
بسم الله الرحمن الرحيم

Respiratory Distress

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- The term **Respiratory distress** is often used to indicate signs and symptoms of abnormal respiratory pattern.

- A child with nasal flaring, tachypnea, chest wall retractions, stridor, grunting, dyspnea, and wheezing is often judged as having respiratory distress.

- **Respiratory failure** is defined as inability of the lungs to provide sufficient oxygen (hypoxic respiratory failure) or remove carbon dioxide (ventilatory failure) to meet metabolic demands.

- Respiratory distress can occur in patients without respiratory disease, and respiratory failure can occur in patients without respiratory distress.

First sign of respiratory distress in most children

- 1. Tachypnea
- 2. Retractions
- 3. Cyanosis
- 4. Tachycardia
- 5.Position:"Sniff" & "Tripod"
- 5. Altered mental status
  - a. Agitation and irritability
  - b. Lethargy and decreased responsiveness

Table 71-2 Examples of Anatomic Sites of Lesions Causing Respiratory Failure

LUNG	RESPIRATORY PUMP
CENTRAL AIRWAY OBSTRUCTION	**THORACIC CAGE**
Choanal atresia	Kyphoscoliosis
Tonsilloadenoidal hypertrophy	Diaphragmatic hernia
Retropharyngeal/peritonsillar abscess	Flail chest
Laryngomalacia	Eventration of diaphragm
Epiglottitis	Asphyxiating thoracic dystrophy
Vocal cord paralysis	Prune-belly syndrome
Laryngotracheitis	Dermatomyositis
Subglottic stenosis	Abdominal distention
Vascular ring/pulmonary sling	
Mediastinal mass	
Foreign-body aspiration	
Obstructive sleep apnea	
PERIPHERAL AIRWAY OBSTRUCTION	**BRAINSTEM**
Asthma	Arnold-Chiari malformation
Bronchiolitis	Central hypoventilation syndrome
Foreign-body aspiration	CNS depressants
Aspiration pneumonia	Trauma
Cystic fibrosis	Increased intracranial pressure
α_1-Antitrypsin deficiency	CNS infections
ALVEOLAR-INTERSTITIAL DISEASE	**SPINAL CORD**
Lobar pneumonia	Trauma
Acute respiratory distress syndrome/hyaline membrane disease	Transverse myelitis
	Spinal muscular atrophy
Interstitial pneumonia	Poliomyelitis
Hydrocarbon pneumonia	Tumor/abscess
Pulmonary hemorrhage/ hemosiderosis	
	NEUROMUSCULAR
	Phrenic nerve injury
	Birth trauma
	Infant botulism
	Guillain-Barré syndrome
	Muscular dystrophy
	Myasthenia gravis
	Organophosphate poisoning

Table 71-3 Nonpulmonary Causes of Respiratory Distress

	EXAMPLE(S)	MECHANISM(S)
Cardiovascular	Left-to-right shunt Congestive heart failure Cardiogenic shock	↑ Pulmonary blood/water content Metabolic acidosis Baroreceptor stimulation
Central nervous system	Increased intracranial pressure Encephalitis Neurogenic pulmonary edema Toxic encephalopathy	Stimulation of brainstem respiratory centers
Metabolic	Diabetic ketoacidosis Organic acidemia Hyperammonemia	Stimulation of central and peripheral chemoreceptors
Renal	Renal tubular acidosis	Stimulation of central and peripheral chemoreceptors
	Hypertension	Left ventricular dysfunction → increased pulmonary blood/water content
Sepsis	Toxic shock syndrome Meningococcemia	Cytokine stimulation of respiratory centers Baroreceptor stimulation from shock Metabolic acidosis

