Musculoskeletal MR

MSK-I *Muscle Imaging/ Cartilage Imaging*
(5 speakers, 90 min)

MSK-II ***Bone Marrow Imaging***
(5 speakers, 90 min)

Wing P. Chan, MD
陳榮邦 教授

Time Table

Sunday, May 22, 2022
Room 202

Time	Topics	Speakers	Moderators
13:30-13:50 (20mins)	LBP and Quantitative Imaging	Sharmila Majumdar	Hung-Ta Wu Mahesh Prakash
13:50-14:10 (20mins)	Physiology of bone marrow perfusion and relationship to bone structure	James F Griffith	Hung-Ta Wu Mahesh Prakash
14:10-14:22 (12mins)	3D dynamic contrast enhanced MRI in bone sarcoma	Hung-Ta Wu	Hung-Ta Wu Mahesh Prakash
14:22-14:30 (8mins)	Q&A		Hung-Ta Wu Mahesh Prakash

Bone Marrow Imaging

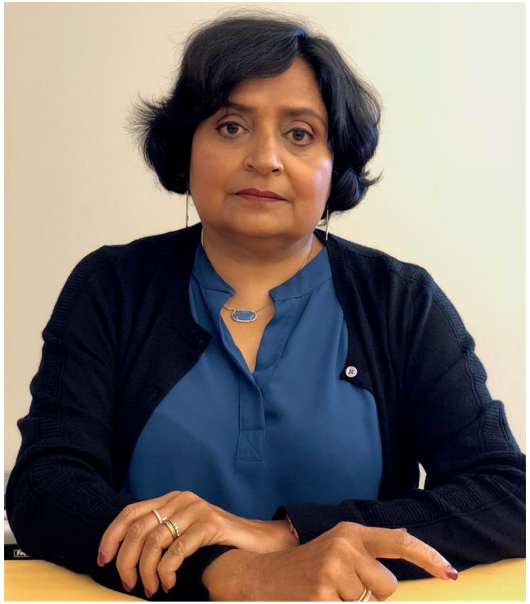
Organizer: Wing P. Chan, MD

Overview:

MRI provides excellent contrast resolution for the evaluation of soft tissue and bone marrow components. However, pattern of red to yellow marrow conversion in the spine may complicate the diagnosis and monitor treatment effects for bone marrow lesions as well as soft-tissue sarcoma further.

Dynamic contrast-enhanced MRI (dMRI) studies the kinetics of the distribution of paramagnetic contrast in the microvessels and in the interstitial space of the tissues being studied. This session will focus the ‘old’ method of dMRI in studying soft-tissue sarcoma, with promising results in differentiating malignant from benign and viable from non-viable tumor, and the explore physiology and hemodynamic changes of bone marrow components by age and sex, and new application of quantitative assessment of low back pain.

LBP and Quantitative Imaging



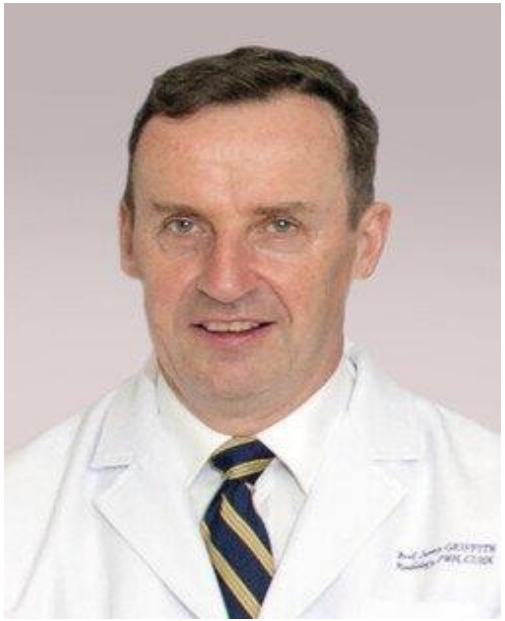
Sharmila Majumdar, MD, PhD, USA

- Vice Chair for Research, Department of Radiology and Biomedical Imaging, UCSF
- Margaret Hart Surbeck Distinguished Professor in Advanced Imaging, UCSF
- Professor, Department of Orthopedic Surgery and Department of Bioengineering & Therapeutic Sciences, UCSF

LBP and Quantitative Imaging

- **Synopsis:**
- Disorders of the spine have a tremendous impact on society, both physically through the morbidity of afflicted individuals, and financially, through lost productivity and increased health care costs. The etiology of symptoms is diverse and unclear in many patients. Challenges contributing to lower back pain include numerous sources of back pain, difficulty in visualization of responsible tissues using any single imaging technique and difficulty in the localization of pain and contributing molecular processes. Magnetic Resonance imaging (MR) has been used to characterize disc, muscle, nerves, and Positron Emission Tomography (PET) has been used to study bone turnover, and facet disease in subjects with lower back pain. Quantitative imaging techniques and key technical advancements in the development of machine learning will be discussed.

