ISSUE 42
AUTUMN 2012

BAMRR news

THE NEWSLETTER OF THE BRITISH ASSOCIATION OF MR RADIOGRAPHERS

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(1) Port M, et al. Efficiency, thermodynamic and kinetic stability of marketed gadolinium chelates and their possible clinical consequences: a critical review. Biometals.2008,.21:469-490

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welcome from your BAMRR PRESIDENT

Welcome to the autumn newsletter. I must begin this letter by thanking Sharon our outgoing president for steering BAMRR through a particularly busy year, with a successful introductory MRI course and development of a new website.

I have just returned from the 29th Annual BAMRR conference which was held at the Mercure Hotel in Leicester. The conference was a great success and I would like to thank the policy board for all the work they did in the organisation of this event. A special thank you must go to Helen Estall from Leicester Royal Infirmary for her part in the event.

BAMRR would like to thank all the speakers who provided excellent educational content. We would also like to thanks the sponsor's of this event, without their assistance we would not be able to keep the costs down.

I am sure no one who attended will forget Steve Ross's talk "It will never happen to me" about the fire in the MRI department at Winchester. To listen to his story and gain advice from his experience first hand was an invaluable lesson for all MR radiographers.

Jenny Boyd Ellison who secured the BAMRR education grant last year fulfilled her duty and gave a presentation on her dissertation subject- a neurologist viewpoint on incidental findings.

Matthew Benbow sparked an emotive debate with his talk on "button pushing" with radiographers discussing the pros and cons of the MRI manufacturer's introduction of automated scanning software.

Congratulations to the poster winner Nick Cantalay and joint proffered paper winners Julia Bigley and Jelena Jovanovik.

A full report on the conference will be in the spring newsletter. We are taking the conference to Bristol next year, it has good rail, and road and airport links so we hope you will find a way to join us.

BAMRR will launch the new website on bonfire night November 5th with a big bang!

The website will make becoming a member of BAMRR more user friendly with the potential for on line payment options being looked at. This facility could be used for registration of future conferences and courses. The member's area will have access to conference presentations, links to websites, an e newsletter and more.

BAMRR membership will be on a rolling year from April 2013. This will mean members get the full year of membership whenever they join us.

After the success of the "Introductory MRI Course" the board is hoping to run a "Further MRI Course" in the spring which will provide the next step in the education of MRI radiographers, once they have a basic knowledge of scanning. Keep an eye on the website for this!

Don't forget the BAMRR educational grant of £1000 is available, please see the website for details of how to apply. There is also payment for educational articles which are accepted for publishing in the newsletter.

Are you interested in the education and development of MR radiographers and want to become involved further with the MR community? We are looking for new members to join the BAMRR policy board. If you are interested please send a short CV to myself via email.

Janine Sparkes

President

from your EDITOR

Welcome to the Autumn 2012 Newsletter - we hope you enjoy the very varied mix of contributions in this edition – from MRI in radiotherapy to hazards with ID bracelets! An important announcement is the launch of the brand new revamped BAMRR website on November 5 2012. A great deal of work is going into making the site responsive to your needs and therefore it is very helpful to get your feedback on this and the Newsletter! Don't forget – letters to the Newsletter attract £50 and technical article contributions when printed earn £200!

David Reed

WELCOME from our sponsor GUERBET

We are glad to be able to continue our support for the BAMMR Newsletter for the 4th year running.

Fully dedicated to medical imaging, Guerbet prides itself on offering a comprehensive range of contrast media, injectors and medical devices for imaging diagnostics. In partnership with MEDTRON AG (**www.medtron.com**), we are now able to offer a truly wireless MR injector which is convenient and easy to use, with the benefit of accepting pre-filled syringes which potentially reduces the cost of using an MR injector.

We are also committed to support continuous professional development for MR Radiographers. Throughout the year, in partnership with Radiologists/Radiographers who are passionate about sharing their knowledge, we organise and support teaching courses which are informative and relevant. Please visit our website **www.guerbet.co.uk** to find out more about the events we hold or sponsor. Don't hesitate to get in touch on **0121 733 8542** or **uk.info@guerbet-group.com** if there is something you would like to tell us. As always, we welcome your comments and suggestions as we are here because of you.

We hope you'll enjoy reading this issue of BAMRR news, which we believe is informative and relevant.

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goodbye

from your OUT-GOING PRESIDENT

This year, BAMRR has witnessed a whirlwind of activity; we've developed a new website, run the Basic course, planned our Conference, hosted a UKRC session and much more.

