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SPRING 2016

BAMRR news

THE NEWSLETTER OF
THE BRITISH ASSOCIATION OF MR RADIOGRAPHERS

SHARE YOUR POSTERS AND PROFESSIONAL KNOWLEDGE AT THE

**BAMRR CONFERENCE
1ST OCTOBER 2016
CARDIFF**

IN THIS ISSUE:

USING TECHNOLOGY TO ENHANCE MRI CPD

FULL REPORT - PAGE 11

welcome

from your BAMRR PRESIDENT

Welcome to the BAMRR Spring 2016 Newsletter. The policy board have been very busy updating our website with current and emerging MRI information.

Last year's conference at the Millennium Gloucester Hotel London Kensington was incredibly informative with excellent speakers and feedback. The MR community is very focused on MR Safety. BAMRR has been working with the BIR to produce a generic risk assessment which will accessible on our website summer 2016. This year we have opted for our conference in Cardiff with a strong emphasis on MR Safety. There are some exciting speakers lined up offering you all the opportunity for interactive discussion on our profession. BAMRR would like to thank the sponsors of the conference once again for their continued support.

Following the success of our basic MRI course we have the pleasure to announce this will run again in April 2016 (see inside for details). Guerbet have again very kindly agreed to sponsor the course to enable us to keep the cost as low as possible and we are very grateful to Guerbet for their continued support of BAMRR.

I hope to see a lot of you at UKRC in Liverpool and look forward to welcoming you all to our BAMRR session on Wednesday 8th June at 2:20pm. This year's session is titled "Contemporary practice in MRI" and should be an excellent session. We have three eminent speakers discussing epilepsy in small animals, liver MRI, and we have the pleasure to announce a 'safety session' by David Grainger Senior Medical Device Specialist (MR & X-ray Imaging) from MHRA.

Janice St John Matthews, senior lecturer at University of West of England has opted to step down from the policy board due to work commitments. I would like to take this opportunity to thank Janice for her commitment to the policy board in particular education and social media. We wish her every success in her PHD studies and thank her for her for continuing support lecturing on our courses.

Just a reminder BAMRR has an education grant of £1000 for MSc study. Successful applicants will have the exciting opportunity to publish their work in a future BAMRR letter.

I hope you enjoy this edition of the newsletter and we look forward to seeing you at one of our future events.

Jill McKenna
BAMRR President

from your EDITOR

2015 has now long since passed, the end of which saw a fantastically attended BAMRR conference in London as well as a superb BAMRR session at UKRC.

The next Introduction to MRI course is already booked up and so it seems to be good-times for BAMRR right now. The membership numbers are still increasing and the policy board are getting stuck in to their duties for 2016. Planning for this year's conference in Cardiff is already well under way, as is this year's UKRC session. Keep checking the website for details.

For me, it means the creation of the latest BAMRR News which I hope you will enjoy.

I have received no 'Letters to the Editor' this month, so please don't be shy if you feel there is anything you would like to ask, share or sound off about – it is your journal! Also, if you have any content you would like to write up for possible inclusion, please just send me an email and we can talk it through. It could be a great way for you to get something published.

I hope you enjoy the read and please let me know if you would like to see anything different next time.

Matthew Benbow
BAMRR Editor

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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

Guerbet wishes you a warm welcome to the Spring edition of BAMRR News.

Welcome to the Autumn edition of BAMRR News. We hope 2015 was a successful year for you and that it will continue throughout 2016.

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 supporting 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. 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.

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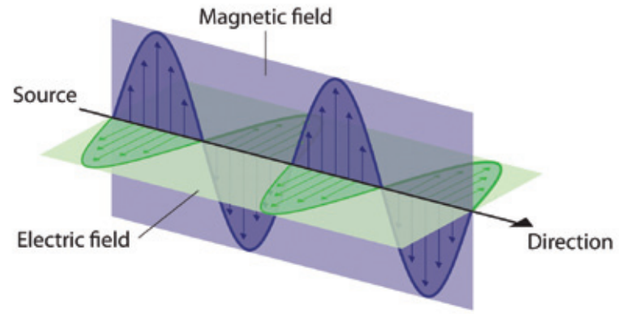
Contrast for Life

Electro Magnetic Field (EMF) Directive 2016



Denise Newsom, BAMRR Safety Officer

In 2004, a European EMF directive was adopted to protect workers from exposure to Electromagnetic fields. This directive covers all industries and not just those who work in MRI. The directive set exposure limit values (ELV's), which would have limited MRI practice and MRI research. After lobbying by the MR community, the directive was delayed and MRI activities have been granted an exemption from the exposure limit values under certain conditions. This exemption only applies to the use of MRI in Healthcare. MRI in veterinary practice is not included.

This new legislation will come into play in July 2016, called the Control of EMF at Work Regulations 2016.

What Changes will our MRI Department have to make?

All MRI departments will have to adhere to this legislation, however minimal impact is expected.

- The most likely action is that Risk Assessments will need updating to include magnetic field exposure assessment. The magnetic field exposure does not need to be measured with expensive equipment, the department can use manufacturers specifications, publications, industry standards and guidelines. There will be guidance provided by the HSE.
- MRI safety training programmes/local rules will need to be updated to include to relevant information regarding exposure to EMF's.

If departments are following the MHRA guidelines then the department is adhering to the directive and only small amendments will be required.

It is expected that Public Health England will produce a practical guide to the implementation and there will be professional guidance nearer the time.

