Osteopathic Approach to Immunity and Infectious Disease

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Disclosures

- None
Objectives

- Describe an “Osteopathic Approach” utilizing osteopathic principles and practices.
- Review anatomy & physiology of lymphatic system
- Explain the effects of somatic dysfunction on lymphatic system, blood circulation, and respiration.
- Review the historical importance of osteopathy and the lymphatic system.
- Discuss contraindications to OMT use.

The “Osteopathic Approach” to the Immune System Is Application of Principles of Applied Anatomy and Physiology using Osteopathic Medical Philosophy
MODERN MEDICINE

- Has no drug that balances and restores the immune regulation.
- OMT can help the body rebalance and enhance the immune response at many different levels and at the same time.

Research Supports Use of OMT and OPP in Treatment of the Immune System

- International and US studies support the use of manual medicine
- Much evidence is coming from the Osteopathic Research Center in Fort Worth with original research on the Lymphatic System, studies on OMT and pneumonia and other studies from our schools such as Kirksville
Osteopathic Approach Overview: Proposed Mechanisms of Action (as Related to 5 Main Osteopathic Models)

Neurological-Autonomic Model: Direct sympathetic innervation of immune system (including fascia & lymphatics), focuses stressors & pain

Behavioral-Biopsychosocial Model: Psychoneuroimmunology and physiology of pain/stress

Respiratory-Circulatory Model: Lymphatic/Fascial roles in healing/immune function, external respiration determines internal respiration

Metabolic-Hormonal Model: Diet, vitamins, cortisol (etc) in stress, role of exercise in immune function

Postural-Biomechanical Model: Elements related to all of above (linked to facilitated segments, chest & diaphragm function, fascial impediments, weight, etc)

Models: Clinical Approach
Time Efficient & Effective

Lymphatic Model
- Respiro-Circulatory

Autonomic Model
- Viscero-Somatic

Postural Model
- Muscular Imbalance
- Biomechanics
Philosophical Approach to Care
(Structure-Function : Homeostasis : Allostasis)

Mind-Body-Spirit: Reduce Allostatic Load
Physiology: Enhance Homeostasis
Anatomy: Maximize Structure-Function

Blood Memorial Lecture
ML Kuchera, DO (2009)

Using OMT as Part of the Osteopathic Approach

OMT addresses the:

- SYMPATHETIC NERVOUS SYSTEM and to a lesser extent the PARASYMPATHETIC NERVOUS SYSTEM.
- Linked LYMPHATIC SYSTEM
- BLOOD CIRCULATORY SYSTEM
- PULMONARY SYSTEM
“Lymph is Life”
- Gordon Zink, D.O. 1966

Lymphatic Circulation and Osteopathy
“We strike at the source of life and death when we go to the lymphatics.”

A.T. Still 1909

LYMPHATIC ROOTS:
Beginning with AT Still, MD, DO

Recognized the Importance of the Lymphatic System

Secondary Circulatory System
Removes protein & metabolites
- Exudates
- Chemical/inflammatory mediators

Fights Infection
- Antigen presentation & stimulation of immune response
- T & B cell proliferation & migration
LYMPHATIC ROOTS:
Beginning with AT Still, MD, DO

“When Harvey solved the circulation of the blood, he only reached the banks of the river of life”
A.T. STILL, MD, DO

Relatively PASSIVE System ...
Forces influence flow
- Extrinsic: Pressure changes, elastic wraps
- Intrinsic: Muscle contractions, GI
- Both: OMT has tremendous influence

Function of Lymphatic System
Four Functions

- Maintain fluid balance in body.
- Purification and cleansing of tissues.
- Defense-Immunity
- Nutrition

Lymphatic Function

FOUR MAIN FUNCTIONS OF THE LYMPHATIC SYSTEM
1. Defense / Immunology
2. Purification/ Cleansing of tissues
3. Maintains Fluid Balance
4. Nutrition

Structures allow and modulate these functions
Primary function of the lymphatic system is to return interstitial fluid and extra cellular protein to venous circulation— ...which means nutrition of the cells and organs.

Function of Lymphatic System

- Plays important role in clearance of microorganisms and particulate foreign matter.
- Starlings Equilibrium- maintaining tissue turgor.
- Lymph fluid typically produced each day has a volume of 2 liters with 200 grams protein.
- Lymph production generally increases with inflammation, trauma or infection.
Usually found apposed to capillaries.