I am particularly delighted that we have reached the point of launching our new website. By using your feedback from the survey, we have been able to produce a website that provides a greatly improved interface to BAMRR. Over the forthcoming year, new and exciting content will be added to the website which I am sure everyone will appreciate. The Policy Board has worked tirelessly over the summer to ensure that this project has continued to move forward to reach the point of delivery. The transition to the new website has been challenging and I would like to thank everyone for being patient and bearing with us as the project has progressed.

This year we brought the Basic course to London for the first time in July. This was a great success with exceptionally positive student feedback. A measure of the popularity of this course is the fact that it was over-subscribed this year. This course is unique in that it offers the opportunity for hands-on scanning and, as such, it is essential for all MR Radiographers. We will build on the success of this course when planning our future courses.

In June BAMRR hosted a session entitled 'MRI - Setting the Pace' at UKRC. We covered a variety of MR topics and the relevance of the subject areas and the quality of the speakers was reflected in the remarkably well-attended session. Indeed, there were no empty seats and many delegates stood at the back of the room in order to listen to the speakers. Given the success of this session, we have already started planning for next year.

I would like to take this opportunity to thank all of the policy board for their support over the past year and their willingness to go the extra mile. It really is a team effort and the successes we have had over the last twelve months shows what a great team we have!

I have been honoured to be President of BAMRR and have thoroughly enjoyed this opportunity. I would like to wish Janine all the best for her tenure as President and I hope she enjoys it as much as I have.

Kind Regards

Sharon Conway

President

Whoops! Apologies for not crediting the "Bitesize Physics" feature in the Spring 2012 Edition to Matthew Benbow, Superintendent Radiographer, Royal Bournemouth Hospital.

MRI Conditional Pacemakers

There was an error on the front cover of the Spring 2012 Newsletter. The headline "MRI Compatible Pacemakers" should have read "MRI Conditional Pacemakers"

BAMRR Basic MRI Course

London 7 & 8 July 2012

Imperial College London** and **Chelsea** and **Westminster Hospital

***Karyn Chappell,** Course Organiser, BAMRR*

Enjoyed the practical sessions; really reinforced the theory.

On a sunny weekend in July Radiographers gathered in London for BAMRRs highly regarded introductory MRI course. Many delegates arrived on the Friday to take advantage of the well priced and ideally located accommodation to enjoy shopping, sightseeing and catching up with friends in London.

All lectures were great, the image optimisation one was particularly good but all the talks were interesting, well presented and helpful.

Saturday morning after registration the oversubscribed course got underway. The morning session was entirely devoted to physics under the guidance of Jonathan Ashmore and Geoff Charles-Edwards delegates started to unravel the mysteries of MRI physics. These entertaining sessions involved x-factor style text voting, rotational discs and a lead lined wheel. Physics has never been so fun!

After a well deserved lunch break delegates split into 3 groups for the more interactive sessions taken by Erica Scurr, Annie Papadaki and Karyn Chappell. With Erica delegates saw many examples of MR artefacts and learnt measures to prevent or reduce them. Annie covered MRI safety with lots of images and examples of when MRI centres get it wrong! Karyn's image optimisation session featured a guest appearance from Bruce Forsyth – you only get this with BAMRR!

I enjoyed every aspect of the course. Areas covered were well thought out. Speakers went out of their way to help and explain everything.

After a hard day of learning it was off to the local watering hole the King's Arms for pre dinner drinks. Some people had made their own plans for the evening but many delegates, lecturers and BAMRR board members drifted across the road for the course meal. Everyone had a great time comparing notes on scanners and work places and most importantly making new friends.

Sunday morning (not quite as early as Saturday) the course reconvened at Chelsea and Westminster Hospital who had very kindly agreed to lend us their scanners for the day. Delegates were divided into 4 groups to maximise everyones learning opportunity. Janine Sparkes took delegates through a number of case studies explaining images of common pathologies whilst discussing the best sequences to image these. Geoff Charles-Edwards came back for another physics session where delegates could ask him to explain any physics topic that they wanted. Erica with her wealth of MRI experience covered problem scenarios with patients in the MRI environment including a drill for quick safe removal in an emergency. Finally double act Jonathan and Karyn scanned a leg of lamb so that delegates could get practical experience of optimising sequences and reducing artefacts without the worry of a real life patient in the scanner.

