Gadolinium Containing Mri Contrast Agents And Nephrogenic

With its high resolution and non-invasive character, contrast-enhanced MR angiography (CE-MRA) is fast becoming a diagnostic method of choice in detecting cardiovascular disease. Additionally, MR scanners can also perform first-pass perfusion studies with contrast agents for the detection and characterization of tissue ischemia. This highly-illustrated text is based on the extensive experience with CE-MRA and perfusion studies by a team of Czech cardiologists and radiologists. They have chosen a practical rather than theoretical approach to apprize the reader of what they need to do when performing MR angiography or perfusion studies with high-concentration contrast agents.

Extracellular MRI and X-ray contrast agents are characterized by their phar- cokinetic behaviour.After intravascular injection their plasma-level time curve is characeterized by two phases. The agents are rapidly distributed between plasma and interstitial spaces followed by renal elimination with a terminal half-live of approximatly 1–2 hours. They are excreted via the kidneys in unchanged form by glomerular filtration. Extracellular water-soluble contrast agents to be applied for X-ray imaging were introduced into clinical practice in 1923. Since that time they have proved to be most valuable tools in diagnostics.They contain iodine as the element of choice with a sufficiently high atomic weight difference to organic tissue. As positive contrast agents their attenuation of radiation is higher compared with the attenuation of the surrounding tissue. By this contrast enhancement X-ray diagnostics could be improved dramatically. In 2,4,6-triiodobenzoic acid derivatives iodine is firmly bound. Nowadays diamides of the 2,4,6-triiodo-5-acylamino-isophthalic acid like iopromide (Ultravist, Fig. 1) are used as non-ionic (neutral) X-ray contrast agents in most cases [1].

Magnetic resonance imaging (MRI) is a medical imaging technique that provides high-resolution images used for diagnostic medicine while maintaining a superior safety profile compared to other radiative techniques. The administration of gadolinium-based contrast agents (GBCAs) improves the diagnostic power of MRI and have been used clinically for over three decades. Although GBCAs are effective at improving the contrast in the image, their detection limits are high and require a large dose to generate an observable effect. This high dose is the consequence of the current available designs of clinical GBCAs; their structures are not tuned to generate optimal efficacy. Efficacy of GBCAs is defined as relaxivity; how effectively the agent increases the T1 relaxation rate constant of protons on water. The isoelectric structure of the f-orbitals of Gd3+ yields it an effective relaxivity agent. However, Gd3+ is toxic and insoluble in vivo, and is therefore bound as a low molecular weight hydrophilic chelate. The ligand which forms the most kinetically inert and safest GBCA is 1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetate (DOTA). Parameters defined by Solomon, Bloembergen, and Morgan (SBM) describe different factors that influence relaxivity of a GBCA. Two of which have been demonstrated to dramatically influence efficacy: chelate tumbling and water exchange rates. A drawback to current ligand systems are low molecular weight; relaxivity increases with slower tumbling chelates. Current GBCAs have a tumbling rate that is much too rapid to achieve high relaxivities. Secondly, while this value is predominating, it is difficult to ascertain the contribution of other SBM parameters. It had been originally hypothesized that to improve relaxivity, water exchange rate needs to be fast. However, research in our group has demonstrated that a chelate which exchanges water too rapidly suffers from a reduction in its hydration state. The implication of this reduction in hydration state on relaxivity has yet to be fully appreciated. The importance of the influence of SBM parameters on relaxivity is realized when advancements in GBCA technology are applied. The non-specific nature of GBCAs means they cannot directly diagnose pathology. One promising approach to reduce detection limits by increasing specificity in vivo is through bifunctional chelators (BFCs). These ligands have two components: a metal chelating group to bind gadolinium (DOTA), and a reactive moiety that couples with a targeting vector to bind desired biological receptors. This allows for defined bioaccumulation in vivo, resulting in improved diagnostics and lower detection limits. But with several BFCs available commercially, each positioning the vector attachment differently on the DOTA scaffold, the ideal scaffold for BFC design while including the influence of SBM is yet to be established. The three most common strategies of targeting vector attachment are off the tetraaza macrocycle, through a monoamide pendant arm, or off an [alpha]-carbon on the acetate pendant arm. A thorough investigation of these three strategies was explored herein, in which BFC precursors were synthesized, and their structures analyzed relaxometrically. It was found that the attachment strategy significantly impacted water exchange parameters and molecular tumbling, which in turn greatly influenced relaxivity. The experiments conducted herein presented compelling new evidence in the way we define water exchange and hydration state. Studies into derivatives of the macrocycle substituted chelate NB-DOTA presented the impact an extremely rapidly exchanging chelate has on hydration state and its effect on relaxivity. Synthesis and analysis of a new tetra [alpha]-carbon substituted chelate, DOTFA, yielded an exceedingly high relaxivity, as well as an interesting and novel impact on water exchange; there is strong evidence that DOTFA chelates exchange water in a mechanism that is not purely dissociative. Finally, studies into amide substituted chelates provided the expected low relaxivity associated with slow water exchange. Yet, it was demonstrated that changing the type of coordinating monoamide pendant arm, water exchange can be tuned to slightly more optimal values. These systematic studies provided novel insight how the most effective targeted GBCA can be designed, synthesized, and analyzed, as well as presented new evidence into the impact functionalization strategies have on relaxometric values.