Further Reading

1. Directive 2004/40/EC of the European Parliament and of the Council of 29th April 2004 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)
2. HPA Advice: Protection of patients and volunteers undergoing MRI procedures, RCE-7, August 2008, http://www.hpa.org.uk/Publications/RadiationDocumentsOfTheHPA/RCE07ProtectionofPatientsandVolunteersUndergoingMRI/
3. MHRA Device Bulletin: Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use V4.2, March 2015 https://www.gov.uk/government uploads/system/uploads/attachment_data/file/476931/MRI_guidance_2015_-_4-02d1.pdf
4. Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and repealing Directive 2004/40/EEC)

BAMRR Conference October 2015

Millenium Hotel London

October saw the 32nd annual BAMRR conference which was held this time in the Millennium Hotel in London.

Over 100 delegates enjoyed a varied agenda which resulted in unanimously positive feedback. Erica Scurr refreshed us all on the possibilities of whole body diffusion before Donald McRobbie entertained us all in his usual way with some anecdotes and descriptions on the history and development of MRI.

Matthew Benbow described simplified physics of spatial encoding before Denise Newsom enlightened us on the challenges faced when using MRI in vetinary practice. Denise retuned in the afternoon to discuss the latest hot safety topics before Helen Estell spoke on her experiences as a reporting MRI radiographer. David Price considered the risks of acoustic noise before Alison Fletcher rounded things up by advising us on the issues to be addressed when setting up a service for scanning patients with conditional pacemaker devices.

The day also benefited from proffered papers from Ruth Avery (online info for 7-11 year olds), Zoe Lingham (proctography service) and Kath Tyler (claustrophobia), as well as hosting information desks and demos from several manufacturers and a poster competition, reproductions of which can be found in this journal.

Next we will move on to Cardiff for the 33rd conference. This will be held in the Marriot Hotel in the city centre on October 1st.

Please keep a look out on the website for more information and registration information. See you there...

BAMRR Policy Board Members, Spring 2016

The co-ordination of the Associations activities is overseen and undertaken by an elected Policy Board. BAMRR consists of up to 15 individuals who are full members of BAMRR and are working in different regions of the UK and Ireland.

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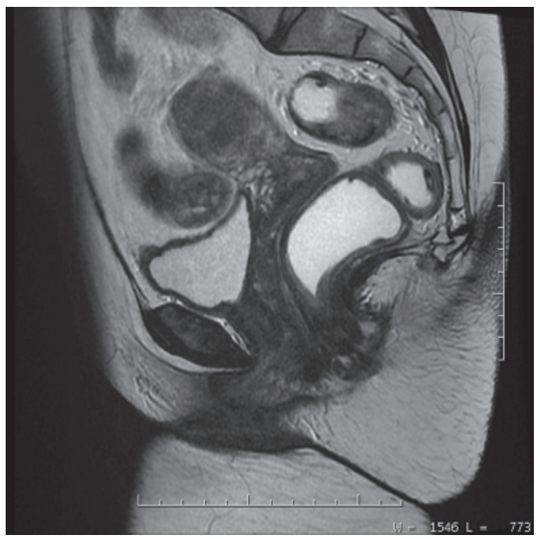
Implementation of a Radiographer Led MR Evacuation Proctography Service

Zoe Lingham, Lead MRI Radiographer, Spire Healthcare Cardiff

Pelvic floor dysfunction is more common than many radiographers are aware. The integrity of the pelvic floor can be compromised by childbirth, pelvic surgery, obesity, constipation, age, and heavy physical activity. Women are 3 times more likely than men to suffer from constipation and are more likely to have pelvic floor dysfunction. Clinical evaluation of patients with pelvic floor dysfunction is difficult and hence imaging such as endoanal Ultrasound, traditional Proctography using fluoroscopic technique or MRI evacuation Proctography may benefit. (Bozkurt et al, 2012).

Historically, fluoroscopic Proctography has played an important role in the diagnosis of functional abnormalities of the pelvic floor; however this technique has its limitations. Primarily, dedication of pelvic soft tissues is restricted without the use of contrast medium (Flusberg et al, 2011). In addition, the fluoroscopic technique exposes the patient to radiation. Both of these points can be overcome through the use of MRI. Whilst endoanal Ultrasound may also be used evaluation of sphincter integrity and associated pathological changes in anatomy, Ultrasound is limited in the assessment of the pelvic floor function. For this reason endoanal Ultrasound may be chosen to be used in conjunction with evacuation MR Proctography; whereby the high quality soft tissue contrast of MRI makes it excellent at visualisation of pelvic viscera and supporting soft tissue structures. Visualisation of pathology has been enhanced by the rest, squeeze, strain and evacuate dynamic imaging which complements the High Resolution T2 weighted sequences used for anatomical assessment. That said however, MRI does still have some limitations. Asking patient to strain and expel in the supine position is often difficult as the gravitational forces aren't present! MRI is therefore often used as a complementary examination.

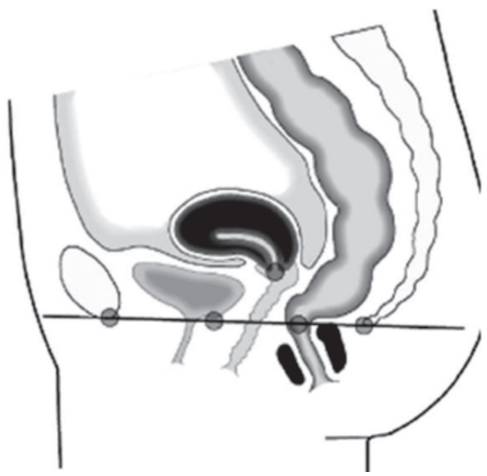
◆Fig 1.0 Sag T2 for anatomical assessment



Our aim at Spire Cardiff Hospital was to create a radiographer led service, with an appropriate pathway in place to ensure patients were treated with respect, dignity and safe practice throughout. A radiographer led service has allowed us to undertake studies during sessions that were suitable for patients; not just when the radiologist was available. It also allowed the 'supervising radiologist' time to focus on more complex procedures during his allocated sessions, rather than undertaking the proctogram scans in a 'hands on' approach himself.

