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AUTUMN 2017

# BAMRR news

THE NEWSLETTER OF
THE BRITISH ASSOCIATION OF MR RADIOGRAPHERS

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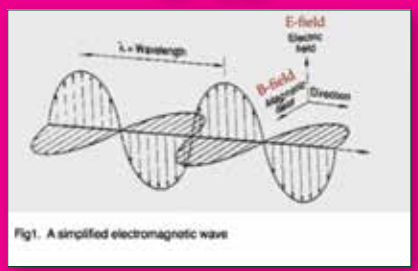


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# welcome

## from your BAMRR PRESIDENT

Hello and welcome to the BAMRR Newsletter Autumn 2017. The volunteer team on the Policy board at BAMRR pride themselves in communicating, educating and informing the MRI Radiographers community in the UK.

The Newsletter serves as a great media to convey MRI safety updates, tips and tricks in scanning and of course providing CPD and educational material for you to enjoy and reflect on.

It is with great pleasure that I welcome new members to the BAMRR team from all around the UK; we have Cath Mills joining from Blackburn and Trudi Whitehead from Derby. You can read more about the new team members in their articles in this Newsletter.

The Spring Introduction to MRI Course in Loughborough was well attended and we are running the Autumn Course on 10th/11th November at the same venue where we can access the MRI scanner for hands on session with the delegates. UKRC took place in Manchester in June and you can read about the BAMMR session and the talks later in the newsletter.

Finally, for 2017 the Annual BAMRR Conference is being held in Glasgow, Scotland on 7th October. This will be an ideal event for CPD and updating your MRI knowledge. Opportunities to network with other MRI users and exhibitors are on hand for products or services queries.

Come join us in Glasgow 2017 and be part of something special. We look forward to meeting you there.

*Paola Griffiths*
BAMRR President

## from your EDITOR

Crazy busy at work right now as I am sure you all are, but I have pressed on to get this edition of BAMRR News out in time for this year's conference. We are very excited to be heading to Glasgow this year and hopefully this edition will have made it to print in time to be in everyone's conference packs.

BAMRR membership is continually growing, so it is more important for me than ever to try to keep the BAMRR News content current and interesting. I am pleased that we have two new policy board members this year and they have already contributed. Please remember however that as a member of BAMRR you are also most welcome to submit articles, case studies, study day reports or letters that you feel others would enjoy reading, or that raise issues you think worthy of discussion.

You can contact me at work on **matthew.benbow@rbch.nhs.uk**

In the meantime, thank you to Guerbet for their continued support in the production of this magazine, as well as to Sarah Moss Designs for so ably arranging the content.

See you in Scotland.

*Matthew Benbow*
BAMRR Editor

# Follow us BAMRR is now on Facebook & Twitter

On Facebook, search for **"BAMRR"** - be our fan and 'like' us and we will keep you update.

For tweeting visit
**twitter.com/#!/BAMRR**

# WELCOME from our sponsor GUERBET

Welcome to the Autumn edition of BAMRR News..

With some exciting education event planned throughout the year we continue with our commitment to supporting CPD for MR radiographers. As always these will be organised together with radiologists and radiographers who are passionate about sharing their knowledge.

Please visit our website **www.guerbet.co.uk** to find out more about the events we hold or sponsor. Do not 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.

Guerbet Laboratories Ltd
Avon House
435 Stratford Road
Shirley, Solihull
B90 4AA UK

Tel: 00 44 (0)121 733 8542
Fax: 00 44 (0)121 733 3120
email: uk.info@guerbet-group.com

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SCoR
THE SOCIETY & COLLEGE OF RADIOGRAPHERS

## Magnetic Resonance Advisory Group (MRAG) what do we do?

***The Society and College of Radiographers have a number of advisory groups whose function is to advise Council and the College Board of Trustees on all matters relating to that area of practice.***

The Magnetic Resonance Advisory Group (MRAG), established in 2011 acts as a forum for the consideration of all magnetic resonance matters affecting radiographers and other members of the magnetic resonance workforce.

The twelve members of the group are drawn from all areas of practice, including clinical practitioners, managers, educationalists and researchers.

Recently, the group has been heavily involved in MRI Safety, mainly revolving around our joint publication with BAMRR 'Safety in Magnetic Resonance Imaging' which is reviewed annually and available to all via the document library on sor.org and to members on the BAMRR website

The group has also been actively involved in providing guidance to members regarding the EUPAD (European Union Physical Agents Directive EMFs) regulations, now transposed into law as the CEMFAW regulations.

Other ongoing work includes involvement with IPEM on an accredited programme for MRI Safety Experts and as a working party member with the wider MR community in the development of e-learning safety modules, with the first pilot module now available via eLfH.

Possibly the most notable recent output is the 'Have you paused and checked?' posters and prompt cards that have been published to serve as a handy reminder for radiographers carrying out MRI examinations and are free to download from the SCoR website.

The posters are designed in a PDF format to allow for easy downloading and printing. They can then be displayed in the department as required.

There are A4 and A3 sizes available and also an A6 pocket version. The guidance covers patient checks, anatomical checks, user checks, system and settings checks, exposure checks and reminders on what to do at the end of an examination.

**https://www.sor.org/news/mri-pause-and-check-materials-published**

The group has recently contributed to work by Skills for Health regarding the National Occupational Standards for MRI and members are also involved in developing a clinical consensus for mp prostate MRI and in development of guidance for installation of MR scanners

And on the horizon is further work, including reviewing the role of Assistant Practitioners in MRI which will contribute to wider work within the organisation

So all in all we're a busy bunch! Information and minutes of meetings can be viewed on the MRI webpages:

**https://www.sor.org/practice/cross-sectional-imaging/mr-advisory-group**

If you have any questions for the Magnetic Resonance Advisory Group (MRAG) please contact **alexl@sor.org**





# BAMRR Policy Board Members Autumn 2017

The co-ordination of the Associations activities is overseen and undertaken by an elected Policy Board. BAMRR consists of up to 11 individuals who are full members of BAMRR and are working in different regions of the UK

