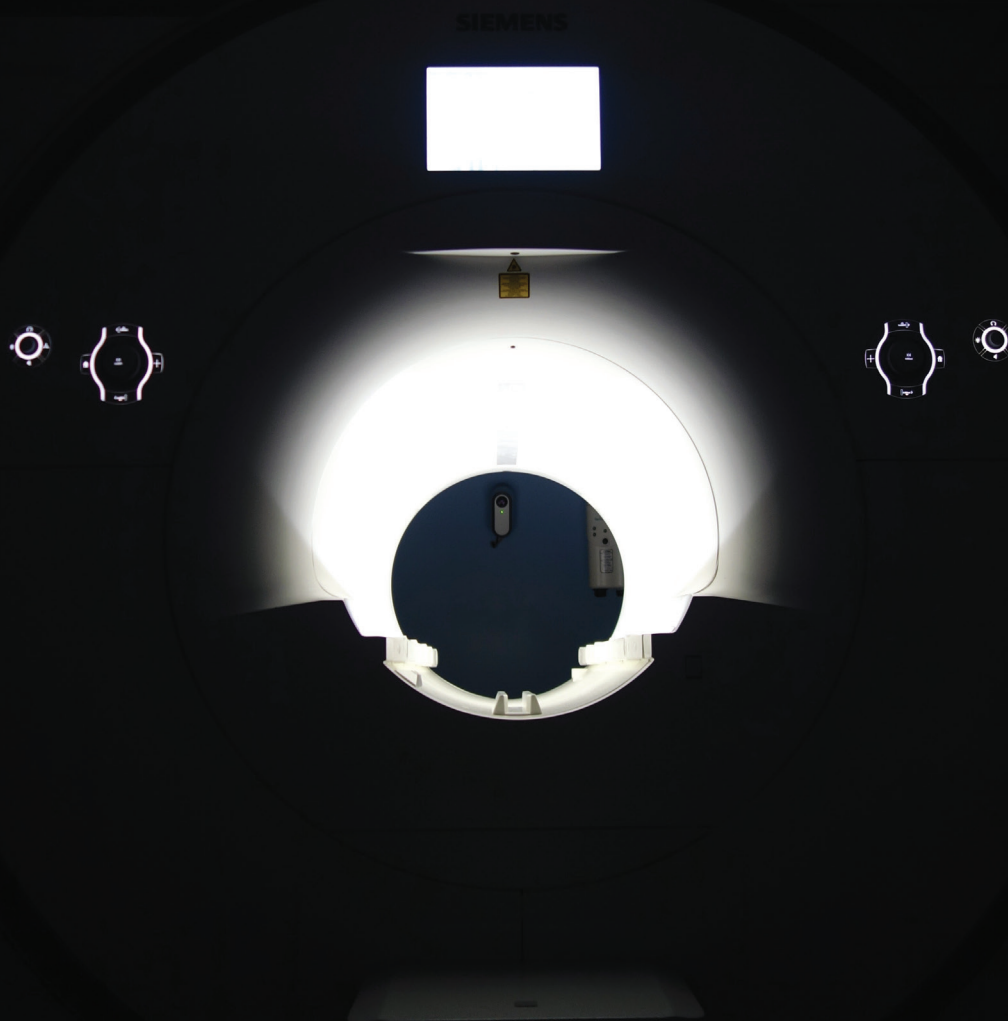


news

THE NEWSLETTER OF
THE BRITISH ASSOCIATION OF MR RADIOGRAPHERS



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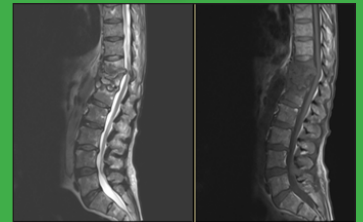
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WITH OUR SOLUTIONS YOU GET **OUR COMMITMENT**

COMMUNITY

Together we can do more. **We pledge to assist our partners** wherever we can, however we can, to achieve our mutual goal.

EXCELLENCE

We promise to continue **to strive for excellence**. We will not be satisfied with anything less than the highest quality, in order to deliver meaningful benefits to you and your patients.

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We re-affirm our ongoing commitment to conducting and supporting research that improves patients' lives and meets physicians' needs. **Ambitious and bold innovation** is in our DNA and we promise to keep it that way.

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welcome

from your **BAMRR PRESIDENT**



Welcome to the Spring edition of the newsletter.

I hope you all had an enjoyable time over the festive period.

It is with great honour that I take over from Rachel Watts as President of BAMRR for this, very exciting year.

2020 sees us introducing a new website which we hope will be much better for our members to use. It should be launched very soon, and we will keep you all updated by email.

Our big 30th anniversary conference is in Manchester in October; don't miss this one, it should be full of lovely surprises!!

We have a stand at the European medical imaging convention, at the National exhibition centre in Birmingham on the 17th and 18th March so come and find us to say hello.

We are bringing our further course, by great demand, to London in May, and our very popular introductory course will again take place in Loughborough in November. Be sure to book your place to avoid disappointment. All details can be found on our website.

I would like to thank the Board in supporting me in this role, they are a very dedicated group of volunteers who are working y hard to provide education and information to the wider MRI community, and all in their own time.

I would also like to thank our sponsors, without whom none of this would be possible

Lastly, I would like to thank you, all our members, for making this association an enjoyable one to work with. Don't forget, if you would like to contribute to the newsletter; send your article to Matthew. If you are chosen you will be rewarded with £100!.

Rachel Watt
BAMRR President

from your **EDITOR**

Times are a-changing.

So, this month seems to have turned out to be a bit of a 'Claustrophobia Special'.

I have received several interesting contributions from members discussing various aspects of this problem. I therefore decided it would be good to put them together in one edition. We all face the difficulties that claustrophobia poses to patients on a daily basis, so any advice or tips that may help smooth the way and to ultimately achieve success must surely be worth reading.

I also managed to find a willing physicist to discuss the reason as to why MRI scanners need to be claustrophobic in the first place. Sounds obvious I know, but like all things, when you start looking into it, there is more to it than meets the eye.

There are also a couple of interesting posters with a safety angle – so it's not all about small, dark spaces!

Thank you to all those that have contributed.

Matthew Benbow
BAMRR Editor



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For tweeting visit
twitter.com/#!/BAMRR

WELCOME from our sponsor **GUERBET**

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

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

We continue our commitment 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

INTRODUCTION TO MRI COURSE 13/14TH NOVEMBER 2020



BAMRR

BAMRR is the British Association of MRI Radiographers and our aims are to support and facilitate education and promote development of MRI skills and knowledge.

www.bamrr.org

We are pleased to offer a 2 day course aimed at radiographers new to MRI scanning.

We are offering an interactive, hands on study day with workshops and contact time on an MRI scanner.

Friday 13th November

Day One
9:30 Registration & Refreshments
10:00 Welcome
10:10 MRI Contrast Agents
11:00 Physics - How MRI Works
12:00 Lunch
13:00 Physics - Pulse Sequences
14:00 MRI Safety
15:00 Coffee
15:30 MRI Artefacts
16:30 Close

(course content and times may be subject to change)

Hands on the GE MRI scanner at NCSEM



Saturday 14th November

Day Two
9:00 Registration & Refreshments
9:30 MSK Imaging
10:30 Coffee
11:00 Neuro Imaging
12:00 Fat Free Imaging
12:30 Lunch
13:30 Workshops (45m)
Group A Hands on Scan
Group B MRI Knee
Group C MRI L-Spine
15:45 Course Review
16:15 Close

Registration (max 28 delegates)
Course registration and payment details can be found on the BAMRR website: www.bamrr.org

Course Fee (inclusive of lunch and refreshments)
• £135 BAMRR member
• £155 course fee with individual BAMRR members joining fee.
• £185 non BAMRR member

Enquiries
If you require further information regarding the Study Day, please contact helen_estill@uni-tr.nhs.uk or zoe.lingham@spirehealthcare.com

Accreditation

The College of Radiographers have granted CPD NOW accreditation



British Association of Magnetic Resonance Radiographers
Company Limited by guarantee No: 9294855
(England and Wales) Registered Office
Address: Riverside, 88 Graham Road,
Sheffield S10 3SP



British Association of MR Radiographers

Introduction to MRI course

Friday 13th Nov and Saturday 14th Nov 2020

National Centre for Sport & Exercise Medicine (NCSEM)
Loughborough University
LE11 3TU

Sponsored by



National Centre for Sports & Exercise Medicine (NCSEM)
Loughborough University
LE11 3TU

BAMRR Policy Board Members, Spring 2020

The co-ordination of the Associations activities is overseen and undertaken by an elected Policy Board. The board currently consists of the following who are members of BAMRR and working in different regions of the UK.