Position

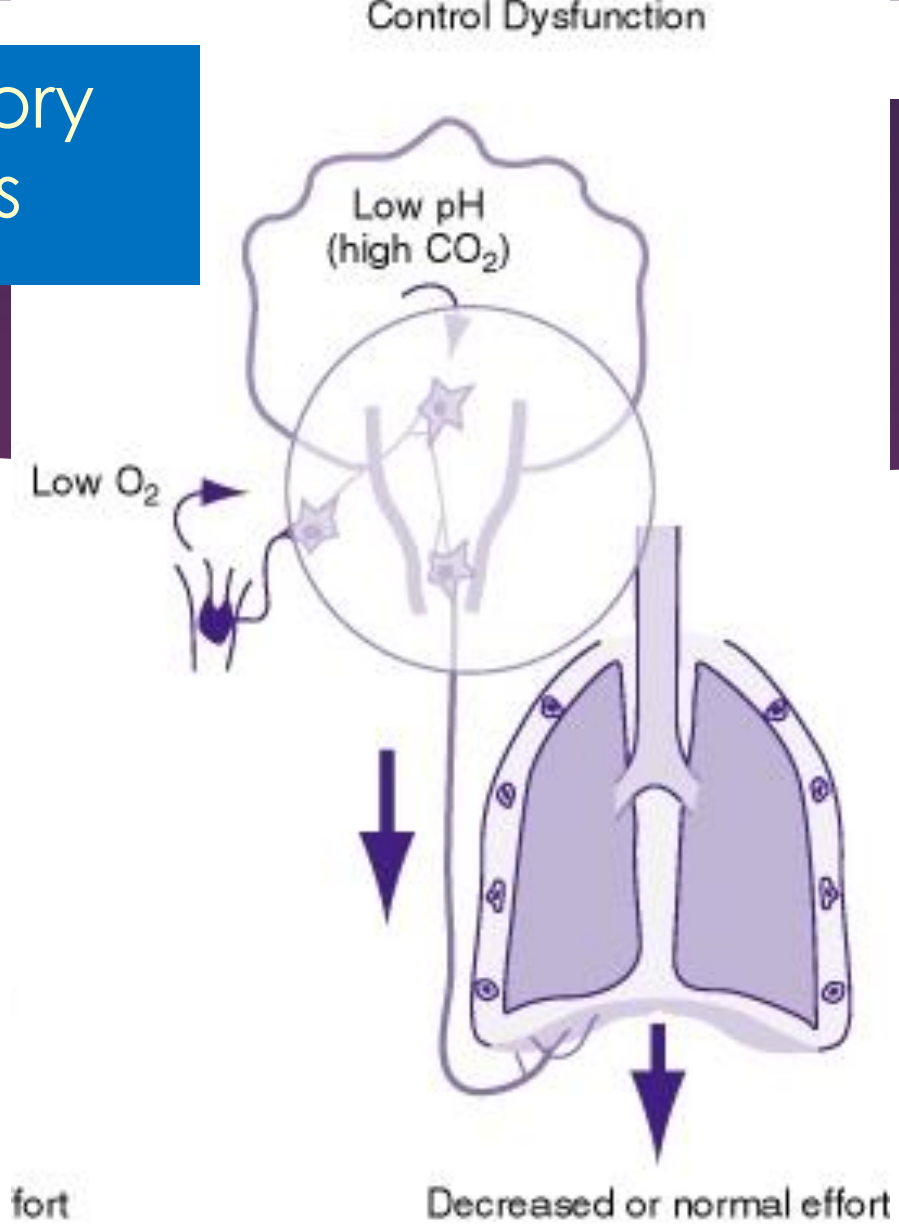
“Tripod” position

Sniffing Position

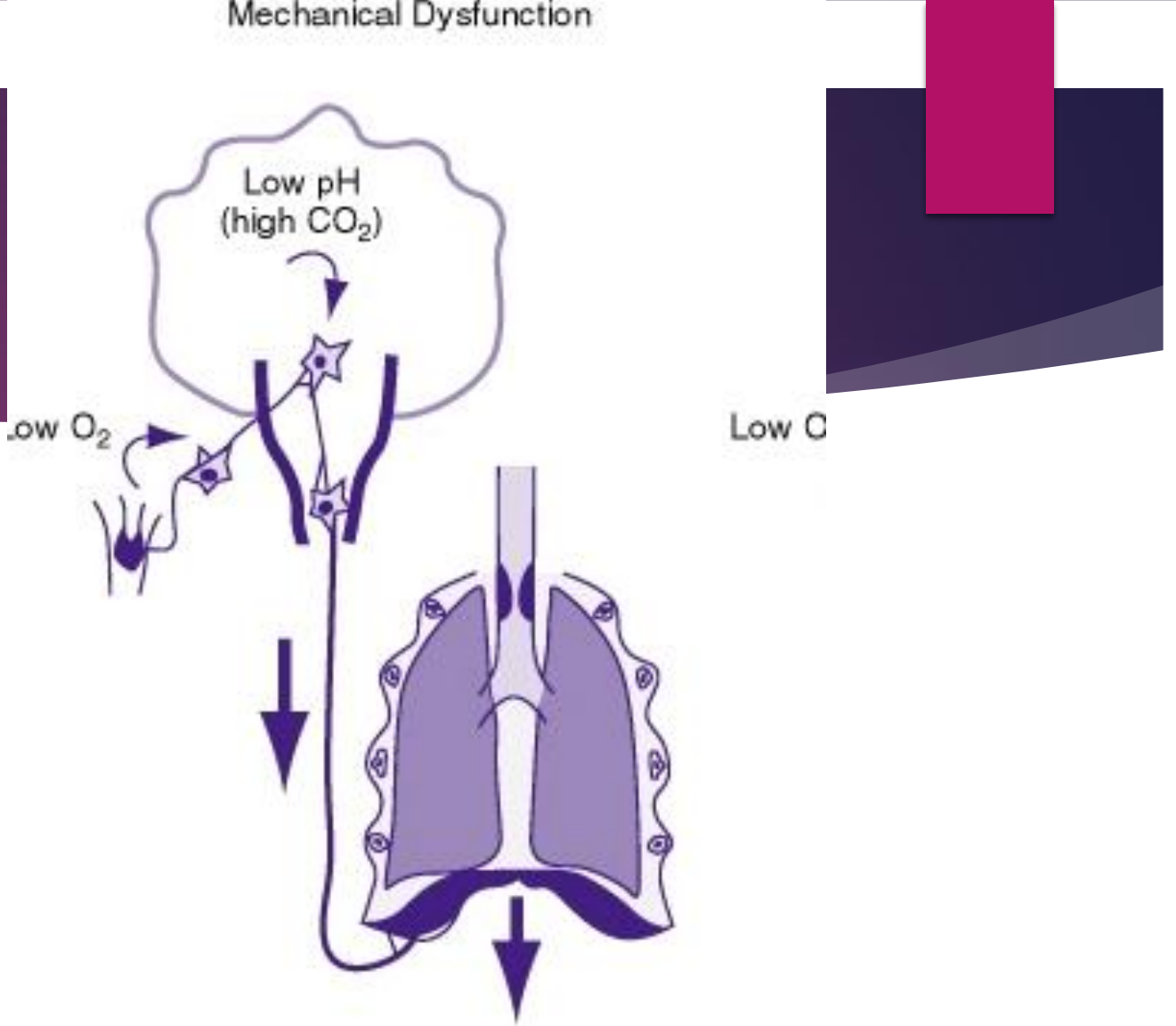
Localization of respiratory distress by physical findings

