Acute Respiratory Failure Lecture Notes

Acute respiratory failure is an inadequate ventilation resulting from the inability of the lungs to adequately maintain arterial oxygenation or eliminate carbon dioxide

- **Two classifications:**
  - Hypoxemic (type I), the most common type, with partial pressure of arterial oxygen (PaO2) less than 55 mm Hg, arterial oxygen saturation less than 88%, and normal or low partial pressure of arterial carbon dioxide (PaCO2)
  - Hypercapnic (type II), with PaCO2 greater than 50 mm Hg accompanied by acidemia or a pH less than 7.3

Pathophysiology

- Primarily hypercapnic respiratory failure results from inadequate alveolar ventilation due to a ventilation-perfusion mismatch and shunting.
- Primarily hypoxemic respiratory failure results from inadequate oxygen exchange between the alveoli and capillaries.
- Combined hypercapnic and hypoxemic respiratory failure commonly occurs.

Causes

- Airway obstruction
- Any condition that increases the work of breathing and decreases the respiratory drive of patients with chronic obstructive pulmonary disease
- Central nervous system depression
- Disorders of the peripheral nervous system, respiratory muscles, and chest wall
- Endocrine or metabolic disorders
- Gas exchange failure
- Heart failure
- Myocardial infarction (MI)
- Pulmonary emboli
- Pulmonary edema
- Respiratory tract infection
- Thoracic, alveolar, or airway abnormalities
- Ventilatory failure
- Sleep apnea
- Stroke

Risk Factors

- History of any disease or condition that affects the muscles, nerves, bones, or tissues that

support breathing
- Accumulated secretions secondary to cough suppression
- History of lung disease
- Smoking
- History of heart disease
- Narcotic use
- Severe or continuous bronchospasm
- Obesity-hypoventilation syndrome
- Hypothyroidism
- Kyphoscoliosis
- Toxin exposure

Incidence

- Acute respiratory failure occurs in patients with hypercapnia or hypoxemia. However, the overall frequency of the condition isn't clear.
- The disorder occurs in patients who have an acute deterioration in arterial blood gas (ABG) values.

Complications

- Tissue hypoxia
- Pulmonary embolism
- Barotrauma
- Pneumonia
- Hypotension
- Arrhythmia
- Acute MI
- Endocarditis
- Pericarditis
- Stress ulcers, gastric distention, pneumoperitoneum
- Chronic respiratory acidosis
- Metabolic alkalosis
- Respiratory and cardiac arrest
- Acute kidney injury

Assessment

History

- Presence of risk factor or underlying disease process
- Restlessness
- Change in mental status or level of consciousness
- Cyanosis
- Dyspnea
- Morning headache

Physical Findings

- Changes in mental status, confusion, somnolence
- Cyanosis of the oral mucosa, lips, and nail beds
- Yawning and use of accessory muscles
- Pursed-lip breathing
- Nasal flaring
- Ashen skin
- Tachypnea
- Cold, clammy skin
- Asymmetrical chest movement
- Accessory muscle use
- Decreased tactile fremitus over obstructed bronchi or a pleural effusion
- Increased tactile fremitus over consolidated lung tissue
- Hyperresonance
- Diminished or absent breath sounds
- Wheezes (with asthma)
- Rhonchi (with bronchitis)
- Crackles (with pulmonary edema)
- Myoclonus, seizures (with severe hypoxemia)
- Asterixis (with severe hypercapnia)
- Tachycardia

Diagnostic Test Results

Laboratory

- Arterial blood gas analysis reveals hypercapnia and/or hypoxemia. (Commonly accepted values include PaO2 of less than 55 mm Hg and PaCO2 of more than 50 mm Hg on room air.)
- White blood cell count and differential is increased in bacterial infections.
- Serum hemoglobin level test and hematocrit test may show anemia, which decreases oxygen-carrying capacity.
- Potassium level (serum) results may reveal hypokalemia, and chloride level (serum) results may show hypochloremia.
- Blood culture or sputum culture shows the pathogen.
- Cardiac enzymes may identify MI as a causative factor.
- Decreased thyroid-stimulating hormone level (serum) may indicate hypothyroidism as a causative factor.

Imaging

- Chest radiography may show underlying pulmonary diseases or conditions, such as emphysema, atelectasis, lesions, pneumothorax, infiltrates, and effusions.
- Echocardiography may reveal a cardiac cause of respiratory failure.
- Computed tomography scanning (thorax) may reveal abnormalities, such as pulmonary embolus.

Diagnostic Procedures

- Electrocardiography may show arrhythmias, cor pulmonale, or myocardial ischemia.
- Pulse oximetry may show decreased arterial oxygen saturation.
- Pulmonary function tests are abnormal.