Sunday lunch was provided by Bayer and delegates enjoyed a tasty spread whilst socialising with other delegates, lecturers and BAMRR board members. After the obligatory course photograph (yes those escalators really are at the front of Chelsea and Westminster Hospital) delegates collected their course certificate and CPD now certificate before saying their goodbyes. Heading home to all parts of the UK including those who had flown in from Ireland and Guernsey. For some delegates the shopping opportunity of the King's Road couldn't be passed by. The BAMRR introductory course was very highly rated by those who attended, a selection of the delegates comments are included. BAMRR hope to run an Introductory and Advanced MR course next year 2013 and after positive feedback this will be in London at Imperial College and Chelsea and Westminster Hospital. If you are interested keep an eye on BAMRRs Spring magazine, website and facebook page. BAMRR would like to say a huge thank you to Chelsea and Westminster Hospital, Imperial College London and all the lecturers who shared their expertise and enthusiasm for MRI and finally the London 2012 Basic course delegates who all worked really hard and made the course a great success.

All excellent especially enjoyed image optimisation and case studies talks. Felt all aspects pitched at the right level - for me at least!

The course for me is the right level, every aspect of it was put in a form that can be easily understood.

◆ BAMRR Basic MRI Course Delegates - still smiling!

Not a series of lectures - handed back to delegates as to what they would like covered.

I found the course very informative. The speakers were excellent, interactive and there was a lot of opportunity to ask questions. Especially enjoyed case studies and safety lecture on day two.

MRAG report

In October 2010 it was brought to our attention that SOR were seeking applications or expressions of interest in joining a new SOR advisory group for MRI. This group would be called MRAG (MR Advisory Group), superceding the previous collaborative committee known as the Consortium for the Accreditation of Clinical Magnetic Resonance Education - CACMRE.

Co-incidentally, an invitation was extended to BAMRR to have representation on the group.

Initially, this invitation was met with some resistance. Some policy board members felt that this would indeed be a positive collaboration for the future, whilst others felt that there was already collaboration between SOR and BAMRR at policy board meetings, and as such were concerned that there would be duplication of roles, and a possible loss of identity for BAMRR.

These concerns were discussed with SOR and their response reassured BAMRR that the role of MRAG was indeed intended to be complimentary to BAMRRs long established influence on MR education and clinical support in the MRI community. Rather, it was envisaged that BAMRRs voice would play an important role in representing the views of its members and provide expert advice to the SCOR and UK Council to ensure that policy development would be appropriate to the implementation of strategic issues relating to service provision such as ensuring the education of radiographic staff, and ensuring an expanding role for radiographers in the provision of MRI services well into the future.

As BAMRR President at that time, I accepted the invitation to the inaugural meeting in March 2011.

The group consisted of Professor Audrey Paterson, SCoR Professional officer Alex Lipton, UK Council members and many experienced MRI radiographers from a various clinical departments across the UK, both public and private sectors, MR reporting radiographers, consultant radiographers and Therapy radiographers new to MRI due to the advancement of MRI technologies in the provision of cancer services. On a personal level, it was great to see so many old friends and colleagues from BAMRR both past and present.

Audrey Paterson presided over the meeting, openly discussing and agreeing on the Terms of Reference for MRAG, giving BAMRR the opportunity to ensure that any duplication of roles was limited.

Minutes from the MRAG meetings, and the agreed Terms of Reference document are available on the SOR website www.sor.org.

In order to address many of the groups concerns on variances in current practices around MRI safety and service development in clinical and research led departments, the initial focus of the group has been to review and update the Safety in MRI document that was published by SOR, in association with BAMRR, in 2007. The revised version will be published in early 2013.

MRAG were also invited to provide feedback to MHRA on proposed updates to their 2007 document, due to be published in 2013 also.

With regard to BAMRR specifically, it is envisaged that MRAG and BAMRR will collaborate on an MR related project, most probably to promote accredited certification for completed training in MRI safety for all levels of staff involved in MRI, from referrers, to practitioners ,to support teams within clinical departments facing 24 hour service demands. As this is likely to take the form of an on-line education tool, work on this project will begin after the launch of the new BAMRR website.

As a result of the contacts made through MRAG, BAMRR are very much looking forward to welcoming therapeutic radiographers new to the intricacies of MRI as a result of MR technologies expanding into the provision of cancer services and treatment. There are huge opportunities out there to work alongside our therapeutic colleagues, learning from each other through BAMRRs expertise in delivering MR education through courses and conferences to ensure we all deliver professional services and expert care to our patients.

Finally, I look forward to BAMRR and MRAG having a positive working relationship that will benefit the entire MRI community well into the future.