The significantly updated second edition of this important work provides an up-to-date and comprehensive overview of cardiovascular magnetic resonance imaging (CMR), a rapidly evolving tool for diagnosis and intervention of cardiovascular disease. New and updated chapters focus on recent applications of CMR such as electrophysiological ablative treatment of arrhythmias, targeted molecular MRI, and T1 mapping methods. The book presents a state-of-the-art compilation of expert contributions to the field, each examining normal and pathologic anatomy of the cardiovascular system as assessed by magnetic resonance imaging. Functional techniques such as myocardial perfusion imaging and assessment of flow velocity are emphasized, along with the exciting areas of artherosclerosis plaque imaging and targeted MRI. This cutting-edge volume represents a multi-disciplinary approach to the field, with contributions from experts in cardiology, radiology, physics, engineering, physiology and biochemistry, and offers new directions in noninvasive imaging. The Second Edition of Cardiovascular Magnetic Resonance Imaging is an essential resource for cardiologists and radiologists striving to lead the way into the future of this important field.

Fluorine Magnetic Resonance Imaging

Enhanced Magnetic Resonance Imaging

A Companion to Braunwald's Heart Disease

Contrast Agents for MRI

Systematic Reviews in Health Care

Imaging of Urinary Tract Diverticula

Preceded by Magnetic resonance imaging: physical principles and sequence design / E. Mark Haacke ... [et al.]. c1999.

Side Effects of Drugs Annual: A Worldwide Yearly Survey of New Data in Adverse Drug Reactions was first published in 1977, and has been continually published as a yearly update to the voluminous encyclopedia Meyler's Side Effects of Drugs. Each annual provides clinicians and

medical investigators with a reliable and critical survey of new data and trends in the area of adverse drug reactions and interactions, with an international team of specialists contributing their expertise each year. Provides a critical yearly survey of the new data and trends regarding the side effects of drugs Authored and reviewed by worldwide pioneers in the clinical and practice sciences Presents an essential clinical on the side effects of drugs for practitioners and healthcare professionals alike

Magnetic Resonance Imaging (MRI) is one of the most important tools in clinical diagnostics and biomedical research. The number of MRI scanners operating around the world is estimated to be approximately 20,000, and the development of contrast agents, currently used in about a third of the 50 million clinical MRI examinations performed every year, has largely contributed to this significant achievement. This completely revised and extended second edition: Includes new chapters on targeted, responsive, PARACEST and nanoparticle MRI contrast agents. Covers the basic chemistries, MR physics and the most important techniques used by chemists in the characterization of MRI agents from every angle from synthesis to safety considerations. Is written for all of those involved in the development and application of contrast agents in MRI. Presented in colour, it provides readers with true representation and easy interpretation of the images. A word from the Authors: Twelve years after the first edition published, we are convinced that the chemistry of MRI agents has a bright future. By assembling all important information on the design principles and functioning of magnetic resonance imaging probes, this book intends to be a useful tool for both experts and newcomers in the field. We hope that it helps inspire further work in order to create more efficient and specific imaging probes that will allow materializing the dream of seeing even deeper and better inside the living organisms. Reviews of the First Edition: "...attempts, for the first time, to review the whole spectrum of involved chemical disciplines in this technique..."—Journal of the American Chemical Society "...well balanced in its scope and attention to detail...a valuable addition to the library of MR scientists..."—NMR in Biomedicine

The book is an on-the-spot reference for residents and medical students seeking diagnostic radiology fast facts. Its question-and-answer format makes it a perfect quick-reference for personal review and studying for board examinations and re-certification. Readers can read the text from cover to cover to gain a general foundation of knowledge that can be built upon through practice or can use choice chapters to review a specific subspecialty before starting a new rotation or joining a new service. With hundreds of high-yield questions and answer items, this resource addresses both general and subspecialty topics and provides accurate, on-the-spot answers. Sections are organized by subspecialty and body area, including chest, abdomen, and trauma, and chapters cover the anatomy, pathophysiology, differential diagnosis, hallmark signs, and image features of major diseases and conditions. Key example images and illustrations enhance the text throughout and provide an ideal, pocket-sized resource for residents and medical students.

