Osteopathic Approach to Concussions

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Who I am...
What I Do!

- Full time pediatrician at Nationwide Children’s Hospital
- 6 sessions per week exclusively pediatric OMT
- 2 sessions per week of general pediatrics
- Teach residents, med students, and more!
- Program director of Osteopathic Residency Track for Pediatric Residency Program
Objectives

- History and epidemiology of concussions
- Evidence to support OMT for concussions
- Anatomy and physiology review
- Discuss treatment options for concussions with OMT
Why are we here?

- Your Brain on Concussion
Epidemiology

- >3 million/year TBI in US
  - 75-95% are mild TBI
- M>F (~2-3:1)

Causes
- MVA 20-45%
- Falls 30-38%
- Occupational accidents 10%
- Recreational accidents 10%
- Assaults 5-17%
Concussions in sports

- 1.6-3.8 million per year in the US
- 20% for contact sports/season
  - Football, ice hockey, boxing, and rugby
- 10% of all US college and 20% of US high school football players per season with concussions
- Often underreported
- Incidence <20 y/o by 71% from 2010-15
  - 119% in females
Long Lasting Effects

- Study from Sweden in August 2016
- TBI in childhood/adolescence → increased adult mortality, psychiatric morbidity, and low educational attainment
- More TBI = more risk
- Relative to siblings without TBI
- Later the injury, the worse long-term effects
Manifestations

- Somatic
  - Pain, photo- and phonophobia, dizziness, N/V, appetite changes, vision changes, tinnitus
- Cognitive
  - Concentration deficiencies, memory loss
- Mood
  - Sadness, irritability, anxiety
- Sleep
  - Altered sleep latency, difficult to stay asleep, too much or too little sleep

Common signs of concussion:

- Dizziness
- Nausea
- Headaches
- Light Sensitivity
- Confusion
Etiology of Symptoms

- Complex mechanisms
  - Pain from direct primary trauma
  - Inflammation and edema cause pressure on dura
    - Trigger intracranial mechanical pain generators
  - Secondary (indirect) trauma from inertia
    - Cervical spine
    - Sacrum
Cervical Spine

- Pain generators
  - Myofascial tissue
  - Nerve compression or discogenic impingement
  - Ligamentous strains
  - Facet joints - innervated by medial branch of dorsal ramus of spinal nerve
    - Each joint supplied by its own level and the one above
    - Pain referred to head, cervical spine, thoracic spine
CNS Facilitation

- Maintenance of a pool of neurons in state of partial or sub-threshold excitation
- Once in the state → require less afferent stimulation to trigger discharges
- Nociception in cervical spine carried through the anterolateral system or spinothalamic tract
- ALS and trigeminal overlap
  - Cervical strains → headaches and associated symptoms
The somatic sensory pathways. (The different pathway for conscious proprioception from the lower limb is not included in this diagram.)
Dizziness/Balance/Vertigo issues

- Cervical spine dysfunction $\rightarrow$ altered input to cerebellum
  - Postural reflexes
- Cranial base dysfunction $\rightarrow$ Temporal bone motion altered
  - Tinnitus
  - Postural reflexes
  - Otolith displacement
- Vestibular changes
  - Acceleration/deceleration from trauma may cause mild prolonged “motion sickness”
Vision Changes

- Facilitation from cervical SD → superior cervical ganglion
- Sympathetic nervous system
- Altered accommodation
Auditory Symptoms

- Cervical SD → facilitation of SNS
- Altered blood flow to middle ear
Auditory Symptoms

- Cervical SD $\rightarrow$ CN5 facilitation
- Influence muscles of palate and middle ear $\rightarrow$ tinnitus and phonophobia
The Orbit

- Frontal bone
- Sphenoid
- Ethmoid
- Lacrimal bone
- Palatine
- Maxilla
- Zygoma
Olfactory Symptoms

- Anosmia - partial or complete
- Affects taste
- Due to olfactory tract pathway, can get symptoms with trauma to multiple areas
Olfactory Projection Pathways

- Olfactory bulb
- Olfactory tract
- Olfactory cortex of temporal lobe (conscious perception of smell)
- Hippocampus (olfactory memory)
- Amygdala (emotional responses)
- Hypothalamus
- Reticular formation (visceral responses to smell)

CN I

Olfactory receptor cells
Facilitation of CN

- Facial Nerve: facial pain
- Glossopharyngeal and vagus: nausea
- Vagus: dysphagia and GI disturbance, appetite changes
- Spinal accessory: Neck stiffness and pain
The Skull Moves?