**PRESIDENT/BIR SIG**
**Paola Griffiths**
paola.a.griffiths@swansea.ac.uk

**PAST PRESIDENT/ MRAG**
**Jill McKenna**
Jill.McKenna@nuth.nhs.uk

**EDUCATION/ COURSE CO-ORDINATOR**
**Zoe Lingham**

**TREASURER**
**David Reed**
drbamrr8@gmail.com

**CONFERENCE CO-ORDINATOR**
**Rachel Watt**
rachelwatta@nhs.net

**MEMBERSHIP SECRETARY**
**Aileen Wilson**
aileen.wilson@bristol.ac.uk

**SAFETY OFFICER**
**Janine Sparkes**
janine.sparkes@abm-tr.wales.nhs.uk

**SOCIETY & COLLEGE OF RADIOGRAPHERS MRI PROFESSIONAL OFFICER**
**Alex Lipton**
AlexL@sor.org

**NEW BOARD MEMBER**
**Cath Mills**
cath.mills@bmihealthcare.co.uk

**PRESIDENT ELECT**
**Helen Estall**
helen.estall@uhl-tr.nhs.uk

**EDUCATION/ COURSE CO-ORDINATOR**
**Jonathan Coupland**
Jonathan.coupland@philips.com

**NEW BOARD MEMBER**
**Trudi Whitehead**
trudi.whitehead@nhs.net

**NEWSLETTER EDITOR**
**Matthew Benbow**
matthew.benbow@rbch.nhs.uk

**SECRETARY**
**Lisa McBain**
Lisa.McBain@hey.nhs.uk

# BAMRR Session UKRC report 2017

***Rachel Watt***


**It was another successful BAMRR session at UKRC in Manchester Central Convention Complex on Wednesday 14th June 2017.**

*Paola Griffiths (President, BAMRR) and Helen Estall (President Elect, BAMRR) chaired the session titled 'MRI in Contemporary Practice'.*

Three excellent speakers shared their expertise with an captivated audience of MRI Radiographers.

*Left to right: Dr Jonathan Phillips, Paola Griffiths, Helen Estall, Dr Martin Graves and Mr. Mark Warren*

In his talk entitled 'Introduction to Compressed Sensing in MRI', Dr Martin Graves, Clinical Scientist and Head of MR Physics and Radiology in Cambridge explained how compressed sensing worked, its uses and limitations, including an interactive session inviting the audience to distinguish between images acquired with and without compressed sensing.


Mr. Mark Warren, Lecturer, School of Health Sciences University of Liverpool shared his 'Experiences with MR guided Radiotherapy' following his fact finding mission to Utrecht regarding the use of MRI in radiotherapy planning.

This will impact on current services with a required approach for collaborative working between diagnostic MRI radiographers and therapy radiographers.

A re-skilling of oncologists and physicists will also be necessary.

Our final speaker, Dr Jonathan Phillips,

Senior research Officer in Medical Imaging of Swansea University Medical School, in his talk, MR Conditional Pacemakers: The MR Physicist's Perspective explained the importance of implementing a local implant protocol for scanning pacemakers, what it should include and the need to constantly review the guidance from each manufacturer.

Work is already underway to secure speakers for next year's BAMMR session at UKRC 2018 to be held at the Exhibition Centre Liverpool on 2-4 July 2018. so save the date...

Your attendance of the BAMRR session at UKRC conference is both appreciated and valuable

Thanks

*Rachel*, BAMRR UKRC co-ordinator





# New BAMRR Board members

◆ **Trudi Whitehead**

Trudi graduated as a diagnostic Radiographer from the South West Trent School of Radiography in Derby in 1993. She first had the opportunity to begin her MRI career at the Glenfield Hospital in Leicester in 1997. She moved back to Derby to practice CT and MRI before becoming fully MRI based. It was at Derby that Trudi became more interested in MRI Safety and has developed and maintains the MR safety practices. She has also established the MR safety training for all staff from radiographers to referrers. Her main experience is on Philips and GE scanners, being involved in the setting up of a new suite of three scanners on the main Derby site. Trudi's current role is Lead MRI Safety Radiographer at Derbyshire Teaching Hospitals NHS Foundation Trust.

◆ **Cath Mills**

Cath first trained in MRI in 1998. She mainly has experience with Siemens MRI scanners and been involved in Applications and setting up new scan services at three sites. During the eleven years she worked at Lancashire Teaching Hospitals Trust her interest in MRI Safety developed. She maintained safety resources for the Radiographers and setup and carried out MR safety training for staff of all disciplines. She won the poster prize at BAMRR in 2013 for some work she did on Mr Conditional Pacemakers. She made the move to Private Healthcare in February 2013 and is currently the Unit Manager in MRI/CT at BMI Beardwood, Blackburn.

# Membership Report


There are currently just over 500 BAMRR members, this is the largest the membership has been for several years which is excellent, thank you. There are 33 site memberships and we currently have several sites with 20 or more members each, we also have 38 student radiographers that have joined us after we started free membership for students. If you have students in your department then please encourage them to join as hopefully it will increase their interest in MRI and encourage them to specialise in MRI in the future.

For those of you in Scotland and Ireland particularly, please encourage your colleagues to join as the majority of our membership is England and Wales based. The advantages of membership are website access to MRI safety resources and educational information. Free twice yearly newsletter and reduced fees to BAMRR courses and conferences plus much more.

If anyone has any membership queries then please contact me via email at **helen.estall@uhl-tr.nhs.uk**

# Treasurers Report

We currently have just over **£46,000** in the accounts which is an increase compared to last year. This is mainly due to increased membership and the generosity of our sponsors which mean that we have managed to keep all of our fees at the same prices for a number of years. This year we will be cutting the cost of the conference fee to our members significantly as a thank you for all of your continued support. Please keep an eye out on the website for details.

For any Treasurer related queries please contact me via email at **helen.estall@uhl-tr.nhs.uk**

# Tolusa-Hunt Syndrome

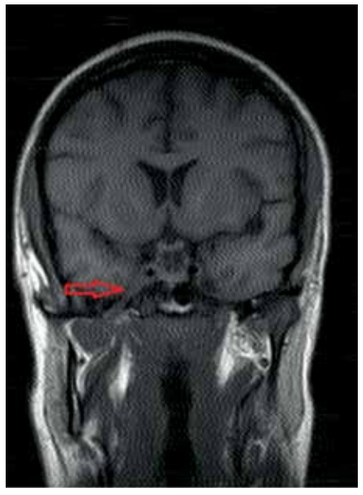
*Helen Estall, Lead Superintendent Radiographer CT/MRI, University Hospitals Leicester*

**Patient History:**

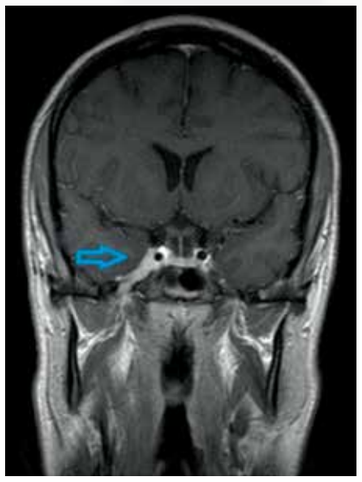
Admitted and referred for MRI with right temple headache, right facial numbness, increasing diplopia, progressive right ptosis and near complete opthalmoplegia.

