Primary and Secondary Respiration

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"Who came first?"
Objectives

- Define:
  - Primary Respiratory Mechanism (PRM)
  - Secondary Respiratory Mechanism (SRM)
- Discuss Relationships Between PRM and SRM
  - How are they related?
  - Where do they meet?
  - What is the clinical significance of this interrelationship?
Primary Respiratory Mechanism

• **Primary** – underlying all other physiologic functions
• **Respiratory** – concerned with cellular respiration
• **Mechanism** – cranial articulations and sacral respiratory motion between the ilia
Anatomy and Physiology of the PRM

- **Structural components:**
  - Cranial articular mechanism
  - Intracranial and intraspinal membranes
  - Sacrum

- **Functional components:**
  - CSF
  - Inherent motion of the CNS
  - Inherent potency
Secondary Respiratory Mechanism (SRM)

- SECONDARY – dependent on the PRM

- RESPIRATORY – concerned with alveolar respiration

- MECHANISM – includes anatomic structures from nasal passages to alveoli; also includes rib cage and diaphragms
Anatomy and Physiology of the Secondary Respiratory Mechanism (SRM)

- Structural components
  - Nasal passages
  - Pharynx
  - Larynx
  - Bronchi
  - Lungs
  - Thoracic cage
  - Diaphragms: thoracoabdominal, pelvic, cranial
Anatomy and Physiology of the Secondary Respiratory Mechanism (SRM)

• Functional components:
  • Concerned with thoracic (alveolar) respiration
  • $\text{O}_2 – \text{CO}_2$ transfer mechanism
  • Intimately connected to other body systems such as cardiovascular, neurological, musculoskeletal
Commonalities Between the Two Systems

- Vital to life
- Phasic in nature
- Respond to metabolic demands
Some Possible PRM-SRM Relationships

• Both have spontaneous excursions
• Can be in or out of phase with each other
• They can move in an unrelated fashion, with the PRM typically slower
• SRM can enhance PRM or assist with treatment of PRM – for example, use of respiratory cooperation
Some Possible PRM-SRM Relationships

- The PRM is constant and stable
- The SRM is more prone to modulation and adaptation to the environment
- The SRM adjusts to the external atmospheric conditions to meet the needs of the internal metabolic processes, including the PRM.
Some Possible PRM-SRM Relationships

- Restriction of motion of cranial bones, and/or cranial, thoracic and pelvic diaphragms can alter PRM amplitude and frequency
- SRM can be used to influence PRM
Some Possible PRM-SRM Relationships

• The PRM continues as long as life persists
• The SRM may be interrupted or stopped, and resumed through forceful manipulation of the temporal bones
An Interesting Analogy?

- The PRM may be compared to the rise and fall of the oceanic tide.
- The SRM may be thought of as the waves of the ocean water that arise from and respond to environmental changes.
Where do the PRM and SRM meet?

- Some examples:
  - Temporal bones
  - Occiput and/or Sacrum
  - Neurological control system for respiration
  - The core link and the three diaphragms
Where do the PRM and SRM meet?

- PRM initiates and maintains activity of CNS respiratory centers.
- These CNS centers then drive the action of the SRM components.
- Provides a “pathway” for the influence and action of the inherent potency of the PRM.
Temporal Bones

Superior View of the Left Temporal Bone Showing the Axis of Rotation
Temporal Bones

Mastoid process moves medial and posterior.