The Policy Board is composed of:



**PAST PRESIDENT/
MRAG / UKIO**
Rachel Watt
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**PRESIDENT ELECT/
SECRETARY**
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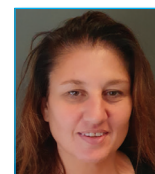
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COURSE
CO-ORDINATOR**
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BAMRR Conference

Bournemouth,

October 2019

◆ Image by Roman Grac from Pixabay



The BAMRR 36th Annual Conference in October 2019 was held at the Queen's Hotel, in the glorious, sunny seaside location of Bournemouth. With over 80 delegates attending, we enjoyed a full day of varied and outstanding speakers. This was as always with thanks to the support from our sponsors.

Rachel Watt (BAMRR President) welcomed delegates, speakers and sponsors and introduced the morning's speakers.

Rachel Watt (BAMRR President) welcomed delegates, speakers and sponsors and introduced the morning's speakers.

Catherine Parry (Superintendent Radiographer; The Christie Proton Beam Therapy Centre) shared **The Christie Hospital's Experience** of the first Christie MR scanner managed by Radiotherapy for Proton Beam planning. She told of the challenges faced from patient positioning to sequence development and the successful collaboration with diagnostic colleagues.

Dr JP Carpenter (Consultant Cardiologist at Poole Hospital) gave an engaging and interactive talk titled **'Implanted Cardiac Devices and MRI – What Can We Scan?'** A topical subject with some really useful, practical advice for delegates to take home.

Alex Lipton (Professional Officer; Society of Radiographers) updated the audience on the information and support available to members and also ongoing initiatives being undertaken by the Society of Radiographers including the development of the MRSE, department design and MRI scanning in Cauda Equina Syndrome.



◆ **Claire Moore, Spinal Conundrum.**

Following a short coffee break, the day continued with **Claire Moore** (MRI Lead and Reporting Radiographer; West Suffolk Hospital) who brought a personal experience, scanning and reporting for **'The Value of The Acute Spinal MRI.'** What's the emergency, and implications and impacts of the GIRFT report on-call, creating lots of questions on the practicalities and implications for radiographers on the front line.

This was followed by an entertaining talk from **Matthew Benbow** (CT/MRI Superintendent Radiographer; Royal Bournemouth Hospital and BAMRR policy Board member) and the a **'Thin-k out of the box'** concept using an Extremity MRI Scanner to cope with the ever-increasing demand for MRI and MRI safety decisions.

The morning session concluded with the BAMRR AGM, before taking time for lunch and allow delegates to mingle with the conference sponsors from a wide range of companies and to view the competition posters.

The afternoon session was introduced by the new BAMRR President, Aileen Wilson and began with **Dr Dan Wilson** (MR Safety Expert, Leeds Teaching Hospital). Dan spoke about the work towards formal certification of the **MRSE** and how it related to the American ABRMS exam.

This was followed by an engaging talk from **Apollo Exconde** (Senior MRI Radiographer; Croydon University Hospital). He spoke of his quest to produce a **Lego Open scanner** to help patients with claustrophobia conquer their anxiety to have their scan. 'Communication is Key!'

Rob Wilson (Siemens Healthcare MRI Applications Specialist) followed with some excellent practical tips to recognise **MRI artefacts** and just as importantly, how to reduce or eradicate them.

He final talk from **Dr Russell Bull** (Consultant Radiologist, Royal Bournemouth Hospital) who discussed **T1 and T2 mapping** and it's use in cardiac MRI, but also future possible use for extra-cardiac applications.





◆ Apollo Exconde, Lego Open MRI



◆ Charlotte Holt and 1st placed poster with Aileen Wilson, BAMRR President.

The 36th Conference was brought to a successful close with the poster prize presentation to **Charlotte Holt** from Guy's and St Thomas' Trust, for her excellent poster **'MRI Artefacts and Safety Considerations Arising From Magnetic Eyeliner'**, which gained her the £150 prize money.

Work is already happening behind the scenes for our 2020 program, including:

Further Course 14th May in London,

BAMRR session at UKIO (1st-3rd June in Liverpool)

Introductory Course

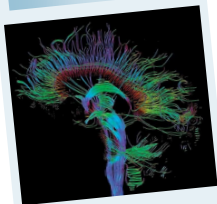
13th-14th November, Loughborough.

Finally, this year we will be celebrating BAMRR's 30th birthday at our annual Conference in the iconic location of Manchester. We hope to see you there!

Trudi Whitehead
BAMRR Social Media Secretary



FURTHER MRI COURSE SATURDAY 16TH MAY 2020



BAMRR

BAMRR is the British Association of MRI Radiographers and our aims are to support and facilitate education and promote development of MRI skills and knowledge.

www.bamrr.org

We are pleased to offer this extended one day course aimed at radiographers keen to further their MRI skills and knowledge base.

Saturday 16th May

The course will commence at 8:30 for registration, and close at 18:00

Content is likely to include:

Hot Topic: Scanning implants without the manufacturer's approval of MR safety Dr Geoff Charles Edwards, Guy's and St Thomas, NHS FT Trust

1.5 VS 3T Safety Implications Dr Martin Graves, Consultant Clinical Scientist, Cambridge University Hospitals NHS FT

Compressed Sense Reconstruction Dr Martin Graves, Consultant Clinical Scientist, Cambridge University Hospitals NHS FT

Cardiac MR – Planning the basic views step by step Mr Jonathan Coupland, BAMRR Policy Board

Understanding Cardiac MR sequences Mr David Higgins, MR Clinical Scientist, Philips

mP-MRI Prostate Imaging Dr Kevin Mulcahy, Consultant Radiologist, UHL NHS trust

(course content may be subject to change)

Whole Body DWI
Mr Will Maguire, MRI Deputy Super
Mount Vernon NHS Trust

Principles of Diffusion in MRI
Dr Geoff Charles Edwards, Guy's and St Thomas NHS FT Trust

Radial Sequences (PROPELLER/BU)
Dr Geoff Charles Edwards, Guy's and St Thomas NHS FT Trust

Plus additional topics yet to be confirmed
(course content may be subject to change)

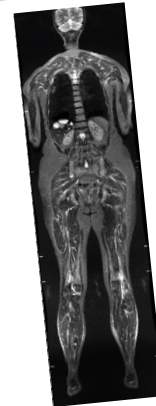
Registration
Registration details can be found online at www.bamrr.org

Course Fee (inclusive of lunch and refreshments)

- £145 BAMRR member
- £175 course fee plus individual BAMRR membership fee
- £195 non BAMRR member

Enquiries
If you require further information regarding the study day please contact:

Zoe Lingham
BAMRR Course Coordinator
zoe.ingham@spirehealthcare.com



British Association of Magnetic Resonance Radiographers.
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BAMRR
British Association of MR Radiographers

Further MRI Course

Saturday 16th May 2020

Millennium Gloucester Hotel
4-8 Harrington Gardens
London
SW74LH

**Millennium Gloucester Hotel
4 - 8 Harrington Gardens
London SW7 4LH**

Introduction

Diagnosis of spondylodiscitis can be difficult: history and clinical symptoms are often vague and non-specific, inflammatory markers may be normal and microbiology cultures negative. Tissue biopsies may be problematic to obtain. MRI remains the mainstay of diagnosis, however differentiation of acute infection and chronic Modic Type 1 changes can be challenging.

In this study we evaluated 104 consecutive MRI scans with potential discitis and compared these with the clinical outcomes. As a result of the study, clear MRI indicators for spondylodiscitis were identified and a subsequent management pathway for patients with equivocal imaging for spondylodiscitis was developed.