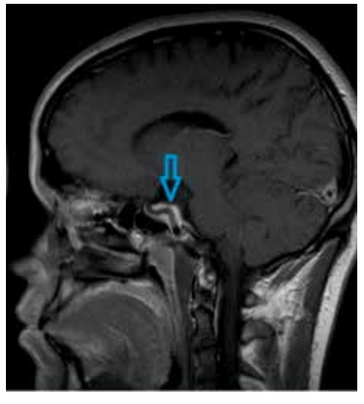
**Images:**

T1 Coronal showing soft tissue mass in an expanded right cavernous sinus (apologies for the image quality, RF artefact on our mobile scanner!):



Post contrast T1 Coronal and Sagittal showing enhancement of the right cavernous sinus, sagittal shows lesion surrounding carotid artery:





**MRI:**

- Inflammatory changes in the cavernous sinus, superior orbital fissure and/or orbital apex
- Focal enhancing, expanding mass in the cavernous sinus can extend into the orbital apex
- Signal characteristics are generally non specific
- T1 – lesion is usually iso or hyperintense
- T2 – lesion is usually hyperintense
- Post contrast – lesion is hyperintense when active, isointense on resolution after treatment

**Report:**

Soft tissue signal mass in the right cavernous sinus which is expanded and enhances after contrast. This is in keeping with Tolusa-Hunt syndrome.

Differential Diagnoses:

- Meningioma
- Sarcoidosis
- Pituitary tumours
- Lymphoma
- Tuberculous meningitis

**Tolusa-Hunt Syndrome:**

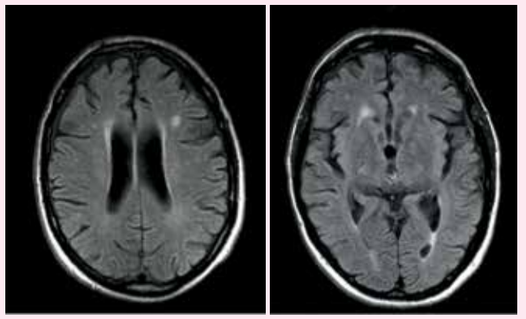
- Rare idiopathic inflammatory syndrome characterized by severe and unilateral headaches with extra ocular palsies
- Usually involves the 3rd, 4th, 5th and 6th cranial nerves
- Pain around the sides and back of the eye plus ophthalmoplegia of certain eye muscles
- Clinical diagnosis of exclusion
- Treatment is with corticosteroids



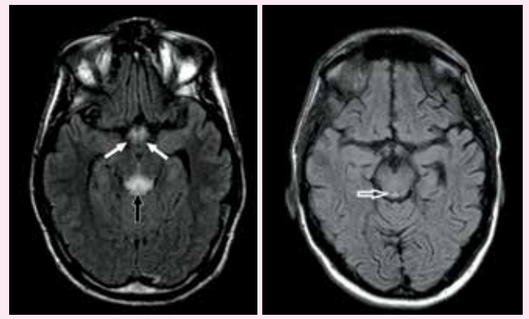


# Wernicke's Encephalopathy

**Images:**



FLAIR axials with periventricular hyperintensities:



FLAIR Axial with hyperintensity of mammillary bodies (white arrows) and region of 3rd ventricle (black arrow): FLAIR Axial with periaqueduct hyperintensity:

**Patient history:**

Patient referred for MRI with ataxia and a history of chronic alcohol abuse.

**MRI:**

- IT2 and FLAIR hyperintense, symmetric lesions in the periaqueductal and periventricular regions, dorsal medial thalamic nuclei and mammillary bodies
- May only affect periaqueductal grey matter
- May or may not have associated T1 enhancement post contrast
- Variably restricted diffusion

**Report:**

T2 and FLAIR hyperintensities in the periaqueductal and periventricular areas. With the clinical history this is suggestive of Wernicke's encephalopathy

**Wernicke's Encephalopathy:**

- Acute neurological syndrome characterised by ataxia, opthalmoplegia, nystagmus, confusion and short term memory loss
- Often results from inadequate intake or absorption of Thiamin (B1)
- Most commonly associated with prolonged alcohol consumption resulting in thiamine deficiency
- Can have non-alcoholic Wernicke's
- Treatment with Thiamin resolves the abnormalities on MRI

# Negative Oral Contrast Media for MRCP

*Matthew Benbow, CT & MRI Superintendent Radiographer, Royal Bournemouth Hospital, BAMRR News Editor*

## Introduction

Magnetic Resonance Cholagiopancreatography (MRCP) generally involves the acquisition of heavily T2 weighted sequences. The aim is to remove as much signal from all tissues other than those containing water-based fluid. In this way the bile filled biliary system should be well seen against a darkened background. *(figure 1 - good one)*

In reality other unhelpful fluids within the scanned volume will also return a high signal. Cerebrospinal fluid in the spinal canal, bile within the gall bladder and urine in the ureters will all appear bright. Whist in the majority of cases these can be either tolerated or removed with post processing, digested fluid in the duodenum can be unacceptably problematic due its close proximity to the area of interest. *(figure 2 - crap one)*

The anatomy of the duodenum is such that it curves in a C-shape from the pyloric sphincter of the stomach, behind the common bile duct to reach the jejunum. Midway along the inner curve, the common bile duct enters the duodenum at the Sphincter of Oddi and it is at this location that stones can very often lodge. It is therefore crucial that unobstructed imaging of this area is achieved - the ideal scenario being that the duodenum is totally empty of water content and thereby returns no signal.

To encourage an empty duodenum it is common practice to prepare the patient by starving them for a few hours before the examination to give time for food and liquid to pass. This is not always completely successful however, so additionally in the lead up to the examination, negative oral contrast media can be used to either 'push' out, or mix with residual gastric and duodenal fluid. It is of course essential that the fluid used produces low signal on T2 weighted imaging.