**Relationship to CAPILLARY BED**

**Filtration of intravascular fluid occurs**

- Passage of fluid, protein, particles from vascular system directly into interstitium
- Fluid diffuses along connective tissue fibers & anchoring filaments
  - Mix with extracellular fluids
  - As fluid accumulates, more gets in than can be removed by capillaries
STRUCTURE

Begins in the tissues as Lymphatic Capillaries (blind endothelial tubes)

Composed of single (1) layer of squamous epithelium
  – Supported by anchoring filaments attached to endothelial cells and extend to surrounding interstitium

Filaments bind tubes to interstitial matrix (fascial continuity into lymphatics; MFR → lymphatic entry)

Open the spaces between endothelial cells with accumulation of fluid
  – Prevents collapse of lymph capillaries

 PATTERNS OF DRAINAGE

Thoracic viscera-drained by Mediastinal trunks
Left side of head & neck- drained by Internal Jugular trunk
Left arm & shoulder- drained by Subclavian trunk
Pelvis- drained by Internal Iliac trunk
PATTERNS OF DRAINAGE

- Lower extremities - drained by External Iliac trunk
- Lumbar region - drained by Lumbar trunk
- Colon & Mesentery - drained by Superior & Inferior Mesenteric trunks
- Liver, Spleen, Stomach, & Pancreas - drained by Gastric trunk

TRUNKS

All of these mentioned trunks drain into two (2) main trunks which empty into venous system in the Cervicothoracic area

- Right Lymphatic Duct (RLD)
- Left Lymphatic Duct (LLD)
  - Thoracic Duct
Abdominal Lymphatics

Cysterna Chyli

- A dilation of the distal portion of the Thoracic duct (LLD)
  - Trunks of Abdomen, Pelvis, & Lower limbs drain here
- Lies @ anterior L1, L2 vertebral bodies @ level of renal vessels
  - Behind Right crus of diaphragm
    - Next to abdominal aorta
      - May be absent in lieu of a plexus of lymph vessels
Breast Lymphatics
Mechanics of the lymph circulation

- **Terminal** – drainage of thoracic duct into the subclavian vein.
- **Vascular** – the movement of lymph through the lymphatic vessels.
- **Formation** – the movement of extracellular fluid into the initial lymphatic
Terminal lymph drainage

- Respiratory/circulatory function
  - J. Gordon Zink
  - 35 – 60% of thoracic duct flow is produced by respiration
    - Relation of crus to cysterna chyli
    - Venturi effect
    - Effects of respiration on lymph entering thoracic duct

Central Lymph

Crura act as pump for cysterna chyli. Crura may obstruct flow when tense (goat and boulder parable)
Can be obstructed with increased tissue tension/somatic dysfunction

Lymph Formation

- There is a small uphill hydrostatic gradient which must be overcome for extracellular fluid to move into an initial lymphatic
- This may be the limiting factor in overall lymph flow
- External forces are necessary for lymph formation.
These Starling forces do not account for the movement of fluid through the interstitial matrix (gel) where cellular respiration takes place.

### Cellular Respiration

1. **Lymph Formation**

By the time fluid reaches the lymphatic, a small uphill gradient must be overcome for lymph to form.

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**Importance of Motion**

There is an interstitial mechanism including tissue movement and fluctuation of extracellular fluid promoting interstitial interchange & facilitating cellular respiration.
In the presence of this interstitial mechanism, lymphatics are adapted to utilize motion for the formation of lymph.

**STRUCTURE**

Begins in the tissues as Lymphatic Capillaries (blind endothelial tubes)

- Composed of single (1) layer of squamous epithelium
  - Supported by anchoring filaments attached to endothelial cells and extend to surrounding interstitium
- Filaments bind tubes to interstitial matrix (fascial continuity into lymphatics; MFR → lymphatic entry)
- Open the spaces between endothelial cells with accumulation of fluid
  - Prevents collapse of lymph capillaries
Anchoring filaments produce a change in volume with alternating movements in the local interstitial tissue.

Overlapping endothelial cells allow the ebb and flow of a fluid fluctuation to move fluid from the interstitium to the lymphatics.