	Disease Present	Disease Absent	Total
MRI Positive	19	16	35
MRI Negative	6	63	69
Total	25	79	104

Sensitivity	0.76
Specificity	0.797
Total Sample Size	104

Table 2. Sensitivity and Specificity. Equivocal cases considered Negative.

	Disease Present	Disease Absent	Total
MRI Positive	24	19	43
MRI Negative	1	60	61
Total	25	79	104

Sensitivity	0.960
Specificity	0.759
Total Sample Size	104

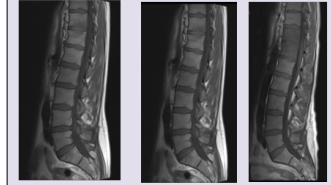
Table 3. Sensitivity and Specificity. Equivocal cases considered Positive.

Level

Modic Type and degree of change
Endplate erosion
Paraspinal collection
Fluid in disc
Enhancement
Progression over time

Table 1. MRI parameters evaluated.

Example 1: 47 male, septic arthritis of the knee, back pain



3 weeks FU with gad

Method

The hospital Radiology Information System (RIS) was queried for Radiology MRI reports over 1 year. The study period was January 2017 to December 2017. Individual reports containing the following terms in the Clinical Details, Report or Report Conclusion were included in the study:

Spondylitis
Discitis
Diskitis
Spondylodiscitis
Spondylodiskitis

The reports and images were evaluated for the presence of imaging parameters which are often associated with Spondylodiscitis. These parameters are displayed in Table 1.

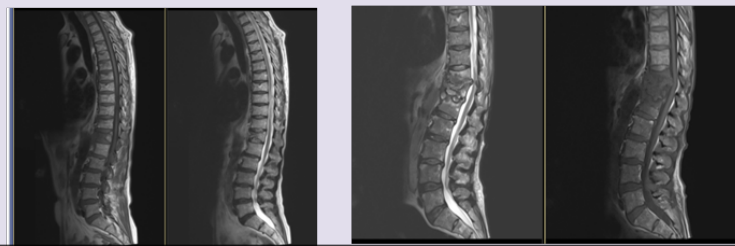
Each case identified was reviewed by 2 of the authors (MMi and MA) and the findings collated on a spreadsheet.

Cases were radiologically classified as either normal (no evidence of Discitis), Equivocal (Suspicion of discitis) or Positive (Discitis) according to the verified report. All cases were compared with the clinical notes by a Consultant Spine Surgeon (MM) who evaluated the clinical outcomes for each case. The clinical outcome was considered the gold standard.

In total 104 records met the criteria for inclusion in the study.

Example 2: MRSA bacteraemia, back pain

4 months later



Results

Most patients were stable on follow up or showed regression/healing
One patient passed away due to septicaemia
One patient developed permanent incontinence and lower limb weakness

All studies which had conclusive MRI for discitis confirmed on clinical follow up had signs of para-spinal collection with disc enhancement.

Studies with equivocal MRI findings showed Modic 1 end plate changes with any of the following additional features:

- Fluid in disc
- Endplate /disc enhancement or both.

Sensitivity and Specificity were calculated under 2 conditions using the clinical outcome as gold standard. The two conditions were MRI equivocal cases classified as "positive" and MRI Equivocal cases classified as "Negative". The results of these analyses are shown in Table 2 and Table 3.

Classifying equivocal MRI results as "positive" resulted in an increased Sensitivity with negligible loss of Specificity.

From these findings and evaluation of the literature guidelines for the evaluation of spinal MRI scans equivocal for MRI were produced. (Figure 1)

Conclusion

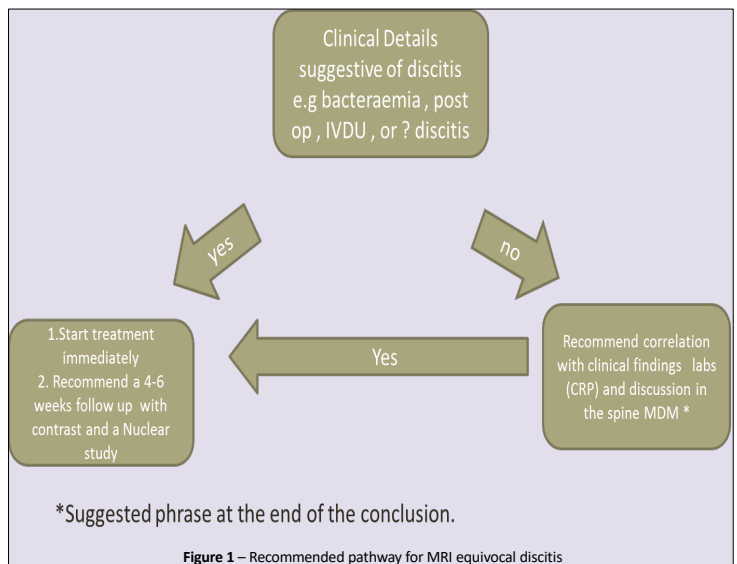
The results of this study align with the published literature on MRI diagnosis of spondylodiscitis. In cases of equivocal MRI, it is suggested that the appearances can be classified as positive for discitis with increased sensitivity and little effect on specificity.

A developed pathway for MRI equivocal cases of discitis suggests that, in patients with clinical suggestion of discitis and equivocal MRI findings the MRI should be considered a positive finding and treatment started immediately. Follow up imaging in 4-6 weeks including contrast enhanced MRI and/or Nuclear Medicine bone scan should be used to demonstrate progression or response to treatment.

Continued evaluation of the pathway and patient outcomes are suggested to determine the clinical effectiveness of the developed pathway.

References

- Dunbar J.A.T., Sandoe J.A.T., Rao A.S., Crimmins D.W., Baig W., Rankine J.J. (2010) The MRI appearances of early vertebral osteomyelitis and discitis. *Clinical Radiology*, 65 pp 974-981
- Pegrum J., Altaf F. (2014). *Spondylodiscitis: The Usefulness of Inflammatory Markers and Biopsy*. *The Spine Journal*, 14, Issue 11, Supplement, page S145





All aboard with the BIR

A light hearted review by Rachel Watt

I was so excited to receive my invite in the post to attend the 'British Institute of Radiology' (BIR) Networking Event on 26th September 2019 in my role as President of the 'British Association of MR Radiographers' (BAMRR)

This celebration kindly organised by the BIR occurs every two years and is an opportunity for an informal gathering of sister societies, Trustees, SIG and branch chairs and corporate members.

I must admit to being more than a little nervous when I thought I saw our boat....



However, I was reassured when we boarded 'HMS Pinafore' City Cruise's vessel from Westminster pier.



It was fantastic being able to see the iconic sights of London from the comfort and warmth of the boat whilst having the opportunity to network with colleagues and friends



Unfortunately the Champagne bottles were for 'display purposes only' (much to my disappointment...)



Following a presentation by Dr Diana Paez Gutierrez - Head of the Nuclear Medicine and Diagnostic Imaging Section, Division of Human Health, Department of Nuclear Sciences and Applications at the International Atomic Energy Agency (IAEA), the highlight of the evening was the launch of the BIR PET-CT webinars and a presentation of awards by BIR President Dr Jane Phillips-Hughes, pictured below.



Andy Rogers was presented with the BIR Distinguished Service Medal. Andy, who is the Lead Interventional Medical Physics Expert at Nottingham University Hospitals Trust has been an enthusiastic supporter of the BIR since he joined back in 2004, having had many roles including serving as President from 2016-18. Andy has ensured the BIR has had a voice, both nationally and internationally, representing the Institute on many working groups and committees dealing with radiation protection and safety, as well as helping to launch the World Partner Network.



I felt somewhat 'vertically challenged' when thanking Simon Thompson (Chief Executive of the BIR) and Richard Evans (OBE) (Chief Executive Officer of The Society and College of Radiographers) for their continued support in improving MRI education and safety through their ongoing collaboration with BAMRR.



It was an excellent evening and I wish to extend my thanks to all involved.