## RF Input and Subsequent Relaxation

When placed into an MRI scanner, the patient's hydrogen protons (and others) will move into alignment either with (parallel), or against (anti-parallel) the main magnetic field. More will go 'with', and the net result is a small magnetic vector in the direction of the main field. Whilst within the scanner, this can be considered as a state of relaxation, i.e. the protons are content to be in this alignment.

If a frequency-matched RF pulse is introduced, some parallel protons will 'flip' dpwn resulting in the initial longitudinal magnetic field being either reduced (<90o pulse) or removed (90o pulse). This amount flipped is dependent on the size of the RF, but either way this reduction in magnetism is not a relaxed state. Once the RF is removed the main magnetic field will force the protons to recover their original magnetisation. Hydrogen protons in differing molecules will do this at differing rates which affords us the ability to exploit this as differing signal strengths from differing tissues, and ultimately image contrast. This is known as T1 recovery and takes a relatively long time.

AT THE SAME TIME (and I emphasise this through a personal dislike of the graph showing the skier going up the slope and then down the mountain that some will be familiar with, which leads you to wrongly believe one happens after the other), yes at the same time that the longitudinal magnetisation recovers, transverse magnetisation will decay. This is known as Free Induction Decay (FID) *(fig 3)*. Transverse magnetisation never existed before the RF pulse as all precessing protons were in random positions and cancelled each other out. The RF pulse has a secondary effect of aligning them in their phase of spin, i.e. they will point in the same direction and hence create a transverse magnetisation. Once the RF is removed the protons will experience an energy transfer between each other and rapidly lose their phase coherence. As a result transverse magnetisation will decay. This is known as T2 (or T2*) decay and happens relatively quickly. This energy transfer is more efficient in some tissues than others. Those tissues where this magnetism loss is rapid i.e. have a short T2 time, produce less signal that those where the loss takes longer. As before an alternative contrast between differing tissues can therefore be obtained and imaged.

Paramagnetism is due to the presence of unpaired electrons in the material, so all atoms with are paramagnetic.

## T1 Contrast Enhancement

We are very familiar with the concept of gadolinium-based contrast media increasing T1 signal, but why is this? Well, it is due to paramagnetism causing T1 shortening. Gadolinium is a paramagnetic element i.e. it has incompletely filled atomic orbitals which result in it gaining magnetization in the presence of an external magnetic field. Tissues that absorb gadolinium will therefore recover their T1 signal more quickly, and so produce a stronger signal in a T1-weighted image. So, by imaging with T1 weighting we can use gadolinium enhancement to cause differential enhancement between normal tissue and pathology and thereby aid diagnosis. *(fig 4)*

## T2 Contrast Darkening

In contrast to T1 relaxation being a recovery, T2 relaxation is a decay. Immediately after the RF excitation there is maximal T2 magnetisation, but this will disappear as a result of energy transfer between spins. This energy transfer is more efficient in some tissues than others. Those tissues where this magnetism loss is rapid i.e. have a short T2 time, produce less signal that those where the loss takes longer. Paramagnetic substances lose their spin coherence very rapidly and so tissues that have absorbed paramagnetic contrast media will darken quickly on T2 weighted imaging. *(fig 5)* So in this way an oral paramagnetic liquid can be used remove unwanted high signal from duodenum during an MRCP1

## Branded Oral Contrast Media

Feromoxsil is a large siloxane coated superparamagnetic iron oxide in a viscous solution. The 10nm particles contain ferric and ferrous iron and as such produce a large amount of T1, T2 and T2* shortening 2. The result with the T2 imaging used with an MRCP study is a significant darkening of any residual fluid that it replaces or mixes with in the duodenum. Though no longer available, GastroMark and Lumirem were both contrast agents once available in the UK for this use.

## Manganese

Manganese is one of the most abundant metals on earth and is a component of more than 100 minerals. Besides being an essential trace element in the metabolic processes in the body, it is also a paramagnetic metal that possesses similar characteristics to gadolinium3. Intravenous manganese was in fact one of the earliest reported examples of MRI contrast media and was for example available for many years in the form of Teslascan, a very successful liver contrast agent4,5. It might yet still have a part to play in the future for newly developing IV contrast media, but in the meantime its existence in naturally occurring juices means that it's paramagnetic properties can assist us in a very cost effective way6.

## Fruit Juice

Manganese occurs in high concentrations in some pure fruit juices including pineapple, blueberry and cranberry. Pure juice can therefore be used as an effective oral negative T2 contrast media for MRCP. Studies have shown pineapple juice for example to give similar effect to branded contrast media in reducing T2 signal, yet with an improved taste!

*Fig 6* shows a scan I performed by scanning a cup of water next to a cup of pineapple juice.

You can see that on both the T2 weighted sequences water gives a high signal, but that the pure pineapple juice gives a low signal. This is due to the fact that whilst water protons have retained T2 phase coherence at the TE time used, the paramagnetic nature of the manganese in the juice has caused a much more rapid decay of transverse magnetism. In fact, by using a very long TE (700), as is common with MRCP imaging, the pineapple juice can be made to lose just about all signal. The transverse magnetisation has had enough time to become completely gone *(decayed)*.

On the T1 sequence, the T1 shortening properties of the manganese in the pineapple juice resulted rapid T1 *recovery* compared with water, and so produces a high signal. The pineapple juice used was a simple, cheap branded carton.

Manganese-containing fruit juices therefore offer a safe, simple and well tolerated method of improving the quality of MRCP T2 weighted imaging. It should be noted that manganese concentration is variable in commercially available brands. Therefore one with high manganese concentration should be selected.7 Never fall into the trap of using a cordial, i.e. mixing concentrate with water, as this is mainly water and therefore will not work!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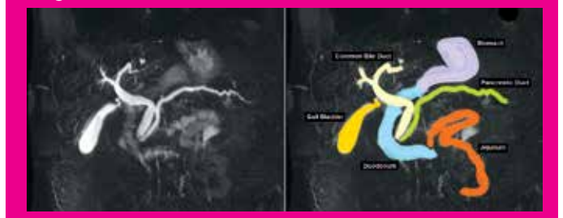
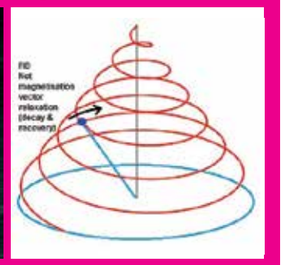
◆ **Figure 1**