Lynn Graham

MRAG representative

October 2012

THE COLLEGE OF RADIOGRAPHERS

BAMRR

Introducing a New Policy Board Member

Following qualification from Teesside University I started my career as a basic grade diagnostic radiographer at Dryburn Hospital and continued professional development specialising in cross-sectional imaging. My first introduction to MRI was at a basic BAMRR course at Stockton prior to implementation of a Siemens Symphony 1.5 T within the department at Durham. I have subsequently completed MRI in Practice basic and advanced (2001) and attended the Somerset MRI course (2002). I completed my MSc in Medical Imaging in 2006 with Anglian Ruskins University, Cambridge.

In 2009 I became MRI Superintendent at the Northern Centre for cancer Care at the Freeman Hospital Newcastle upon Tyne. The implementation of a Siemens Espree 1.5T for radiotherapy planning will improve target delineation for RTP both for initial radiotherapy treatment of tumours but also potentially for re-treatments by being able to differentiate between changes due to recurrent cancer or that secondary to post-treatment fibrosis. It will also provide better delineation of organs at risk (OARs) for dose avoidance in RTP.

The wide bore system is also utilised to incorporate the trusts claustrophobic and bariatric patents and streamline diagnostic patient care for NCCC patients.

My role has developed to encompass operational management of the pre-treatment section to include two CT scanners and the MRI scanner. With the introduction of stereotactic and more conformal radiotherapy, imaging is becoming an integral part of radiotherapy planning therefore diagnostic and therapy radiographer's roles are merging which will lead to a sharing of knowledge between the two professions.

As a new policy Board member and through the introduction of the new BAMRR website I hope the vast experience and knowledge of diagnostic MR radiographers can be shared and through Basic and advanced BAMRR courses and the annual conference both diagnostic and therapy radiographer will gain up-to-date expertise which is essential to patient care.

Jill McKenna

BAMRR Policy Board Members, October 2012

EFFECTIVE FROM OCTOBER 2012

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Is MRI really necessary in Radiotherapy Planning ?

Jill McKenna/Jim Snell *Northern Centre for Cancer Care, Freeman Hospital*

The Newcastle upon Tyne Hospitals NHS Foundation Trust, Northern Centre for Cancer Care purchased a dedicated MRI scanner for radiotherapy planning which has been operational since 2009. We routinely scan patients with prostate, cervix, endometrial and head and neck cancer.

MRI offers superior soft tissue differentiation with the potential for improved visualization of tumour. Excellent contrast resolution results in improved multi-planar target volume delineation and assessment of planning margins by manipulating a wide range of contrast parameters. With an increase in conformal dose delivery, inter-observer variability in tumour identification and delineation can play an ever more critical role in the accuracy of dose delivery. MRI has been demonstrated to improve intra-observer variability. [1]

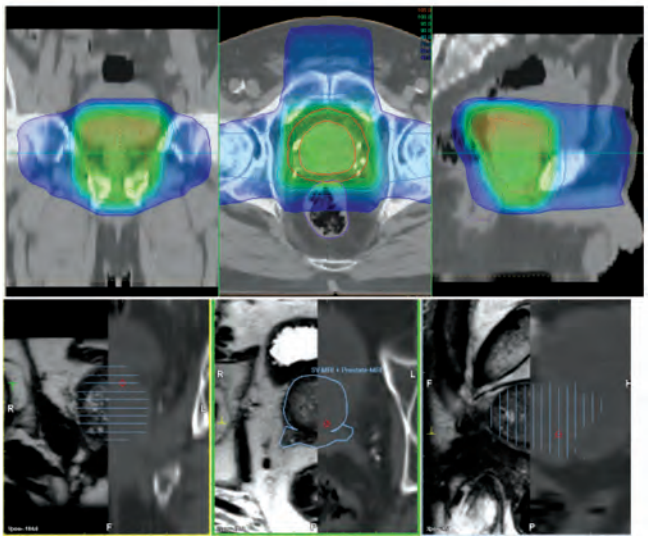
MRI for radiotherapy treatment planning requires excellent geometric accuracy. [5] At NCCC, the Siemens 3D geometric distortion correction is routinely used to ensure optimal geometric accuracy. The integration of MRI into the planning process can improve target delineation compared to delineation on CT alone, both for initial radiotherapy treatment of tumours and also potentially for re-treatments by being able to differentiate between changes due to recurrent cancer or changes secondary to post-treatment fibrosis. It can also provide better delineation of organs at risk (OARs) for dose avoidance in RTP .[7]

Protocol Design/Commissioning

MR scans for radiotherapy require that the patient is positioned as far as possible in the same position during imaging for localisation and treatment i.e. positioned in an appropriate immobilisation device on a flat couch top. The MR coils should be positioned to avoid distortion of the patient's external contour or internal organs. Within NCCC a multidisciplinary approach was adopted bringing together expertise from Radiologists, Oncologists, Radiographers(diagnostic and therapy) and physicists from anatomical site specific areas under investigation. Protocols were then developed with sequences to give the required anatomical detail whilst keeping scan time to a minimum, due to the sometimes difficult and uncomfortable positions needed for radiotherapy.