Electronic Relaxation Properties of Gadolinium Based MRI Contrast Agents

MR Contrast Agents, An Issue of Magnetic Resonance Imaging Clinics - E-Book

Safety Issues and ESUR Guidelines

A Worldwide Yearly Survey of New Data in Adverse Drug Reactions

A Review of Safety

Experimental Methods

Journalists, always very direct and in search of sensation, essentially asked me two questions on the occasion of this workshop: What were the goals of the meeting? With the improvement of diagnosis through the development of image techniques, didn't the contrast media already have their future behind them? Many answers were provided during the course of the workshop, and in order to best answer the journalists I proposed the following synopsis. 1. Since the 1979 Colorado Springs workshop organized by E. Lasser, progress has been so rapid and the newly available works so numerous that another meeting on an international level for the purpose of pre senting and discussing these advances appeared indispensable. Why not then in Europe and why not in Lyon? To expand on this progress, by 1981 the new contrast media with less-hyperosmolar molecules, still in the trial stage in 1979, were al most all available commercially for angiography, albeit at prohibitive prices. The advantages of these various media are becoming better known; moreover, in the wake of Lasser's work, our understanding of the pathophysiology of their noxious effects is also advancing rapidly owing to the use of models (for the target organs: heart, vessel wall, nervous system, kidney; and for the more general reactions: blood cells, coagulation, complement system, circulating enzymatic systems). In addition, further new molecules are currently being studied in re search laboratories. 2. The field of nanotechnology is a rapidly growing field. In the past few decades, nanoparticles have been utilized for use in biomedical applications with a huge impact in enhancing diagnostic techniques. Protein cages and virus-like particles are biological examples of

nanoparticles. They are highly symmetric, well-defined architectures made from multiple protein subunits and can be genetically or chemically engineered to impart desired new functionalities and have been used for design of nanomaterials for improving current diagnostic techniques, as discussed in this thesis. One of the main techniques for diagnosis used today is magnetic resonance imaging (MRI) as it provides good spatial resolution of soft tissues without using harmful ionizing radiation. However, due to poor sensitivity of this technique, contrast agents are often utilized by clinicians to aid in diagnosis of diseased tissues. The main MRI contrast agents used in T1-enhanced imaging are small Gd-containing molecules. Due to the toxicity of free Gd ions, these agents are administered in a tightly chelated form. Even in this form, high doses increase the risk of toxicity. Thus, it is important to reduce overall dosage of these contrast agents. In this thesis, we discuss design principles for virus-like particle based MRI contrast agents as next generation diagnostics which can overcome the above mentioned barriers. Conjugating clinically approved contrast agents to nano-sized virus-like particles changes the intrinsic properties of the contrast agent, directly impacting and increasing MRI contrast. Modifying the interior surface of these cage-like containers to grow functionalizable polymers provides multiple sites for conjugation of small molecule contrast agents, resulting in high payload of these agents. Modifying the exterior surface of these cage-like containers to present targeting ligands and enable them to localize at desired tissues of interest. All three of these design considerations contribute to higher contrast, significantly lower clinical dose requirements, and allow for safe administration of Gd (III) ions for enhanced imaging. As gadolinium-based contrast agents are directly linked with nephrogenic systemic fibrosis, a rare but deadly disease that causes hardening of tissues and organs, an alternate low-risk metal-complex, Mn (III) porphyrins, has also been explored for bioconjugation to virus-like particles.

The most common MRI contrast agents that are in clinical use today are gadolinium chelates and superparamagnetic iron oxide nanoparticles, both of which have their own advantages in terms of contrast enhancement properties. In the past few years, however, there has been interest in utilizing metal-containing clusters for MRI contrast enhancement as these materials bridge the gap between the constrained structure and magnetic properties of the gadolinium chelates with the superparamagnetic behavior of the iron oxide nanoparticles. Recently, metallic clusters containing Mn and Fe metal centers have received increased attention mainly because of their potential for high spin states and benign nature.

