Acute Breathing Failure

Muscles of Breathing - Diaphragm

Muscles of Breathing - Skeletal

Control of Breathing – Volitional

Control of Breathing - Automatic

Integrated Control of Breathing

Control of breathing involves numerous afferent and efferent neural arcs, including volitional, sensory, and biochemical input and motor output to respiratory muscles, facial structures, and airway effectors.

All of these signals are integrated, modulated, and emitted to effector organs by the brain. It is for this reason that brain death eliminates all breathing function.
Motor Neuron Failure

- Guillain Barre
- Spinal Muscle Atrophy
- Myasthenia Gravis
- Polio

Atrophy of Thoracic Skeletal Musculature
Primary Regulatory Dysfunction

- Prematurity
- Chiari Malformation
- Ondine’s Curse
- Stroke

Cerebral Dysfunction

- Encephalopathy
- Encephalitis
- Meningitis
- Respiratory Syncytial Virus
- Tetanus (Impairs inhibitory CNS messengers)

Failure of Breathing

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Failure of neural control</td>
<td>Uncal herniation, central hyperventilation</td>
</tr>
<tr>
<td>Failure of muscles or breathing</td>
<td>Insufficient muscle diadochokinesis, hypoxemia</td>
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<tr>
<td>Failure of mechanics of breathing</td>
<td>Flail chest, diaphragmatic paralysis</td>
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</tbody>
</table>

Causes of Muscle Failure

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Example</th>
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<tbody>
<tr>
<td>Muscle exhaustion</td>
<td>Lung dysfunction, airway obstruction</td>
</tr>
<tr>
<td>Overwork</td>
<td>Shock, hypoxemia</td>
</tr>
<tr>
<td>Inadequate substrate</td>
<td>Hypoxemia</td>
</tr>
<tr>
<td>Muscle plegia</td>
<td>Hypokalemia</td>
</tr>
<tr>
<td>Muscle tetany</td>
<td>Tetanus, hypocalcemia</td>
</tr>
</tbody>
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Muscle Failure – Clinical Premise
Respiratory muscles may not be able to perform the work required for normal respiratory gas exchange. This results in primary breathing failure.

- Inadequate Substrate Availability (shock)
- Reduced Muscle Capacity (myopathy)
- Diminished Muscle Bulk (muscle wasting)
- Neuromuscular Disease or Blockade (vecuronium)
- Neurologic Disease (Guillain Barre)
- Excessive Respiratory Demand (lung disease)

Muscle Anaerobic Capacity

Why intubate the patient in shock?
Treat inadequate substrate delivery.

- Avert respiratory arrest.
- Reduce whole body oxygen demand.
- Facilitate diagnostic and therapeutic procedures.
- Prevent hypoxemia.

Inability of Respiratory Muscles to Match Work to Respiratory Demand
Muscular Dystrophy
Muscle Wasting
- Chronic illness
- Starvation

Neuromotor Junction Failure
- Curare (succinyl choline, vecuronium, etc.)
- Myasthenia Gravis
- Botulism

Mechanical Disadvantages
The normal position of the diaphragm allows it to stretch or “load” during expiration. In inspiration, its muscular attachment to the thorax pulls it vertically downward like a piston.

Mechanical Disadvantages
Infancy

Air-trapping, abdominal distension, or other disorders that cause flattening of the diaphragm interfere with “loading” and with the direction of contraction.
Mechanical Disadvantages

Infancy

Malacia

- Abdominal distension
- Ascites
- Sacrococcygeal Teratoma
- Bronchopulmonary Dysplasia
- Hyperinflation (Asthma)
Mechanical Disadvantages - Intrinsic Lung Disease

- Host of etiologies which cause:
  - Impaired respiratory gas exchange
  - Elevated work of breathing
  - Respiratory inefficiency

Mechanical Disadvantages - Scoliosis

Mechanical Disadvantages - Paralysis or Eventration of Diaphragm

- Diaphragmatic Paralysis
- Flail Chest
- Diaphragmatic Hernia

Mechanical Disadvantages - Jeune's Syndrome (Asphyxiating Thoracic Dystrophy)
Mechanical Disadvantages
Miscellaneous Congenital Airway Defects

Mechanisms of Acute Breathing Failure

- Failure of Neural Control
- Failure of Muscles of Breathing
- Failure of Mechanics of Breathing

Thank you...