- William G. Sutherland, D.O. discovered Osteopathy in the Cranial Field

- “As I stood looking and thinking in the channel of Dr. Still’s philosophy, my attention was called to the beveled articular surfaces of the sphenoid bone. Suddenly there came a thought; I call it a guiding thought- beveled like the gills of a fish, indicating articular mobility for a respiratory mechanism.”
Primary Respiratory Mechanism

1. Inherent motility of the brain and spinal cord
2. Fluctuation of the CSF
3. Mobility of the intracranial and intraspinal membranes
4. Articular mobility of the cranial bones
5. Involuntary mobility of the sacrum between the ilia
The Dura
Innervation of Dura

- No true pain fibers in brain parenchyma
- Meningeal pain fibers
  - Anterior and middle cranial fossa from: CN5
  - Posterior cranial fossa: C1-3 via CN9 & 10
Other Thoughts on Dura

- Attachments outside of the head → Pain other than HA
  - Neck pain
  - Back pain
  - Sacral/pelvic pain
Anything Else?

- Studies have shown there is a pathophysiologic cascade following concussion
  - Neuronal depolarization
  - Release of excitatory neurotransmitters (glutamate)
  - Ionic shifts (K, Ca, Na, Mg)
  - Changes in glucose metabolism (to meet demands of shifts)
  - Altered cerebral blood flow (energy crisis!)
  - Impaired axonal function (poor neural connectivity)
  - Altered mitochondrial oxidative metabolism, increased free radical, increased inflammatory response
  - Increased lactic acid

Lymphatic Influence

- This inflammatory cascade could explain cognitive, mood, and sleep symptoms
- Address the “baffles” of the body to help engage flow
  - Tentorium cerebelli (and the rest of the cranial dura)
  - Thoracic inlet
  - Abdominal diaphragm
  - Pelvic diaphragm
Glymphatic System

- Newly discovered anatomy
- Waste disposal system for the CNS
- “Facilitates brain-wide distribution of several compounds, including glucose, lipids, amino acids, growth factors, and neuromodulators”
- Functions mainly during sleep
Glymphatic Structure

- Perivascular tunnel system (formed by astroglial cells)
- CSF ↔ Interstitial fluid
  - CSF driven into Virchow–Robin Space → interstitial space → perivenous spaces of large veins → deep cervical lymphatic system

http://jonlieffmd.com/blog/immune-t-cells-are-critical-for-cognitive-functiona
Osteopathic Research
Lymphatic Techniques and TBI

- Performed on 24 comatose patients in ICU
  - 18-69 years old
- Treated with pedal and lymphatic pump
- Group 1: baseline ICP ≤ 20 mmHg: slight decrease in ICP, increased CCP
- Group 2: baseline ICP > 20 mmHg: decreased ICP, increased CCP
Lymphatic Techniques

- With techniques that treat the lymphatic/fluid systems in the body studies have shown:
  - Increased flow toward the thoracic duct
  - Increased leukocyte release into lymph/mobilization of leukocytes
  - Mobilization of inflammatory modulators
  - Improved healing
CV4

- Shown to improve sleep latency vs sham and no treatment
- Also improvement in sympathetic nerve activity
PTSD and TBI

- Received "light touch manual therapy"
- Active duty soldiers
- 10 men, 27-45 y/o
  - 80% TBI, 90% HA, 100% PTSD
- 2 one-hour sessions one week apart
- Showed decrease in intensity of HA and anxiety, increased cognitive function and mobility
Case Studies

- 16 y/o F with 3 prior head injuries including most recent ~1 month prior
  - Sxs included amnesia, fatigue, HA, labile mood, vertigo, photo and phonophobia, concentration problems, insomnia, and vision problems
  - Resolution of symptoms over ~1 month of OMT
- 27 y/o with TBI after snowboarding
  - Had dizziness, nausea, fogginess, tinnitus
  - Resolution of symptoms following 25 minutes of OMT and improvement in sensory organization test following OMT
- 38 y/o F with 3 months of post-concussion symptoms
  - Multi-disciplinary approach including OMM, assessing psychological factors, pharmacologic interventions, injections, PT
Questions?

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References