Physiology of bone marrow perfusion and relationship to bone structure



- Professor and Chairman Department of Imaging & Interventional Radiology Faculty of Medicine
- The Chinese University of Hong Kong

James F Griffith, MD, MRCP, FRCR, Hong Kong

Physiology of bone marrow perfusion and relationship to bone structure

- ## Synopsis:

Physiology of bone marrow perfusion & relationship to bone structure

JF Griffith, Professor and Chairman, Dept of Imaging and Interventional Radiology, The Chinese Univiserity of Hong Kong

Good bone perfusion is essential for bone growth, day-to-day metabolism, and fracture healing (1). Many techniques have been used since the 1940' s to try and measure bone blood flow or perfusion (2). The varied anatomy of bone does not make this an easy task. However, with MRI, and to a lesser degree with PET/CT, bone perfusion can be measured quite accurately and reliably with dynamic contrast-enhanced MRI (3,4). Intravoxel incoherent motion (IVIM) provides another new method of measuring bone perfusion (5). IVIM is advantageous in that it does not require intravenous contrast though is currently not as robust as dynamic contrast-enhanced MRI. The anatomy of the bone circulation is briefly reviewed including its relevance to bone metabolism (2). Functioning bone marrow (i.e. red marrow) is the main driver of bone marrow perfusion. As marrow fat increases with age and osteoporosis, the amount of red marrow within the skeleton decreases, and bone perfusion decreases accordingly (3,4,6). One can appreciate that both poor bone perfusion may result in inadequate microfracture healing, leading to microfracture propagation, and the eventual recurrence occurrence of a clinical insufficiency fracture.

Whilst bone marrow perfusion is still in the research arena with respect to bone metabolism, it is likely that more routine clinical evaluation of bone perfusion will occur as a means to predict outcome, and follow treatment response in patients with infiltrative bone marrow disorders such as leukaemia, myeloma or lymphoma (1). This is likely to be done with refined IVIM techniques rather than with dynamic contrast-enhanced MRI imaging, given the current problems surrounding potential gadolinium retention (1,5).

Keywords: MRI; bone marrow; blood flow; physiology; anatomy

- ## Key Reference:

1. Griffith JF van der Heijden RA. Bone marrow perfusion imaging and potential for tumour evaluation. Skeletal Radiology (in press). 2022

2. Brookes M, Revell WJ. Blood vessels in Bone Marrow. In:Brookes M, Revell Ed. Blood Supply of Bone, Scientific aspects. Cambridge, UK. Springer, 1998; 75-107

3. Chen WT, Shih TT, Chen RC, Lo SY, Chou CT, Lee JM, Tu HY. Vertebral bone marrow perfusion evaluated with dynamic contrast-enhanced MR imaging: significance of aging and sex. Radiology. 2001;220(1):213-8.

4. Griffith JF, Yeung DK, Tsang PH, Choi KC, Kwok TC, Ahuja AT, Leung KS, Leung PC. Compromised bone marrow perfusion in osteoporosis. J Bone Miner Res. 2008 ;23(7):1068-75.

5. Le Bihan D. What can we see with IVIM MRI? Neuroimage. 2019 15;187:56-67.

6. Griffith JF. Age-Related Changes in the Bone Marrow. Curr Radiol Report 2017;5:24.

3D dynamic contrast enhanced MRI in bone sarcoma

- Chief of Musculoskeletal Section, Department of Radiology, Taipei Veterans General Hospital
- Assistant Professor, Department of Radiology, School of Medicine, National Yang Ming University

Hung-Ta Wu, MD, Taiwan

3D dynamic contrast enhanced MRI in bone sarcoma

- **Synopsis:**

Osteosarcoma (OS) is the most common malignant bone tumors in children and adolescents. OS has caused pediatric patients great suffering. Preoperative chemotherapy plays an essential role in the treatment effect and prognosis. Accurate evaluation of preoperative tumor response or necrosis is essentially important in treatment plan and outcome prediction.

Recently, advanced imaging like quantitative MR plays an essential role in advanced bone tumor imaging. Dynamic contrast enhanced (DCE) MR imaging has been applied in evaluation of vascularity or treatment response of bone sarcoma, e.g. OS. Toft' s two-compartment pharmacokinetic model is recommended to define the microvascular permeability: the fraction of a vascular space and the tissue space: extravascular extracellular space (EES), which changed as the contrast agent leaks through the microvascular wall to EES (wash in), and moves back from EES to vascular lumen (wash out). Theoretically after tumor destruction, a fraction of the contrast agent should leak into the extravascular extracellular space and back to vascular space of the bone sarcoma. The key parameters of the model include: 1)Ktrans, transfer constant from the vasculature to the EES; 2)Kep, rate constant from the EES to vascular space; 3)Ve, the volume of the EES per unit volume of tissue; and 4)Vp, total blood plasma volume.

In this mini-lecture, the effect and value of 3D DCE MR imaging in assessment of hemodynamics of osteosarcoma (OS) will be discussed.

- **Key Reference:**