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Role of diffusion-weighted MRI in evaluation of pediatric musculoskeletal soft tissue masses

Mohamed Ali El-Adalany¹, Nevertiti Kamal El-Din Eid¹, Salma Othman² and Dina El-Metwally^{1*}

Abstract

Background: In pediatric patients, soft tissue masses encompass a wide heterogeneous group of benign and malignant lesions. MRI is a powerful diagnostic tool in the workup of soft tissue tumors in children, and it helps in characterization of lesion and evaluation of the extent of the lesion. However, conventional MRI techniques are not specific in differentiating benign from malignant lesions. So to improve characterization of tumors, DWI was added to MRI techniques as it increases sensitivity and specificity by detecting the micro-diffusion changes of water into intra- and extracellular spaces. The aim of this work was to highlight the diagnostic value of DWI in detection and characterization of different musculoskeletal soft tissue masses in pediatrics.

Results: There was a statistically significant difference regarding the mean ADC value of benign and malignant masses (P value = 0.001*). The mean ADC value for all benign masses ($n = 41$) was $1.495 \pm 0.55 \text{ SD} \times 10^{-3} \text{ mm}^2/\text{s}$, while the mean ADC value for all malignant masses ($n = 21$) was $0.449 \pm 0.27 \text{ SD} \times 10^{-3} \text{ mm}^2/\text{s}$. The cutoff ADC value between benign and malignant masses was $0.88 \times 10^{-3} \text{ mm}^2/\text{s}$. This cutoff ADC value has sensitivity of 100.0%, specificity of 92.3%, PPV of 66.7%, NPV of 100.0% and diagnostic accuracy of 93.3%.

Conclusion: In pediatric patients, DWI is an innovative valuable noninvasive imaging technique for characterization of musculoskeletal soft tissue masses and discrimination between benign and malignant masses.

Keywords: MRI, DWI, Soft tissue, Masses, Benign, Malignant, Pediatrics

Background

Soft tissue masses and osseous lesions are commonly encountered in pediatric patients. Musculoskeletal soft tissue masses encompass a wide heterogeneous group of benign and malignant lesions that developed from connective tissue other than bone. Although benign in most cases, a significant proportion of pediatric musculoskeletal soft tissue masses constitutes malignant tumors [1]. Patients who have a soft tissue tumor or tumor-like mass usually presented with non-specific clinical findings such as soft tissue swelling or pain. In many cases, a detailed history and physical examination are sufficient to make a diagnosis, but in circumstances when the diagnosis is

uncertain, imaging can be very helpful to characterize the mass [2].

MRI is a powerful diagnostic tool in the workup of soft tissue tumors in children due to its high spatial and contrast resolution [3]. However, there is often an overlap in the MRI appearance of benign and malignant soft tissue tumors, resulting in decreasing the diagnostic confidence. The specificity of conventional MRI in differentiating benign from malignant soft tissue tumors was variable among previous studies, presumably because benign and malignant soft tissue tumors may share the same morphologic features regarding the size, margin, location, signal intensities and contrast enhancement [4, 5].

So to improve characterization of tumors, DWI was added to MRI techniques as it increases sensitivity and specificity by detecting the micro-diffusion changes of water into intra- and extracellular spaces [4]. DWI is a

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Mri Of Musculoskeletal Masses

P. Reimer, P.M. Parizel, F.-A. Stichnoth

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the authors' names.