Identifying respiratory failure
Use these measurements to identify respiratory failure:

- Vital capacity less than 15 mL/kg
- Tidal volume less than 3 mL/kg
- Negative inspiratory force less than -25 cm H2O
- Respiratory rate more than twice the normal rate
- Diminished PaO2 despite increased fraction of inspired oxygen
- Elevated PaCO2, with pH lower than 7.3

Treatment

General

- Treatment of underlying cause
- Venous thromboembolism (VTE) prophylaxis while hospitalized

Diet

- Fluid restriction (if the underlying cause is heart failure)
- Small frequent meals when on noninvasive positive pressure ventilation or when extubated
- Enteral tube feedings or parenteral nutrition if the patient is mechanically ventilated

Activity

- Bed rest initially, early mobilization as tolerated
- Passive or active range-of-motion exercises

Medications

- Cautious oxygen therapy to increase PaO2
- Possible high-flow nasal cannula oxygen therapy for patients with acute hypoxemic respiratory failure
- Histamine-receptor antagonists, such as famotidine, as ordered
- Antibiotics to treat underlying infection
- Antipyretics, such as acetaminophen or ibuprofen, for fever if infection is the underlying cause
- Bronchodilators, such as terbutaline sulfate, albuterol sulfate, theophylline, or ipratropium

bromide, to alleviate obstruction and bronchospasm
- Corticosteroids such as methylPREDNISolone to reduce inflammation
- Positive inotropic agents, such as DOPamine hydrochloride or DOBUTamine hydrochloride, to increase cardiac contractility and vasodilation to improve perfusion
- Loop diuretics such as furosemide for pulmonary vascular congestion or pulmonary edema or to alleviate heart failure
- Nitrates, such as nitroglycerin or nitroprusside sodium, to reduce preload and afterload resulting in a decreased myocardial oxygen demand
- Morphine sulfate as an adjunct treatment for acute pulmonary edema to decrease preload and systemic vascular resistance and to reduce anxiety
- Enoxaparin sodium for VTE drug prophylaxis

Procedures

- Extracorporeal membrane oxygenation for severe but potentially reversible respiratory failure
- Noninvasive positive pressure ventilation for mild to moderate respiratory failure
- Mechanical ventilation with an endotracheal (ET) tube or a tracheostomy tube

Surgery

- Possible tracheostomy

Nursing Considerations

Nursing Interventions

- Give prescribed drugs as indicated (via inhalation, oral route, nebulization, or IV). If giving IV, ensure patent IV access and perform IV site care according to facility guidelines.
- Orient the patient frequently. Provide reminders to help the patient remain oriented.
- Administer humidified supplemental oxygen as ordered based on oxygen saturation levels via pulse oximetry readings or ABG values.
- Maintain a patent airway.
- Help clear the patient's secretions with postural drainage and chest physiotherapy; also suction as necessary.
- Obtain blood samples for ABG analysis, as ordered.
- Routinely check all noninvasive positive pressure device and ventilator settings according to facility guidelines.
- Secure the ET or tracheostomy tube and perform care according to facility guidelines.
- Administer enteral tube feedings as ordered and monitor tolerance.
- Provide alternative communication means, such as a pen and paper or communication board.
- Provide sedation as necessary.
- Encourage pursed-lip breathing, coughing, and diaphragmatic breathing exercises.
- Note the color and characteristics of any sputum produced.
- Encourage the use of incentive spirometry to promote lung expansion.
- Turn and reposition the patient regularly and frequently, unless contraindicated. Base the

frequency of repositioning on the patient's tissue tolerance, skin condition, mobility, medical condition, and treatment goals. Assist with or perform oral hygiene.
- Auscultate heart and lung sounds for changes.
- Position the patient for comfort, with the head of the bed elevated 30 to 45 degrees, if appropriate, to promote optimal gas exchange and prevent ventilator-associated pneumonia (if a ventilator is being used).
- Maintain normothermia with antipyretics.
- Cluster care activities to provide for frequent, uninterrupted rest periods. Institute energy conservation measures.
- Obtain daily weight. Check skin turgor and inspect mucous membranes for changes in color or moisture.
- Ensure adequate hydration and nutrition. Test stool and other drainage for occult blood.
- Obtain specimens for such laboratory tests as complete blood counts, serum electrolyte levels, and ABG values, as ordered.
- Apply antiembolism stockings or sequential compression stockings to prevent VTE.