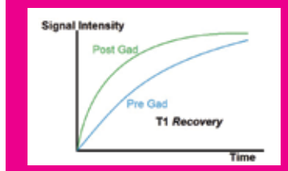



◆ **Figure 2**

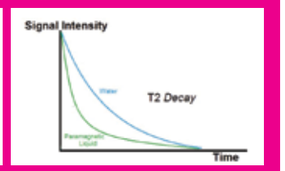
◆ **Figure 3**



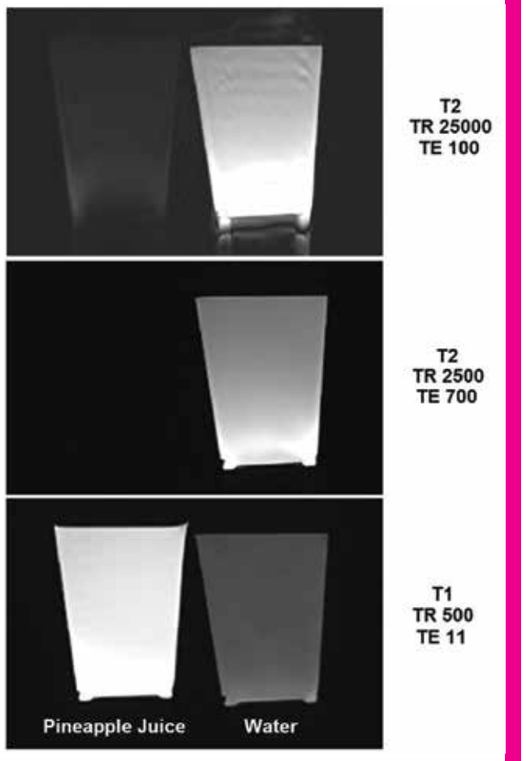

◆ **Figure 4**




◆ **Figure 5**




◆ **Figure 6**



# Piriformis Syndrome

## '5 minute CPD'

**Cath Mills** *BMI Healthcare*

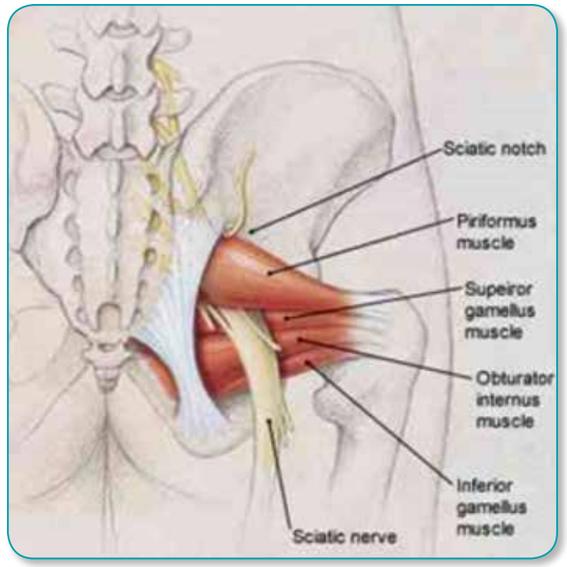
### Piriformis Syndrome:

Is a neuromuscular disorder caused by abnormal condition of the piriformis muscle such as hypertrophy, inflammation or anatomic variations. It compresses or irritates the sciatic nerve causing pain, tingling and numbness in the buttocks and along the path of the sciatic nerve descending down the lower thigh and into the leg. Diagnosis is often difficult. Clinicians need to rule out whether the patients' sciatica results from compression/irritation of spinal nerve roots from a herniated lumbar disc before diagnosing Piriformis Syndrome. Compression may be present, but not causal, in the setting of sciatica due to piriformis syndrome. It may be due to anatomical variations in the muscle-nerve relationship, or from overuse or strain.

### The Piriformis muscle

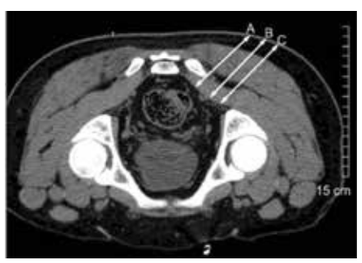
Arises from the front of the sacrum, passes out of the pelvis through the greater sciatic foramen, is inserted into the upper border of the greater trochanter of the femur, and rotates the thigh laterally.

**PIRIFORMIS**
**'PEAR SHAPED'**




### The role of MRI and CT in imaging piriformis syndrome

CT does have a role in imaging the piriformis, however it is more commonly used in order to locate the muscle to give pain relief injections.




*Arrows from skin surface to right Piriformis muscle*

Clinical examination and MRI are used to exclude conditions that replicate the symptoms, and an MRI report that is negative for lumbar-sacral pathology will point towards Piriformis Syndrome as a differential diagnosis. Radiographic appearance of Piriformis syndrome depends on the cause, and often no abnormality is noted. If muscle injury or inflammation is present then increased signal within the piriformis muscle may be seen on T2 MRI, and oedema may be seen on STIR sequence.


### Related articles

CT and MRI in the Evaluation of Extraspinal Sciatica http://www.birpublications.org/doi/full/10.1259/bjr/76002141

MRI of Piriformis Syndrome http://www.ajronline.org/doi/full/10.2214/ajr.183.1.1830063?src=recsys&

Author : cmills@bmihealthcare.co.uk

### *Possible Clinical Indications on MRI scan referral :*

- Dull ache in the buttock
- Pain down the back of the thigh, calf and foot (sciatica)
- Pain when walking up stairs or inclines, worse after prolonged sitting, walking or running, and may feel better after lying down on the back.
- Increased pain after prolonged sitting
- Reduced range of motion of the hip joint



# INTRODUCTION TO MRI COURSE REPORT

March saw the first of the BAMRR education courses for 2017 with a change of venue. The two day introductory to MRI course was held in Loughborough at the National Centre for Sports and Exercise Medicine (NCSEM) which is a state of the art facility built as part of the London 2012 Olympic legacy programme.

