

RESPIRATORY ACID-BASE IMBALANCES

The body has the remarkable ability to maintain plasma pH within a narrow range of 7.35–7.45. It does so by means of chemical buffering mechanisms involving the lungs and kidneys. Although simple acid-base imbalances (e.g., respiratory acidosis) do occur, mixed acid-base imbalances are more common (e.g., the respiratory acidosis/metabolic acidosis that occurs with cardiac arrest).

RESPIRATORY ACIDOSIS (PRIMARY CARBONIC ACID EXCESS)

Respiratory acidosis (elevated PaCO₂ level) is caused by hypoventilation with resultant excess carbonic acid (H₂CO₃). Acidosis can be due to/associated with primary defects in lung function or changes in normal respiratory pattern. The disorder may be acute or chronic.

Compensatory mechanisms include (1) an increased respiratory rate; (2) hemoglobin (Hb) buffering, forming bicarbonate ions and deoxygenated Hb; and (3) increased renal ammonia acid excretions with reabsorption of bicarbonate.

Acute respiratory acidosis: Associated with acute pulmonary edema, aspiration of foreign body, overdose of sedatives/barbiturate poisoning, smoke inhalation, acute laryngospasm, hemothorax/pneumothorax, atelectasis, adult respiratory distress syndrome (ARDS), anesthesia/surgery, mechanical ventilators, excessive CO₂ intake (e.g., use of rebreathing mask, cerebral vascular accident [CVA] therapy), Pickwickian syndrome.

Chronic respiratory acidosis: Associated with emphysema, asthma, bronchiectasis; neuromuscular disorders (such as Guillain-Barré syndrome and myasthenia gravis); botulism; spinal cord injuries.

CARE SETTING

This condition does not occur in isolation, but rather is a complication of a broader health problem/disease or condition for which the severely compromised patient requires admission to a medical-surgical or subacute unit.

RELATED CONCERNS

Plans of care specific to predisposing factors/disease or medical condition, e.g.:

Cerebrovascular accident (CVA)/stroke

Chronic obstructive pulmonary disease (COPD) and asthma

Craniocerebral trauma (acute rehabilitative phase)

Eating disorders: obesity

Alcohol: acute withdrawal

Spinal cord injury (acute rehabilitative phase)

Surgical intervention

Ventilatory assistance (mechanical)

OTHER CONCERNS

Fluid and electrolyte imbalances

Metabolic acidosis

Metabolic alkalosis

Patient Assessment Database

Dependent on underlying cause. Findings vary widely.

ACTIVITY/REST

May report: Fatigue, mild to profound

May exhibit: Generalized weakness, ataxia/staggering, loss of coordination (chronic), to stupor

CIRCULATION

May exhibit: Low BP/hypotension with bounding pulses, pinkish color, warm skin (reflects vasodilation of severe acidosis)
Tachycardia, irregular pulse (other/various dysrhythmias)
Diaphoresis, pallor, and cyanosis (late stage)

FOOD/FLUID

May report: Nausea/vomiting

NEUROSENSORY

May report: Feeling of fullness in head (acute—associated with vasodilation)
Headache, dizziness, visual disturbances

May exhibit: Confusion, apprehension, agitation, restlessness, somnolence; coma (acute)
Tremors, decreased reflexes (severe)

RESPIRATION

May report: Shortness of breath; dyspnea with exertion

May exhibit: Respiratory rate dependent on underlying cause, i.e., decreased in respiratory center depression/
muscle paralysis; otherwise rate is rapid/shallow
Increased respiratory effort with nasal flaring/yawning, use of neck and upper body muscles
Decreased respiratory rate/hypoventilation (associated with decreased function of respiratory center as in head trauma, oversedation, general anesthesia, metabolic alkalosis)
Adventitious breath sounds (crackles, wheezes); stridor, crowing

TEACHING/LEARNING

Refer to specific plans of care reflecting individual predisposing/contributing factors.
Discharge plan DRG projected mean length of inpatient stay: 4.9 days
considerations: May require assistance with changes in therapies for underlying disease process/condition
Refer to section at end of plan for postdischarge considerations.

DIAGNOSTIC STUDIES

ABGs: PaO₂: Normal or may be low. Oxygen saturation (SaO₂) decreased.

PaCO₂: Increased, greater than 45 mm Hg (primary acidosis).

Bicarbonate (HCO₃): Normal or increased, greater than 26 mEq/L (compensated/chronic stage).

Arterial pH: Decreased, less than 7.35.

Electrolytes: Serum potassium: Typically increased.

Serum chloride: Decreased.

Serum calcium: Increased.

Lactic acid: May be elevated.

Urinalysis: Urine pH decreased.

Other screening tests: As indicated by underlying illness/condition to determine underlying cause.

NURSING PRIORITIES

1. Achieve homeostasis.
2. Prevent/minimize complications.
3. Provide information about condition/prognosis and treatment needs as appropriate.

DISCHARGE GOALS

1. Physiological balance restored.
2. Free of complications.
3. Condition, prognosis, and treatment needs understood.
4. Plan in place to meet needs after discharge.

NURSING DIAGNOSIS: Gas Exchange, impaired

May be related to

Ventilation perfusion imbalance (e.g., altered oxygen-carrying capacity of blood, altered oxygen supply, alveolar-capillary membrane changes, or altered blood flow)

Possibly evidenced by

Dyspnea with exertion, tachypnea

Changes in mentation, irritability

Tachycardia

Hypoxia, hypercapnia

DESIRED OUTCOMES/EVALUATION CRITERIA—PATIENT WILL:

Electrolyte and Acid-Base Balance (NOC)

Demonstrate improved ventilation and adequate oxygenation of tissues as evidenced by ABGs within patient's acceptable limits and absence of symptoms of respiratory distress.

