An Osteopathic Understanding of the Diaphragm

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- I have no financial disclosures to make
- I have a free-access website that I will be referring to in my talk
  - www.drrobrehab.com
  - YouTube “drrobhrehab” - please subscribe…

Osteopathic Teaching Model

How do neurons with terminations inside skeletal muscle signal muscle pain and fatigue

Experiments using real-time imaging

Alan R. Light, Ph.D.

With help from Dr. Jeff Woodbury, and Dr. Jesse Zhang

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University Hospitals
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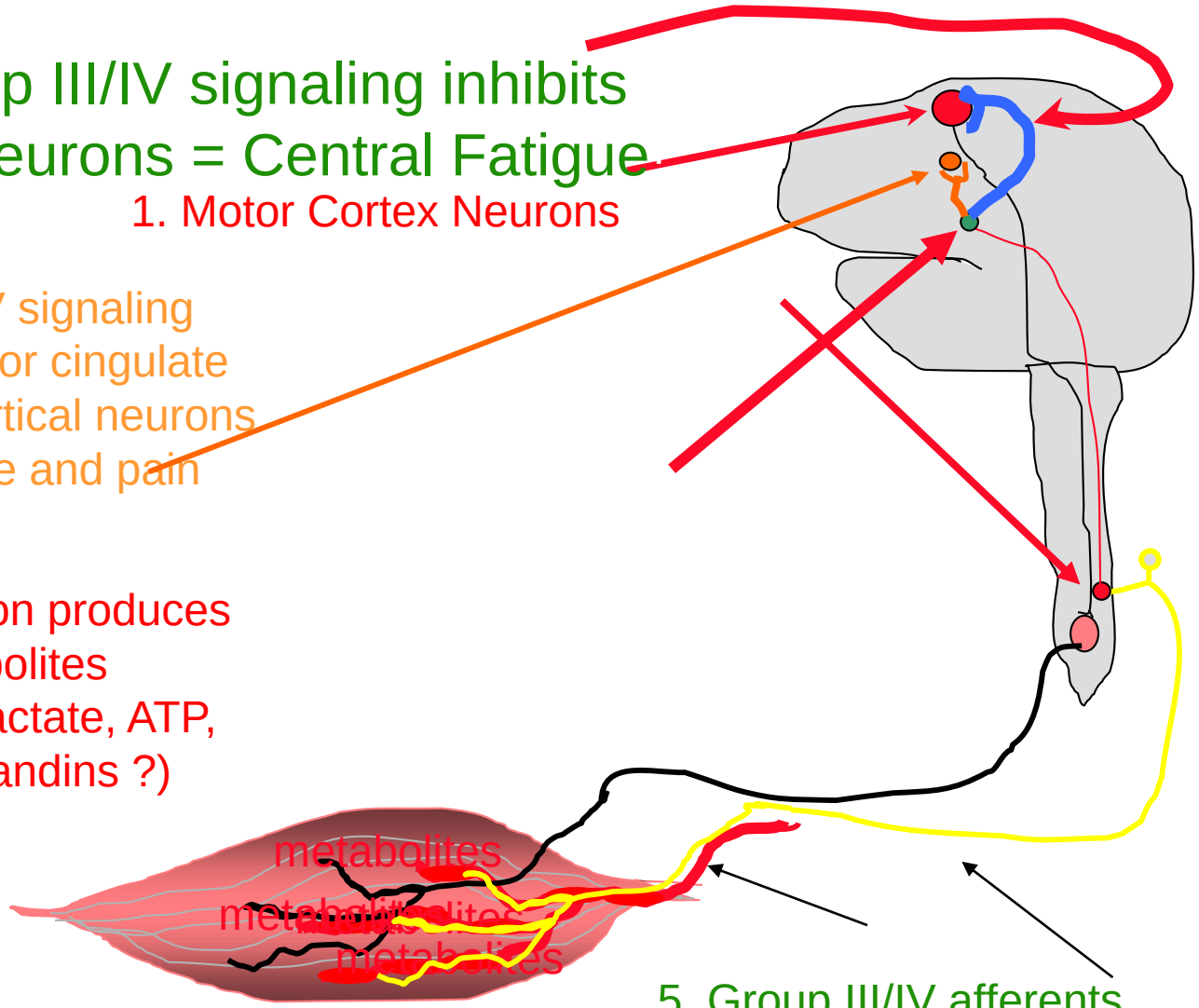
Central Fatigue, Pain, and Group III/IV muscle afferents,