Motion opens, Swelling opens, Motion opens, Swelling increases, Too much swell closes.
It is at this cellular level that we apply OMT

- Mechanical forces
- Rebalancing Sympathetic Nervous System innervation of the lymphatics, blood and the neuro immune system
- Chapman’s reflex treatment is a direct neurolymphatic reflex diagnosis and treatment
- Parasympathetic influence has not thought to be a major part of treatment but indirectly through the Vagus will affect circulation and oxygenation

Clinical applications

- Asthma
- All infections
- Rheumatic diseases
- All post surgical cases
- Few disease process occur without a local inflammatory process

Optimum choice of osteopathic model id enhanced by knowing mechanisms of underlying pathophysiology & the body unit's homeostatic response to try to return to health
Circulation

- **Inflammation** ⇒ change in capillary permeability
- **Leads to large protein efflux into the interstitium**
- **Produces an inflammatory exudate, which can only be drained via the lymphatics**

Lymph circulates due to:

**EXTRINSIC Forces:**
- Changes in the intrathoracic pressure with respiration.
- Pumping action of muscles in extremities.
- Pulsations of adjacent arteries
- Exercise
- Osteopathic Manipulative Treatment

**INTRINSIC Forces:**
- Smooth muscle contractions
- Interstitial fluid pressure
- Contractions of the lymphatic vessels themselves!
Pumping action of large lymphatics.

Compression of lymphatics by arterial pulsations.
  – Positive and negative pressures and pulsation cause “tidal waves” of circulation

We Use the Innervation of the Lymphatic System—primarily balancing the Sympathetic Nervous System.

Much sympathetic control to lymphatic duct is by intercostal nerves and the cisterna chyli innervation at T11, and is treated with ‘Rib Raising OMT’, some by dilating the vessels.
Pulmonary Lymphatics

Consists of networks of vessels and nodes.
Superficial nodes and vessels drain skin and deeper tissues of head, neck, and extremities.

Right (minor) and Left (major) Lymphatic Ducts

- The right lymphatic duct drains into the right brachiocephalic vein and the left drains into the left internal jugular and subclavian vein.
- The right lymphatic duct serves the right upper extremity, right hemicranium (including the head and face), pericardium, heart and all but the left upper lobe of the lungs.
- The left lymphatic duct serves the rest of the body.
- Both are closely affected by the thoracic inlet.
Deep nodes and vessels receive drainage from superficial system and visceral organs of trunk.
Keep in mind that:

- The Spleen is the largest structure in the lymphatic system.
- It has a major part of the immune response system at the cellular-immune level and the lymphatic circulatory level.
- Has contractile response for circulation of blood and lymph. (ANS)

Pathophysiology of Lymph

- Excess accumulation of lymph is edema.
Recognition of efficacy of “Osteopathic Approach” first occurred with the application of OMT to the lymphatic system.
History:

- Lymphatic fluid was observed as early as Greek and Roman times.
- Lymphatic system first described by Olaf Rudbeck (Sweden) in 1653.
- A.T. Still emphasized treatment of the lymphatic system for maintaining health and treating disease 1894.

- Frederic Millard, DO, was one of Still’s students, and researched the structure and functions of the lymphatic system and published “Applied Anatomy of the Lymphatics” in 1922.

- Manual treatment for draining lymphatic edema was described by Alexander of Winiwarter (1848-1910). Millard also described “lymphatic drainage” techniques.

- Earl Miller in 1926 was one of the first to describe lymphatic pump techniques.

- William Galbreath, DO, in 1929, described the Galbreath technique, a method for mobilizing lymphatic fluid in the mandibular region and for draining accumulated fluid from the middle ear.

- Frank Chapman, DO, another student of A.T. Still, elucidated a series of neurolymphatic reflexes, in the 1930’s, he believed to correspond to visceral structures.

- Bruno Chikly, MD, further advanced the understanding of the lymphatic system, “mapped” lymphatic drainage, and popularized treatment of the lymphatic system.
Spanish Flu Epidemic 1917 - 1919

- “last great plague”
- Estimated 20 million deaths
- 500 million influenza cases
- 1 in 4 persons in U.S. got influenza (20 million US cases)
- OMT gave 1 in 16 death rate, same w/o OMT 1 in 2 death rate, or 0.37% vs. 2.5% mortality - *JAOA, 1919*.
- Life insurance retrospective studies showed DO treated cases had a 1/4th mortality rate as MDs
- That means-Thoracic Lymphatic Pump gave 40 times greater chance of surviving.

Spanish Flu 1917-1919

- Exported with our troops to Europe- WWI
- Influenza/pneumonia caused deaths of 1 out of 4 US soldiers who died in WWI
- Kansas base typical example
U.S Army Base in Kansas 1917

Hospital Ward of Influenza Patients
Army Hospital in Kansas

Army Hospital Ward in Kansas
The Osteopathic Lymphatic Treatments of Spanish Flu:

- Literally identified Osteopathy and OMT as an effective medical treatment.
- OMT gained Recognition for the first time by the medical community as efficacious.
- Utilized independent retrospective studies of Pulmonary OMT outcome by the life insurance companies.