This book offers a comprehensive overview of the use of breast MRI for screening high-risk women, including those with familial-genetic hereditary predisposition and previous chest radiation therapy, typically lymphoma survivors. It discusses the historical background of studies and research that provided the body of evidence in favor of MRI screening of these women. Technical and clinical topics are treated in dedicated chapters, including models for individualized risk estimation, radiogenomics of breast cancer in high-risk women, computer-aided detection/diagnosis and machine learning systems applied to breast MRI, and psycho-oncology issues. Alternatives to breast MRI screening such as pharmaco-prevention and prophylactic mastectomy are also discussed, taking into account the public debate on the "Angelina Jolie" effect. The high breast cancer risk model is proposed as a paradigm for personalized medicine. This book will be of interest to radiologists, surgeons, oncologists and to all professionals devoted to female healthcare.

Magnetic Resonance Imaging of the Central Nervous System

Optimizing Relaxivity at High Magnetic Field

New Gadolinium Contrast Agents for MRI.

A Practical Guide

Medical Imaging Contrast Agents: A Clinical Manual

Contrast Media

In Contrast-Enhanced Clinical Magnetic Resonance Imaging, Val M. Runge and other leading experts present an overview of the basic principles regarding MR contrast media, a review of clinical applications in the head, spine, and body, and a look at future developments. Their focus is on clinical applications, with extensive illustrations to demonstrate the use of MR in each anatomic area and to aid in film interpretation.

What do we do if different studies appear to give different answers? When applying research to questions for individual patients or for health policy, one of the challenges is interpreting such apparently conflicting research. A systematic review is a method to systematically identify relevant research, appraise its quality, and synthesize the results. The last two decades have seen increasing interest and developments in methods for doing high quality systematic reviews. Part I of this book provides a clear introduction to the concepts of reviewing, and lucidly describes the difficulties and traps to avoid. A unique feature of the book is its description, in Part II, of the different methods needed for different types of health care questions:

frequency of disease, prognosis, diagnosis, risk, and management. As well as illustrative examples, there are exercises for each of the sections. This is essential reading for those interested in synthesizing health care research.

This volume highlights and broadens our understanding of the correct use and the possible contraindications of contrast agents applied in radiology. Written by experts in the field, it not only focuses on the chemistry, physiochemical properties and pharmacokinetics of both iodinated and gadolinium-containing contrast agents, but also on the relevant safety issues such as frequency of their short- and long-term side effects and ways to avoid them nephrotoxicity risk related to the iodinated contrast agents NSF (nephrogenic systemic fibrosis) accumulation of gadolinium in the brain use of contrast agents in pediatric patients and pregnancy It also includes essential data on the use of contrast agents, such as scanning protocols, in the context of various clinical conditions. This comprehensive manual addresses all professionals involved in radiological imaging and is an invaluable tool for radiologists and technologists, as well as for residents and clinicians.

Radiology Secrets Plus—a Secrets Series title in the new PLUS format—offers an easy-to-read, information-at-your-fingertips approach to radiology. Drs. E. Scott Pretorius and Jeffrey A. Solomon provide the expert perspective you need to grasp the nuances of this specialty. This new edition offers more information and expanded full color visual elements to provide an overall enhanced learning experience. All this, along with the popular question-and answer approach, makes it a perfect concise board review tool and a handy clinical reference. Maintains the popular and trusted Secrets Series® format, using questions and short answers for effective and enjoyable learning. Provides the most current overview and authoritative coverage of all topics thanks to contributions from an impressive list of experts in the field of radiology. Introduces the new PLUS format, with an expanded size and layout and full color for easier review, more information, and more visual elements for an overall enhanced experience. Provides the current standards of radiology practice through thorough updates to every chapter that reflect the most up-to-date information. Contains more, larger images (including new full color PET and CT images), to offer a clearer picture of what is seen is practice.

Insights Into Competitive Chelation Processes and Their Impact on the Relaxation of Water in Polysaccharide Environments

A Question and Answer Guide

Clinical Arrhythmology and Electrophysiology E-Book

Macrocyclic and Linear Gadolinium Based Contrast Agents for Adults Undergoing Magnetic Resonance Imaging

Radiology Secrets Plus E-Book

Development of Water-soluble Mn(III) Porphyrin as Extracellular MRI Contrast Agents

This issue of MRI Clinics of North America focuses on Update on Imaging Contrast Agents, and is edited by Drs. Carlos Zamora, Mauricio Castillo, Richard Semelka. Articles will include: Historical Perspective of Imaging Contrast Agents; Current Radiographic Iodinated Contrast Agents; Contrast-enhanced Sonography; Myelography: From Lipid-based to Gadolinium-based Contrast Agents; Acute Allergic Reactions with Gadolinium-based Contrast Agents: Diagnosis and Treatment; Deposition and Chronic Toxicity of Gadolinium-based Contrast Agents; Managing Allergic Reactions to Contrast Agents; Safety of Contrast Material Use in Children; Molecular Imaging and Contrast Agents; Contrast Agents for MR Imaging: Gadolinium, Manganese, SPIO, Superparamagnetic Iron Platinum, and Oral Agents; Contrast-induced Nephropathy: Pathophysiology, Manifestations, Prevention, and Management; and more!