Upper airway obstruction
Sniffing position: neck is flexed with head extended to open airway
Nasal flaring: also seen with lower airway disease
Prolonged inspiration
Retractions: supraclavicular, suprasternal
Abnormal voice: hoarseness, hot potato voice
Stridor
Barking cough
Transmitted upper airway sounds (stertor)
Lower airway disease
Retractions: intercostal, subcostal
Nasal flaring: also seen with upper airway obstruction
Prolonged expiration
Wheezing: intrathoracic airway obstruction
Grunting: may indicate severe respiratory distress or severe pain from an intraabdominal process
Rales (crackles)
Pleural rub
Bronchophony
Pulsus paradoxus: caused by severe lower airway obstruction or cardiac tamponade
Cardiac disease
Gallop
Cardiac murmur
Rales (crackles)
Jugular venous distention
Hepatomegaly
Peripheral or periorbital edema
Pulsus paradoxus: caused by cardiac tamponade or severe lower airway obstruction
Central nervous system
Abnormal respiratory pattern (Cheyne-Stokes, or ataxic)
Metabolic
Kussmal respirations

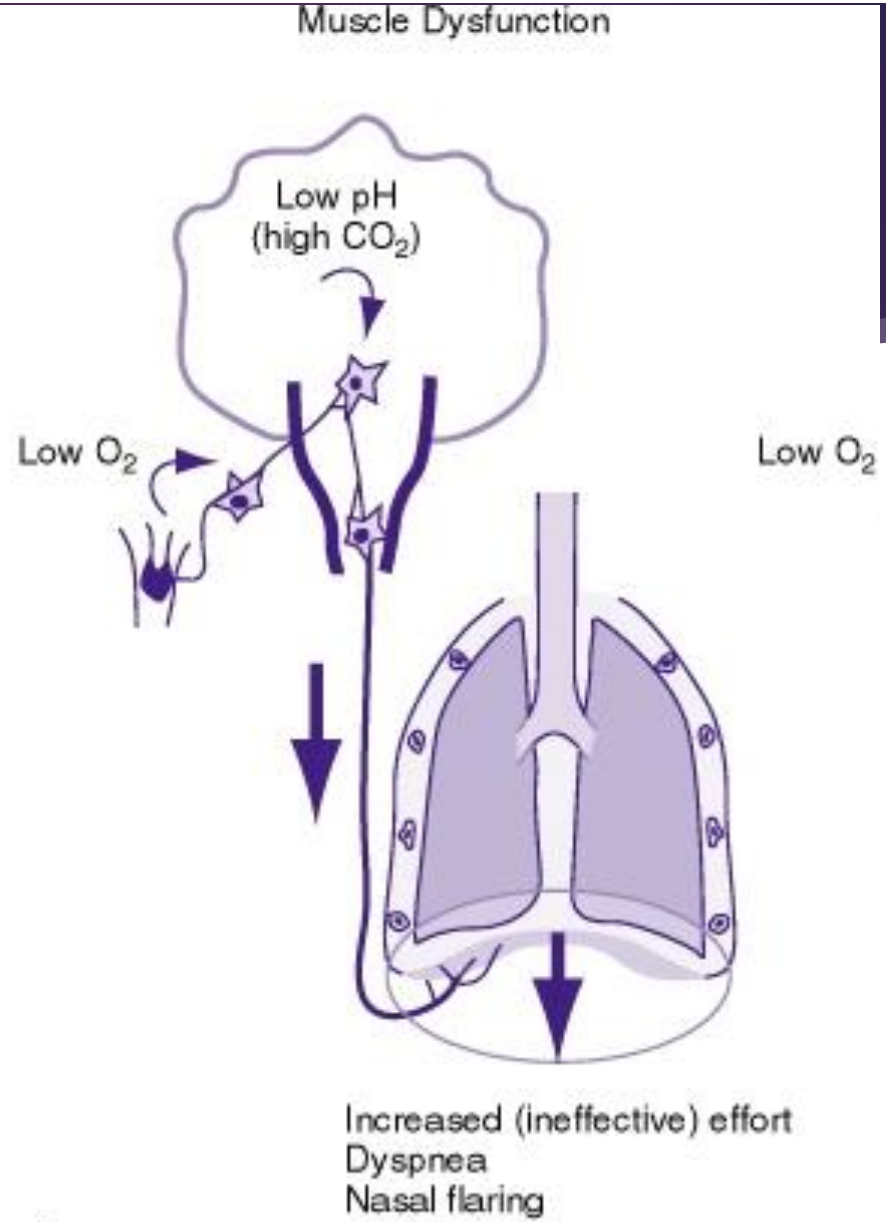
Respiratory Distress



Respiratory Distress



Respiratory Distress



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Characteristic clinical findings of restrictive and obstructive lung disease in infants and children

		Obstructive Disease	
finding	***Restrictive Disease***	***Extrathoracic***	***Intrethoracic***
RR	Increased	↓or ↑or Nl	Nl or ↑
Ins time	Reduced	Prolonged	Unchanged
Ex time	Reduced	Unchanged	prolonged
Accessory muscles	Inspiratory	Inspiratory	Ins & Ex

Characteristic clinical findings of restrictive and obstructive lung disease in infants and children(Con)

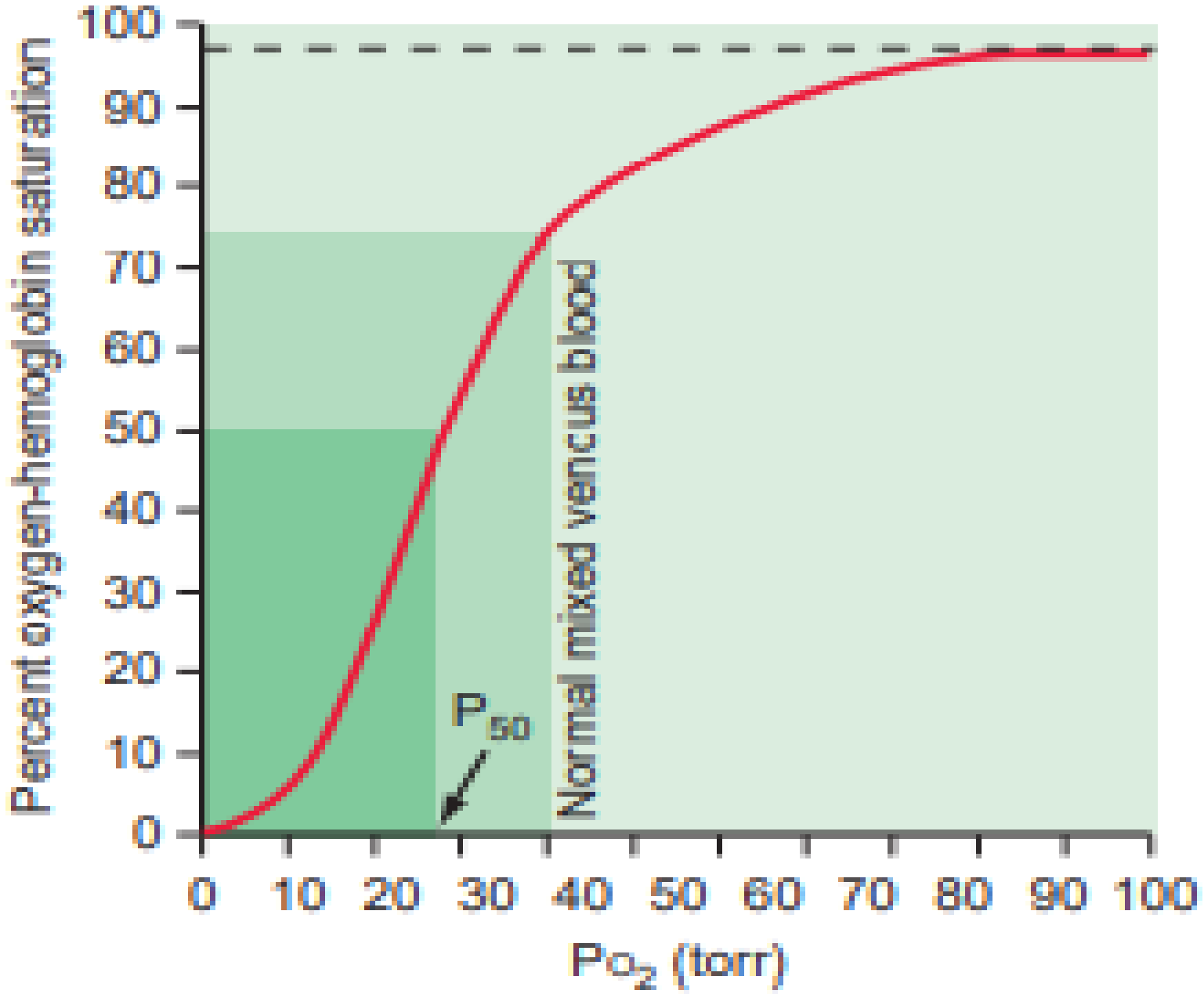
finding	*Restrictive Disease*	*Obstructive Disease*	
		Extrathoracic	*intrethoracic*
Chest retractions	Present	Present	Often present
Breathing effort	Shallow	Nl or ↓	Nl or ↓
Auscultatory findings	Crackles, grunting	Ins stridor	Exp wheezing
Lung Xray	↓LV alveolar densities	Normal	↑ lung volume