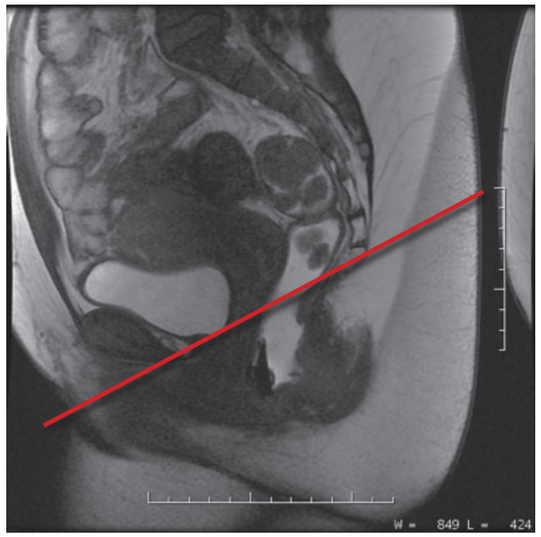
Following a number of observational sessions, a policy was created which ensured roles and

responsibilities were set out. The framework outlined the training, guidance and supervision required for radiographers and detailed the radiologist's responsibility for supervising a minimum of 5 cases before formally signing off each staff member. Staff members also complete a competency document in relation to rectal gel insertion which ensures patient safety is assured. MRI scans are booked by the MRI staff and explanations given via the telephone. This has helped put patients at ease and prepare them for what could be a daunting examination should they not feel comfortable. MRI Referrals are only accepted from consultants, to ensure appropriate cases referred.



From a radiographers perspective, an important anatomical landmark is the Pubococcygeal line (PCGL) shown in Fig 2.0 (extending from the pubic bone to the coccyx)

◆Fig 2.0 Pubococcygeal Line



Pelvic floor descent below the PCGL can be indicative of pelvic floor failure and/or prolapse. During the strain and expel dynamic studies we have demonstrated examples whereby the rectum and vaginal contents have descended below the PCGL. Formal evaluation of the images requires a radiologists who specialises in Evacuation Proctography.

Our observations and experiences have proved that supine MR evacuation proctography demonstrates the structural abnormalities associated with obstructed defaecation syndrome, with pathologies such as rectoceles, enteroceles, spastic perineum and pelvic floor descent observed in a large number of the cases examined, some in various combinations. The association of multiple compartment dysfunctions is common and its recognition alters the surgery treatment

Due to the wider choice of scan dates we can offer, patients now have more choice, which in turn has led to a greater throughput. With radiographers carrying out the proctogram procedure this means that we are not reliant on radiologists' availability during busy sessions.

Imaging itself plays a very important role indicating the optimal treatment strategy for patients. If imaging doesn't reveal any significant structural abnormalities then the patients can be offered conservative treatment like diet and lifestyle modifications.

References:

Andreas G Schreyer et al (2012) World J Gastroenterol. Available from: http://www.wjgnet.com/1007-9327/full/v18/i46/6836.htm [Accessed 09 Feb 2016].

Bozkurt et al, 2012 Significance of defecography and the role of rectocele in constipated patients Open Journal of Gastroenterology, 2, 40-44

Flusberg M et al (2011) Dynamic MR Defecography: Assessment of the Usefulness of the defecation phase. AJR; 196:394-399

BAMRR MEMBERSHIP REPORT

There are currently just under 500 BAMRR members, this is the largest the membership has been for several years which is excellent, thank you. There are 34 site memberships and we currently have five sites with 20 or more members each, we also have 17 student radiographers that have joined us after we started free membership for students in 2014. If you have students in your department then please encourage them to join as hopefully it will increase their interest and encourage them to specialise in MRI in the future.

In 2015 we started to offer corporate membership at a reduced rate for groups of 50 or more members as well.

The two images below show the spread of membership for sites and individuals, for those of you in Scotland and Ireland particularly, please encourage your colleagues to join.

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

BAMRR

Bamrr Education Grant

from the Bristish Association of MRI Radiographers

- An £1000 award is available per year for MRI research or improved service development

All applicants should meet the following criteria:

- Be a full member of BAMRR
- Be enrolled on MSc course at present and currently progressing the research in the field of MRI.
- Outline use of the grant and provide an audit trail on completion
- Give a presentation at next BAMRR annual conference
- Provide an article for publication in the BAMRR Newsletter

How to apply:

- Complete the application form available on the website under "About Us" -Education Grant .
- Applications must submit a brief outline of the intended project (*maximum 750 words*)
- Applications must to send to (email) by 31st Dec 2016

www.bamrr.org.uk

Send your proposals/abstracts to:

Rachel Watt
Lead MRI Superintendent
MRI Department - West Aberdeen
Royal Infirmary
NHS Grampian
Foresterhill Road
Aberdeen
Scotland AB25 2NZ

or email: rachelwatt@nhs.net

Using Technology to Enhance MRI CPD

#SoMe

Janice ST John Matthews

The British Association of MR Radiographers prides it's self in providing education and knowledge exchange through the facilitation of Continued Professional Development for radiographers and other professionals associated with radiography and of students within the field of MRI. Alongside our popular annual conference, two day introduction/ further MRI courses and UKRC BAMRR stream, the policy board team also has a number of social media outlets that members can access to further their appreciation of all things MRI.