Two years only after the publication of the ? rst edition of " Contrast media – Safety issues and ESUR guidelines " in our book series Medical Radiology in 2006, it appeared that a second edition was urgently needed. The ? rst edition was indeed an exceptional success with our readership and sold out rapidly, but moreover the safety of MR contrast media urgently required a reappraisal after the publication of a new and dramatic adverse reaction to some of the gadolini- based agents: the so called NSF syndrome. I am very much indebted to Professor Henrik S. Thomsen and his academic colleagues from the ESUR Contrast Medium Safety Committee for accepting the task to prepare a second edition of their remarkable book.Within a record short period of time they have been able to complete this fully revised new volume. It offers to the readers a comprehensive overview of all problems related to the use of contrast media in modern radiology and of our latest knowledge and insights in the mechanisms of adverse reactions related to contrast media. It answers all questions that radiologists and referring physicians are confronted with in their daily practice when they consider the administration of these agents to their patients.

There are insufficient achievements in the field of cancer diagnosis and treatment for new dual agents, which would provide health care specialists the ability to simultaneously image patients' cancerous tissues as well as treat the diseases. Prussian blue (ferric hexacyanoferrate) is a nontoxic FDA approved compound used clinically as an antidote for thallium and radioactive cesium poisoning. In this thesis development of simple methods for the synthesis of biocompatible Prussian blue nanoparticles (PBNPs) and its analogues as well as their applications for magnetic resonance imaging (MRI) contrast agents and drug delivery have been studied. The extensive magnetic properties investigations show that Prussian blue nanoparticles and gadolinium doped analogue nanoparticles significantly shorten the T1 relaxation time in aqueous solution and in HeLa cells treated with PBNPs, demonstrating their potential use as MRI contrast agents. Although the relaxivity values of Prussian blue nanoparticles are approximately an order of magnitude lower than the typical commercial Gd3+-based T1 contrast agents but it is found to be comparable to the values obtained for the MnO nanoparticles-based T1 agents. In order to provide high contrast, gadolinium doped Prussian blue nanoparticles (Gd-PBNPs) were prepared. It was also found that the Gd-PBNPs can shorten the T1 relaxation time significantly and provide potential use for clinical applications. In order for Prussian blue and its analogues nanoparticles to be concurrently utilized as drug delivery agents they must be biocompatible and capable of crossing the plasma membrane. Therefore, Prussian blue nanoparticles and related analogues were synthesized and functionalized by carboxylic acids such as citric acid as capping agents to control size distribution. To study the intracellular uptake of Prussian blue and analogue nanoparticles, their surfaces were functionalized separately with the small molecule dyes such as 5-carboxyfluorescein and Alexa Fluor ® 350 cadaverine, as well as the anticancer agent. Confocal fluorescence imaging of HeLa cells

treated with the functionalized nanoparticles shows fluorescent signals in the cells suggesting intracellular uptake of the Prussian blue and Gd-PB nanoparticles. The HeLa cells internalized Prussian blue nanoparticles and gadolinium-containing Prussian blue nanoparticles could also enhance the T1 MRI contrast. The results clearly show that these nanoparticles can be used as an effective T1 contrast agent for cellular imaging. Functionalized Prussian blue nanoparticles and related analogues with both MRI contrast and drug delivery capabilities may become powerful dual agents for simultaneous cancer treatment and assessment of treatment effectiveness.