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MRI of Musculoskeletal Masses Alan Laorr, Clyde A. Helms, 1997 *Magnetic Resonance Imaging of Bone and Soft Tissue Tumors and Their Mimics* A.M.A. de Schepper, A.D. Degryse, 2012-12-06 Magnetic resonance imaging has already become a most valuable imaging modality in the diagnostic work up of musculoskeletal neoplasms While high accuracy of MRI for staging purposes has been proven we will focus in this monograph on the characterization of primary bone and soft tissue tumors by MRI The major purpose of this monograph is to provide an atlas of magnetic resonance features of primary bone and soft tissue tumors for radiologists orthopedic surgeons and physiotherapists The results presented are based on investigations of 94 primary bone and soft tissue tumors and mimicking conditions by magnetic resonance imaging Although the scale of the material allows for statistical handling the number of patients per subgroup is too small to come to definite conclusions We will therefore limit ourselves to the description of and comments on a great number of cases to illustrate the diagnostic potential of this new imaging modality We would like to thank the anonymous cooperators referring clinicians pathologists nurses technicians and secretaries whose help enabled us to present this monograph We would also like to express our gratitude to the firms Siemens AG and Schering AG for technical support **MRI of Bone and Soft Tissue Tumors and Tumorlike Lesions** Steven P. Meyers, 2008 This unique encyclopedic guide takes the same approach you apply in clinical practice It features fully illustrated differential diagnosis tables organized according to MRI findings and the locations of tumors An in depth reference section provides information on each lesion In addition almost 3000 high quality images make this practical text an invaluable tool in the diagnosis of common and rare tumors and other disorders of the musculoskeletal system Features 20 differential diagnosis tables based on anatomic locations of lesions rather than disease fully illustrated reference chapters containing concise detailed information for each lesion from relative frequency and age rangers to MRI findings treatment and prognosis over 2900 state of the art illustrations covering the wide range of imaging features for various lesions an exceptional level of detail helping you to differentiate between diseases and conditions that have similar appearances and extensive cross referencing to further up to the minute resources **BOOK JACKET **Imaging of Soft Tissue Tumors**** P.M. Parizel, L. De Beuckeleer, F. Vanhoenacker, Arthur M. De Schepper, 2013-04-17 This richly illustrated revised second edition provides a comprehensive survey of the growing role of medical imaging studies in the detection staging grading tissue characterization and post treatment follow up of soft tissue tumors For each tumor group imaging findings are correlated with clinical epidemiologic and histologic data The relative merits and indications of various imaging modalities are discussed and compared Particular emphasis is placed on MRI The updated edition includes new chapters on soft tissue lymphoma soft tissue tumors in the pediatric patient and biopsy of soft tissue tumors It aims to serve both as a systematic descriptive textbook and as a rich pictorial database of soft tissue masses *Imaging of Soft Tissue Tumors* Filip M. Vanhoenacker, Arthur M. de Schepper, Paul M. Parizel, Jan L.M.A. Gielen, 2006-04-26 This richly illustrated

book provides a comprehensive survey of the growing role of medical imaging studies in the detection staging grading tissue characterization and post treatment follow up of soft tissue tumors For each tumor group imaging findings are correlated with clinical epidemiologic and histologic data The relative merits and indications of various imaging modalities are discussed and compared Particular emphasis is placed on MRI because of its unique contrast resolution and multiplanar imaging capabilities This third revised and updated edition includes new chapters on genetics and molecular biology and on pathology of soft tissue tumors with respect to the new World Health Organization WHO classification of soft tissue tumors It aims to serve both as a systematic descriptive textbook and as a rich pictorial database of soft tissue masses The addition of numerous new illustrations of common and rare soft tissue tumors will further increase the scientific and educational value of this third edition

Imaging of Soft Tissue Tumors Mark Kransdorf, Mark D. Murphey, 2013-09-26 imaging technology plays an essential role in the diagnosis of soft tissue tumors as well as in surgical planning Not only can imaging studies such as CT and MRI determine the relationship between a tumor and adjacent vessels and nerves but because some soft tissue tumors possess specific radiologic presentations imaging can help pinpoint the tumor type Based on cases seen at the Armed Forces Institute of Pathology and the Mayo Clinic this comprehensive reference offers detailed visually supported information on the radiologic evaluation of soft tissue tumors and tumor like lesions Inside readers will explore the full spectrum of soft tissue pathologies with over 1400 images that highlight both common and atypical presentations The book's expert authors offer valuable advice on selecting the most appropriate imaging modality for each tumor type

Magnetic Resonance Imaging of Musculoskeletal Tumors Loralie D. Ma, 1999 **Practical MRI of the Foot and Ankle** Alison R. Spouge, Thomas L. Pope, 2000-09-21 EXPAND YOUR KNOWLEDGE OF MRI OF THE FOOT AND ANKLE The introduction of MRI together with rapid technological advancements over the last five years has provided a powerful diagnostic tool Despite this development clinicians are unfamiliar with MRI of the foot and ankle due to the complexities of this imaging modality and the anatomy and

Enzinger and Weiss's Soft Tissue Tumors Sharon W. Weiss, John R. Goldblum, Andrew L. Folpe, 2007-11-29 Here's your ideal reference on the diagnosis of tumors of the skeletal muscles connective tissue fat and related structures No other textbook matches its scope and depth of coverage in this complex and challenging area of surgical pathology and no other text contains as much practical information on differential diagnosis Throughout microscopic findings are correlated with the latest developments in molecular biology cytogenetics and immunohistochemistry to provide you with a comprehensive and integrated approach to evaluation and diagnosis Almost 2 000 superb illustrations capture the appearance of a complete range of entities and help relate these to their specific classifications The result is an essential resource for all who diagnose and treat soft tissue tumors Get all the assistance you need in one reference to effectively diagnose these often complex and challenging entities Confirm your diagnostic suspicions by comparing your findings to nearly 2 000 full color high quality illustrations representing the complete range of soft tissue tumors Access all of the essential clinical and prognostic data

