mg/kg	60-100 mg	100-200 mg
Onset 1 minutes		
Duration 5-15 minutes		

Less hypotension

May increase ICP (evidence weak)

Can be used for awake intubations (preserves resp drive)

Reemergence phenomenon concerning

Phenylephrine

Neosynephrine

IV bolus dosing 100 mcg q 5 minutes

IV infusion dose 0-4 mcg/kg/min

100-200 mcg/minute

Hypotension is so common Neo should be part of your induction agent medical list

Most Patients are Dry

Have NS hanging and do not hesitate to give 1-3 liters

Have not been eating well

Induction agents will vasodilate

Even the CHF patient may be intravascular dry and need some fluid

What do I do

- Versed 4 mg IV given while I set up to intubate
- 50-100 mcg fentanyl and 50-100 mg of propofol
- Start to bag mask ventilate as they fall asleep (eyelash test)
- Look, if fail then more sedation +/- rocuronium

What do I do (2)

- 3 attempts with laryngoscope
- Watch sat's and heart rate
  - abort attempt and bag when pulse starts to fall
- Glidescope
- Consider a intubating stylet
- Cricothyroidotomy (kit)

To RSI or Not to RSI

- Most fellowship trained ED MDs always RSI
- I will usually try once without paralytic and use it if I think I will get a better view on the second attempt
- More likely to use RSI if no concerns after an LEMON airway assessment, TBI, overdose patient, full stomach

Intubation Failure Rates

- Difficult intubation rate quoted as 30 %
  - more than one attempt
- Unsuccessful intubation rate 10 %

Prediction of the Difficult Airway

- LEMON approach
  - Look externally
  - Evaluate 3-3-2 rule
  - Mallampati score
  - Obstruction/Obesity
  - Neck mobility

Look externally

- Clinician's general impression
  - abnormal facies or body habitus
  - unusual anatomy
  - facial trauma
- Specific but not sensitive
  - If it looks like a difficult airway then it most likely will be
  - Absence of external signs of a difficult airway does not predict success

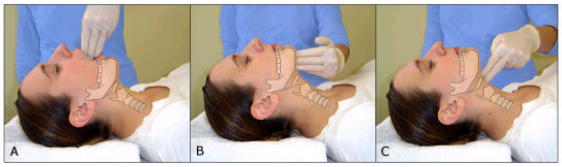
3-3-2 Rule

A. Extent of mouth opening
B. Size of the mandible
C. Distance between mentum and hyoid bone

A.

Extent of mouth opening

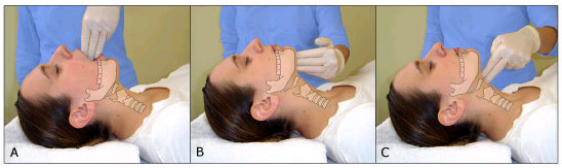
Patient should be able to fit three of their own fingers between the incisors



B.

Size of the mandible

Patient should be able to place three of their own fingers along the floor of the mandible between the mentum and the neck/mandible junction



C.

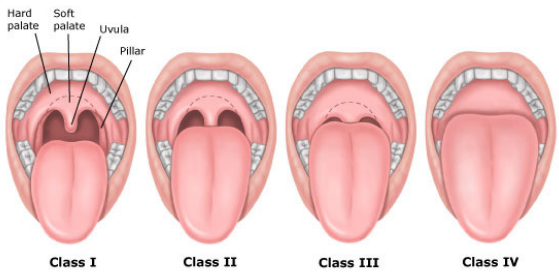
Distance between mentum and hyoid bone

Patient should be able to place 2 of their own fingers in the superior laryngeal notch

If larynx is too high (anterior) hard to see

Mallampati

- Predicts the view during laryngoscopy based on the view looking into the patients open mouth
- Class I or II easy laryngoscopy
- Class III difficult
- Class IV extreme difficultly



M score in the ED

- Often patients unable to cooperate
- Open the mouth with tongue blade of laryngoscope blade and try to get the best view possible

O: Obstruction/Obesity

- Upper airway obstruction (rare)
  - mass, foreign body, infection
- Redundant tissues obese patient can make views difficult, may want a bigger laryngoscope blade

N: Neck Mobility

- Ideal position for intubation sniffing position
- Flexing neck forward and elevating the head
- Trauma patients with concern neck injury require in-line stabilization which can limit views
- Medical conditions like RA, ankylosing spondylitis, DJD in the elderly