A collaboration between Bracco Imaging S.p. A. and Durham University allowed the work described in this thesis on the design and synthesis of new contrast agents for MRI. Significant enhancements in the relaxivity of contrast agents for MRI can be gained by increasing the complex rotational correlation time ((_TR)). Incorporating a Gd(111) ion within a ligand structure possessing a suitably large dendritic framework, inspired the first part of this project. Thus, the periphery of a Gd-DOTA derivative was adorned with carbohydrate containing wedges. The symmetry of the mono- aqua tetra-substituted structure places the gadolinium-water vector at the centre of any tumbling motion, allowing a coherent tumbling of the macromolecule and an optimization of its rotational correlation time. The carbohydrates ensured high water solubility and favoured a large second sphere hydration contribution to the relaxivity. An increase in the hydration around the metal centre and a rapid exchange of the water molecules with the bulk solvent can also significantly increase the contrast agent efficacy, by efficiently transmitting the paramagnetic effect from the Gd(111) to the solvent. In a second part of the work, the development was undertaken of diaqua systems based on the seven-membered heterocycle 6-amino-6-methyl-perhydro-1,4-diazepin (AMPED). The three N-positions were substituted with different phosphinate and carboxylate groups and lanthanide complexes (Eu(111), Gd(111), Yb(111)) prepared and studied by multinuclear NMR methods The alkylation of the amino groups with chiral 1,5-dicarboxylate pendant arms led to complex diastereisomers, possessing different water exchange rates. The individual water exchange rates of each isomer were determined, and differed by a factor of six. Furthermore, the periphery of the isomer possessing a faster water exchange rate was adorned with carbohydrate containing wedges, and the relaxation properties studied.

Essential Radiology Review

Uniquely Branched and Structurally Versatile Lanthanide-based Contrast Agents for MRI

Clinical Applications of Synthetic MRI of the Brain

Magnetic Resonance Imaging

Contrast-Enhanced Clinical Magnetic Resonance Imaging

Pediatric MRI

MRI contrast agents improve visibility of internal body structures. This issue offers a complete, practically focused review of the use of a variety of contrast agents for MR Imaging. A contrast agent not only must be safe, but also efficacious and cost-effective, and the articles in this issue address all three of these concerns and the uses of contrast agents for a variety of applications.

Contrast agents are widely used for magnetic resonance imaging (MRI) and angiography. These agents are administered intravenously and enhance the detail and clarity of images for more precise diagnoses. Although generally considered to be safe, the use of contrast agents may result in mild to severe adverse effects. The current Rapid Response report will seek to identify and synthesize the evidence around the risks and safety of macrocyclic and linear GBCAs for adults undergoing MRI.

Part of the highly regarded Braunwald's family of cardiology references, Clinical Arrhythmology and Electrophysiology, 3rd Edition, offers complete coverage of the latest diagnosis and management options for patients with arrhythmias. Expanded clinical content and clear illustrations keep you fully abreast of current technologies, new syndromes and diagnostic procedures, new information on molecular genetics, advances in ablation, and much more.

The book focuses on two concurrent experimental therapies in cancer treatment known as boron neutron capture therapy (BNCT) and gadolinium neutron capture therapy (GdNCT) using a variety of boron- and gadolinium-based compounds. Some of the gadolinium compounds serve the dual purpose as being MRI contrast agents and GdNCT agents. The book describes why BNCT & GdNCT were not at the forefront of the clinical trials during the past seven to eight decades since the discovery of neutrons by John Chadwick in 1932 and how the latest development in the synthesis of target boron- and gadolinium-based drugs has turned the area into the hottest one worthy of further investigation with the new clinical trials in the USA and elsewhere.

Metal-Oxo Containing Polymer Nanobeads As Potential Contrast Agents for Magnetic Resonance Imaging

The Chemistry of Contrast Agents in Medical Magnetic Resonance Imaging

Gadolinium Complexes Containing Polyaminocarboxylate Ligands for the Use of Magnetic Resonance Imaging (MRI) Contrast Agents

Cardiovascular Magnetic Resonance Imaging

Cardiovascular MRI

Appraisal and Prospects

Magnetic Resonance Imaging (MRI) has a high soft-tissue contrast with a high sensitivity for detecting pathological changes in the brain. Conventional MRI is a time-consuming method with multiple scans that relies on the visual assessment of the neuroradiologist. Synthetic MRI uses one scan to produce conventional images, but also quantitative maps based on relaxometry, that can be used to quantitatively analyse tissue properties and pathological changes. The studies presented here apply the use of synthetic MRI of the brain in different clinical settings. In the first study, synthetic MR images were compared to conventional MR images in 22 patients. The contrast, the contrast-to-noise ratio, and the diagnostic quality were assessed. Image quality was perceived to be inferior in the synthetic images, but synthetic images agreed with the clinical diagnoses to the same extent as the conventional images. Patients with early multiple sclerosis were analysed in the