Pneumonia Research in Children at Los Angeles County Osteopathic Hospital

A Preliminary Report

JAMES O. WATSON, D.O., M.D.
Senior Pediatrician, Los Angeles County Osteopathic Hospital

And

EVANGELINE N. PERCIVAL, D.O.
Junior Pediatrician, Los Angeles County Osteopathic Hospital

Los Angeles

*J.A.O.A. November 1939

Compared Los Angeles County Osteopathic Hospital vs. N.Y.C. Municipal Hospital

- Bronchopneumonia mortality
  - DO: 10.7%
  - MD: 29.6%
- Lobar pneumonia mortality
  - DO: 11.2%
  - MD: 10.8%
“The effect of direct splenic stimulation on the cells and antibody content of the blood stream in acute infectious diseases”

*Castillo - Ferris - Swift*  
*JAOA 1934*

**Splenic Stimulation OMT**

- ↑ leukocyte count (80% cases)
  - average ↑ 2,000 cells
  - right shift (mature cells)
- ↑ opsonic index (>80% cases); expulsion of formed antibodies into general circulation
- ↑ serum bacteriolytic power 68%

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**Lymphatic Pump Treatment Enhances Survival and Reduces Pulmonary Bacteria during Experimental Pneumonia Infection**

*Hodge LM & Bellard MD, et al. JAOA 107(8): 355-6*

Rats 1x10^8 bacterial infection (BI); Treatment given 2 hrs post-BI & on days 1 & 2 [1/2 = 8 min lymph pump (LPT) ≠ ½ sham manual care (MC)]; Weights & survival were measured each day post-BI. Pulmonary bacteria were counted in each euthanized rat (day 3).

Results: LPT enhanced survival 20% by day 3 post-infection (≠ MC). LPT delayed weight loss during infection (day 2). LPT reduced pulmonary bacteria 30% suggesting that innate immune mechanisms are enhanced by LPT and contribute to clearance of pulmonary infection.

This is the 1st study to demonstrate that LPT can enhance survival & reduce pulmonary bacteria during acute pneumonia infection. It also creates an animal model (rat) to allow collection of samples to examine the mechanisms by which lymphatic pump enhances immunity and clears pulmonary infection.
How much lymph can a lymph pump pump ... ?

Cover & 2006 Northup Osteopathic Research Award

5 dogs surgically instrumented to record thoracic duct lymph flow (TDF). After recovery, canine subjects were placed in a standing-support sling.

3 protocols different days; Measured TDF and cardiac parameters

Result: Thoracic Duct Lymph flow (TDF)
- Abdominal Pump OMT (30 seconds): 1.57mL/min → 4.80mL/min
- Thoracic Pump OMT (30 seconds): 1.20mL/min → 3.45mL/min
- Exercise (level treadmill @ 3 miles/hr) 1.47mL/min → 5.81mL/min


Application of Lymphatic Pump for 30 seconds in dog (Knott 2005)

Thoracic OMT Pump in Dogs  Abdominal OMT Pump in Dogs
Abdominal Lymphatic Pump Treatment Increases Leukocyte Count and Flux in Thoracic Duct Lymph


This canine model abdominal lymph pump may provide a rational basis for the use of OMT to \(\uparrow\) immune function & treat infection.

Leukocyte mobilization & Lymph flow (WBC X Flow = Leukocyte Flux)
- Both probably important mechanisms in Lymph Pump OMT effect
- 2-3X \(\uparrow\) # of leukocytes in lymph (4.8\(\rightarrow\)11.8 million cells/ml \(p<0.05\))
- Almost 4-fold increase in lymph flow (ml/min) in the thoracic duct
- \(\uparrow\) leukocyte flux through the thoracic duct to the circulation \(8.2\rightarrow60\) million leukocytes/min

Leukocytes possibly mobilized from mucosal tissues
- Macrophages, neutrophils, total lymphocytes, T cells, B cells, and IgG forming B cells increased similarly during LPT
- IgA antibody forming B cells \(\uparrow\)ed from 5.8\% \(\rightarrow\) 17\% (with OMT)

References

- Chila, Anthony, Ed. Foundation of Osteopathic Medicine, 2011, pp786-808, Kuchera- Lymphatics; pp 853-856, Kuchera, Devine, Fossum, Wilson; Chapman’s Reflex
- Special thanks to Dr. Michael Kuchera for contributions to this lecture and Osteopathic Medicine
More References