- Early rise in ICP results in stimulation of respiratory centers, leading to increases in the rate (tachypnea) and depth (hyperpnea) of respiration.
- Cerebral hemispheric and midbrain lesions often result in hyperpnea as well as tachypnea.
- Pathology affecting the pons and medulla manifests as irregular breathing patterns such as:
- apneustic breathing (prolonged inspiration with brief expiratory periods),
- Cheyne-Stokes breathing (alternate periods of rapid and slow breathing), and
- irregular, ineffective breathing or apnea.
- Bradycardia and apnea may be caused by CNS-depressant medications, poisoning, prolonged hypoxia, trauma, or infection.

MONITORING A CHILD IN RESPIRATORY DISTRESS AND RESPIRATORY FAILURE

- Clinical Examination
- Pulse oximetry
- Capnography
- Blood Gas
- AssessmePao2/Fio2 rationt of Oxygenation and Ventilation Deficits
- A-ao2 gradient
- Pao2/Fio2 ratio
- Pao2/Pao2
- Oxygenation index (OI)
- Ventilation index (VI)

(A-a) O2 gradient


Percent oxygen-hemoglobin saturation
100
90
80
70
60
50
40
30
20
10
0
P_{50}
Normal mixed vencus blood
0 10 20 30 40 50 60 70 80 90 100
Po_2 (torr)

Causes and troubleshooting erroneous pulse oximetry readings

Problem and potential errors	Solution
Inadequate waveform	
Malposition of probe	Reposition probe, alternate site
Motion artifact	Reposition probe, alternate site
Hypoperfusion	Reposition probe, alternate site, warming
Hypothermia	Use ear or forehead probe, warming
Skin pigment	Measure arterial blood gas
Falsely normal or elevated oximetry reading	
Carboxyhemoglobin (eg, carbon monoxide poisoning)	Co-oximetry
High levels of glycohemoglobin A1c	Measure arterial blood gas
Methemoglobin, sulfhemoglobin*	Multiwavelength co-oximetry (metHb), biochemical analysis (sulfHb)
Ambient light	Remove ambient light source
Skin pigment	Measure arterial blood gas
Falsely low oximetry reading	
Inadequate waveform	Reposition probe, alternate site
Methemoglobin*	Multiwavelength co-oximetry
Sulfhemoglobin*	Biochemical analysis
Sickle hemoglobin and inherited forms of abnormal hemoglobin	Measure HbS and abnormal Hb levels
Severe anemia	Measure arterial blood gas
Venous pulsations or congestion	Loosen probe, reposition patient or probe, measure arterial blood gas
Ambient light	Remove ambient light source
Nail polish	Remove polish or change site
Vital dyes	Usually transient, measure arterial blood gas

Diagnostic studies for evaluation of acute respiratory distress

Test	Indications	Comments
Bedside testing		
Pulse oximetry	All patients with respiratory distress	Erroneous readings may occur with improper probe application, poor waveform readings, or certain medical conditions. Refer to UpToDate content on causes of erroneous pulse oximetry readings.
$EtCO_2$ measurement	Confirmation of successful endotracheal intubation Noninvasive monitoring of ventilation in intubated and non-intubated patients Noninvasive monitoring for sedation in children	Measurable in non-intubated and intubated patients.
Electrocardiogram	Clinical suspicion of cardiac disease (eg, cardiac murmur, gallop, differential pulses or blood pressure between upper and lower extremities)	Typically combined with chest radiograph to assess heart size and pulmonary vasculature in order to determine need for echocardiography.
Point-of-care ultrasound	Clinical suspicion of pulmonary pathology (eg, pneumonia, pleural effusion, pneumothorax, or hemothorax), heart failure (can assess myocardial function and presence of pulmonary edema), or pericardial tamponade	To be performed by an appropriately trained and experienced provider. Other uses include confirmation of endotracheal tube placement, blood volume status, and presence of intra-abdominal or pelvic fluid.