Rachel Watt
 Past BAMRR President
 Lead MRI Superintendent NHS Grampian



MRI Scanning and claustrophobia

Evanthia Kousi & Owen White, Royal Marsden NHS Foundation Trust

MRI can be extremely challenging for patients with claustrophobia, particularly when scans are performed in closed MRI systems. Patients may experience mild to severe distress in the MR environment, due to being restricted in an enclosed space for prolonged period of time. Although they may trigger patient discomfort, closed bore designs are more popular in diagnostic systems compared to the patient friendlier open systems.

But why does the bore have to be so narrow?

The standard bore width of an MRI scanner used to be 60cm; more recently 70cm bore scanners have become widely available. The bore houses the fundamental components of an MRI scanner; which are: the magnet, the gradient coils and the transmit RF body coil (figure 1).



◆ **Figure 1:** Simplified diagram of the concentric arrangement of the coils in the MR scanner. (Courtesy of The Royal Marsden Hospital, London, UK).

The main magnet is the largest component of an MRI system and produces the strong and uniform magnetic field (B_0). The majority of closed bore designs used in MRI diagnostic systems are superconducting magnets.

Superconductivity is a macroscopic quantum mechanical phenomenon, where certain materials have zero electrical resistance below a critical temperature near absolute zero (-273 Celsius). At zero resistance, an electric current introduced in a superconducting loop will circulate indefinitely without the need of an external power supply. Although other types of MR magnets exist (permanent magnets, resistive magnets, electromagnets), superconducting magnets have the advantage of reaching higher and stable B_0 fields ($>1.5T$) and the cylindrical configuration provides

excellent B_0 uniformity. Open MRI systems based on either permanent or electromagnets operate in $<1T$ magnetic fields.

A superconducting magnet consists of loops of wires (niobium-titanium conductors inside a copper matrix) that are immersed in a large chamber of liquid helium. The helium is exceptionally cold and keeps the temperature of the wires below the critical temperature. This chamber, or cryostat, is surrounded by a vacuum shield to minimise helium boil-off rates. The applied current in the solenoid generates the static magnetic field. Another set of current-carrying superconducting wires of opposite polarity are arranged outside of the primary windings to reduce fringe field strength.

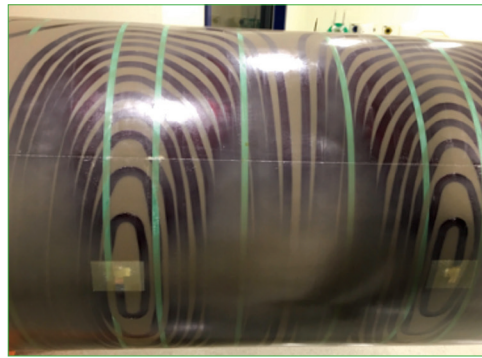
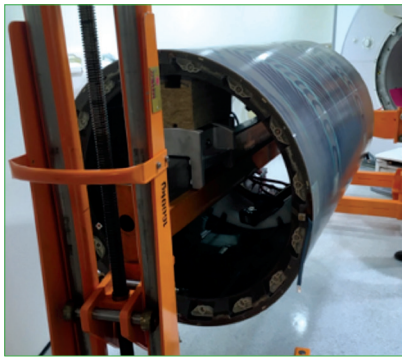
For a given magnetic field strength, increasing the

diameter of the bore would mean that higher currents would be required in the superconducting wires since the distance between the isocentre and the wires is larger - Ampere's law for further reading.

So, most of the bore's inner volume has been occupied by the large magnet and the cryostat... but there are more to add!

Three more sets of coils exist just inside the bore of the magnet. These are wire loops on a cylindrical cell (figure 2) through which currents can be circulated in a controlled manner to introduce linear magnetic field gradients in the three orthogonal directions (G_x , G_y , and G_z). These gradients vary the Larmor frequency of the hydrogen nuclei as a function of their position and therefore the acquired MR signal is spatially encoded.





◆ **Figure 2:** Gradient coil on a cylindrical former. The stripes represent bundles of wires. (Courtesy of Ms Rosie Goodburn).

The overall dimensions of the magnet's bore are constrained by both the magnet (as discussed earlier) and gradient coils. Although different gradient coil configurations are being investigated for shorter-bore MRI scanners to improve gradient coil performance (minimize the coil's inductance) and overcome claustrophobia, the minimum coil size is limited for achieving a field that varies linearly with position over a volume of interest.

On top of being inserted into a confined tube, patients have to endure the weight of radiofrequency (RF) coils. This might not be so bad in some cases, if it's just a wrist or knee exam, but can become overwhelming when patients have to be 'mummified' for a whole-body scan or tolerate unusual coil arrangements and a thermoplastic mask to immobilise the head and the neck for radiotherapy planning MRI scans (Figure 4).

Why are there so many RF coils? And why do they have to be wrapped round the patient?

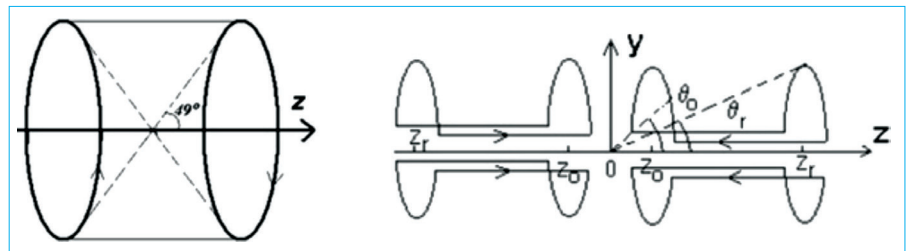
The RF coils are sophisticated antennas used to excite the magnetisation by transmitting magnetic field pulses (B_1) at specific frequencies, tipping the magnetisation away from alignment with the main magnetic field (B_0). The precession of the magnetisation around the main field changes the magnetic flux 'seen' by the RF coil, which produces a small but measurable electrical voltage on the order of millivolts - Faraday's law of induction for physics nerds. This small voltage is the NMR signal, which can be manipulated to contain all the spatial encoding required to create an MR image. This signal needs to be amplified, filtered, digitised, and sent to a computer for processing.

Typically, the RF coils used to transmit the B_1 field are embedded inside the magnet housing, one layer in from the gradient coils – another reason why the bore has to be quite small! These so-called volume coils have extremely good uniformity over a large area in the magnet bore, which is of critical importance to delivering the exact amount of RF power to the volume of interest. Head coils are also often used as volume transmit coils, but the smaller the desired volume gets, the harder it is to maintain a uniform B_1 field.

Going back to our poor patients in figure 4, most of the RF coils you can see here are being used to receive the signal. But why?

One of the most important properties of RF receive coils is enabling the acquisition of a 'good' image with a high signal-to-noise ratio (SNR); for that purpose the coil must be as close as possible to the volume of interest. In addition, every RF receive coil picks up random noise, mostly coming from the patient. Volume coils can be used to receive the signal too, but because they receive signals over a large field of view, they also pick up a lot of noise. Surface coils typically have a much poorer B_1 homogeneity, but they do have excellent sensitivity over a small field of view. This makes their noise volume much smaller; as shown in figure 5. Joining up lots of small coils in an array allows you to cover a large area, while reducing the overall noise received. An array of RF coils also allows you to do lots of interesting post-processing, including parallel imaging, due to their ability to spatially localise the signals.

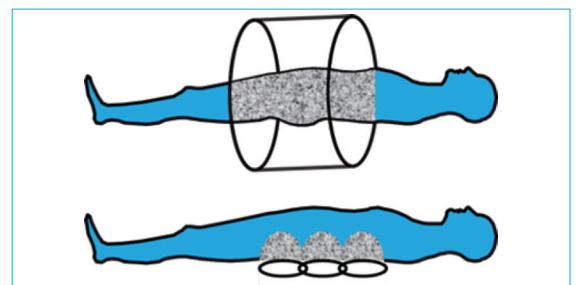
So, in essence, the more coils you can wrap around a patient, the more you can use parallel imaging techniques to speed up the acquisition and the better the SNR gets. So mummification, at the present, may continue to be necessary.



◆ **Figure 3:** Maxwell coil configuration (left), Goyal coil configuration (right). Images taken from: <https://onlinelibrary.wiley.com/doi/epdf/10.1002/cmra.20163>



◆ **Figure 4:** Receiver coil arrangements for whole body MRI (left, courtesy of Ms Erica Scurr) and head and neck MRI for radiotherapy planning (right, courtesy of Head & Neck Radiotherapy Team at Royal Marsden Hospital, London, UK) demonstrated on volunteers.