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Clinical MR Imaging
P. Reimer,P.M. Parizel,F.-A. Stichnoth,2006-05-11 Magnetic resonance imaging MRI has become the leading cross sectional imaging method in clinical practice Continuous technical improvements have significantly broadened the scope of applications At present MR imaging is not only the most important diagnostic technique in neuroradiology and musculoskeletal radiology but has also become an invaluable diagnostic tool for abdominal pelvic cardiac breast and vascular imaging This book offers practical guidelines for performing efficient and cost effective MRI examinations in daily practice The underlying idea is that by adopting a practical protocol based approach the work flow in a MRI unit can be streamlined and optimized For the second edition all chapters have been thoroughly reviewed and new techniques and figures were included This book will help beginners to advance their starting point in implementing the protocols and will aid more experienced users in updating their knowledge

Oncology Alfred E. Chang,Patricia A. Ganz,Daniel F. Hayes,Timothy Kinsella,Harvey I. Pass,Joan H. Schiller,Richard M. Stone,Victor Strecher,2007-12-08 Title consistently uses the evidence based approach Evidence based tables make documentation of care plan easy Interdisciplinary orientation all aspects of patient care are covered Only book that involves experts from the entire range of cancer treatment in the fields of medical surgical and radiation oncology Includes hot topics such as prevention and breast cancer Offers ground breaking sections on the latest research and clinical applications in cancer survivorship Chapter on PET addresses imaging issues and how to get the best results Most comprehensive sections on the biology and epidemiology of cancer as compared to competitors

Advanced Musculoskeletal MR Imaging. An Issue of Magnetic Resonance Imaging Clinics of North America Roberto Domingues,Flavia Costa,2018-10-16 This issue of MRI Clinics of North America focuses on Advanced Musculoskeletal MR Imaging and is edited by Drs Roberto Domingues and Flavia Martins Costa Articles will include Quantitative Whole Body MRI Multiparametric Bone Marrow Imaging MET RADS P in Practice Whole Body MRI Beyond Oncology Whole Body Imaging in Multiple Myeloma MRI Neurography in Musculoskeletal Disorders MR Imaging in Rheumatology Multiparametric MRI of Soft Tissue Tumors and Pseudotumors Multiparametric MRI of Benign and Malignant Bone Tumors MR Imaging of Fetal

Musculoskeletal Disorders MRI at Rio 2016 Olympic and Paralympic Games Our Experience using State of the art 3.0 T and 1.5 T Wide bore MRI Scanners in High Performance Athletes Ultrasound and Advanced MRI Fusion for Musculoskeletal Tumors Biopsy and more **Dynamic Contrast-Enhanced Magnetic Resonance Imaging in Oncology** Alan

Jackson, David L. Buckley, Geoffrey J. M. Parker, 2005-11-02 Dynamic contrast enhanced MRI is now established as the methodology of choice for the assessment of tumor microcirculation in vivo This is assisting clinical practitioners in the management of patients with solid tumors and is finding prominence in the assessment of tumor treatments including anti angiogenics chemotherapy and radiotherapy In this book targeted at both clinical practitioners and basic scientists the principles of the methods their practical implementation and their application to specific tumor types are discussed by the leading authorities in the field today The book will serve as an invaluable single volume reference covering all the latest developments in contrast enhanced oncological MRI Soft Tissue Sarcomas: New Developments in the Multidisciplinary Approach to Treatment H.M. Pinedo, J. Verweij, H.D. Suit, 2012-12-06 Where do you begin to look for a recent authoritative article on the diagnosis or management of a particular malignancy The few general oncology textbooks are generally out of date Single papers in specialized journals are informative but seldom comprehensive these are more often preliminary reports on a very limited number of patients Certain general journals frequently publish good in depth reviews of cancer topics and published symposium lectures are often the best overviews available Unfortunately these reviews and supplements appear sporadically and the reader can never be sure when a topic of special interest will be covered Cancer Treatment and Research is a series of authoritative volumes that aim to meet this need It is an attempt to establish a critical mass of oncology literature covering virtually all oncology topics which is revised frequently to keep the coverage up to date and which is easily available on a single library shelf or by a single personal subscription We have approached the problem in the following fashion first by dividing the oncology literature into specific subdivisions such as lung cancer genitourinary cancer pediatric oncology etc and second by asking eminent authorities in each of these areas to edit a volume on the specific topic on an annual or biannual basis Each topic and tumor type is covered in a volume appearing frequently and predictably discussing current diagnosis staging markers all forms of treatment modalities basic biology and more *MR Imaging of the Foot and Ankle, An Issue of Magnetic Resonance Imaging Clinics of North America* Mary G.