Group III/IV signaling inhibits cortex neurons = Central Fatigue

1. Motor Cortex Neurons

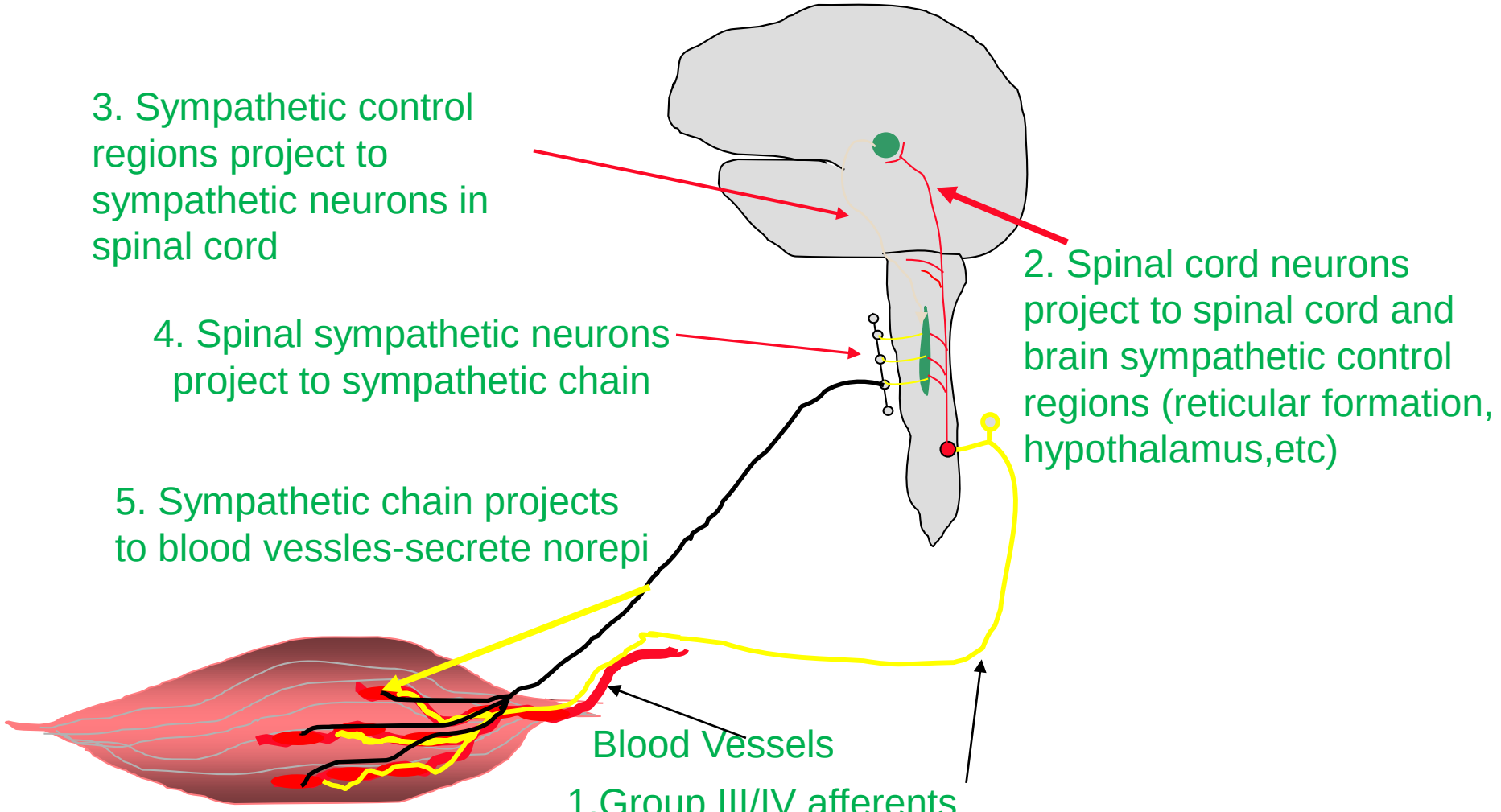
8. Group III/IV signaling Excites Anterior cingulate and other cortical neurons = muscle ache and pain and fatigue?