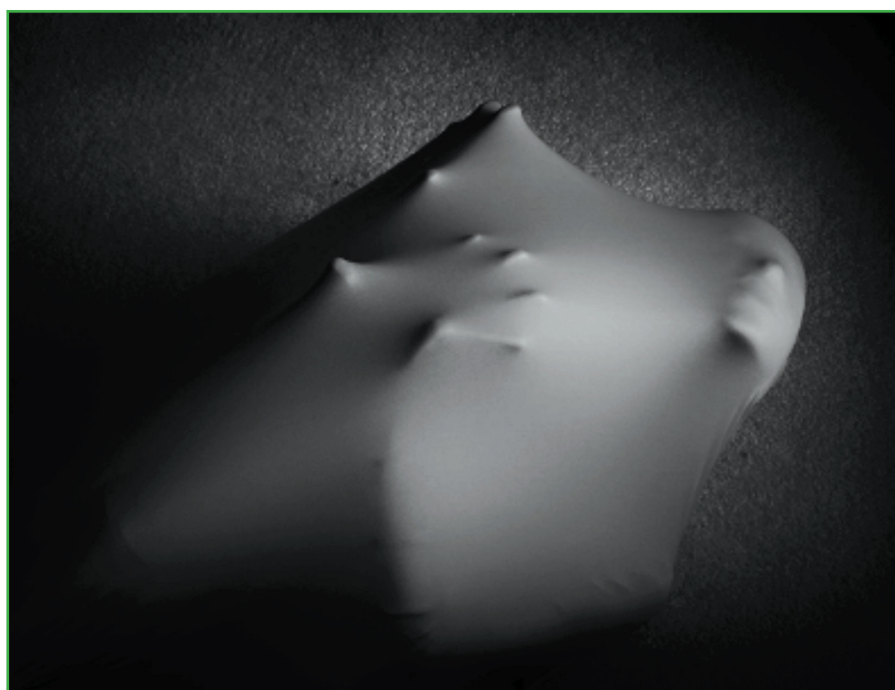
◆ **Figure 5:** Examples of the noise volumes detected by the RF coils when using a large volume coil and three small surface coils. If this was, say, a lumbar spine protocol, then the three surface coils would be able to image the spine without all the noise coming from the rest of the patient.

References

- [1] <https://onlinelibrary.wiley.com/doi/epdf/10.1002/cmra.20163>
- [2] <file:///C:/Users/ekousi/Downloads/Asymmetricgradientcoil设计foruseinashortopenboremagneticresonanceimagingsscanner.pdf>
- [3] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6175221/pdf/JMRI-48-590.pdf>

By failing to prepare you are preparing to fail

The effect of a patient information leaflet on MRI scan outcome for patients suffering from claustrophobia or anxiety Elizabeth Ashburner, Lead MRI Radiographer, Pennine Acute NHS Trust



Everybody has something they fear. Even if they don't know it yet! A significant part of an MRI Radiographer's job is persuading people to go through with the scan due to claustrophobia or anxiety.

It is estimated 10% of the UK population suffer from claustrophobia (1) and 5% from generalised anxiety disorder (2). These existing conditions can be exacerbated, or even experienced for the first time during an MRI scan. In addition to a poor patient experience, this can result in failed or cancelled MRI scans, or movement and poor image quality if the patient does manage to tolerate it. A basic MRI in the NHS costs £130 (3), meaning significant cost to the NHS if the patient doesn't manage the scan or takes several attempts.

It is good practice to strive to improve the service we provide to our patients and look for ways to improve patient experience. In August 2017 it came to my attention that the existing patient information leaflets for MRI scans within our trust were not being sent to patients as they had expired. I was shocked to realise that for months our patients had received no information to help prepare them for their scans. I began to wonder if this was a factor in the subtle increase in patients being referred to our 'wide bore' scanner after failed attempts at other sites with standard bore machines.

When I looked at the patient information leaflet with the intention of trying to get it renewed, I realised that the two page leaflet was extremely basic and outdated. I didn't consider it fit for purpose. With this in mind, I began to do some research on information leaflets for other NHS trusts and private companies.

The range of information was varied and of different qualities. I decided to obtain as many examples as I could and attempt to combine the good points of each to create an informative, useful patient information leaflet.

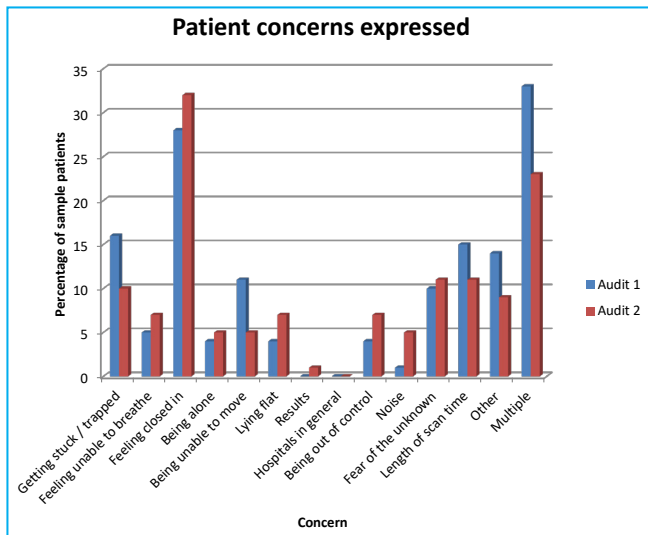
It was difficult to balance giving enough information so the patient could make an informed decision about the examination, without making it too complicated or scary! There's always the risk some people will not read it if it is too long. Having consulted various colleagues for their opinions, I decided it was better to provide more information, then it's their choice if they read it or not.

The leaflet took several months to be approved. In the meantime I decided to do an audit to see if my hunch about patients being unprepared for their scan (receiving no information) had any influence over the outcome of their scan. I decided to look at whether they completed the scan or not, whether they moved or not (an indicator of compliance/tolerance and understanding the need to be still), along with what concerns they had about the scan and at what point during the examination they expressed those concerns.

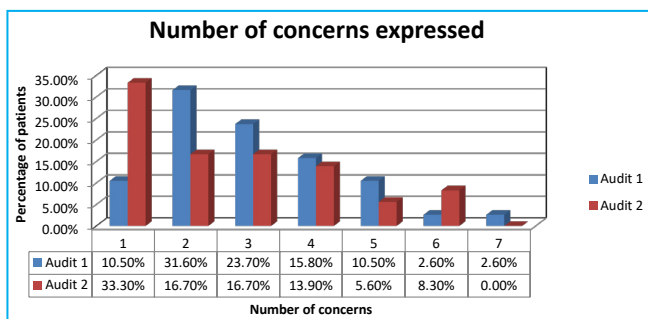
I asked my team of MRI Radiographers to complete questionnaires for patients who suffered from anxiety or claustrophobia to provide me with this information. No patient identifiable information was recorded. Once the new patient information leaflet had been approved and was being sent out with the appointment letters, we repeated the audit and compared the results.

The conclusions surprised even me. 38 out of 475 patients (8% in Audit 1) and 36 out of 495 patients (7.2% in Audit 2) expressed feelings of claustrophobia or anxiety and were included in the audit.

Patients expressed a wide range of concerns regarding an MRI scan, and often had more than one concern:

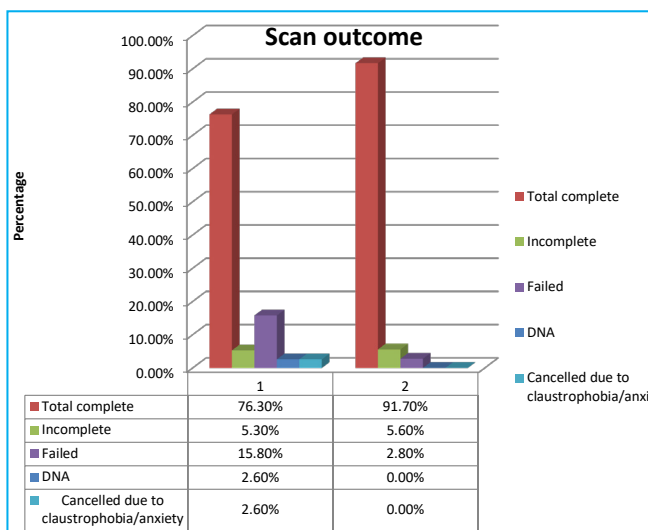


The number of concerns expressed by patients generally reduced between audit 1 and 2, and significantly more (three times as many) patients had only one concern in audit 2. This may suggest patients had been reassured by the information leaflet and had a lot of their questions answered.