second study. In patients with multiple sclerosis, contrast-enhancing white matter lesions are a sign of active disease and can indicate a need for a change in therapy. Gadolinium-based contrast agents are used to detect active lesions, but concern has been raised regarding the long-term effects of repeated use of gadolinium. In this study, relaxometry was used to evaluate whether pre-contrast injection tissue-relaxation rates and proton density can identify active lesions without gadolinium. The findings suggest that active lesions often have relaxation times and proton density that differ from non-enhancing lesions, but with some overlap. This makes it difficult to replace gadolinium-based contrast agent injection with synthetic MRI in the monitoring of MS patients. Malignant gliomas are primary brain tumours with contrast enhancement due to a defective blood-brain barrier. However, they also grow in an infiltrative, diffuse manner, making it difficult to clearly delineate them from surrounding normal brain tissue in the diagnostic workup, at surgery, and during follow-up. The contrast-enhancing part of the tumour is easily visualised, but not the diffuse infiltration. In studies three and four, synthetic MRI was used to analyse the peritumoral area of malignant gliomas, and revealed quantitative findings regarding peritumoral relaxation changes and non-visible contrast enhancement suggestive of non-visible infiltrative tumour growth. In conclusion, synthetic MRI provides quantitative information about the brain tissue and this could improve the diagnosis and treatment for patients.

As a practical reference guide for designing and performing experiments, this book focuses on the five most common classes of contrast agents for MRI namely gadolinium complexes, chemical exchange saturation transfer agents, iron oxide nanoparticles, manganese complexes and fluorine contrast agents. It describes how to characterize and evaluate them and for each class, a description of the theory behind their mechanisms is discussed briefly to orient the new reader. Detailed subchapters discuss the different physical chemistry methods used to characterize them in terms of their efficacy, safety and in vivo behavior. Important consideration is also given to the different physical properties that affect the performance of the contrast agents. The editors and contributors are at the forefront of research in the field of MRI contrast agents and this unique, cutting edge book is a timely addition to the literature in this area.

Gadolinium ions are the paramagnetic component of the most common intravenous contrast agents for medical magnetic resonance imaging (MRI). Because gadolinium ions are toxic, these MRI contrast agents include chelating agents that bind the gadolinium ion strongly. Five such agents are FDA approved. Unfortunately, all of them are the subject of recent FDA rulings that impose new labeling requirements, due to patients with severely impaired kidneys developing a rare but potentially fatal disease called Nephrogenic Systemic Fibrosis, which is linked to gadolinium exposure. Pure gadolinium or gadolinium oxide nanoparticles, with proper encapsulation, may provide a safer and equally or more effective alternative to chelated gadolinium ions in this application. The High Temperature Reducing Jet (HTRJ) process is a novel flame based aerosol synthesis method that can produce metal nanoparticles with a thin carbon coating in a single step. Carbon-coated gadolinium and gadolinium oxide nanoparticles have been synthesized in this reactor system. The surface of these nanoparticles was modified with dextran and other biocompatible molecules to enable their dispersion in water and biological media. The resulting nanoconstructs were characterized by TEM, SEM/EDS, XRD, Raman spectroscopy, TGA, and DSC. Most importantly, their T1 relaxivity was measured to determine their potential for use in MRI contrast enhancement. Sensitive colorimetric chemical assays for gadolinium ions were used to monitor release of gadolinium ions. The High Temperature Reducing Jet (HTRJ) reactor system may also be able to produce low reduction potential metal nanoparticles. Magnesium-containing nanoparticles were synthesized in order to be used as a master comparison with the gadolinium-containing nanoparticles. The resulting metal and metal oxide particles were characterized by TEM, SEM/EDS, and XRD and their size, morphology, chemical composition, and stability were compared against the gadolinium nanoparticles.

This monograph covers all aspects of the radiologic diagnosis of urinary tract diverticula, including calyceal, ureteral, bladder and urethral diverticula. Characteristic and subtle diagnostic features are identified with the aid of numerous high-quality ultrasound, X-ray and magnetic resonance images, the vast majority of which are drawn from the author’s personal clinical practice. In addition, issues relating to terminology, classification, statistics, etiology, pathogenesis, clinical presentation and differential diagnosis are discussed. The text is complemented by two helpful appendices that document the latest recommendations of the European Society of Urogenital Radiology regarding use of contrast media and the European Medicines Agency on minimizing the risk of nephrogenic systemic fibrosis when using gadolinium-containing contrast agents. This book will be of value for specialists in radiology and urology and also trainees and medical students.

Gas-phase Synthesis of Gadolinium Nanoparticles for Magnetic Resonance Imaging Contrast Agents

Physical Principles and Sequence Design

Boron and Gadolinium Neutron Capture Therapy for Cancer Treatment

Clinical Emergency Radiology

Prussian Blue Nanoparticles and Its Analogues as New-generation T1-weighted MRI Contrast Agents for Cellular Imaging
Contrast Media in Radiology

A clinician's visual guide to choosing image modality and interpreting plain films, ultrasound, CT, and MRI scans for emergency patients.