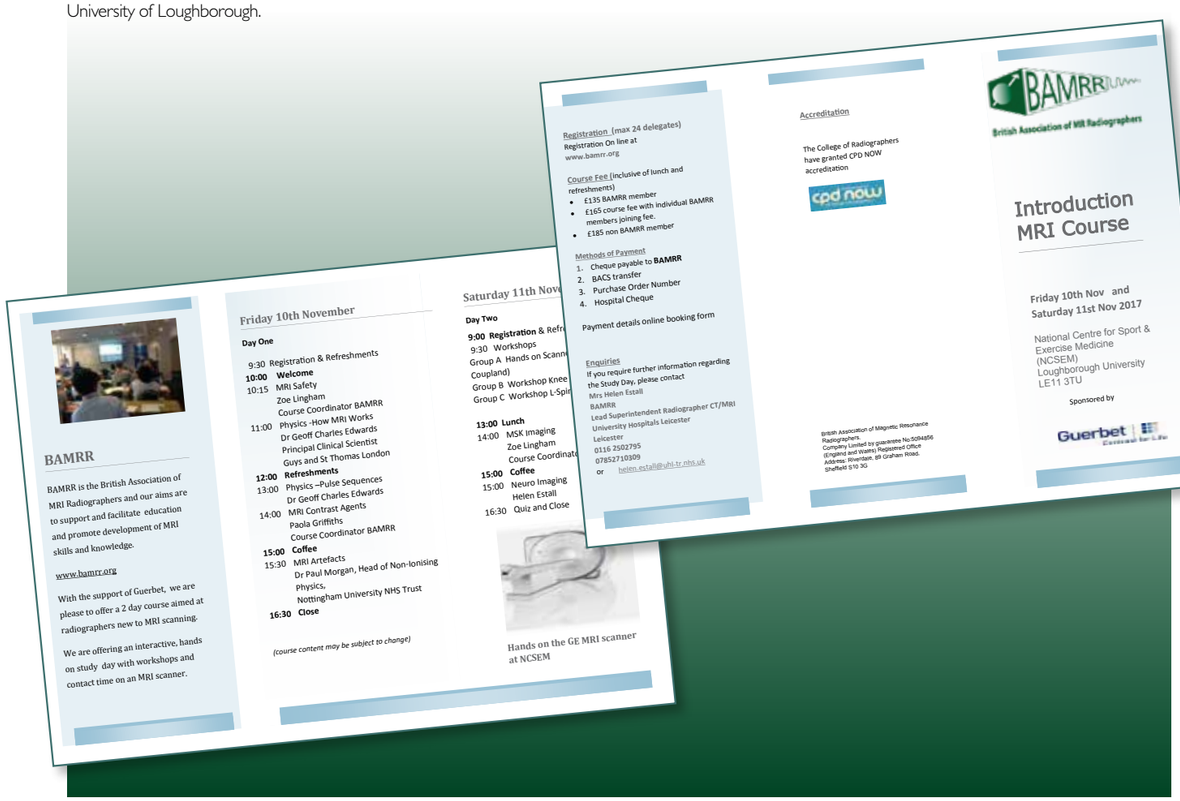
The two day course was yet again oversubscribed with a full room of delegates eager to learn.

The topics covered ranged from MRI physics explained by Dr Geoff Charles-Edwards from Kings College London to MR Artefacts given by Dr Paul Morgan from the University of Nottingham. The BAMRR policy board members kindly gave up their time to host the course and to speak about MRI safety, contrast agents, MSK and Neuro MRI.

On day two the breakout sessions proved very popular with specific sessions discussing MRI techniques and pathologies of the knee and lumbar spine. There was also a 'hands on' session using the 3T scanner at NCSEM looking at parameter manipulation and the effect of image quality.

The feedback from the delegates was excellent and I would like to thank my colleagues on the policy board for giving up their time to provide a well-structured educational course for new (or not so new) MRI radiographers.

The next introductory course will be held on the 10th & 11th November and will be again at the National Centre for Sports and Exercise Medicine at the University of Loughborough.



# B1+rms *as a* Condition of Use

***Wm. Faulkner,*** *BS,RT(R)(MR)(CT), FSMRT, MRSO (MRSC™)*

## Introduction

When performing and MRI exam on patients implanted with an MR Conditional active implant and/or device, it is often critical to be aware of, and control the amount of RF power utilized. Historically, the metric utilized for this purpose has been SAR. However, SAR has been shown to not be an accurate metric for RF-induced heating relating to implants and devices[1].

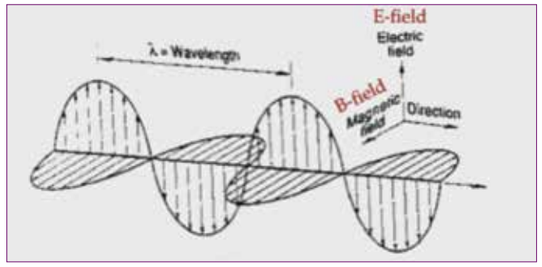
SAR (Specific Absorption Rate) is a measure of the rate at which RF energy is deposited in tissues. As the term describes; it is specific to the body part, and it is what is absorbed over time. SAR is estimated by the MRI system software, and it is estimated for each sequence. We know that SAR is proportional to the power of 2 for the resonant frequency. Therefore, doubling the field strength (for example going from 1.5 T to 3.0 T) will result in a fourfold increase in SAR. We know that SAR is proportional to the power of 2 for the amplitude of the RF pulse. This means that doubling the flip angle will result in a fourfold increase in SAR. SAR is also proportional to the power of 5 for a patient's circumference and proportional to the average conductivity of a patient.

No universal standard is in place for estimating SAR. Therefore, the method, calculations and resultant value reported will vary with the MR equipment manufacturer. Each manufacturer uses their own assumptions regarding the patients size and tissue composition to estimate the SAR. Based on these known factors, regarding SAR estimation, we expect that displayed SAR values will vary greatly depending on the patient and the MR equipment vendor. So in summary, a small patient with a given MR conditional implant or device will have a different displayed SAR value than a larger patient with the same implant or device. Additionally, the same patient with a given MR conditional implant or device will have different SAR values on different MR systems even if the acquisition parameters are identical. Furthermore, although it varies, the SAR estimates by the MR system vendors is extremely conservative. Using a low SAR value (such as 0.1 W/kg) can greatly limit the sequence and parameter options one can utilize. This can easily adversely affect the overall quality and clinical usefulness of the MR exam.

A Joint Working Group, comprised of engineers and scientists from MR equipment and device manufacturers along with the FDA have recommended B1+rms be used as a metric for device heating as opposed to SAR.