The results show that patients also expressed their concerns to staff sooner in audit 2 than audit 1, with an increase of 15.4% of patients expressing them before the scan in Audit 2 (Graphs 4a and 4b). This may be due to the information leaflet encouraging patients to voice their concerns. The earlier the Radiographers know about the patient's concerns, the earlier they can implement aids to relieve the symptoms, avoid potential triggers, or reassure the patient.

The results suggest that increased awareness of what to expect, and better preparation in the form of reassurance at an earlier stage in the patient experience, leads to a better outcome. Completed scans increased from 29/38 (76.3% success rate in Audit 1) to 33/36 (91.7% success rate in Audit 2). DNAs (did not attend) and cancellations decreased from 2/38 (5.2% Audit 1) to 0/36 (0% Audit 2).

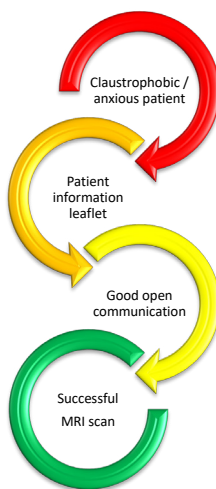


It was also found that patients who had previously failed an MRI but had successful scans this time increased from 3/38 (7.89% Audit 1) to 10/36 (27.8% Audit 2). Completed scans without movement artefacts or the need to use blade/fast scans increased from 19/36 (50% Audit 1) to 28/38 (77.8% Audit 2). This suggests that patients understood the reasons for the need to remain still, and that their compliance was improved by having their concerns addressed. So not only did more patients go through with their scans, meaning they got answers to their clinical queries, but the quality of the images was better, meaning the Radiologists could report them more easily and accurately.

Conclusion:

Better informing patients prior to their scan appointment using an information leaflet enables us to help and reassure people suffering from claustrophobia or anxiety. This in turn results in a positive experience, and a positive outcome with a significant improvement in completion rate and scan quality. It also saves the NHS money due to less DNAs and repeat appointments. A well written patient information leaflet is therefore extremely important.

Recommendations:



- Send patient information leaflets out to every patient prior to their appointment to give them time to read them.
- Provide patient information leaflets on wards to be given to inpatients at the time of referral.
- Make patient information leaflets available in waiting areas for those given appointments at short notice via phone.

- Provide information posters in waiting areas about what to expect during an MRI scan.
- Good open communication at all stages seems to be key to successful scans for patients suffering from claustrophobia and anxiety.

Other options for techniques to help patients suffering from anxiety or claustrophobia include:

- Send a patient information leaflet with the appointment letter (provide them in the waiting area / on wards for those booked at short notice)
- Pre-visit prior to appointment to have a look at the department and scanner, and discuss the examination
- Offer an appointment on a wide bore scanner if possible
- Scan feet first / prone if possible
- Open and honest communication – encourage questions!
- Use layman's terms
- Take your time – sit down with them, don't rush
- Display information posters in the waiting area
- Informative video playing in the waiting area
- Offer a blindfold / mirror / prism glasses
- Offer someone to accompany them during the scan
- Tailor music / audio to their personal preference
- Coach in breathing techniques
- Encourage positive visualisation
- Talk to your patient throughout the scan
- Put the patient in control – let them test the buzzer!
- Mild oral sedative (prescription only)
- Aromatherapy
- Group therapy sessions
- Dedicated lists for claustrophobic / anxious patients – longer appointment times, quieter environment
- Siemens book / interactive app
- Children - involve play specialists

References

- Image: Peck, W. c2010. No Escape. [Online]. [01 May 2019] Available from: <https://www.flickr.com/photos/wespeck/4122998132>
- 1: NHS (2017). Claustrophobia. [online]. [05 Aug 2017] Available at: <https://www.nhs.uk/conditions/claustrophobia/>
- 2: NHS (2017). Generalised Anxiety Disorder. [Online]. [05 Aug 2017] Available at: <https://www.nhs.uk/conditions/generalised-anxiety-disorder/>
- 3: NHS Improvement (2019) Annex A: The National Tariff Workbook. [Online]. [10 May 2019] Available at: <https://improvement.nhs.uk/resources/national-tariff/>

Clinic for the preparation of claustrophobic patients prior to attending for MRI scans

Kath Tyler, Superintendent radiographer *The Walton Centre NHS Foundation Trust*

Patients who are claustrophobic need compassion, empathy & understanding. They often feel silly for behaving in what they see as an irrational way, but, that is the nature of phobias (as one who is afraid of dentists & spiders I know exactly how they feel!). However, with help & preparation from the right person before their scan, most claustrophobic patients are able to successfully complete a very valuable diagnostic investigation.

The problem

Claustrophobia, or the fear of confined spaces, is a serious problem preventing many patients from having medically necessary MRI scans. Studies have shown that between 5% and 10.6% of people screened prior to an MRI scan had claustrophobia (1), with as many as 25% of all patients suffering moderate to severe anxiety. (2) At the Walton Centre we already have a good success rate, with an average of 1.5% of all patients recorded as Claustrophobic. However, this is not an insignificant problem, as 1.5% equates to an average of 200 patients per year.

Failure to complete an MRI investigation can not only exacerbate anxiety, result in poor quality imaging and therefore reduce diagnostic reliability of the examination, but may also result in patients requiring a more invasive and therefore risky diagnostic procedure. Patients for whom there is no alternative diagnostic test may require an MRI scan under General anaesthetic with the associated risks and expense involved.

Failure of patients to undergo or complete MR examinations results in lost scanning slots with loss of money & increased waiting lists due to rescheduling. (3)

The solution

It is our experience, and studies have demonstrated, that an increase in the compliance of claustrophobic patients can be achieved when they are given detailed information about the MR procedure by a trained healthcare professional prior to the examination. In a 2000 study, Souse & Gedroye (4) performed a survey of 50 patients, and found that 42% of patients felt they had not received adequate explanation prior to their scan. Furthermore, "where information was provided by letter only 22% actually understood it". They concluded that verbal information was better absorbed than written information.

Spending time with the technical staff who will perform the scan prior to the examination allows the patient to discuss concerns they may have regarding the procedure, plan strategies for managing anxiety and most importantly establish trust in the staff member looking after them.

Most people feel more confident if they know what is expected of them and particularly with claustrophobia, that they are in control.

In the past, the solution implemented for dealing with known claustrophobic patients was to book them an appointment on either an Open scanner or "wide bore" (70cm) closed scanner which is proving to be a very tolerable option for claustrophobic patients. However, no extra time was allocated for the preparation of the patient which can add an average of 10-15 mins on to the appointment time (4). Patients have often been stressed regarding the examination for several days before their appointment and have, thereby, unnecessarily worked themselves into an even more anxious state prior to arrival.

The time spent with the patient, explanation given & empathy shown is, regrettably, not consistent and is very dependent on the staff members on duty at the time.

In early 2014, Walton Centre Trust Governor Louise Ferguson launched The Roy Ferguson Compassionate Care Award in memory of her late husband. The award provides an annual £5,000 grant aimed to fund ideas providing compassion & care for patients, that might not otherwise secure funding. I had felt for some time that claustrophobic patients would benefit from spending time with a suitably experienced Radiographer prior to their appointment. This would allow staff to discuss the procedure with the patient and reassure them, without there being pressure on the patient, as there would be at the time of their appointment, or on the staff trying to keep a busy scanning list on schedule. This could take the form of a clinic one half day per month. Nurse led clinics have for some time now been part of the gamut of facilities provided by the Walton Centre, and I felt that suitably experienced Radiographers could also make this work.