4. Contraction produces Metabolites (protons, lactate, ATP, prostaglandins ?)

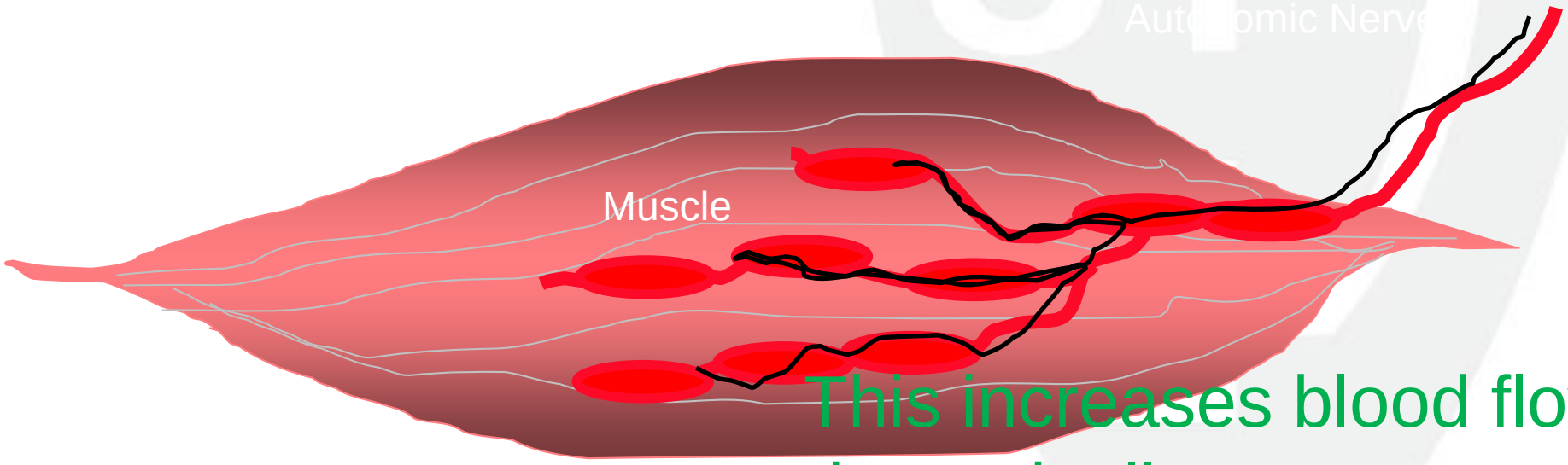


5. Group III/IV afferents on blood vessels detect metabolites project to spinal cord neurons

Autonomic systems activated by same neurons- More important than cognition!



Norepi activates beta adrenergic receptors- causes dilation of blood vessels supplying working muscle, alpha adrenergic receptors cause constriction of blood vessels supplying non-working muscles



This increases blood flow dramatically, washing out metabolites, returning metabolites to resting levels

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Brodoni, B and Zanier, E. Anatomic Connections of the diaphragm: Influence of respiration on the body system. Journal of Multidisciplinary Healthcare 2013:6 281–291

Travell & Simon. Chapter 45: Intercostal Muscles and the Diaphragm. Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol 1. 2nd Ed. Lippincott Williams&Wilkens. 1999.