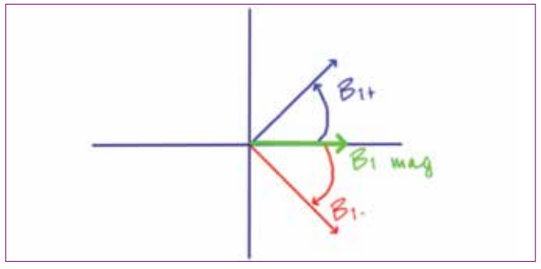
B1+rms is the average effective RF magnetic field generated by the RF transmit coil for a given pulse sequence. The B1+rms is calibrated by the MR system software during the "prep" or "prescan" phase or measurements. B1+rms is patient independent and it is determined by basic MRI requirements. It is interesting to note that B1+rms is used in every MR system manufacturers SAR calculations.

To further explain B1+rms, recall that RF pulses are used to excite hydrogen protons and cause the net magnetization to rotate it through a specific angle which we typically refer to as the "flip angle". This RF pulse is an electromagnetic wave which consists of an electric field (the E-field) and a magnetic field (the B-field). A simple electromagnetic wave is shown in figure 1.




◆ **Figure 1** - A simplified electromagnetic wave

In MRI, it is a component of the magnetic field that we use to excite the protons. The E-field doesn't do anything for imaging but only contributes to heating. The B-field can be decomposed into two rotating components or vectors (figure 2). In the diagram, the blue vector represents the positively rotating component and the red vector represents the negatively rotating component. The green vector represents the vector sum of the two. It is actually only the positively rotating component that excites the protons. The negative component has no effect regarding the excitation of the protons .




◆ **Figure 2** - Positive rotating component of the B-field (blue arrow)

Root mean square (rms) is also known as the quadratic mean. It is a statistical measure of the magnitude of a varying quantity. It is especially useful when the variates are positive and negative such a sinusoid (like our B-field).

Therefore, B1+rms is a measure of the magnitude of the positive rotating component of the Bfield. B1+rms is expressed in units of microtesla (uT). An important characteristic of B1+rms is that it is not an estimated value but a known value based on the pulse sequence and the associated parameters. It is not patient dependent nor is it calculated differently based on the MR system manufacturer. A given B1+rms value on system A is the same on system B.



In 2013, the IEC (International Electrotechnical Commission) mandated all MR systems manufactured going forward must display the B1+rms1. It was not mandated to update older systems to display the B1+rms. Therefore this will not be displayed on all MR system currently in use. Some manufacturers, however, have modified certain older systems to display B1+rms.

## B1+rms as a Condition of Use

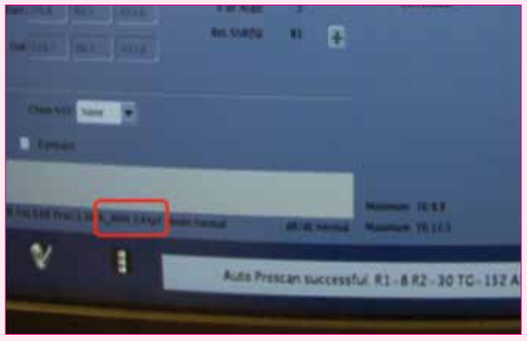
Given that B1+rms is a more precise RF exposure metric than SAR, device manufacturers have begun to have labeling approved with a given B1+rms value not to be exceeded. When following B1+rms as a condition of use, the SAR value is irrelevant (unless a particular operating mode is specified). If your particular MR system does not display B1+rms, then SAR limits must be maintained as per the device labeling.

How one modifies scan parameters to affect the B1+rms will vary somewhat between MR system brands. However, in general terms, whatever you do to reduce SAR on your system will likely reduce the B1+rms. If your system displays B1+rms, you will find it in the same area which you find SAR. Here are a few examples.

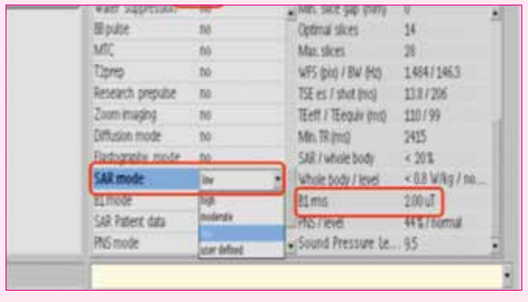
Figure 3 shows where B1+rms is displayed on this particular version of software. Again, it is adjacent to the SAR value. Also remember, not all versions of software (particularly the older versions) will display B1+rms.

Figure 4 shows where the B1+rms is displayed on a Philips system and Figure 5 is the display on a Siemens system.

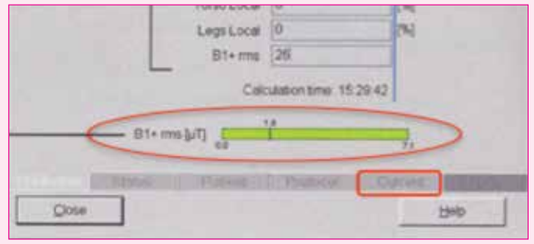
As previously stated, the exact parameters one uses to modify B1+rms will vary with the particular MR system. However, some examples of parameters and options one can adjust to reduce B1+rms include:




◆ **Figure 3** - GE SAR Display along with B1+rms




◆ **Figure 4** - B1+rms display on a Philips system




◆ **Figure 5** - B1+rms display on a Siemens system

- Increase the RF pulse duration
- Utilize a "Low SAR" mode
- Increase the TR without reducing slices
- Reduce the number of slices for a given TR
- Reduce the Echo Train Length (ETL)
- Reduce the refocusing angle (FSE sequences)
- Reduce the flip angle (GRE sequences)
- Use a GRE sequence in place of a SE or FSE sequence

Again, not all of these options will be available on every MR system. Read your user manual or contact your MR vendors clinical education specialists for information about your specific system.

Aside from being a more precise RF exposure metric than SAR, another advantage to using B1+rms as opposed to SAR is that once you adjust a particular sequence to a desired B1+rms value, you can save it in your protocol library. It will then remain at that value for the next patient (unless you alter the scan parameters). This is not possible with SAR as SAR will vary depending on the patient.

In summary B1+rms is now beginning to be used by device manufactures in their MR conditional labeling. Education is important in order to understand B1+rms and know how to adjust your protocols to achieve a desired B1+rms value for the safety of your patients. As a member benefit, the SMRT makes available, safety videos and other materials which are a valuable resource for todays MRI Technologists.