Monitoring

- Vital signs and pulse oximetry
- Oxygen saturation levels
- Respiratory status, including respiratory rate and depth and breath sounds
- Intake and output
- Laboratory studies, including ABG and electrolyte levels
- Daily weight
- Level of consciousness
- Cardiac rate and rhythm
- Hemodynamic values
- Chest radiography results
- Complications
- Sputum quality, consistency, and color
- Signs and symptoms of infection
- Skin integrity
- Noninvasive positive-pressure ventilation device and ventilator settings, including positive end-expiratory pressure and fraction of inspired oxygen
- ET tube position and patency; tracheostomy tube function, patency, and insertion site
- Signs and symptoms of stress ulcer
- Enteral tube feeding tolerance

Associated Nursing Procedures

- Aerosol treatment
- Alignment and pressure-reducing device application
- Arterial puncture for blood gas analysis
- Bedside spirometry
- Cardiac monitoring
- Chest physiotherapy
- Continuous positive airway pressure (CPAP) use
- Endotracheal tube removal

- Endotracheal tube repositioning
- Enteral feeding tube insertion, gastric and duodenal
- Enteral feeding tube removal, gastric and duodenal
- Extracorporeal membrane oxygenation (ECMO) monitoring and care
- Humidifier therapy, active, bubble
- Incentive spirometry
- Intubation with direct visualization
- Mechanical ventilation, positive pressure
- Nasotracheal suctioning
- Oral care for an intubated patient
- Oronasopharyngeal suctioning
- Oropharyngeal airway insertion and care
- Oxygen administration
- Pulse oximetry
- Sputum collection by expectoration
- Sputum collection by tracheal suctioning
- Tracheal cuff pressure measurement
- Tracheal suctioning, intubated patient
- Tracheostomy cuff inflation and deflation
- Tracheostomy ties change
- Tracheostomy tube cannula and stoma care
- Weaning a patient from a ventilator

Patient Teaching

General

Include the patient's family or caregiver in your teaching, when appropriate. Provide information according to their individual communication and learning needs. Be sure to cover:

- disorder, diagnostic testing, underlying causes, monitoring, and treatment, including the possible need for intubation, equipment, and monitoring devices being used
- medications and their potential adverse effects, such as increased heart rate with bronchodilators and electrolyte imbalances with diuretics
- signs and symptoms of therapy effectiveness
- need for and use of mechanical ventilation
- rationale for tracheostomy, if indicated; tracheostomy tube and site care
- potential complications of treatment, such as gastrointestinal bleeding and infection
- signs and symptoms to report to the practitioner, such as increasing respiratory difficulty
- smoking cessation, if appropriate
- communication techniques if the patient is intubated
- signs and symptoms of respiratory infection
- measures to prevent VTE
- need for continued monitoring and follow-up to evaluate the effectiveness of therapy
- recommendations for immunizations, such as pneumococcal and influenza vaccines, to reduce the risk of infection.

Discharge Planning

- Participate as part of a multidisciplinary team to coordinate discharge planning efforts. The team may include the bedside nurse, social worker, care manager, respiratory therapist, physical therapist, nutritionist, and pulmonologist.
- Determine the appropriate posthospital setting to which the patient should be discharged.
- Assess the patient's and family's understanding of the diagnosis, treatment, prognosis, follow-ups, and warning signs for which to seek medical attention.
- Assess the patient's level of independence before admission.
- Evaluate how the current illness will impact the patient's independence.
- Identify the patient's formal and informal supports.
- Identify the patient's and family's goals, preferences, comprehension, and concerns about discharge.
- Confirm arrangements for transportation to initial follow-ups.
- Provide a list of prescribed drugs, including the dosage, prescribed time schedule, and adverse reactions to report to the practitioner. Provide the patient (and family or caregiver, as needed) with written information on the medications that the patient should take after discharge.
- Assess the patient's and family's understanding of prescribed medication, including dosage, administration, expected results, duration, and possible adverse effects.
- Assess the patient's ability to obtain medications; identify the party responsible for obtaining medications.
- Instruct the patient to provide a list of medications to the practitioner who will be caring for the patient after discharge; to update the information when the practitioner discontinues medications, changes doses, or adds new medications (including over-the-counter products); and to carry a medication list that contains all of this information at all times in the event of an emergency.
- Ensure that the patient and caregivers receive medical contact information.
- Ensure that the patient or caregiver receives a copy of the discharge instructions and that a copy is placed in the patient's medical record.
- Provide information on smoking cessation, if appropriate.
- Provide contact information regarding local support groups or services.
- Document the discharge planning evaluation in the patient's clinical record, including who was involved in discharge planning and teaching, their understanding of the teaching provided, and any need for follow-up teaching.