Brodoni, B and Zanier, E. Anatomic Connections of the diaphragm: Influence of respiration on the body system. Journal of Multidisciplinary Healthcare 2013:6 281–291

- Dome-Shaped
  - Central tendinous portion (phrenic center)
  - Peripheral muscular portion
- Insertion
  - Sternal portion - under the xiphoid process
  - Costal portion – last 6 ribs
  - Lumbar section -
    - Right T11 – L2
    - Left T11 – L4
  - Connections to pulmonary pleura, pericardium, abdominal peritoneum

Brodoni, B and Zanier, E. Anatomic Connections of the diaphragm: Influence of respiration on the body system. Journal of Multidisciplinary Healthcare 2013:6 281–291

- Perinephric fat, liver, esophagus, ascending colon, duodeno-jejuno junction
- Interdigitates with:
  - Deep spinal muscles/Thoracolumbar fascia
  - Transverse abdominus/Internal and External Oblique
  - Psoas
  - Quadratus Lumborum
- Dynamic functional connection:
  - Pelvic floor muscles
  - Oral cavity floor

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- Neural Considerations:
  - Phrenic nerve: C3, 4, 5.
    - Overlapping neural connections with
      - Cervical Plexus
      - Brachial Plexus
      - Vagus Nerve
  - Sympathetic nerves to the abdominal plexus –
    - Course through the diaphragm
  - Indirect influence on the hypoglossal nerve
  - Proprioceptive and nociceptive properties

Brodoni, B and Zanier, E. Anatomic Connections of the diaphragm: Influence of respiration on the body system. Journal of Multidisciplinary Healthcare 2013:6 281–291

- Vascular Considerations:
  - Diaphragm connects to the pericardium
  - Aorta courses through the diaphragm
  - Inferior Vena Cava changes diameter with respiration
    - Decreases with inhalation
    - Increases with exhalation

- Lymphatic Considerations
  - Lymph moved through the negative pressure from inhalation
  - Moves from abdominal to the thoracic duct, left neck

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- Fascial Considerations:
- Interdigitates with:
  - Deep spinal muscles/Thoracolumbar fascia
  - Transverse abdominus/Internal and External Oblique
  - Psoas
  - Quadratus Lumborum

3 Dimensional aspect of the diaphragm and its mechanical movement through the fascia

Summary So Far:

- Diphragm functions:
  - ***Respiration/gas exchange***
  - ***Intra-abdominal Pressure for lumbar stability***
  - Negative-positive pressure changes to help with fluid flow
  - Mechanical movement of organs
  - Balance/Posture

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Research

- The effects of Doming of the Diaphragm in Subjects With Short-Hamstring Syndrome: A Randomized Trial Valenza, MC Cabrera-Martos I. Torres-Sanchez, I. Graces-Garcia A, Mateos-Toset S, Valenza-Demet G.J of Sports Rehab 2015, 24, 342-348.
- Doming of the Diaphragm: Improved hamstring flexibility and lumbar and cervical RoM Improve motor-control system and strategy

- Effects of diaphragm stretching on posterior chain muscle kinematic and rib cage and abdominal excursion: a randomized controlled trial. Gonzalez-Alvarez, F. Valenza, MC. Sanchez, I. Cabrera-Martos I. Rodriquez-Torres, J. Castellated-Caballero,Y. Braz J Phys Ther. 2016 Sept-Oct; 20(5):405-411.
- Doming of the Diaphragm improved cervical RoM, rib excursion , finger-to-floor test

Research

- Ultrasound Evaluation of Diaphragmatic Mobility and Contractility After Osteopathic Manipulative Techniques in Healthy Volunteers: A Prospective, Randomized, Double-Blinded Clinical Trial. Mancini, D. Cesar I, M. Lunghi, C. Benigni, AM. Incalzi, RA. Scarlatti, S. J Manipulative Physiology Ther 2019;42:47-54.
-
  - Showed significant Diaphragm mobility vs placebo
-
- Rocha T, Souza H, Branda˜o DC, Rattes C, Ribeiro L, Campos SL, Aliverti A, de Andrade AD (2015) The Manual Diaphragm Release Technique improvesdiaphragmatic mobility, inspiratory capacity and exercise capacity in people with chronic obstructive pulmonary disease: a randomised trial. Journal of Physiotherapy 61: 182–189
  - Improved diaphragm mobility, exercise capacity, and inspiratory capaticly in COPD patients