Over the past decade, fluorine (19F) magnetic resonance imaging (MRI) has garnered significant scientific interest in the biomedical research community owing to the unique properties of fluorinated materials and the 19F nucleus. Fluorine has an intrinsically sensitive nucleus for MRI. There is negligible endogenous 19F in the body and thus there is no background signal. Fluorine-containing compounds are ideal tracer labels for a wide variety of MRI applications. Moreover, the chemical shift and nuclear relaxation rate can be made responsive to physiology via creative molecular design. This book is an interdisciplinary compendium that details cutting-edge science and medical research in the emerging field of 19F MRI. Edited by Ulrich Flögel and Eric Ahrens, two prominent MRI researchers, this book will appeal to investigators involved in MRI, biomedicine, immunology, pharmacology, probe chemistry, and imaging physics.

This dissertation, "Gadolinium Complexes Containing Polyaminocarboxylate Ligands for the Use of Magnetic Resonance Imaging (MRI) Contrast Agents" by Wai-yan, Chan, □□□, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Abstract of thesis entitled GADOLINIUM COMPLEXES CONTAINING POLYAMINOCARBOXYLATE LIGANDS FOR THE USE OF MAGNETIC RESONANCE IMAGING (MRI) CONTRAST AGENTS submitted by Chan Wai Yan for the degree of Doctor of Philosophy at The University of Hong Kong in June 2005 The development of contrast agents has an irreplaceable role in elaborating the endless possibilities of Magnetic Resonance Imaging (MRI) as a salient technique in medical diagnosis. In this study, new tailor-made gadolinium complexes were synthesized and investigated with the aim of achieving better medical diagnosis. Three new gadolinium polyaminocarboxylates stem from DTPA-bis(amide) macrocycles, including [Gd(25-DTPA-DOAM)] GdL1, [Gd(26-DTPA-TOAM)] GdL2 and [Gd(16-DTPA-PNAD)] GdL3, were synthesized and well characterized. GdL1 and GdL2 are featured by having ether-linked annular oxygen atoms that bring water molecules to the hydration sphere, while GdL3 has a pendant rigid hydrophobic adamantane moiety that increases specificity. Detailed studies of the relaxometric properties of the complexes using 17 the nuclear magnetic resonance dispersion (NMRD) profiles, variable-temperature O NMR transverse relaxation, pH dependence and temperature dependence relaxivity and luminescence lifetime measurements are discussed. Stability data are obtained from three aspects, the thermodynamic stability by potentiometry; in vivo stability using the rat model provided information on the biodistribution and excretion; and cell assay gives data on toxicity. The three complexes have promising stability, overall neutral charge and one innersphere water molecule. The thermodynamic formation constants (∑logK) are GdLHn -1 -1 within the range of 20-22. The measured relaxivities are in the order of GdL2 (6.14 mM s) -1 -1 -1 -1 > GdL3 (5.96 mM s) > GdL1 (5.87 mM s) at 20 MHz and 25C. With reference to the clinically approved contrast agents, the new complexes show an average of 30% increase in relaxivity and the thermodynamic stability is comparable to the clinical agents. It is worth mentioning that GdL3 demonstrates excellent liver targeting versus the commercial hepatobiliary agent Gd-BOPTA, and a 23-36 % higher contrast enhancement was found during the 3-hour MRI scan. GdL3 was found to be non-toxic in the in vivo environment and in vitro cell study. Moreover, it is an intracellular agent showing hepatocellular uptake that is an average of 1.97 times larger than that of Gd-BOPTA. The long residence lifetime τ is a major obstacle in attaining high relaxivity for the Gd-based clinical contrast agents. [Gd(DO3Aad)] GdL5 was 1,4,7-tris(acetic acid)-1,4,7,10-tetraazacyclododecnae (DO3A) type ligand designed with a sterically compressed environment to accelerate the water exchange rate and promote relaxivity. The τ was found to be 155 ns (k = 4.1 10), which is 1.5 times faster than the clinical agents m ex -1 -1 and is the fastest among the neutral Gd complexes. The relaxivity of GdL5 is 6.14 mM s -1 -1 and its interaction with human serum albumin (HSA) boosts the relaxivity to 18.4 mM s by retarding the reorientational correlation time τ . It has the same adamantane moiety as GdL3, having the liver as the targeting site in the in vivo study. The intensity enhancement is 4 times higher during the delay phase as compared with Gd-BOPTA. The new acyc

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