The Primary Respiratory Mechanism

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Lecture Objectives
At the end of this lecture the student should be able to:

1. Discuss the five phenomena of the primary respiratory mechanism (PRM).
2. Understand these five phenomena as a tensegrity structure; inseparable physiologic components of whole body unity and health.
Recommended Reading


The Primary Respiratory Mechanism

PRM

• Primary
  – First or principal

• Respiratory
  – Related to respiration at cellular level

• Mechanism
  – Arrangement or grouping of parts of anything which has a definite action

The PRM is a unit of physiologic function which involves the whole body.
The Primary Respiratory Mechanism

Five Phenomena

1. Inherent *motility* of the CNS.
2. *Fluctuation* of cerebrospinal fluid.
3. *Mobility* of the intracranial and intraspinal membranes. (Reciprocal Tension Membrane)
4. Articular *mobility* of cranial bones.
5. Involuntary *mobility* of sacrum between the ilia.
Motility vs. Mobility

- **Motility** – exhibiting or capable of motion.
- **Mobility** – capable of being moved.
The Primary Respiratory Mechanism

Five Phenomena

1. Inherent motility of the CNS.
2. Fluctuation of cerebrospinal fluid.
3. Mobility of the intracranial and intraspinal membranes.
5. Involuntary mobility of sacrum between the ilia.
The Primary Respiratory Mechanism

Five Phenomena

1. Inherent *motility* of the CNS.
Motility of the CNS

- CNS consists of the brain and spinal cord.
- Contractility of glial cells has been demonstrated.
  - Glial cells are the most numerous cell type in the CNS.
- As CNS develops embryologically, the neural tube enfolds upon itself.
  - Coiling like a Ram’s Horn
Motility of the CNS

- The CNS coils and uncoils as if responding to its embryological heritage.

Magoun, H. *Osteopathy in the Cranial Field*. 1976: p. 35
Motility of CNS
Cerebral Ventricles

- Ventrices are shaped like a bird.
  - Body = 3rd and 4th ventricles
  - Wings = lateral ventricles
  - Tail / feet = spinal cord
Motility of CNS
Cerebral Ventrices

Inhalation (Flexion Phase)

Ventricles shorten and widen
Wings spread and tail rises


flickr.com
Motility of CNS
Cerebral Ventrices

Exhalation (Extension Phase)

Ventricles get longer and narrower

Wings fold, tail drops

The Primary Respiratory Mechanism

Five Phenomena

2. Fluctuation of cerebrospinal fluid.

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Fluctuation of CSF

• Fluctuation – from Webster’s Dictionary
  – A motion like that of waves; a moving in this and that direction; as, the fluctuations of the sea.
  – The motion or undulation of a fluid collected in a natural or artificial cavity, which is felt when it is subjected to pressure or percussion.
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Fluctuation of CSF

- CSF formed in choroid plexus of cerebral ventricles.
- Fluctuates within ventricles and subarachnoid space of brain and spinal cord.
- Returned to venous system via arachnoid granulations of venous sinuses.
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Fluctuation of CSF

- CSF in subarachnoid space permeates perineural sleeves of nerve roots.
  - Hydrates peripheral nervous system.

- CSF ultimately drains out into extracellular fluid and into lymphatic system.

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Fluctuation of CSF

- Cranial rhythmic impulse (CRI)
  - Woods and Woods coined the term in 1961 as a “usual rate” of CSF fluctuation in normal adults.
    - 10-14/min

- Various rates of CSF fluctuation identified.
  - Magoun – 10-14/min
  - Jealous – 2.5/min
  - R. Becker – 0.6/min

- Leim, T. *Cranial Osteopathy Principles and Practice*, 2004: p. 4
  - Cites 25 “frequencies of primary respiration” recorded in world literature.
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Fluctuation of CSF

CRI

Rate Cycle

Neutral

Flexion

Extension

Amplitude

Time
The Primary Respiratory Mechanism
Fluctuation of CSF

• Dr. Still called CSF “the highest known element.”
• Dr. Sutherland used the metaphor of the tide to describe CSF fluctuation.
  – Ebb and flow
  – Expansion and contraction.
  – He described a Potency / Invisible element / Intelligence in the fluctuation of CSF.
  – “Something that you can depend on to do the work for you.”
The Primary Respiratory Mechanism
Five Phenomena

   (Reciprocal Tension Membranes)

Reciprocal Tension Membranes
Falx Cerebri

• Point of origin =
  – Straight sinus

• Anterior superior pole attachment =
  – Crista galli of the ethmoid

Reciprocal Tension Membranes

Tentorium Cerebelli

- **Point of origin =**
  - Straight sinus

- **Posterior pole**
  - Internal occipital protuberance and along transverse ridges