Laboratory testing		
Arterial or venous blood gas	For arterial sample only, determine PaO_2 for calculation of physiologic measures of oxygenation (eg, A-a gradient, PaO_2/FiO_2 ratio) Correlate pCO_2 with $EtCO_2$ measurements Measure pH and correlate with venous pH	$EtCO_2$, pulse oximetry, and venous blood gases may be used as less invasive methods for ongoing monitoring of oxygenation, ventilation, and acid-base status if they correlate with arterial blood gas measurements.
Electrolytes, blood urea nitrogen, creatinine	Patients with metabolic acidosis	Assesses for the presence of an anion gap and renal dysfunction.
Glucose	Altered mental status, diabetic ketoacidosis	
Ammonia	Altered mental status and other findings suggestive of urea cycle defects	
Carboxyhemoglobin cooximetry	Smoke inhalation Altered mental status, headache, vomiting, and possible exposure to carbon monoxide (eg, blocked furnace flue)	Pulse oximetry is falsely elevated in the presence of carboxyhemoglobin.
Methemoglobin cooximetry	Cyanosis in the presence of a normal PaO_2 on arterial blood gas Exposure to agents known to cause methemoglobinemia (eg, nitrites, benzocaine, aniline dyes) or young infants with severe dehydration	Oxygen saturation by cooximetry identifies the presence of an abnormal hemoglobin if specific measure of methemoglobin is not available. Methemoglobinemia causes falsely normal or elevated pulse oximetry readings.
D-dimer	Clinical findings suggestive of pulmonary embolus (eg, low oxygenation, pleuritic chest pain, wedge-shaped infiltrate on chest radiograph, and predisposing condition [eg, sickle cell disease, thrombotic condition])	Pulmonary embolus is a rare cause of respiratory distress in children. Imaging is indicated for patients with moderate to high clinical probability. For recommended studies, refer to UpToDate topics on imaging for venous thromboembolism in children.

Imaging		
Lateral neck radiograph	Clinical findings suggestive of epiglottitis, retropharyngeal abscess, or ingested foreign body	Croup can usually be diagnosed clinically without a radiograph.
Chest radiograph	All children with significant respiratory distress and those with focal lung findings	
Forced expiratory or bilateral decubitus chest radiograph	Suspected foreign body aspiration	Hyperaeration noted on the side with the bronchial foreign body.
Unilateral decubitus chest radiograph	Assess whether lung opacity is due to parenchymal disease or effusion	Loculated effusions and very large effusions may not show evidence of layering.
Echocardiography (including bedside ultrasonography)	Identify cardiac tamponade; assess cardiac function and presence of structural heart disease	
Abdominal radiographs (supine and upright or cross-table lateral)	Significant abdominal tenderness and/or distension with concern for intestinal obstruction or perforation	Other testing (eg, ultrasound, upper gastrointestinal contrast study, abdominal CT or MRI) may also be indicated depending upon clinical findings and likely etiologies.
CT or MRI of the head	Clinical findings suggestive of increased intracranial pressure or intracranial mass lesion	

MANAGEMENT

- *Oxygen Administration*
- *Airway Adjuncts*
- *Inhaled Gases*
- *Positive-Pressure Respiratory Support*

Table 89.8 Approximate Oxygen Delivery According to Device and Flow Rates in Infants and Older Children*

DEVICE	FLOW (L/min)	FIO_2 DELIVERED
Nasal cannula	0.1-6	0.21-0.4
Simple face mask	5-10	0.4-0.6
Partial rebreather	6-15	0.55-0.7
Non-rebreather	6-15	0.7-0.95
Venturi mask	5-10	0.25-0.5
Hood/tent	7-12	0.21-1.0
High-flow systems	1-40	0.21-1.0

Airway Adjuncts

- Airway Adjuncts Maintenance of a patent airway is a critical step in maintaining adequate oxygenation and ventilation.

- Artificial pharyngeal airways may be useful in patients with oropharyngeal or nasopharyngeal airway obstruction and in those with neuromuscular weakness in whom inherent extrathoracic airway resistance contributes to respiratory compromise.

- ***Oropharyngeal airway***

- ***Nasopharyngeal airway***

Inhaled Gases

- Inhaled Gases Helium-oxygen mixture (heliox) is useful in overcoming airway obstruction and improving ventilation. Helium is much less dense and slightly more viscous than nitrogen. When substituted for nitrogen, helium helps maintain laminar flow across an obstructed airway, decreases airway resistance, and improves ventilation.

