When Moving Hurts

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GLOBAL YEAR AGAINST MUSCULOSKELETAL PAIN

OCTOBER 2009 – OCTOBER 2010

• **FACT SHEET No. 2**

Basic Aspects of Muscle Pain

Introduction

- Musculoskeletal disorders are the leading causes of pain in every population.
- Pain from muscles and pain from the skin are subjectively and objectively distinct.
- Muscle pain is aching and cramping, and cutaneous pain is sharp and pricking. In contrast to cutaneous pain, muscle pain is referred to other deep somatic structures.
- Muscle pain is associated with autonomic symptoms such as slowing of pulse, drop in blood pressure and nausea. These symptoms do not appear with cutaneous pain.
- The neuronal pathways of nociceptive information from muscle and skin are different in the central nervous system (CNS).
- The contractile functions of muscles are closely connected to fasciae which have a relatively dense innervation including nociceptors ("myofascial pain").

Morphology and Functional Properties of Muscle Nociceptors

- Muscle nociceptors are free nerve endings that are connected to the CNS by thin myelinated (group III) or unmyelinated (group IV) fibers.
- Nociceptive muscle afferents are not blocked by tetrodotoxin (TTX), which indicates the presence of TTX-resistant sodium channels.
- Group III and IV fibers comprise high-threshold mechanosensitive (presumably nociceptive) and low-threshold mechanosensitive (presumably non-nociceptive) muscle receptors. The latter probably mediate pressure sensations from muscle.
- Dorsal root ganglion cells projecting in a muscle nerve contain neuropeptides such as substance P (SP), calcitonin gene-related peptide (CGRP), and somatostatin.
- By releasing neuropeptides and other vasoactive substances the free nerve endings influence the microcirculation in the vicinity of the endings.

Effective Stimuli for Peripheral Muscle Nociceptors

- Particularly important stimulants are adenosine triphosphate (ATP) and protons (low pH, tissue acidosis). These substances excite muscle nociceptors at (patho)physiological

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concentrations.

- Receptor molecules are P2X2–5 for ATP and ASIC3/TRPV1 for protons. Most muscle nociceptors are polymodal and respond to both noxious pressure stimulation and pain-producing substances.
- In lesioned muscle, nociceptors lower their mechanical threshold and respond to weak stimuli, because they are sensitized by substances such as PGE2, NGF, and SP released in the course of the lesion.This change in threshold may be the basis of muscle tenderness.
- Repeated intramuscular injections of acidic solutions induce generalized muscle pain.
- The density of innervation with sensory free nerve endings increases in inflamed muscle and fascia.

Central Effects of Nociceptive Activity from Muscle

- Nociceptive input from muscle is more effective in inducing central neuroplastic changes than is input from the skin.
- Chronic nociceptive input from a muscle does not lead to spasm of that muscle. The α-motoneurons of a painful muscle are centrally inhibited, and the α-motoneurons of the antagonist are activated (pain adaptation model). If a muscle is in spasm, the spasm is probably due to a painful disorder outside that muscle (in joints or other muscles).
- Every long-lasting input from muscle nociceptors to the CNS increases the excitability of central sensory neurons, leading to pain, hyperalgesia, and pain referral. The referral is probably due to the opening of silent synapses (ineffective connections).
- The postsynaptic receptor molecules responsible for central sensitization include N-methyl D-aspartate (NMDA), α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid (AMPA), and neurokinin-1 receptors.
- Even subthreshold synaptic activity sensitizes dorsal horn neurons.
- Glial cells, microglia in particular, are activated by a muscle lesion and release sensitizing factors such as ATP, prostaglandins, TNF-α, and brain-derived neurotrophic factor. These factors sensitize sensory neurons.
- In monotonous, light muscle work, always the same motor units of a muscle are used. These motor units are overloaded (repetitive strain disorder).This mechanism may be essential for some cases of occupational muscle pain.
- Muscle tone is not due to involuntary contractions of muscle but to the viscoelastic (physico-chemical) properties of muscle tissue.

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