- **Lateral pole**
  - Petrous portion of temporals

- **Anterior inferior pole**
  - Clinoid processes of sphenoid

Reciprocal Tension Membranes

- Tension constant in RTM (Tensegrity Structure).
- Guides and limits motion of cranial bones.
- Allows change of shape while maintaining constant volume of the skull.
- Allows motion of PRM in spite of constant tension of the membranes.
Reciprocal Tension Membranes
Flexion (Inhalation phase)

- Falx cerebri
  - Shifts forward in arc of its sickle
  - Lowers (inferiorly) slightly

- Tentorium cerebelli (Tent)
  - Shifts anteriorly and flattens

Reciprocal Tension Membranes
Extension (Exhalation phase)

• Falx cerebri
  – Shifts posteriorly - uncoils
  – Raises (superiorly) slightly

• Tentorium cerebelli (Tent)
  – Shifts posteriorly and rises into tent shape
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Five Phenomena

4. Articular *mobility* of cranial bones.
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Cranial Bone Mobility

- Cranial bones are being moved by dural membrane tension and motion.
  - Think of cranial bones as hard places within dural membranes.

- Cranial sutures permit normal though minimal motion, persisting throughout life.
  - A resiliency combined with yielding and suppleness.

- Motion of cranial bones represents a solid manifestation of motion driven by fluid dynamics.

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Cranial Bone Mobility

Adapted from Chaitow, L. Cranial Manipulation Theory and Practice. 1999.
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Five Phenomena

5. Involuntary *mobility* of sacrum between ilia.
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Mobility of Sacrum Between Ilia

• **Core Link** – occiput to sacrum
  – Think of the dural tube as a set of cables connecting occiput to sacrum.

• Only firm attachments of dura from cranium to sacrum:
  – Foramen magnum
  – C2-3
  – S2

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Mobility of Sacrum Between Ilia

Inhalation (Flexion) phase

1. SBS rises.
2. Occiput circumducts.
3. Foramen magnum moves anteriorly and superiorly.
4. Spinal dura drawn superiorly.
5. Sacral base moves posteriorly and superiorly.

The Primary Respiratory Mechanism
Five Phenomena

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The Primary Respiratory Mechanism
Tissue Matrix System

Ingber, D. *Scientific American*. 1998
The Primary Respiratory Mechanism
Tissue Matrix System

Pienta, K., Coffey, D. Cellular harmonic information transfer through a tissue tensegrity-matrix system. Medical Hypothesis; Vol. 34. 1991: pp. 88-95.

• Tissue matrix system is a tensegrity stucture composed of:
  – Extracellular matrix
  – Integrins
  – Cytoskeleton
  – Nuclear matrix

• Information transferred from cell periphery through cytoplasm and into nuclear matrix system.

• Harmonic wave motions propagated within this matrix.
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Tissue Matrix System

• Ca²⁺ ion concentration produces:
  – Cylical cell-volume changes
  – Solute movement in and out of cells.

• Ebb and flow of water into and out of cells depends on hormones, ions, and the condition of the extracellular matrix.

• “The PRM is a well-orchestrated system down to the subcellular, molecular and energetic level of mechanotransduction, involving the entire tissue matrix system.” – R. Paul Lee, D.O.
Tissue Matrix System
Inhalation Phase of PRM


- **In the CNS:**
  - Expansion of the volume of CSF in ventricles and subarachnoid space
  - Brain substance compacts.

- **In the periphery:**
  - Contraction of actin microfilaments within cytoskeleton.
  - Matrix becomes more fluid (sol phase)
  - Water and nutrients move into the cells from ECF.
  - Water, metabolites and protein move into lymphatic system.
Tissue Matrix System
Exhalation Phase of PRM


- **In the CNS:**
  - Flushing of CSF from ventricles and subarachnoid space.
  - Brain substance expands.
- **In the periphery:**
  - Matrix becomes less fluid (gel phase).
  - Decrease electrolyte concentration in ECF.
  - Water and nutrients leave cells into ECF.
Primary Respiratory Mechanism

Summary

• The PRM functions as a tensegrity structure within the body.
• The PRM is generated everywhere in the body and can be palpated everywhere in the body.
• Motion interfaces between Mind and Matter.
Primary Respiratory Mechanism

Summary

• The PRM then is an inseparable part of body unity Dr. Still called:
  – Mind (mind)
  – Matter (body)
  – Motion (spirit or life)

• This ebb and flow of the Tide delivers health to an otherwise nonliving body of connective tissue.
The Primary Respiratory Mechanism

Summary

“At the very core of total health, there is a potency within the human body manifesting it in health.”

“We have to learn to feel the structure-function messages from within the body of the patient.”

– Rollin Becker, D.O.