How to use LEMON

Do as much assessment of the airway as possible prior to intubation

If factors present that predict difficult intubation then plan ahead

- gather special supplies
- alert personnel

Proceed with intubation +/- paralysis

Alternative devices

Glidescope

Awake intubation/nasal intubation

Extraglottic airway devices

- LMA/Intubating LMA
- Combitube, Kingair, others

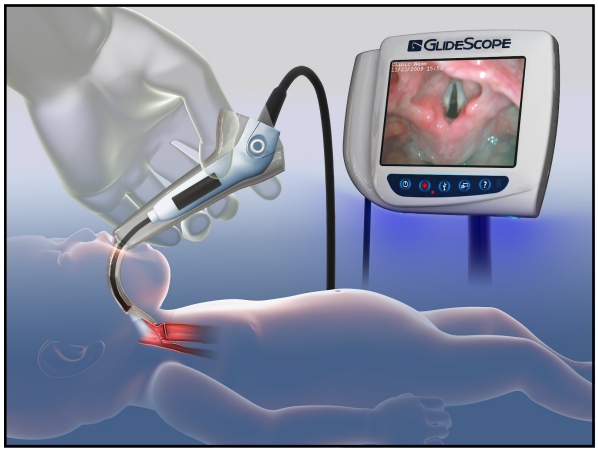
Intubation over a bronchoscope

Surgical airway (cric/trach)

Glidescope

Plastic lighted laryngoscope with a camera

http://verathon.com/products/glidescope-video-laryngoscope

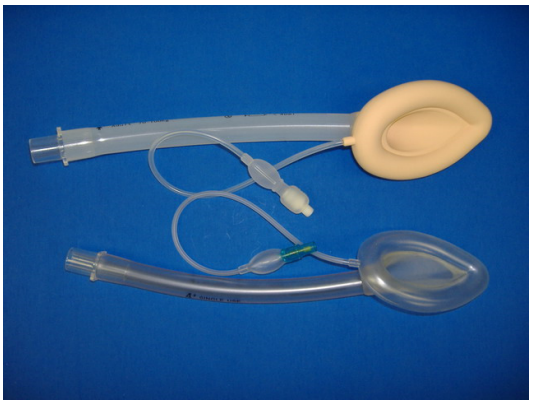


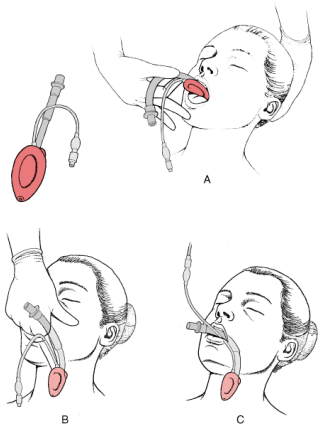
Extraglottic Airway Devices

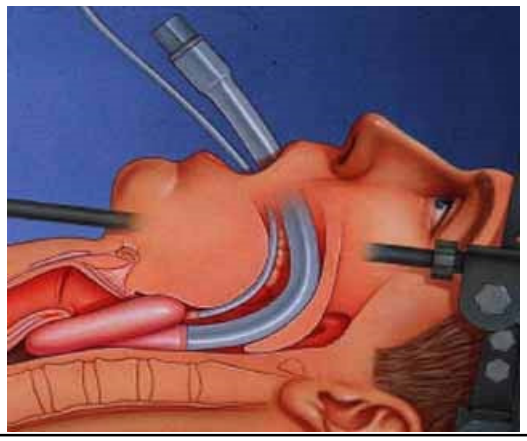
- LMA
- Combitube
- Kingair

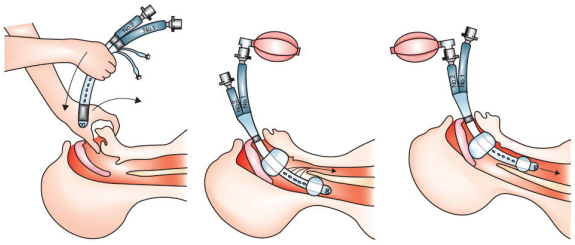
LMA

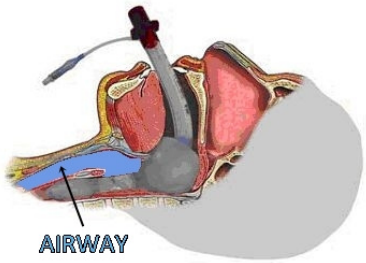
- Laryngeal Mask Airway
- Video regarding use and placement
  - NEJM Nov 4, 2013 e26
- Not as easy to place as pictures and videos imply
- Should practice on dummy or in OR

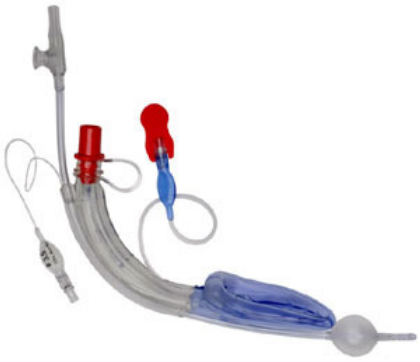












Questions