When I saw the advert for the award I felt this project could fit nicely within the aims of the award. Fortunately the bid was successfully chosen from the many applications, this allowed us the opportunity to demonstrate the clinic could work & be cost effective.

The Clinic

Referral to the clinic comes in several ways. Patients referred specifically with claustrophobia as identified by the referring clinician, those specifically requesting MR under General anaesthetic and patients expressing concerns when offered an appointment are all invited to attend the clinic prior to their appointment.

The clinic started at the weekend when limited

scanning lists are taking place, reducing the feeling of pressure on the patient. During the clinics' 45 minute appointments patients have privacy & personal time to speak with a member of staff, who can discuss their fears, explain the procedure & coping mechanisms and build trust & rapport with the patient. The patients can see the scanners available, try lying in them & discuss adaptations to suit their needs. Eg. the use of prism glasses, or a feet first approach into the scanner. The patient can thus be assessed to determine which scanner would best meet both their clinical and emotional needs prior to the appointment being made, so avoiding wasted scanning slots.

We can try adaptations to normal scanning procedures & techniques.

- Being "introduced" to the scanner; being able to look around it & explaining how it works all seem to help patients understand & come to terms with what is going to happen to them.
- Acknowledge that the patient is not going to like the scan & that it is going to be hard for them, but give them the tools they need to be able to tolerate it. Mainly giving the patient tasks to focus on during the scan like supermarket shopping, packing for & reliving a holiday in minute detail, thus taking their mind off the scan.
- Emphasise the diagnostic benefits of the scan & the impact that potentially successful treatment could have on their lives.
- Breaking the scanning into small "bite size" pieces helps. I liken it to pieces of a jigsaw. If the patient manages one 3 minute scan we will get some information. If the patient is happy we can continue with the next 3 minute scan & so get further information as to what may be causing the problem. A 3 minute scan is less scary & more achievable than a half hour examination.
- Going in the scanner is the hard bit. The patient must keep their eyes closed as the table is fed into the scanner. Although the scanner is fixed in position, moving into the scanner creates the optical illusion that the top of the scanner is coming down towards you. This scares a lot of people.
- Often once they are in the scanner & the scan has started patients relax & settle down. The noise created by the scanning is rhythmic & strangely relaxing. Also the noise is the patients' only indication of the passage of time. A scan lasts about the same time as a record on the radio. Once that is finished it is one less to do. Patients tend to become more anxious in the quiet, planning stages of the scan.

- Communication with the patient is key. Even during the examination patients appreciate being told how long the next scan will take & particularly if the table is going to move. There is nothing worse than unexpectedly feeling the table move you further into the scanner.
- Many patients prefer to enter the scanner feet first.
- Use of mirrors / prism glasses makes a huge difference, the patients are looking out of the scanner rather than at the top of the bore. One patient likened it to "looking out of a window".
- Being able to scan the head without having the anterior portion of the head coil in situ reduces the feeling that patients are trapped / locked into the scanner with no means to escape.
- Lying very flat can give the impression of falling backwards. Prop the head up if possible.
- Spine coils integrated into the table bring the patient lower in the bore, so the top is further away from the face.
- Spine scanning with the patient feet first in the scanner, in the prone position (with the surface coil on top of the back to improve signal) is possible & whilst image quality is degraded by movement artefact from the patient breathing, fast sequences result in diagnostic, if not aesthetic imaging. As the patient does not see the scanner at all this has proved popular (with one patient actually reading a magazine whilst having their scan!)

The outcomes so far

Due to demand the Clinic now runs on one session (4 patients) per week, with 4 Radiographers trained to host the clinics. To date we have seen 525 patients over a 5 year period.

All but 76 patients have successfully completed full MRI examinations equating to 85.5% success rate. Of the unsuccessful patients 12 failures were unrelated to claustrophobia, eg. unable to lie flat due to pain, learning difficulties, spasm, compromised breathing, body habitus. We now, increasingly, see large numbers of patients with generalized anxiety rather than solely claustrophobia, this has reduced our success rate compared to the first year (95%).

Patients are now required to attend the clinic before we will put them on the waiting list for MRI under general anaesthetic.

Feedback from the patients (from results of patient feedback survey 2015)

The patients appreciate having the time to spend talking about their fears. It is important that they know you understand how they feel and can relate to their anxiety. We are all frightened of something – those who say they aren't just haven't found what it is yet!

Most patients are looking for any excuse not to go through with their scan. If they come when there is a busy list, it is easy to refuse the scan without trying - with excuses like "they're really busy", "I am wasting their time", "I am keeping other patients waiting". At the clinic they do not feel this added pressure, and can take their time familiarising

themselves with the equipment (& escape routes).

Having a family member or friend with the patient is very reassuring.

"Building trust with a member of staff is important". "A familiar friendly face can make a big difference." I always try to at least say hello when patients return for their appointment even if they don't require me to be present during the scanning.

The benefits to the patient

- Patient is able to feel more in control of their examination
- Appointment is made on scanner most suitable to the patient needs.
- Patient has the opportunity to find out accurate information about what the examination involves, eg. Scan times & what is required of them. Currently patients are dependent on hearsay & the internet.
- Patients build trust & rapport with staff members increasing confidence.
- Patient can discuss coping mechanisms.
- Patients have a successful investigation leading to accurate diagnosis & appropriate treatment.
- Patient has an agreeable experience with reduced anxiety both at this appointment and in the future.
- Avoids Claustrophobia being exacerbated by a bad experience in an MR scanner.

Testimony

Patient X was one of the first to attend the claustrophobia clinic and successfully complete an MRI scan.

X said: "I started suffering vision problems and no one knew what was causing it. I was going to hospital more frequently and it got to the point where I was signed off work."

"I was sent for an MRI scan and although I felt very unsure about doing it I hoped it would be okay because I wanted answers. Unfortunately I couldn't go through with it as I'm very claustrophobic. I can't do lifts and I even panic in the car."

X was then referred to The Walton Centre and placed on a waiting list for MRI under general anaesthetic.

"Shortly afterwards I received a call saying there was a new claustrophobia programme at The Walton Centre and would I be interested," said X. "I was prepared to try anything so I came in on a Saturday and met Superintendent Radiographer Kath Tyler."

"At first we looked at the open scanner and I immediately thought 'no chance'. But Kath persuaded me to look around the department and we had a good chat. I sat on the bed of one of the conventional MRI scanners and the next thing I was having a go."

"Kath talked me through everything. She made me think of it as lots of little scans rather than one big scan. In the end I managed to stay in the scanner for a few minutes. It was so reassuring to know Kath was going to be there on the day when I came back, she really understood my fear."

"When it came to the day of my scan about two weeks later, no one in my family thought I would be able to go through with it, but I managed and I was in there for about 30 minutes in total."

"It made a huge difference that I'd already been in the scanner. Even on the morning of the scan I wasn't panicking, which meant I was in a more positive place going into it. The claustrophobia programme is absolutely fantastic, something so simple but it will make a big difference."

The benefits to the Trust

- Increased efficiency with less wasted MR appointments during the working day due to delays resulting from time spent preparing patients.
- Reduction of overall patient waiting times resulting from rescheduled appointments.
- Increasingly the services of the clinic are utilized by other hospitals with remuneration to the Trust.