The current policy board members have clocked up in excess of 150 years of scanning experience between them and we are keen to share our experience with the wider MRI community. In a climate of limited study leave and/ or funding opportunities, social media offers the organisation another means of achieving this. In response to increasing pressures surrounding CPD, Policy Board member Janice St. John-Matthews will officially be taking on the role of Social Media (#SoMe) Co-Ordinator from October 2015. Janice currently uses #SoMe as an adjunct to her undergraduate radiography teaching and is also a regular blogger on all things relating to academia, radiography and leadership.

Janice's first task was to relaunch the BAMRR Facebook and Twitter accounts: @BAMRR & @BAMRRSafety. (The latter will be supported by the BAMRR Safety Officer, Denise Newsome).

The College of Radiographers have now issued the "SoMeRAD: Guidance for the radiography workforce on the professional use of Social Media". Information on this professional document can be found at: http://www.sor.org/learning/document-library/somerad-guidance-radiography-workforce-professional-use-social-media

BAMRR members might find the following blog answers some common questions on the use of #SoMe in a professional capacity:

https://janicestjohnmatthews.wordpress.com/2015/07/12/using-technology-to-acceletrate-the-radiography-profession/

The BAMRR team looks forward to networking and collaborating in these virtual spaces. See you there!

BITESIZE PHYSICS

Magnets

Very Small to Extremely Big

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

We are quite right rightly concerned about the strength of the magnetic field before allowing personnel to enter our MRI scan rooms. Safety is always at the forefront of our minds and we religiously question and frisk our patients to ensure they are not going to come to any harm. But just how powerful are our magnets? Most of us will be using scanners with between 0.5 and 3 Tesla. A few will have less powerful open systems and some in research might be working with 7 Tesla, but how does this stack up compared with other magnets in existence?

Well did you know that your brain has a magnetic field? At about 1 picoTesla (0.000 000 000 001 Tesla it is not very strong but theorists claim it may have something to do with our consciousness. Certainly it is of no consequence to our everyday life and is not strong enough to prevent you losing your car keys by sticking them to your forehead.

Some of us are old enough to remember cassette players and video cassette recorders. They used magnetic tape of about 25 microTesla (0.000025 Tesla) to store sound, images or data. This was then read by running it past a reading head. Once again pretty weak but nonetheless a very successful and elegant solution, so long as your device didn't chew the tape up.

What about the earth's magnetic field? This varies depending a bit on where on the planet you are, but is about 50 microTesla (0.00005 Tesla) so again a reasonably low field strength, but one that is now large enough for us to perhaps envisage and observe the effects of, especially if you have used a compass to travel far enough north to witness the aurora borealis. If you are a pigeon, maybe it is even enough for you to find your way back to Bolton afterwards.

Anyone with children can these days barely locate their fridge/freezer behind an array of fridge magnets. These are in the order of 5 milliTesla (0.005 Tesla) and are strong enough for us to be able to feel the attraction when we hold it next to the fridge door, though it will probably fall off if used to hold up more than one sports day certificate.

But there are stronger magnets in the home. In the back of your stereo loudspeaker you will find a magnet used to drive soundwaves to your ear. It may surprise you to know that at 1 Tesla it is quite possibly as powerful as your MRI scanner. If you are into death metal you probably have a system that allows you to crank things up to crazy volumes. Such a system may have magnets up to 2.5 Tesla. This demonstrates very well that not only does the magnetic field strength play an important role in the attraction of a magnet, but also its mass. Think of the crane magnets used in scrap yards. These are also around 2 Tesla, but their size means that they can attract much heavier lumps of iron such as cars, or Jaws in The Spy Who Loved Me. They also have the advantage that they are electromagnets and so can be switched off to drop MOT failures into a crusher or oversized henchmen into a shark infested tank whilst you run around with scantily clad women.

◆ **A villain in peril**

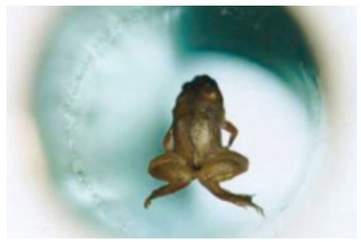
At somewhere around 5 Tesla we reach the field strength of the Magnetically Levitating (Maglev) trains. They travel along guideways using magnets to create both lift and propulsion, thereby reducing friction by a great extent and allowing very high speeds. They are very new, but already China, Japan and South Korea have them in commercial use. The Shanghai Maglev Train, also known as the Transrapid, is the fastest commercial train currently in operation and has a top speed of 430 km/h (270 mph). The line was designed to connect Shanghai Pudong International Airport and the outskirts of central Pudong, Shanghai, covering a distance of 30.5 kilometres (19.0 miles) in just 8 minutes.

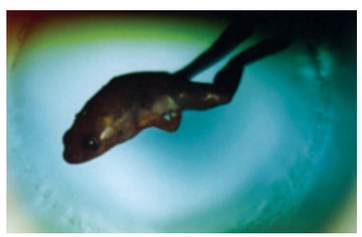
Maglevs in Beijing, Tokyo and Tel Aviv already under construction, but many other countries including the UK have demonstrated a great interest in the technology.

◆ **Shanghai Maglev**

And so we have reached the kind of field strengths that we need to exercise some caution around and that we consider to be really powerful. But are they? And how far can we go? And what can we do with it?

Well, now we start to get into the realms of research. We have reached the domain of men in white coats - real ale drinkers with beards and clipboards who find it amusing to levitate frogs (check Youtube) which incidentally can be done at 16 Tesla.





◆ **Kermit Maglev**

The strongest field strength achieved by a resistive magnet is a massive 37.5 Tesla. This world record was taken by the High Field Magnet Laboratory in Nijmegen in March 2014. At only around £1million to construct it is over 10 times less expensive than similar strength hybrid systems. Much research is undertaken here including optical experiments, semiconductor work and nanotechnology. It is in here that Kermit enjoyed his flight.