Prostate RTP MRI

The patient is positioned and registered to the couch as per CT. Reference Points are identified utilising an in-room LAP laser. The anterior reference is defined with an MRI marker. A T2 weighted 3D acquisition is performed for the image fusion and T2 axial sFOV to inform the outlining process. MRI suffers from a lack of electron density information and potential spatial image distortion. As a result, MR images cannot be imported alone into RTP systems to readily create and plan three-dimensional (3D) external beam radiotherapy as they provide no dosimetric information to facilitate planning.[6]



◆ **A Fused Image of CT (top) and MRI (bottom) Allowing outlining on both imaging modalities simultaneously**

Cervix Radiotherapy planning

Brachytherapy is an integral component in the treatment pathway of locally advanced cervical cancer at NCCC. Patients currently are prescribed 44Gy in 22 Fractions of external beam radiotherapy (EBRT) using CT/MRI fusion (figure 1) to outline clinical tumour volume and organs at risk. Repeat MRI at 4 weeks determines the effects of chemoradiotherapy on the tumor volume (figure 2), in particular tumor shrinkage, and assessment of the uterine canal.

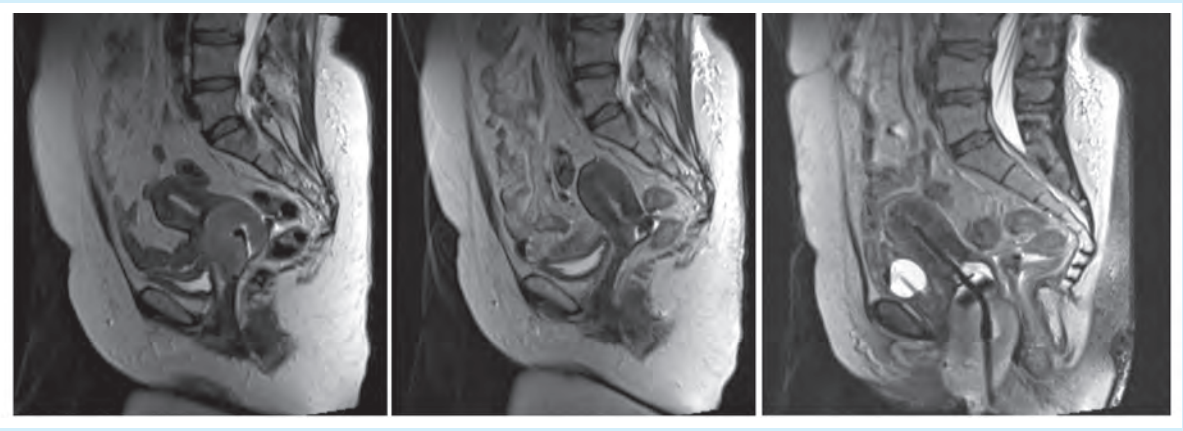


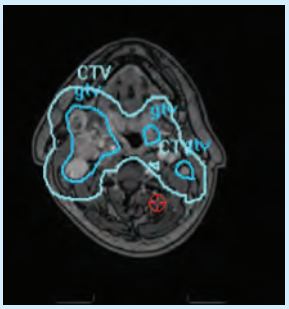
Fig 1
◆ **Planning sc**

Fig 2
◆ **Four week follow up**

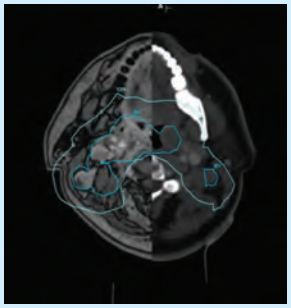
Fig 3
◆ **Post brachytherapy insertion**

A T2 weighted 3D axial (SPACE) utilises the multiplanar capabilities of MRI whilst T2 weighted axial and sagittal images provide improved resolution. Scanning is performed with a full bladder to simulate position of the cervix in theatre as bladder filling provides an echogenic window for image guided ultrasound. A full bladder during transabdominal ultrasound guidance not only facilitates visualization of the cervical canal and the endometrial strip, but also renders the negotiation of the cervico-uterine junction easier by decreasing anteflexion of the uterus in women with an anteverted uterus. A third MRI (figure 3)following insertion determines positioning of the intracavity brachytherapy probe. uterus.[5]