**William Faulkner & Associates, LLC**
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[1] International Electrotechnical Commission. IEC 60601-2 33:2010+A11:2011 and Corrigendum 1:2012. Medical electrical equipment. Part 2-33: Particular requirements for the basic safety and essential performance of magnetic resonance equipment for medical diagnosis. 3rd. Geneva: International Electrotechnical Commission, 2010

# 34th Annual BAMRR CONFERENCE


***Saturday 7th October 2017***

*Golden Jubilee Conference Hotel, Beardmore, Glasgow*

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Guerbet
Contrast for Life

# Guerbet Announces Plans to Streamline Its Contrast Media Portfolio

Villepinte (France), July 10, 2017 (7:00 AM CET) – Guerbet (FR0000032526 GBT), the global specialist in contrast products and solutions for medical imaging, announced today that it will phase out sales throughout the world of two products: Hexabrix® (meglumine and sodium ioxaglate) and Optimark® (gadoversetamide).

Following the acquisition of Mallinckrodt's contrast media & delivery systems business, Guerbet has taken measures to streamline its brand portfolio.

In 2015, it announced the withdrawal in the US of Hexabrix®, an iodinated contrast medium for X-ray imaging that has the same indications as two other Guerbet products, Optiray® (ioversol) and Xenetix® (iobitridol). Hexabrix® sales in Europe, Asia and Latin America will progressively cease, by the end of 2019 at the latest. Guerbet's offer (Optiray® and Xenetix®) covers more than 70 countries.

Similarly, Guerbet's decision to phase out Optimark® is part of its product portfolio prioritization. Optimark® and Dotarem® (gadoteric acid) are both gadolinium-based contrast agents and have similar indications for MRI. Optimark® is a linear agent and faces decreasing worldwide demand, while Dotarem®, a macrocyclic and ionic agent, has seen worldwide demand increase. Dotarem® is registered in more than 70 countries.

Sales of Optimark® will end first July 26, 2017 in European Union countries. Then, and in order to ensure a smooth transition and continuous supply for patients, Optimark® phase out will be progressively implemented in other geographic areas until end of 2019.

This move to streamline its gadolinium-based contrast agent portfolio through a focus on Dotarem® is consistent with recent recommendations of the Pharmacovigilance Risk Assessment Committee (PRAC) of the European Medicines Agency

*"This rationalization will enable us to live up to our undertaking to offer health professionals a complete range of efficient and safe contrast media to improve diagnosis, prognosis and quality of life for patients all over the world, while ensuring our enhanced industrial and commercial efficiency"*, says Guerbet CEO Yves L'Epine.

## About Guerbet

Guerbet is a pioneer in the contrast agent field with over 90 years' of experience and is one of the leaders in medical imaging worldwide. It offers a full range of pharmaceutical products, medical devices and services for X-ray (RX) and Magnetic Resonance Imaging (MRI) scanners and Interventional Radiology and Theranostics (IRT) to improve the diagnosis and treatment of patients. With 7% of its revenue and more than 200 employees dedicated to R&D, Guerbet invests heavily in research and innovation. Guerbet (GBT) is listed on Euronext Paris (Segment B – Mid Caps) and generated €776 million in revenue in 2016.
For more information about Guerbet, visit **www.guerbet.com**.

## Media Relations Contacts

**Guerbet Global**
**Alize RP**

Caroline Carmagnol & Wendy Rigal
+33 (0)1 44 54 36 66 / +33 (0)6 48 82 18 94
guerbet@alizerp.com

**Guerbet US**
**Ted Deutsch**

(609) 578-8765
ted@taftcommunications.com

# The Benefits of a Regional MRI Safety Group

**As MRI Safety is such a huge part of our roles as MRI Radiographers, with new policies coming in, new implants becoming available and knowledge varying from person to person, we decided at Hull and East Yorkshire Hospitals it would be a good idea to try and form a regional safety group to share knowledge and learn from each other.**

Around 3 years ago Nicola Scott an MRI Radiographer colleague and myself ran a study morning to try and meet colleagues from the surrounding areas and see if they would have an interest in forming a group. This study morning proved so successful that we manged to draw people from much further afield and are continuing to run this event. Colleagues from Scunthorpe, Grimsby and Scarborough our local hospitals to Hull were very keen to set up a regional group and we set a date to meet up in Hull. Obviously an email or a phone call to a local department manager or talking to colleagues you know in other sites can get the ball rolling to see if there is interest.

One or two Radiographers from each site came and a physicist. I set an agenda, a good one for a first meeting being Policy for intra orbital foreign bodies, policy for scanning coronary stents and heart valves, any incidents that have happened in your site and MRI Safety and scanning of the unconscious patient. It is still surprising how policies vary from site to site. Obviously Frank Shellock has made some of his policies to aid us all. In the meetings we are able to talk about these policies, talk about how they are interpreted, share information. Other itemswe have discussed have been a new implant that has come into the market eg Hoffman 3 external fixator, the policy that orthopaedic implants can be scanned immediately after implantation. Other things we have talked about include Harrington rod scanning, silver dressings, tatoos, preventing burns, people giving updates from any safety courses or lectures they've been on including Eden Safety Learning, the MRI Safety day in Scotland and updates from the IPEM Meetings, Interpretation of the EMF Guidelines 2016, aneurysm coils and clips, baclofen pumps and QA to name a few.

We arrange to meet about once a quarter and vary the location we go to. The host makes an agenda. One of us provides not formal minutes but just a list of what we have talked about. As we can have patients coming between hospital sites, it is a good idea to know a department's policy on certain implants and it is a great way of meeting people in the profession, having someone to give a phone call to sometimes if you need clarity on a safety issue that has arisen and we've discussed it or to get a third opinion.

We all unfortuantly have safety incidences that happen in a department and it is good to share the experiences, discuss what happened, how it could have been prevented and how we can all learn and reflect on these incidents to ensure the safety of all patients, staff and visitors in the MRI environment.

If anyone would like any more information or advice on how to set up a regional safety group or any other questions please don't hesitate to email. **Lisa.mcbain@hey.nhs.uk**

*Lisa McBain*

*A regular feature for MRI reporting radiographers in BAMRR News is being proposed. This could include education, interesting cases and any other topics related to MRI reporting. If you feel you would be interested in reading and possibly contributing to this feature then please email me on drbamrr8@gmail.com*

*Thank you*

*David Reed*

## The Role of the Radiographer in MRI

*The Society and College of Radiographers recently published " The role of the radiographer in MRI" this forms part of a series of promotional resources about the role of the radiography workforce which can be downloaded from the website*

https://www.sor.org/about-radiography/promotional-resources

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