Tuesday, 23 April 2013 -- Imaging Muscle Structure & Function
13:30-13:50 -- Clinical Aspects of Muscle Physiology & Pathology

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HIGHLIGHTS

- There are many potential opportunities to further the impact of MR in evaluating muscle physiology and pathology, including at systemic, regional, and local levels.

TARGET AUDIENCE

- Clinicians, radiologists, and researchers who wish to update their knowledge of how MRI relates to the study of normal and deranged skeletal muscle.

OBJECTIVES: Upon completion of this course, participants should be able to:

- Better understand clinically relevant aspects of muscle physiology
- Improve upon clinical MRI diagnosis of pertinent muscle pathology
- Identify strengths, weaknesses, and potential future needs of MRI in the diagnosis of muscle derangements

PURPOSE: To discuss the importance of understanding muscle physiology and pathology at three different levels: [I] SYSTEMIC, affecting the body as a whole (e.g., sarcopenia, sarcopenic obesity); [II] REGIONAL, affecting muscle groups (e.g., role of periarticular muscles in providing dynamic stability to joints); and [III] LOCAL, affecting individual muscles or muscle fibers (e.g., imaging of muscle injury and healing; natural history of muscle findings in the setting of a rotator cuff tear).

METHODS: To identify recent trends, theses, and controversies in the evidence-based medical literature, with an emphasis on the strengths, the weaknesses, and the potential future needs of clinical MRI in the diagnosis of muscle derangements.

RESULTS: [I] SYSTEMIC. Skeletal muscle is the single largest tissue in the body, generally making up 25-50% of one's total body weight. The health of muscle can have systemic affects on the body. 'Sarcopenia' refers to loss of muscle mass and function, and results in elevated risks for high health care costs, disability, and death. 'Sarcopenic obesity' is defined by the presence of sarcopenia with elevated fat mass in the body – often with a viscous cycle in which muscle wasting lowers the resting metabolic rate and physical activity, which promotes fat accumulation, insulin resistance, and muscle catabolism. Given the high prevalence of sarcopenia in our aging population (up to 50% after the age of 80 years), there is an intense interest answering pressing questions about the quantity and quality of skeletal muscle.

For example: [1] What role can MRI play for diagnosis and staging the severity of sarcopenia and sarcopenic obesity (including intracellular/extracellular intramuscular fat distribution and visceral/subcutaneous extramuscular fat distribution)?; [2] How much of the sarcopenia problem is intrinsic to muscle at a cellular level (e.g., myonuclear apoptosis), as opposed to other causes such as degraded neural or vascular supply (e.g., denervation resulting in disuse atrophy)?; [3] Can MRI be used as a cost-effective biomarker to study the prevention and treatment of sarcopenia (e.g., with particular

types of exercise, nutrients, or treatments such as testosterone, stem cells, or 'gene doping')?; [4] Given that muscle strength does not depend solely on muscle mass (and the relationship between strength and mass is not linear), are there anatomic or physiologic variables that would help in assessing muscle *quality* by MRI?

[II] REGIONAL. Muscles normally act in concert as dynamic stabilizers for articulations.

Abnormal muscles (e.g., due to weakness or 'dyskinesia') may potentially contribute to a wide array of disorders, including: [1] elevated fracture risk (e.g., because of a positive correlation between muscle mass and bone mass, as well as issues relating to fall prevention and muscle bulk 'cushioning' bone from traumatic forces); [2] premature osteoarthritis (due to abnormal loading or shearing stresses at articulations); [3] spine-related pain (e.g., relating to altered biomechanics of paravertebral muscles); and [4] shoulder pain (e.g., caused by dynamic external impingement in the setting of scapular dyskinesis).

[III] LOCAL. A wide array of insults can affect (one or more) individual muscles, including: traumatic tears and contusions; ischemia and necrosis; inflammation and infection; congenital and inherited conditions; neoplasms; and various iatrogenic insults. After an insult, muscle has a limited array of stereotypical responses, with sequelae that include atrophy, fibrosis, and hematoma/seroma.

Hot topics of investigation continue to include: [1] How can MR be optimized (e.g., functional techniques) in order to improve diagnostic specificity (e.g., tissue characterization), stratify patients into appropriate treatment groups, and predict prognosis (e.g., of traumatic lesions such as tears or hematomas), and [2] What can MR do (and not do) for the assessment of muscle atrophy, fatty infiltration, and musculotendinous inelasticity (e.g., in patients with rotator cuff or gluteal tendon tears)?

CONCLUSION: Muscle is a complex organ. By studying skeletal muscle at the systemic, regional, and local levels, we can more fully understand the key role it plays in both the quality and quantity of life. Although there are numerous gaps in our current knowledge, there also are many promising new horizons.

SELECTED REFERENCES

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