Research

- **Aishwarya Nair, Gopala Krishna Alaparthi ,Shyam Krishnan,Santhosh Rai,R. Anand, Vishak Acharya,and Preetam Acharya. Comparison of Diaphragmatic Stretch Technique and Manual Diaphragm Release Technique on DiaphragmaticExcursion in Chronic Obstructive Pulmonary Disease:**
- **A Randomized Crossover Trial. Pulmonary Medicine. Vol 2019. pages 1-7.**

- **Conclusion: Both techniques improve ultrasound assessed diaphragmatic excursion**

- Kolar P Sulc J Kyncl M Sanda j, Cakrt O, Andel R, Kumagai K, Kobesova A. Postural Function in of the diaphragm in persons with and without chronic low back pain. J Orthop Sports Phys Ther 2012; 42(2):352-62.
  - Diaphragm essential for Intra-abdominal pressure (IAP) to stabilize the spine
  - Essential for postural stability during lifting tasks

Diaphragm Evaluation

Bruno Bordoni, F Marelli B Morabito B Sacconi Manual evaluation of the diaphragm muscle.International Journal of COPD 2016:11 1949–1956

Figure 1 The hands must be gently placed on the lateral sides of the costal margins to receive palpation feedback of the costal behavior during breathing.

Diaphragm Evaluation

Bruno Bordoni, F Marelli B Morabito B Sacconi Manual evaluation of the diaphragm muscle.International Journal of COPD 2016:11 1949–1956

Figure 2 The hands can be held anteriorly on the costal margins, with the thumbs being at the level of the margins and the other fingers placed across the upper ribs. This manual position can be used to assess the diaphragmatic excursion.

Diaphragm Evaluation

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Figure 6 For medial ligaments, the spinal elasticity needs to be evaluated, with the patient being supine. The operator should hold the last phalanges of the fingers (of one or both hands) placed in the interspinous spaces of D11 and D12; by using a gentle push towards the ceiling, a passive extension of the vertebra is obtained, in order to deduce information on their elasticity.

Diaphragm Evaluation

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- An Osteopathic 7-step diaphragm evaluation

Diaphragm-Core evaluation

- Patient supine and knees bent at 90 degrees
- Place doctor's hands under lumbar spine and assess:
  - Lordosis
  - Lumbar movement during inhalation-exhalation (2-3 times)
  - Patient is to assess ease of breathing

- Before next breath, patient attempts to flatten spine against hands and then another breath and assess:
  - Ease of breathing and holding lumbar flattening
  - How much neck-head is recruited during this breath

Treatment:

Hands held underneath ribs for 5 minutes – Used for
Posterior Chain study
Hamstring Syndrome study
Hands under ribs for 2 sets of 10 deep breaths – Used for
COPD comparison of techniques

Treatment – vertebral insertion points Diaphragm Treatment of COPD patient

- Patient is sitting
- Clinician's thenar and hypothenar eminence at the T12-L3 transverse process
- Patient inhales and exhales
- During exhalation, anterior-medial pressure is applied and held during next inhalation
- This is repeated for at least 3 cycles

Treatment: - two different COPD studies

Fingers under ribs 7-10.
During inhalation, ribs pulled gently cephalad.
During exhalation, deepens finger contact
2 sets of 10 breaths with 1 minute between sets

Treatment:

Travell & Simons' Trigger Point Manual. 2nd Ed. Chpt 45

Diaphragm release. Standing opposite side and placing thumbs and hands shown, the patient calmly breaths. During exhalation, the clinician's thumbs follow the diaphragm inward under the ribs and then lift the rib cage anteriorly. This is repeated until there is a release.

Treatment:

Travell & Simons' Trigger Point Manual. 2nd Ed. Chpt 45

Self-release of diaphragm. Patient lays as shown and hooks fingers under the lower ribs and breaths. During exhalation, the fingers follow the diaphragm in and under ribs and apply an upward traction for several breath cycles

References

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- Hodges PW, Gandevia SC. Activation of the human diaphragm during a repetitive postural task. J Appl Physiol. 2000. 522:165-75.

Questions??

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