◆ **High Field Magnet Laboratory in Nijmegen**

The National High Magnetic Field Laboratory in Talahassee in Florida State University has not only 14 large resistive magnets, but several hybrid magnets of which one holds the world record for such a unit at 45 Tesla. Hybrid systems use both a static magnet (in this case 33.5 Tesla) inside an electromagnetic insert (11.5 Tesla) and can maintain the field so long at the power is on. The research carried out here includes work into bio fuels for the future as well as MR imaging to learn more about HIV, Alzheimer's and Parkinson's. If you are in the area you can arrange a visit. From the website you can even click to request some magnet time but bear in mind the bore size is only 32mm before you think of using it for helping reduce your waiting list!.

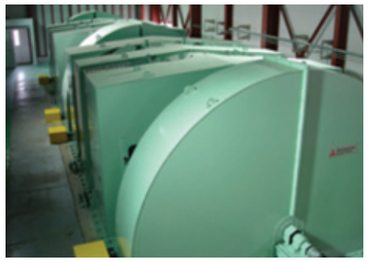
◆ **National High Magnetic Field Laboratory in Talahassee**

But we are still not at the top. In New Mexico is the Los Alamos National Laboratory magnet which can reach 100 Tesla, but only for a few seconds. Their aim is to learn more about how materials behave when subjected to high fields. Immense stresses are placed on the coils such that they are at risk of destroying themselves.

The energy that this would release would be so great that the building is evacuated whenever the magnet is switched activated.

◆ **Get out of there man!**

The strongest field ever produced in a laboratory is 730 Tesla by the Institute for Solid State Physics in Tokyo in its coolly named International MegaGauss Science Laboratory. It is not a machine that you should ever be fooled into bidding to own on ebay however as you would just get a box of nuts and bolts because the field causes the equipment to destroy itself when it is powered up

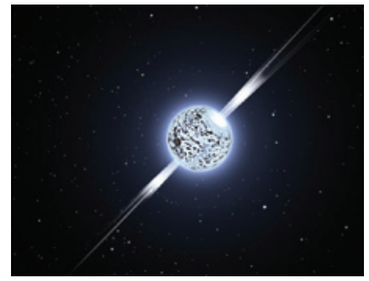


◆ **MegaGauss (Mega name!)**

By using the MC-1 Generator in a laboratory in Russian Federal Nuclear Center, All-Russia Scientific Research Institute of Experimental Physics, Sarov, Russia, scientists used explosives to produce the strongest ever man-made pulsed field at 2800 Tesla. Once again the aim was to produce conditions where the properties of substances under extreme conditions can be observed, though from the picture it seems as you may have to venture into a quarry to do this.

◆ **The MC-1- Generator….really?**

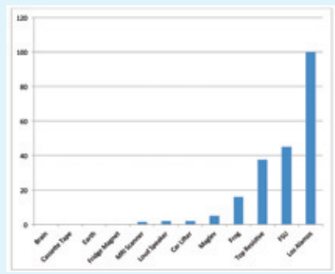
These are all massive fields by us earthlings standards, but nothing when you compare them to what is happening beyond our solar system. Consider a neutron star. These may only have a diameter of 10 miles or so, but are heavier that the sun. Putting this another way, if you collected a matchbox size of neutron star matter, you would need a big crane to lift it, as this small amount would weigh 5 trillion tons. All sounds rather incomprehensible, but we aren't done yet as just as amazingly, all this can be spinning at over 700 times per second. All this is combined with an incredible magnetic field of between 1 and 100 megaTesla (1000000 – 100000000 Tesla), so make sure you take your earrings out before visiting one. 'But it's hard enough getting an appointment for an MRI scan, let alone a neutron star!' I hear your cry…well not really. Whilst there are only around 6 MRI scanners per million population in the UK, there is more than one neutron star each for us in our galaxy alone.



◆ **A neutron star last week**

But we are still not done yet. There is one last celestial body which holds the crown for the biggest magnet of them all, and what another great name – the Magnetar. They are types of neutron stars and are similarly sized such that you could walk right round one in an afternoon, that is if it didn't rip you to shreds whilst blasting you with copious gamma and x-rays. Their magnetic field is up to 100 gigaTesla (1000000000000 Tesla). This is so strong that if someone plonked one in southern Spain, it would kill everyone in London purely by ripping out all of their electrons such that they had no discernible atoms any more. Nice

So that's it. A collection of magnets covering quite a range of strengths. Below is a bar graph showing the relative field strengths of some of the magnets discussed in this article. However, the Tokyo MegaGauss, the Sarov MC and the neutron and magnetar have been left off as their inclusion would have scaled the others down into insignificance. You can include them mentally for yourself though. The bar for the MegaGauss would be around 1 metre long, whilst the MC-1 would stretch to around 30 metres. But this is nothing when you consider that you would need to draw a bar 100 kilometres for the neutron stars and up to 1000 kilometers for the magnetar.



The Use of Plain Film and Magnetic Resonance Imaging in Paediatric Skeletal Surveys for Non-Accidental Injury: A Systematic Review.

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UNIVERSITY OF LEEDS

Highlights

- Examines the use of whole-body magnetic resonance imaging in non-accidental injury.
- Application should be given serious consideration for non-accidental injury.
- Work needs to be completed to improve understanding of sensitivity and specificity.