Hochman, 2016-11-28 This issue of MRI Clinics of North America focuses on Imaging of the Foot and Ankle and is edited by Dr Mary Hochman Articles will include Technical Considerations Best Practices for MR Imaging of the Foot and Ankle Normal Variants and Potential Pitfalls in MRI of the Ankle and Foot Medial Sided Ankle Pain MRI of the Deltoid Ligament and Beyond MRI of Impingement and Entrapment Syndromes of the Foot and Ankle MRI of the Diabetic Foot MRI of the Midfoot MRI of the Plantar Plate Normal Anatomy Turf Toe and other Injuries MRI of Common Bone and Soft Tissue Tumors in the Foot and Ankle MRI of the Post operative Ankle and Foot New Techniques in MR Imaging of the Ankle and Foot MRI of the

Pediatric Foot and Ankle What Does Normal Look Like and more Muscle Imaging in Health and Disease James L. Fleckenstein, John V. III Cruess, C.D. Reimers, 2012-12-06 A comprehensive text reference of imaging skeletal muscle This book is distinguished by its presentation of all available modalities x ray CT ultrasound and MRI This is an area of vital importance to neurologists and orthopaedists as well as radiologists

Differential Diagnosis in Orthopaedic Oncology Adam Greenspan, Gernot Jundt, Wolfgang Remagen, 2007 This volume presents both the radiologist's and the pathologist's approach to differential diagnosis of musculoskeletal tumors and tumor like lesions and details the radiologic and histopathologic features helpful in confirming a diagnosis The book is illustrated with over 1 200 radiographs CT and MR images full color photomicrographs and schematic drawings Tables list important diagnostic features and schematic drawings summarize both radiologic and pathologic differential diagnoses This edition includes state of the art information on PET thin section CT 3 D CT MRI enzyme histochemistry immunohistochemistry flow cytometry cytogenetics and molecular cytogenetics The new co author Gernot Jundt was instrumental in revising the WHO classification of musculoskeletal lesions Illustrations have been updated and improved captions begin with the diagnosis

Computed Body Tomography with MRI Correlation Joseph K. T. Lee, 2006 Grundlæggende om CT og MRI og deres anvendelse i forbindelse med undersøgelse af kroppens organer Først beskriver principperne bag CT teknik og MRI og derefter gennemgås undersøgelse af kroppens organer systematisk Bogen beskriver både normale og abnorme fund med tekst og billeder og giver instruktioner i hvorledes man optimerer billedkvalitet analyse og fortolkninger samt undgår de mest almindelige fejlfortolkninger

Functional Imaging in Oncology Antonio Luna, Joan C. Vilanova, L. Celso Hygino Da Cruz Jr., Santiago E. Rossi, 2014-07-08 In the new era of functional and molecular imaging both currently available imaging biomarkers and biomarkers under development are expected to lead to major changes in the management of oncological patients This two volume book is a practical manual on the various imaging techniques capable of delivering functional information on cancer including diffusion MRI perfusion CT and MRI dual energy CT spectroscopy dynamic contrast enhanced ultrasonography PET and hybrid modalities This second volume considers the applications and benefits of these techniques in a wide range of tumor types including their role in diagnosis prediction of treatment outcome and early evaluation of treatment response Each chapter addresses a specific malignancy and is written by one or more acclaimed experts The lucid text is complemented by numerous high quality illustrations that highlight key features and major teaching points

Computed Tomography & Magnetic Resonance Imaging Of The Whole Body E-Book John R. Haaga, Daniel Boll, 2008-12-08 Now more streamlined and focused than ever before the 6th edition of CT and MRI of the Whole Body is a definitive reference that provides you with an enhanced understanding of advances in CT and MR imaging delivered by a new team of international associate editors Perfect for radiologists who need a comprehensive reference while working on difficult cases it presents a complete yet concise overview of imaging applications findings and interpretation in every anatomic area The new edition of this classic reference

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