◆ **CT demonstrating CTV**



◆ **T1 post contrast MRI**



◆ **CT/MRI fused image**

Head and Neck RTP

MRI is being increasingly used in oncology for staging, assessing tumour response and also for treatment planning in radiotherapy. MRI is most often utilized as the primary imaging modality when evaluating tumour spread in the paranasal sinuses, cavernous sinuses, dura, brain, nasopharynx, oropharynx, palate, base of tongue, and floor of mouth.[2] The use of MRI has been demonstrated adjunct to the simulation of complex radiation treatments for tumours of the head and neck allowing improved visualization of head and neck tumors.[3] The increased flexibility in varying tissue contrast or signal intensities offers much better characterization of soft tissues even when these structures possess very similar X-ray attenuation properties or electron densities. Patients can not be scanned in the conventional head and neck coil due to incompatibility with immobilisation necessary for radiotherapy therefore the spine coil is intergrated with the body matrix . A T1 weighted 3D axial (VIBE) post contrast is imported into the planning system and fused with the CT to outline the GTV whilst a T2 weighted sequence is performed to outline OAR and assess lymph nodes. By using different MRI sequences, better tissue discrimination can be obtained between the extent of tumour with its boundaries of infiltration and the adjacent normal structures.[4]

Conclusion

MRI has superior tissue differentiation& multiplanar capabilites allowing improved delineation of tumour volumes and OARs.

The necessity for MRI in the radiotherapy community is now recognised. Manufactures are starting to develop MRI systems for radiotherapy.

Radiotherapy poses specific demands on MRI Patient positioning/ Geometrical accuracy/high quality images MRI poses specific demands on radiotherapy.

References

1 Yamazaki et al (2011) Quantitative assessment of inter-observer variability in target volume delineation on stereotactic radiotherapy treatment for pituitary adenoma and meningioma near optic tract Radiation Oncology 6:10

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6 Prabhakar R (2007) Feasibility of using MRI Alone for 3D Radiation Treatment Planning in Brain Tumours Jpn J Clin Oncol;37(6)405/411

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How to delineate on multi-planar images/Will we adapt radiotherapy during treatment/We know exactly where the tumour is why can't we just dose paint and get on and treat it ?

BAMRR Special Focus Session

MRI – Setting the Pace

Sharon Conway *Past President, BAMRR*

UKRC

This popular session produced some enlightening presentations on breast imaging, mr conditional pacemakers, safety issues and delivering imaging to the Olympics.

Dr O'Flynn presented an overview of Breast MRI: clinical indications, how to perform and report and further applications e.g. 3T, fMRI. Breast MRI is currently the most sensitive technique (97-98%) however with limited specificity (75%) not suitable for every clinical indication. It's useful for patients with invasive lobular cancer; a multifocal disease difficult to detect using mammography, MR assists in surgery planning. Other advantageous applications are: screening high risk (BRCA1+2) patients recommending annual MR from age 30, implant scanning utilising silicone specific sequences and monitoring the response to chemotherapy, MR being more accurate than US in depicting tumour size.

Carole Burnett, Imaging lead Olympics 2012 shared her experience in the tremendous task of implementing this service and recruiting volunteers. As the largest volunteer programme ever in the UK at times proved very frustrating until Carole renewed the whole of the application process, she now has a team of 27 Radiologists, 56 Radiographers and 23 Radiographic Assistants. Carole then had the task of organising training on the equipment and shared the complications in producing a rota for the required 9 weeks. Images were shown of the impressive facilities, with the 2 wide bore scanners in relocatable units outside the centre.

Alison Fletcher presented practical experiences of scanning patients with MR conditional pacemakers, providing overviews of the function and types of pacemaker. She stressed the importance of ensuring the whole system is MR compatible (device and both leads) and the need for departments to set up robust policies – including the involvement of many departments with a comprehensive safety checklist and forms to be signed and completed by all staff prior to scanning .Images were shown and she stressed the need for radiographers to understand how protocols and pulse sequences may need to be altered due to e.g. artefacts caused by the box.

Dr Mclean updated delegates on MR safety issues reporting on a fire that destroyed an MR unit and looking at current and future safety issues. He talked about the development of a new safety standard for active implants (AIMDs) ISO/IEC 10974 due for completion 2015.He reported on the postponement of EUPAD until 2013 and mentioned current work surrounding the possible use of a fixed parameter option. Delegates were then provided with a list of useful MR safety resources.