Introduction

Child abuse affects around 40 million children between 0 and 14 years of age and can take the form of physical, emotional, sexual abuse or neglect.[1,2] Current standards for imaging paediatric patients for non-accidental injury (NAI) include the use of plain film and Computed Tomography (CT) in the first instance.[2,3] As most children imaged for NAI are under 2 years of age due to the communication barriers, the radiation dose that is received during these tests can be considered excessive.[2,3,4,5,6]

Plain film skeletal surveys are used within the first 48 hours of initial presentation, and consist of anywhere between 16 and 22 individual images, with an additional chest film in 10-14 days to assess for callus formation around rib fractures.[4] Continuing clinical concerns may necessitate a repeat skeletal survey, further adding to the excessive radiation dose, and a full repeat skeletal survey is being worked into new Royal College of Radiologists (RCR) guidelines as recommended follow-up imaging.[7]

Magnetic resonance imaging (MRI) is currently only used for imaging the brain in non-accidental head injury (NAHI), but the application of whole-body MRI (WB MRI) in oncology patients suggests that this modality may also be able to be applied to the study of NAI.[4,8]

This study, therefore, aimed to analyse whether MRI, as a non-ionising radiation imaging method, has the potential to provide an alternative method of imaging paediatric patients for suspected NAI.

Methods

A systematic literature review was conducted with four databases selected for inclusion in searches. Medline, Embase, CINAHL and Science Direct were all consulted, and a hand search of grey literature was performed by the primary author.

Search terminology included words, phrases and truncations surrounding MRI, paediatrics and non-accidental injury, and results were filtered for papers published between 2005 and 2015.

Inclusion and exclusion criteria (Table 1) were used in order to select the relevant papers through a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart[9] (Figure 1).

Inclusion Criteria	English language
	2005 – 2015
	Children below 2 years (24 months)
	Skeletal survey
	Magnetic Resonance Imaging
	Non accidental injury
	Child abuse
Exclusion Criteria	Not English language
	Pre-2005 papers
	Children over 2 years (24 months)
	Post-mortem skeletal survey
	MRI autopsy
	No clear ethical consideration statement
	No focus on imaging

Table 1. Inclusion and exclusion criteria

Figure 1. PRISMA flowchart

Once papers had been selected through the PRISMA flowchart, critical appraisal using the Critical Appraisal Skills Programme (CASP) tool[10] was undertaken.

Statistical tests are available for meta-analysis but were not used in this study as the results selected for synthesis were not sufficiently comparable, meaning that statistical analysis would not be of use to this literature review.

Overall, nineteen papers were available for synthesis into the review, with most focussing on the use of WB MRI (Table 2).

Group	Description	Number
1	Focus on WB MRI in paediatric patients	6
2	MRI in non-accidental head injury	3
3	MRI discussed as a potential or alternative imaging method	4
4	Anaesthesia, sedation or immobilisation of paediatrics for MRI	3
5	General application of MRI in paediatrics	3

Table 2. Grouping of articles retrieved from literature search

Results

It was found that MRI is currently used in the assessment of brain injuries resulting from NAHI, and that WB MRI is being used successfully in screening for metastases in paediatric oncology patients of all ages.[11,12,13]

Meta-analysis from one study[8] suggested that WB MRI carries a high specificity (95%) for NAI, but that sensitivity for pathognomic fractures was low at 40%. This was confirmed with findings from another study[14] which indicated that the coronal views typical of WB MRI scans will not clearly demonstrate fractures of the ribs, sternum, scapulae and skull. It was also suggested that the minimal bone marrow changes caused by rib and metaphyseal fractures would prevent their appearance on WB MRI scans.[14]

However, MRI has the potential to locate suggestions of subtle fractures through the identification of soft tissue and muscular lesions which cannot be seen on plain film images.[15] A small-scale study[2] was identified which demonstrated rib fractures being detected on WB MRI and not on initial plain film radiographs. This indicates that there is potential for WB MRI to identify these types of fractures and suggests that further work needs to be applied to this area.

Predominantly, papers suggested that WB MRI did have the potential to be used as an alternative imaging modality, but that it was still very much a work in progress requiring more studies using larger sample sizes in order for standards to be brought to an acceptable level for general use[16,17] (Table 3).

Additionally, it was highlighted that children, and particularly infants, are unable to remain still for long scans, and that anaesthesia or sedation may be required in order for scans to be completed.[15,18,19] Some papers[20,21,22] did suggest the use of immobilisation techniques such as using a feed-and-wrap technique with a Med-Vac splint to negate the risk of complications from anaesthesia or sedation.

Another consideration when using MRI must be the inability of children to thermoregulate effectively and that the increase in body temperature caused by radiofrequency energy may lead to intracellular or DNA changes.[23]

Paper	Design Type	Sample Size
Altinok et al. (2009)	Case Report	1
Stranzinger et al. (2007)	Review and Case Study	1
Eltermann et al. (2007)	Case Report	4
Perez-Rossello et al. (2010)	Retrospective Cohort Study	21
Benavente-Fernández et al. (2010)	Prospective Cohort Study	33
Golan et al. (2011)	Prospective Cohort Study	40
Fanconi & Lips (2010)	Prospective Cohort Study	44
Reilly et al. (2012)	Retrospective Cohort Study	72
Bradford et al. (2013)	Retrospective Cohort Study	105

Table 3. Sample sizes of studies included in this review

Conclusions

The use of MRI is currently restricted to NAHI and the results from this study indicate that brief studies into the use of WB MRI have produced encouraging results. WB MRI has been demonstrated to be a very promising method of imaging for musculoskeletal, brain and soft tissue injuries, whilst preventing distress from immobilisation for plain film and reducing exposure to ionising radiation.

Despite this promising outlook, dedicated, detailed, large-sample cohort studies need to be considered in this area to enable further assessment of the specificity and sensitivity of this imaging method.