EXTERNAL

POSTERIOR

INTERNAL

Mastoid process moves lateral and anterior.
Occiput and Sacrum
Connection to the Neurological System

**Human Nervous System**

- **Central Nervous System (CNS)**
  - Brain and spinal cord
  - Interneurons

- **Peripheral Nervous System (PNS)**
  - Everything else
  - Sensory & motor neurons

**Somatic Nervous System**

- Voluntary
- Input from sense organs
- Output to skeletal muscles

**Autonomic Nervous System**

- Involuntary
- Input from internal receptors
- Output to smooth muscles & glands

**Sympathetic Motor System**

- "fight or flight" responses
- Neurotransmitter: noradrenaline
  - "Adrenergic System"

**Parasympathetic Motor System**

- Relaxing responses
- Neurotransmitter: acetylcholine
  - "Cholinergic System"
Neural Control of Respiration

- Higher centers of the brain (voluntary control of breathing)
- Emotional stimuli acting through the limbic system
- Peripheral chemoreceptors: $O_2 \downarrow$, $CO_2 \uparrow$, pH $\downarrow$
- Central chemoreceptors: $CO_2 \uparrow$, pH $\downarrow$
- Hering-Breuer reflex (stretch receptors in lungs)
- Proprioceptors in muscles and joints
- Receptors for touch, temperature, and pain stimuli
- Centers in the medulla and pons determine basic rhythm of respiration
Connection to the Musculoskeletal System
The Core Link and the Three Diaphragms
What is a Diaphragm?

• A connective tissue septum which divides a body cavity into superior and inferior compartments.
• This septum is attached at its periphery to a mobile part of the bony skeleton and is subject to rhythmic motion related to the phases of respiration.
Cranial Diaphragm

Superior View of the Tentorium Cerebelli
Thoracoabdominal Diaphragm
Pelvic Diaphragm
Connection to the Cardiovascular System
Consider the extensive nature and function of fascia
Another Thought

Another Thought

• Unspecialized “loose” connective tissue forms an anatomical network throughout the body. The hypothesis is that, in addition, connective tissue functions as a body-wide mechanosensitive signaling network.
Another Thought

- Three categories of signals are studied: electrical, cellular, and tissue remodeling, each potentially responsive to mechanical forces over different time scales.
Another Thought

• It is proposed that these types of signals generate dynamic, evolving patterns that interact with one another.

• Such connective tissue signaling would be affected by changes in movement and posture, and may be altered in pathological conditions (e.g. local decreased mobility due to injury or pain).
Another Thought

- Connective tissue thus may function as a previously unrecognized whole body communication system.
Another Thought

- Since connective tissue is intimately associated with all other tissues (e.g. lung, intestine), connective tissue signaling may coherently influence (and be influenced by) the normal or pathological function of a wide variety of organ systems.
Another Thought

- Demonstrating the existence of a connective signaling network therefore may profoundly influence our understanding of health and disease.
A. T. Still on fascia:

- “This connecting substance must be free at all parts to receive and discharge all fluids, and use them in sustaining animal life, and eject all impurities, that health may not be impaired by dead and poisonous fluids.”

- “By its action we live and by its failure we die.”

- “The soul of man, with all the streams of pure living water, seems to dwell in the fascia of his body.”
Clinical Correlations

- Deep inhalation (SRM) can enhance the PRM
  - Newborn first breath
- Biomechanical factors – Exercise: try breathing with
  neck extended vs. flexed
- Realignment of core link elements (diaphragms)
- Temporal bone influence on respiration
- CV4 technique
- Sutherland’s (and others’) experience with
  respiratory arrest patient
Breath of Life

PRM

SRM

Images and diagrams showing different aspects of the respiratory system.
Primary vs. Secondary Respiration

**PRM**
- Inherent motility of the brain and spinal cord
- Fluctuation of the cerebrospinal fluid (potency)
- Mobility of the intracranial and intraspinal membranes
- Articular mobility of the cranial bones
- Involuntary motion of the sacrum between the innominares

**SRM**
- Structural components
  - Nasal passages
  - Pharynx
  - Larynx
  - Bronchi
  - Lungs
  - Thoracic cage
  - Diaphragms: thoracoabdominal, pelvic, cranial
  - Respiratory centers in the brain
- Functional components:
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PHYSIOLOGIC FUNCTIONS...
Physiologic Functions

• Respiration
  – Cellular
  – Tissue

• Fluid Exchange
  – Arterial blood
  – Venous blood
  – Lymph
  – Cerebrospinal fluid
References

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Thank you!