◆ **Carole Burnett talks about MRI at the UK Olympics and Para-Olympics**

◆ **left to right: Sharon Conway with Dr Elizabeth O'Flynn, Alison Fletcher, Dr John McLean and Carole Burnett**

EU PAD UPDATE

Following the further extension of this directive (to October 2013), the Danish presidency worked hard to produce a compromise proposal . This proposal does contain a provision for derogation from the exposure value limits for the medical MRI sector. Although some member states still hold strong views on the need for derogation there was a general acceptance that derogation provisions are necessary

Cyprus has now taken over the presidency and work has continued on the wording of the draft proposal. The presidency is keen to get agreement
from the majority of member states by October so that it can be considered by the European parliament.

For further information and forthcoming updates please see the BAMRR website

SoR Website

https://www.sor.org//practice/cross-sectional-imaging/european-union-physical-agents-directive-eu-pad

Alliance for MRI

http://www.myesr.org/cms/website.php?id=/en/eu_affairs_research/alliance_for_mri.htm

Alexandra Lipton

Professional Officer Diagnostic Service Managers and Cross Sectional Imaging Lead

30th Annual BAMRR CONFERENCE

October 2013 - Bristol

Soak up some English heritage + some MRI!

Details are now available on the website

www.bamrr.org

◆ **BAMRR Policy Board hard at work in Leicester 5 October 2012**

we need you

We are constantly looking for members for the BAMRR board, so if you feel you would like to join us in promoting MR safety and education – and, of course, helping to organise our annual conference – then please contact any member of the policy board.

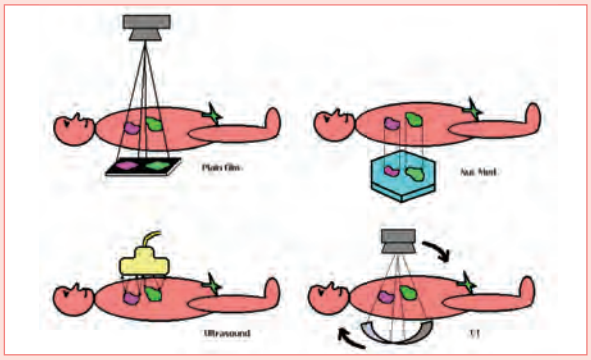
Spatial Encoding
Part 1 – Slice Selection

Matthew Benbow *Superintendent Radiographer Royal Bournemouth Hospital*

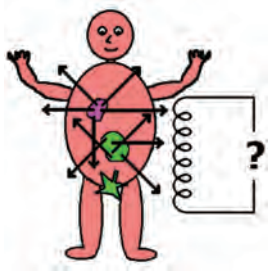
Introduction

For any medical imaging modality it is necessary for the receiving device to display the output in an order that correlates to the patient's anatomy, i.e. that the resultant image represents the patient.

With plain radiography and Nuclear Medicine, the patient is positioned directly in front of the receiving device, and therefore the anatomy is projected directly into a corresponding position to that found in vivo. With Ultrasound, the signals are reflected back to the transducer, but remain in their true anatomical positions. Even though in CT the detectors rotate, at any given time in this rotation the anatomy is being mapped such that the reconstruction system can create a true image. MRI however is different.



MRI scanning produces many signals of varying strengths from within the patient, and these induce currents within the receiving coil. The difference from other imaging modalities is that there is no direct correlation between the signal origin and where it is received by the detector system (coil), and thereby translated into the position it will appear in the final image. To put this simply, signals produced in the patient can generate a current in any part of the receive coil. So how does this system know where all these signals have originated? Without 'tagging' the signals with accurate spatial information it would be impossible to reorder them and therefore create an image.



So how is this done? The answer is 'Spatial Encoding' and as it is a three dimensional problem, can be explained by three distinct processes. This first article in this set of three tackles the first dimension, 'Slice Selection'.

Slice Selection

NB For ease of description, the following explanation will describe the process for true axial slice acquisition. However, by using alternative gradients, or indeed a combination of each gradient system, the scanner system is of course able to perform these functions in any direction and therefore produce any obliquity the user chooses to prescribe.

To reduce the problem of where in three dimensions space a signal came from, down to a two dimensional problem which will be continued in the next issue, a process called Slice Selection is performed. This ensures that at any given time, only protons in the slice of interest will produce a signal, i.e. only one slab at a time across the patient (in this case axial) will be imaged.