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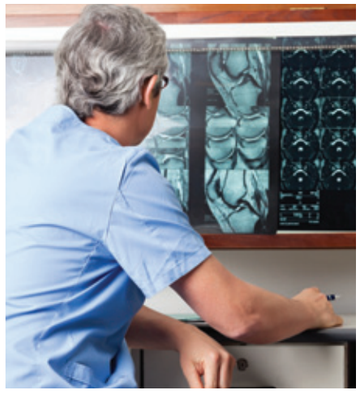

Radiographer

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

BAMRR session at UKRC

Arena and Convention Centre Liverpool
Wednesday 8th June 2016
2.20pm onwards

Ms Eli Jovanovik, Head of Imaging Fitzpatrick Referrals
(As seen on national television's 'The Super Vet')
'Paws for thought: MRI epilepsy in small animals'

Dr T Blakeborough, Consultant Radiologist
Royal Hallamshire Hospital
'Hepatobiliary MRI'

Mr David Grainger, Senior Device Specialist
Medicines & Healthcare Products Regulatory Agency
'MHRA MRI safety guidance update'

Please see UKRC website for more information
Hope to see you there.....

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Yorkshire RADIOLOGY

MRI AUDIT:

A repeat audit to determine if accuracy of labral tear detection using MRI Hip Arthrography has improved when compared with Surgical Arthroscopy.

UNIVERSITY OF BRADFORD
MAKING KNOWLEDGE WORK

Author: Hannah Whitaker

Background

2012-2013 Protocols. [1]
- Axial Oblique T1 SPIR
- Coronal T1 SPIR
- Sagittal T1 SPIR
- Coronal T2

2014-2015 Protocols.
- PD Axial Oblique
- PD Coronal
- PD Coronal FS
- PD Sagittal True FISP
- PD Sagittal FS
- +/- dynamic Axial True FISP motion study

Figure 1. MRI Hip Arthrography old and new protocols

- A departmental study performed in 2013 revealed lower than expected values (based on target ranges from current literature) for sensitivity, 59.3% (60-100%) and specificity, 25% (44-100%) [6]
- Introduction of a new MSK Consultant Radiologist and a Siemens Aera 1.5T scanner (with improved coil capability) in August 2014 led to adaptation and revision of the MRI protocols. (see figure 1)
- Significant increase in MR Arthrogram referrals (see figure 2).
- The MRI arthrogram procedure is both time and resource consuming (requiring fluoroscopy and MRI rooms/staff). [3]
- Re-audit was deemed necessary to assess whether MRI hip arthrography is a useful and benefial tool to detect labral tear.

Figure 2. A graphic representation of the number of MRI hip arthrography referrals

Labral Tear

- Symptoms include anterior hip pain, buttock pain, clicking, locking or giving way of the affected hip. [8]
- Without treatment, labral tear is associated with development of osteoarthritis. [2]
- Treatment includes conservative management (rest and anti-inflammatory medication), physiotherapy or surgery (arthroscopic debridement and surgical repair) [2, 4]

Figure 3. Axial Oblique PD sequence demonstrating a complete labral detachment.

MRI Arthrogram Procedure

- Dilute gadopentetate dimeglumine (Magnevist) is injected into the affected hip using fluoroscopy. [3]
- The patient is transferred to MRI on a trolley to minimise contrast displacement. [6]
- Images are acquired using a 1.5T Siemens Aera using a body (surface) coil wrapped around the affected hip for maximum spatial resolution. [1]
- Images are dictated by a single MSK Consultant Radiologist. At a later stage, MSK Radiologists convene to discuss their interpretations before the final issue of the report. [6]

Figure 4. Coronal PD with no labral tear

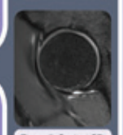

Figure 5. Sagittal PD Fat Sat demonstrating a complete labral detachment

Figure 6. Axial Oblique PD demonstrating a sublabral recess.

Method

- Approval was gained from the clinical effectiveness department.
- MRI hip arthrography data was collected using AGFA impax 6 PACS between 1st October 2014 and 1st May 2015.
- Surgical data was extracted using a list of surgical arthroscopy cases from the BMI Duchy Hospital and the Bluespier Theatre Management system at Harrogate District Hospital.
- The following data was recorded:
  - Patient hospital number,
  - Date of MRI examination
  - Affected side
  - Radiological detection of labral tear (yes/no/indeterminate)
  - Relevant comments
  - Surgical Arthroscopy date
  - Surgical detection of labral tear (yes/no)

Results

Cohort of 28 patients

- 18 true positive
- 1 true negative
- 1 false negative
- 3 false positive
- 5 indeterminate*

*The 5 indeterminate reports were excluded from the study as the labrum could not be properly assessed on MRI.

- 2 patients had grossly abnormal labrums
- 1 patient had undergone previous surgery
- 2 patients were unable to tolerate the joint injection resulting in minimal contrast injected. (Furthermore, 1 of these patients was unable to tolerate the MRI scan and resultant imaging suffered from motion artefact)

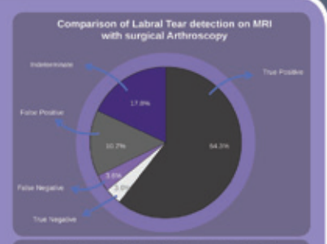

Figure 7. distribution of results when comparing labral tear detection on MRI with surgical Arthroscopy

Sensitivity = 94.7% (59.3%)

Specificity = 25.0% (25.0%)

Accuracy = 82.6% (50.0%)

Error rate = 17.4% (41.0%)

Figure 8. Calculated values for the 2014-2015 audit compared to previous values (2012-2013).