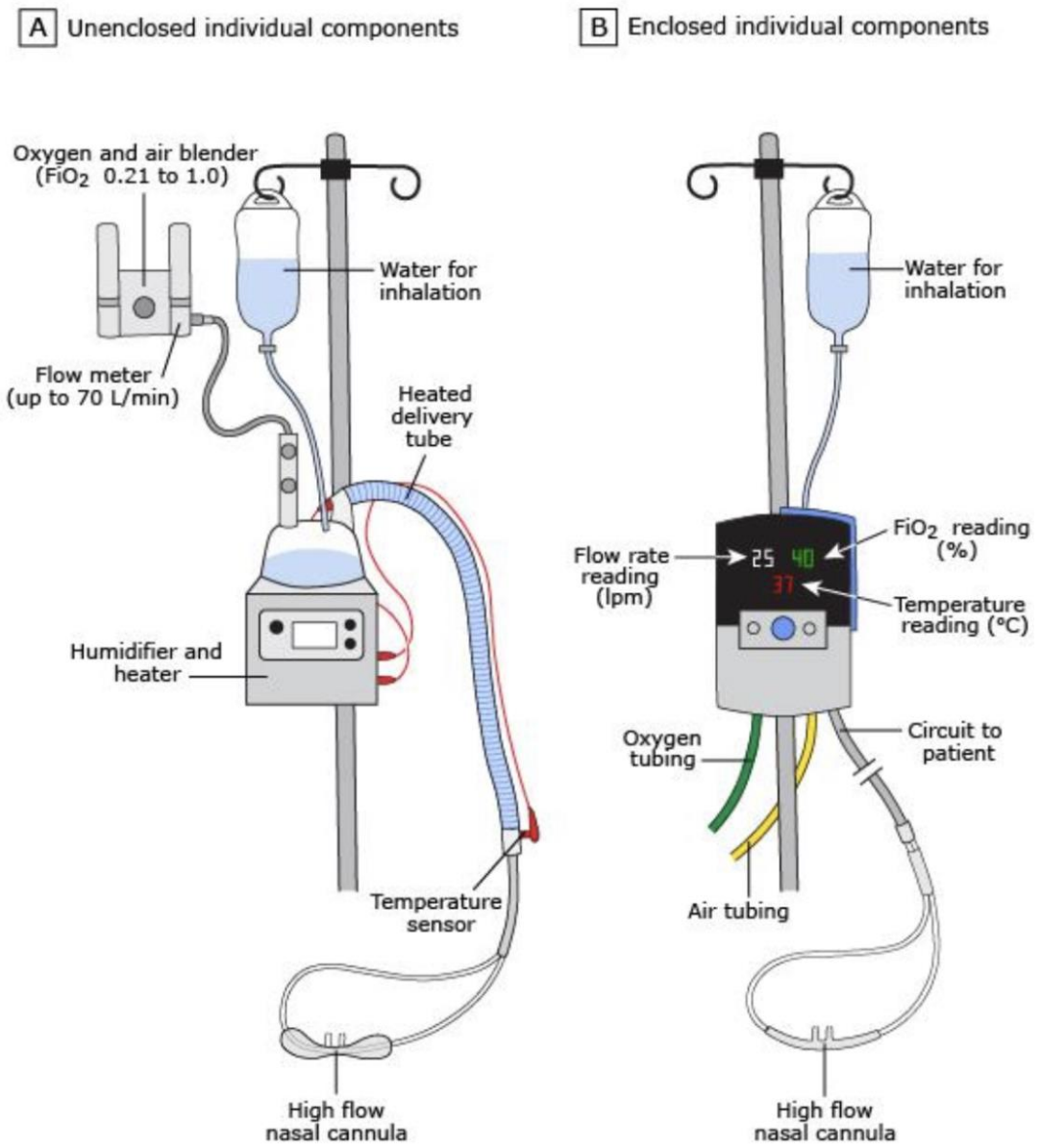
- Inhaled nitric oxide (iNO) is a powerful inhaled pulmonary vasodilator.

Positive-Pressure Respiratory Support

- *Positive airway pressure helps with aeration of partially atelectatic or filled alveoli, prevention of alveolar collapse at end-exhalation, and increase in functional residual capacity (FRC).*
- *These actions improve pulmonary compliance and hypoxemia, as well as decrease intrapulmonary shunt. In addition, positive pressure ventilation is useful in preventing collapse of extrathoracic airways . Improving compliance and overcoming airway resistance also improves tidal volume and therefore ventilation*

- ***High-flow nasal cannula***
- ***CPAP***
- ***BiPAP***
- ***Endotracheal Intubation and Mechanical Ventilation***

Common high-flow nasal cannula oxygen delivery circuits [1-3]



Management of life-threatening causes of acute respiratory compromise in children