Knowledge: Disease Process (NOC)

Verbalize understanding of causative factors and appropriate interventions.

Participate in treatment regimen within level of ability/situation.

ACTIONS/INTERVENTIONS	RATIONALE
<p>Acid-Base Management: Respiratory Acidosis (NIC)</p> <p>Independent</p> <p>Monitor respiratory rate, depth, and effort.</p> <p>Auscultate breath sounds.</p> <p>Note declining level of awareness/ consciousness.</p> <p>Monitor heart rate/rhythm.</p> <p>Note skin color, temperature, moisture.</p> <p>Encourage/assist with deep-breathing exercises, turning, and coughing. Suction as necessary. Provide airway adjunct as indicated. Place in semi-Fowler's position.</p>	<p>Alveolar hypoventilation and associated hypoxemia lead to respiratory distress/failure.</p> <p>Identifies area(s) of decreased ventilation (e.g., atelectasis) or airway obstruction and changes as patient deteriorates or improves, reflecting effectiveness of treatment, dictating therapy needs.</p> <p>Signals severe acidotic state, which requires immediate attention. <i>Note:</i> In recovery, sensorium clears slowly because hydrogen ions are slow to cross the blood-brain barrier and clear from cerebrospinal fluid and brain cells.</p> <p>Tachycardia develops early because the sympathetic nervous system is stimulated, resulting in the release of catecholamines, epinephrine, and norepinephrine, in an attempt to increase oxygen delivery to the tissues. Dysrhythmias that may occur are due to hypoxia (myocardial ischemia) and electrolyte imbalances.</p> <p>Diaphoresis, pallor, cool/clammy skin are late changes associated with severe or advancing hypoxemia.</p> <p>These measures improve lung ventilation and reduce/prevent airway obstruction associated with accumulation of mucus.</p>

ACTIONS/INTERVENTIONS	RATIONALE
<p>Acid-Base Management: Respiratory Acidosis (NIC)</p> <p>Independent</p> <p>Restrict use of hypnotic sedatives or tranquilizers.</p> <p>Discuss cause of chronic condition (when known) and appropriate interventions/self-care activities.</p> <p>Collaborative</p> <p>Assist with identification/treatment of underlying cause.</p> <p>Monitor/graph serial ABGs, pulse oximetry readings; Hb, serum electrolyte levels.</p> <p>Administer oxygen as indicated. Increase respiratory rate or tidal volume of ventilator, if used.</p> <p>Assist with ventilatory aids, e.g., IPPB in conjunction with bronchodilators. Monitor peak flow pressure.</p> <p>Maintain hydration (IV/PO)/provide humidification.</p> <p>Provide appropriate chest physiotherapy, including postural drainage and breathing exercises.</p> <p>Administer IV solutions such as lactated Ringer's solution or 0.6 M solution of sodium lactate.</p> <p>Administer medications as indicated, e.g.: Naloxone hydrochloride (Narcan);</p> <p>Sodium bicarbonate (NaHCO₃);</p>	<p>In the presence of hypoventilation, respiratory depression and CO₂ narcosis may develop.</p> <p>Promotes participation in therapeutic regimen, and may reduce recurrence of disorder.</p> <p>Treatment of disorder is directed at improving alveolar ventilation. Addressing the primary condition (e.g., oversedation, lung/respiratory system trauma, pulmonary edema, aspiration) promotes correction of the acid-base disorder.</p> <p>Evaluates therapy needs/effectiveness. <i>Note:</i> Bedside pulse oximetry monitoring is used to show early changes in oxygenation before other signs or symptoms are observed.</p> <p>Prevents/corrects hypoxemia and respiratory failure. <i>Note:</i> Must be used with caution in presence of emphysema because respiratory depression/failure may result.</p> <p>Increases lung expansion and opens airways to improve ventilation, preventing respiratory failure.</p> <p>Assists in correction of acidity and thinning/mobilization of respiratory secretions.</p> <p>Aids in clearing secretions, which improves ventilation, allowing excess CO₂ to be eliminated.</p> <p>May be useful in nonemergency situations to help control acidosis, until underlying respiratory problem can be corrected.</p> <p>May be useful in arousing patient and stimulating respiratory function in presence of drug overdose/sedation, or acidosis resulting from cardiac arrest.</p> <p>May be given in small IV doses in emergency situations to quickly correct acidosis if pH is less than 7.25 and hyperkalemia coexists. <i>Note:</i> Rebound alkalosis or tetany may occur.</p>

ACTIONS/INTERVENTIONS	RATIONALE
<p data-bbox="267 310 735 373">Acid-Base Management: Respiratory Acidosis (NIC)</p> <p data-bbox="235 415 407 443">Collaborative</p> <p data-bbox="235 464 488 491">Potassium chloride (KCl);</p> <p data-bbox="235 667 399 695">Bronchodilators;</p> <p data-bbox="235 724 781 787">Provide low-carbohydrate, high-fat diet (e.g., Pulmocare feedings), if indicated.</p>	<p data-bbox="824 464 1382 638">Replaces potassium that shifts out of cells during acidotic state. Correction of the acidosis may cause a relative serum hypokalemia as potassium shifts back into cells. Potassium imbalance can impair neuromuscular/respiratory function, causing generalized muscle weakness and cardiac dysrhythmias.</p> <p data-bbox="824 667 1377 695">Helps open constricted airways to improve gas exchange.</p> <p data-bbox="824 724 1354 787">Helps reduce CO₂ production and improves respiratory muscle function and metabolic homeostasis.</p>

POTENTIAL CONSIDERATIONS following acute hospitalization (dependent on patient's age, physical condition/presence of complications, personal resources, and life responsibilities)
Refer to Potential Considerations relative to underlying cause of acid-base disorder.