Discussion

- Results show a significant improvement in the correlation between MRI hip arthrography and surgical arthroscopy findings in comparison with the previous 2013 study.
- In order to assess where the accuracy of MRI reporting may be improved, discrepancies between MRI and surgical report were reviewed.

False Positives
- 3 cases described tears where no tears were demonstrated at surgery.

Sub-standard imaging due to motion artefact reduced spatial resolution. Contrast resolution remained satisfactory.

Diminutive labrum made assessment difficult. It may have been more appropriate to issue an indeterminate report.

A sublabral recess was contiguous with classic appearances of a large labral tear. Further discussion with the surgical team will be planned.

False Negative
- 1 case described a degenerate labrum, suggesting abnormality, but excluded a tear.
- Surgery revealed a torn labrum.

Descriptions of findings are subjective so careful wording is imperative to avoid insinuation of incorrect findings.
Future re-audits could use criteria such as 'abnormal/ normal labrum noted' rather than categorising 'labral tear/no labral tear'.

- Limitations of the study could offer an explanation for the particularly low specificity value.

Limitations

- Arthroscopy is assumed as the 'gold standard' in the diagnosis of labral tears. Although it is highly accurate, it requires skill and experience and there is likely to be variation in technique between surgeons. [5]
- Some patients will not undergo surgical arthroscopy. [8] The accuracy of MRI arthrography labral tear detection cannot be assessed within this cohort.
- Low numbers of false positive and true negative values are expected.
- In this case, specificity was calculated from a total of 4 results, 3 false positives and 1 false negative, there is subsequently doubt over whether there is enough data to accurately measure this.
- Long waiting times for surgical arthroscopy has resulted in a small sample of data.

Conclusion

- A significant improvement in the accuracy of MRI hip arthrogram reporting has been demonstrated.
- Unfortunately there has been no improvement in the specificity value but limitations of the study are felt to be the cause for this.
- Review of cases of discrepancy has highlighted the need to acquire good quality images with no artefact.
- CPD sessions will be planned where Radiographers will be educated in what the Radiologists assess for when reporting. This is hoped to further improve the quality of imaging.
- It has been conveyed on many occasions by our MSK Radiologists that the most recent imaging produced on the Siemens Aera, using the 18 channel body coil is far superior to the imaging produced using the previous Philips Achieva with the dual element Flex M coil.

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HOT TOPICS

Gadolinium retention in the brain
Practical implications

Denise Newsom *BAMRR Safety Officer*

The use of Gadolinium based contrast agents (GBCAs) is well established in clinical MRI and essential for the diagnosis of many conditions. It has been used in more than 100million people (2) and has a very good safety record in spite of the issue of Nephrogenic Systemic Fibrosis (NSF). As a result of discovering NSF in renally impaired patients, new standards of care have been introduced (3). For example, patients are screened for their renal function, doses have been modified and the gadolinium products have been catorgorised into high, medium and low risk as below:

European Medicines Agency: Categorisation of GBCAs according to NSF risk, based on their thermodynamic and kinetic properties	
High risk	
A. Linear nonionic chelates	Gadoversetamide (OptiMark), gadodiamide (Omniscan)
B. Linear ionic chelates	Gadopentetic acid (Magnevist, Magnegita, and Gado-MRT-ratiopharm*)
Medium risk	Gadofosveset (Vasovist), gadoxetic acid (Primovist) and gadobenic acid (MultiHance)
Linear ionic chelates	
Low risk	Gadoteric acid (Dotarem), gadoteridol (ProHance) and gadobutrol (Gadovist)
Macrocyclic chelates	

*Gadopentetic acid generics - http://www.auntminnieeurope.com/index.aspx?sec=ser&sub=def&pag=dis&ItemID=611896

Overview

Recently there has been an increase in publications highlighting that deposits of gadolinium maybe remaining in the brain. After being administered, Gadolinium contrast agents are mostly eliminated from the body through the kidneys. However, it is being queried whether trace amounts of gadolinium may stay in the body long-term. Recent studies conducted in people and animals have confirmed that gadolinium can remain in the brain: even in individuals with normal kidney function (2,6-12).

Available information does not identify any adverse health effects.

Image Appearances

On the brain MRI images, high signal intensity has been seen in the dentate nuclei and globus pallidus on patients who have had previous repeated MR contrast exams. On the unenhanced MRI scans, these structures should be darker grey on the T1 weighted images, however T1 shortening effects can be seen and the structures and have increased signal.

Radbruch in his paper (10) compares a high risk contrast agent and a low risk agent and the observations appear to follow the risk categories of NSF. The linear agent displayed the high signal in the dentate nucleus but the macrocylic agent didn't, supporting the hypothesis that the T1 shortening may be a result of the dissociation of the gadolinium ion from the chelating ligand molecule.

Gadolinium may also deposit in other body structures such as bone and skin.

Reccommendations

- Administer gadolinium contrast only if clinically necessary and the benefit outweighs the risk
- Establish renal function of the patient
- Use low risk MRI contrast agents (Macrocylic chelates) – see table above
- Keep dose to a minimum

There is no evidence it is harmful to patients or there is a clinical risk. The FDA and European Medicines Agency are investigating and until further information is available, there is no change to clinical practice:

Further Reading

1. FDA Drug Safety Communication: FDA evaluating the risk of brain deposits with repeated use of gadolinium-based contrast agents for magnetic resonance imaging, Jan 2016 (MRI)http://www.fda.gov/Drugs/DrugSafety/ucm455386.htm
2. Residual or Retained Gadolinium: Practical Implications for Radiologists and Our Patients: http://pubs.rsna.org/doi/full/10.1148/radiol.2015150805
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