Condition	Maneuver	Comments
Foreign body with acute airway obstruction¶	Back blows/chest thrusts (<1 year of age)	Maneuvers should only be used for patients who are unable to phonate.
	Abdominal thrusts (≥1 year of age)	Maneuvers should only be used for patients who are unable to phonate.
	Manual removal with finger sweep	Perform this maneuver only when a foreign body is visible in the oropharynx.
	Laryngoscopy and removal with Magill forceps	
	Needle cricothyrotomy	For patients with complete obstruction not rapidly relieved by the above actions and who have a supraglottic foreign body, this procedure is a temporizing measure that can provide oxygenation but not ventilation.
Laryngospasm[Δ]	Positive pressure with a ventilation bag and tight-fitting mask	Additional measures such as rapid sequence intubation or needle cricothyrotomy may be necessary if laryngospasm persists despite bag-mask ventilation.
Soft tissue upper airway obstruction[Δ]	Head tilt/chin lift	Avoid in patients who may have cervical spine injury.
	Jaw thrust	Use for patients who may have cervical spine injury.
	Nasopharyngeal airway	Use for conscious or unconscious patient.
	Oropharyngeal airway	Use only in an unconscious patient.
Respiratory failure[Δ]	Bag-mask ventilation	Suspect upper airway obstruction if unable to ventilate with proper size equipment and technique.
	High-flow nasal cannula[◇]	Use for spontaneously breathing patients with hypoxemic respiratory failure without hypercarbia.
	Noninvasive ventilation[§]	Use for spontaneously breathing patients with hypoxemic or hypercarbic respiratory failure. Contraindicated in children with upper airway disease, high risk for aspiration, or hemodynamic instability.
	Endotracheal intubation[¥]	Use for patient in respiratory failure requiring more than a few minutes of bag-mask ventilation, those with impending airway compromise (eg, thermal burns, severe epiglottitis, or airway trauma), and/or those who are unconscious or have altered mental status with an absent gag reflex. In a patient with an airway that is manageable with bag-mask or noninvasive ventilation, chest compressions and vascular access should be prioritized over intubation.
Tension pneumothorax	Needle thoracentesis	Patients will require chest tube or pigtail placement following emergency decompression.
Cardiac tamponade	Pericardiocentesis[‡]	Use ultrasound guidance whenever available.

Rapid overview: Emergency management of anaphylaxis in infants and children*

Diagnosis is made clinically:
The most common signs and symptoms are cutaneous (eg, sudden onset of generalized urticaria, angioedema, flushing, pruritus). However, 10 to 20% of patients have no skin findings.
Danger signs: Rapid progression of symptoms, evidence of respiratory distress (eg, stridor, wheezing, dyspnea, increased work of breathing, retractions, persistent cough, cyanosis), signs of poor perfusion, abdominal pain, vomiting, dysrhythmia, hypotension, collapse.
Acute management:
The first and most important therapy in anaphylaxis is epinephrine. There are **NO absolute contraindications to epinephrine** in the setting of anaphylaxis.
Airway: Immediate intubation if evidence of impending airway obstruction from angioedema. Delay may lead to complete obstruction. Intubation can be difficult and should be performed by the most experienced clinician available. Cricothyrotomy may be necessary.
IM epinephrine (1 mg/mL preparation): Epinephrine 0.01 mg/kg should be injected intramuscularly in the mid-outer thigh. For large children (>50 kg), the maximum is 0.5 mg per dose. If there is no response or the response is inadequate, the injection can be repeated in 5 to 15 minutes (or more frequently). If epinephrine is injected promptly IM, patients respond to one, two, or at most, three injections. If signs of poor perfusion are present or symptoms are not responding to epinephrine injections, prepare IV epinephrine for infusion (see below).
Place patient in recumbent position, if tolerated, and elevate lower extremities.
Oxygen: Give 8 to 10 L/minute via facemask or up to 100% oxygen, as needed.
Normal saline rapid bolus: Treat poor perfusion with rapid infusion of 20 mL/kg. Re-evaluate and repeat fluid boluses (20 mL/kg), as needed. Massive fluid shifts with severe loss of intravascular volume can occur. Monitor urine output.
Albuterol: For bronchospasm resistant to IM epinephrine, give albuterol 0.15 mg/kg (minimum dose: 2.5 mg) in 3 mL saline inhaled via nebulizer. Repeat, as needed.
H1 antihistamine: Consider giving diphenhydramine 1 mg/kg (max 50 mg IV, over 5 minutes) or cetirizine (children aged 6 months to 5 years can receive 2.5 mg IV, those 6 to 11 years of age can receive 5 or 10 mg IV, over 2 minutes).
H2 antihistamine: Consider giving famotidine 0.25 mg/kg (max 20 mg) IV, over at least 2 minutes.
Glucocorticoid: Consider giving methylprednisolone 1 mg/kg (max 125 mg) IV.
Monitoring: Continuous noninvasive hemodynamic monitoring and pulse oximetry monitoring should be performed. Urine output should be monitored in patients receiving IV fluid resuscitation for severe hypotension or shock.
Treatment of refractory symptoms:
Epinephrine infusion ¶: In patients with inadequate response to IM epinephrine and IV saline, give epinephrine continuous infusion at 0.1 to 1 mcg/kg/minute, titrated to effect.
Vasopressors ¶: Patients may require large amounts of IV crystalloid to maintain blood pressure. Some patients may require a second vasopressor (in addition to epinephrine). All vasopressors should be given by infusion pump, with the doses titrated continuously according to blood pressure and cardiac rate/function monitored continuously and oxygenation monitored by pulse oximetry.


خسته نباشین