When the patient is placed in a magnetic field the Larmor Equation states that their hydrogen protons will precess at predictable frequency. In this example we will consider a 1.5Tesla system, so the precessional frequency will be:

1.5 (Tesla) x 42.57
(the gyromagnetic constant for hydrogen) = 63.86 MHz

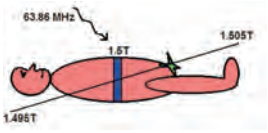
If radio frequency matching this frequency is introduced, then all of the hydrogen protons will receive a maximal energy transfer and be 'flipped' into a higher energy state - this being resonance.

Whilst having all protons excited in this way purposely occurs in 3D imaging sequences, we will concentrate on standard 2D imaging for the moment. In 2D imaging we need to only excite one slab of tissue, or slice is excited at a time. So how is this achieved?

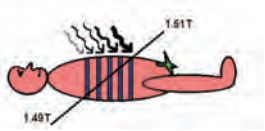
To do this a Slice Selection Gradient is used, and in our example of an axial acquisition, this will therefore utilise the z axis gradient system. By switching this gradient on, the magnetic field experienced by the patient can be made to be slightly stronger than 1.5T at one end of the patient, and slightly weaker at the other. The result of this is that the protons at the higher field end will spin faster and those at the lower field slower than 63.86 MHz.

This gradient is left 'on' when the RF pulse is introduced. Due to the properties of resonance whereby energy transfer only occurs where frequencies match, only protons precessing at the same frequency to that introduced will achieve the energy transfer, i.e. be flipped into a high energy state. In this way, we can achieve a condition where only one slice can be excited. This has therefore reduced our spatial encoding problem to a two dimensional problem whereby we now only need to know from where in the x and y direction of this slice each signal originates, to enable the scanner to be able to create an image. How this is done will be covered in next two issues of BAMRR news.

When you choose to scan a thinner slice, the scanner achieves this by setting a stronger slice select gradient. With a stronger gradient, the distance along the patient, again in this case the z direction, where the precessional frequency would match closely enough to the proton spins for resonance to occur well would be smaller, and hence the slice width excited would be thinner.



So this explains how to excite one slice, but we rarely scan a single slice. Usually we acquire a series of several slices in one acquisition, so how is this achieved? To do this, multiple radio frequencies are introduced in turn at subtly differing frequencies corresponding to the precessional frequencies of protons at each required slice location. Where the introduced RF and the gradient affected precessional frequencies match, resonance will occur, and the slice will be excited. Within one TR several slice positions can be achieved in this way. Each slice excitation takes an amount of time, but generally several can be fitted within your chosen TR. When the TR time is reached, the scanner must go back and re-excite the first slice again to perform the next phase encoding (see next time) and therefore there will always be a limit to how many slices can be obtained in each TR. This explains why increasing your TR will generally allow you to acquire more slice positions.



In the next issue of BAMRR Newsletter we will examine Phase Encoding.

Ataxia Telangiectasia

Helen Estall *Superintendent Radiographer, Leicester Royal infirmary*

Ataxia Telangiectasia (A-T) - A condition that may lead to a MRI request rather than a X-ray

A-T, also known as Louis-Bar Syndrome, is a rare childhood neurodegenerative genetic condition. Incidence is thought to be between 1 in 40,000 and 1 in 100,000 with an average life expectancy of 25 years.

Symptoms include ataxia, oculomotor apraxia, involuntary movements, telangiectasia (dilated blood vessels over the white of the eye and sometimes on sun-exposed skin) and a weakened immune system. The condition also prevents repair of broken DNA. It is this latter symptom which increases the risk of cancer for these patients, particularly lymphomas and leukaemias. A-T patients have about a 10% risk of developing cancer and are 37-times more likely to develop cancer than the general population. This means that treatment should avoid the use of radiation therapy if possible and if necessary, this should only be carried out in specialised centres.

A-T sufferers also have an increased sensitivity to the effects of diagnostic X-rays. In general, X-rays should only be done if the result will influence therapy and there is no other way to obtain the information that the X-ray would provide. Trust Radiation Safety Advisors suggest that a Radiologist should justify and authorise exposures to all this patient group and that they should be made aware of the patient's A-T status. This is so that further consideration can be given to alternative imaging techniques, which may give the same information at less or no radiation dose.

Wikipaedia

National cancer institute fact sheet at - http://www.cancer.gov/cancertopics/factsheet/Risk/ataxia or http://www.communityatcp.org/Document.Doc?&id=6

John Hopkins - 'Important facts about A-T and x-rays info leaflet.

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