MR scan failure followed by MRGA

Cost Per Patient **£683**
Cost for 50 patients **£34,150**

MRGA

Cost Per Patient **£545**
Cost for 50 patients **£27,250**

MR & Claustrophobic Clinic attendance

Cost Per Patient **£182**
(£44 is clinic cost)
Cost for 50 patients **£9,100**
(£2,200 is clinic cost)

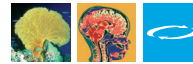
Saving to the Trust

Cost Per Patient **£456/£363**
Cost for 50 patients **£25,050/£18,150**

NB. Figures from 2014 –when clinic first began

References:

- (1) Proscan imaging brochure www.proscan.com
- (2) Croyden MRI scanning centre
- (3) Karen Duncan, Royal College of Radiologists, Clinical Radiology audit live.
- (4) E. Spouse & W.M. Gedroyc "MRI of the claustrophobic patient: interventionally configured magnets" The British Journal of Radiology, Feb 2000
- (5) Gollub, R.L., and Shellock, F.G. Claustrophobia, Anxiety, and Emotional Distress in the Magnetic Resonance Environment. In, Magnetic Resonance Procedures: Health Effects and Safety. F.G. Shellock, Editor; CRC Press, Boca Raton, FL, 2001.
- (6) Shellock, F.G., Claustrophobia, anxiety, and panic disorders associated with MR procedures. In: Magnetic Resonance: Bioeffects, Safety, and Patient Management. F.G. Shellock, and Kanal, E., Editor; Lippincott-Raven Press, New York, 1996, pp. 65



DOTAREM®

Gadoteric acid

NO COMPROMISE in THE DOTAREM WORLD



DOTAREM® 0.5 mmol/ml (Gadoteric acid) Solution for injection, vials and pre-filled syringe (PFS)

Please consult Full Summary of Product Characteristics (SmPC) before using. The following is a summary.

ACTIVE INGREDIENT: Gadoteric acid, 279.32 mg/ml (equivalent to 0.5 mmol/ml). Osmolality: 1350 mOsm.kg⁻¹. Viscosity at 20°C: 3.2 mPa.s (2.0 mPa.s at 37°C), pH: 6.5 to 8.0.

THERAPEUTIC INDICATIONS: Dotarem should be used only when diagnostic information is essential and not available with unenhanced magnetic resonance imaging (MRI). **Adults and paediatric population (0-18 years):** Contrast enhancement in Magnetic Resonance Imaging. **Encephalic and spinal MRI:** Detection of brain tumours, tumours of the spine and surrounding tissue, intracranial disc prolapse, infectious diseases. **Whole Body MRI:** Including renal, cardiac, uterine, ovarian, breast, abdominal and osteo-articular pathology. **Angiography:** Dotarem is not recommended for angiography in children under 18 years of age due to insufficient data on its efficacy and safety in this indication.

POSOLGY AND METHOD OF ADMINISTRATION: The lowest dose that provides sufficient enhancement for diagnostic purposes should be used. The dose should be calculated based on the patient's body weight, and should not exceed the recommended dose per kilogram of body weight detailed in this section. The product is intended for IV administration only. Intravascular administration of contrast media should, if possible, be done with the patient lying down. After the administration, the patient should be kept under observation for at least half an hour, since experience shows that the majority of undesirable effects occur within this time.

Adults including the elderly: Encephalic and spinal MRI: The recommended dose is 0.1 mmol.kg⁻¹, i.e. 0.2 ml.kg⁻¹ to provide diagnostically adequate contrast. A further injection of 0.2 mmol.kg⁻¹, i.e. 0.4 ml.kg⁻¹ within 30 minutes, may improve tumour characterisation and facilitate therapeutic decision making. **Whole body MRI and angiography:** The administration of 0.1 mmol.kg⁻¹, i.e. 0.2 ml.kg⁻¹ is recommended to provide diagnostically adequate contrast. **Angiography:** In exceptional circumstances administration of a second consecutive injection of 0.1 mmol.kg⁻¹, i.e. 0.2 ml.kg⁻¹ may be justified. However, if the use of 2 consecutive doses of DOTAREM® is anticipated prior to commencing angiography, the use of 0.05 mmol.kg⁻¹ (i.e. 0.1 ml.kg⁻¹) for each dose may be of benefit, depending on the imaging equipment available.

Paediatric population (0-18 years): Brain and spinal MRI and whole body MRI: the recommended and maximum dose of Dotarem is 0.1 mmol/kg body weight. More than one dose should not be used during a scan. Due to immature renal function in neonates up to 4 weeks of age and infants up to 1 year of age, Dotarem should only be used in these patients after careful consideration, at a dose not exceeding 0.1 mmol/kg body weight. **Angiography:** The efficacy and safety of DOTAREM® in children under 18 years has not been established.

Patients with renal impairment: The adult dose applies to patients with mild to moderate renal impairment (GFR > 30ml/min/1.73m²). Nephrogenic systemic fibrosis (NSF) has been reported with gadolinium-containing contrast agents in patients with acute or chronic severe renal impairment (GFR < 30ml/min/1.73m²). As there is a possibility that NSF may occur with DOTAREM®, it should therefore only be used in this group after careful risk/benefit assessment and if the diagnostic information is essential and not available with non-contrast enhanced MRI. If it is necessary to use DOTAREM®, the dose should not exceed 0.1 mmol.kg⁻¹. Because of the lack of information on repeated administration, DOTAREM® injections should not be repeated unless the interval between injections is at least 7 days. **Patients with hepatic impairment:** The adult dose applies to these patients. Caution is recommended especially in the perioperative liver transplantation period. **CONTRA-INDICATIONS:** Hypersensitivity to gadoteric acid, to meglumine or to any medicinal product containing gadolinium. **SPECIAL WARNINGS AND PRECAUTIONS OF USE:** Do not use by intrathecal route. Take care to maintain strictly intravenous injection: extravasation may result in local intolerance reactions, requiring the usual local care. The usual precaution measures for MRI examination should be taken, such as exclusion of patients with pacemakers, ferromagnetic vascular clips, infusion pumps, nerve stimulators, cochlear implants, or suspected intracorporeal metallic foreign bodies, particularly in the eye.

Hypersensitivity: Hypersensitivity reactions can be either immediate (< 60 minutes) or delayed (up to 7 days), allergic or non-allergic. Anaphylactic reactions occur immediately, can be fatal and are independent of dose. There is always a risk of hypersensitivity regardless of the dose injected. Patients with hypersensitivity or previous reaction to contrast media are at increased risk of severe reaction. In these patients DOTAREM® should only be administered after careful consideration of the risk/benefit ratio. Hypersensitivity reactions may be aggravated in asthmatic patients or those taking beta-blockers. During the examination, supervision by a physician is necessary. If hypersensitivity occurs, administration of the contrast medium must be discontinued immediately and appropriate specific therapy instituted. **Impaired renal function:** Prior to administration of DOTAREM®, it is recommended that all patients especially those above 65 years are screened for renal dysfunction by obtaining laboratory tests. Due to the risk of NSF in patients with acute or chronic severe renal impairment, administration in this group should be considered and performed as above. Haemodialysis shortly after administration may be useful in removing DOTAREM® from the body. However, there is no evidence to support the initiation of haemodialysis for prevention or treatment of NSF in patients not already undergoing haemodialysis. **CNS disorders:** Special precaution is necessary in patients with a low threshold for seizures. All equipment and drugs necessary to counter any convulsions must be readily available. **INTERACTIONS:** No interactions with other medicinal products have been observed. Formal drug interaction studies have not been carried out. **PREGNANCY AND LACTATION:** There is a lack of human data on the use of gadoteric acid in pregnancy. Animal studies do not indicate direct or indirect harmful effects. Administration during pregnancy should be avoided unless absolutely necessary. **Lactation:** Gadolinium containing contrast agents are excreted into breast milk in very small amounts (see section 5.3 of the SmPC). At clinical doses, no effects on the infant are anticipated due to the small amount excreted in milk and poor absorption from the gut. Continuing or discontinuing breast feeding for a period of 24 hours after administration of DOTAREM®, should be at the discretion of the doctor and lactating mother. **UNDESIRABLE EFFECTS:** Side effects associated with use of gadoteric acid are usually mild to moderate in intensity and transient in nature. Injection site reactions, nausea and headache are the most frequently observed reactions, as well as feeling cold, hypotension, somnolence, dizziness, feeling hot, burning sensation, rash, asthenia, dysgeusia and hypertension are also common. These reactions can be immediate (within 60 minutes after injection) or delayed (within 7 days after injection). Immediate reactions include one or more effects, appearing simultaneously or sequentially, and often cutaneous, respiratory, gastrointestinal, articular and/or cardiovascular reactions. Each sign may be warning of starting shock and go very rarely to death. Isolated cases of nephrogenic systemic fibrosis (NSF) have been reported with gadoteric acid most of which were in patients co-administered with other gadolinium-containing contrast agents. Children: Safety of paediatric patients was considered in clinical trials and post-marketing studies. As compared to adults, the safety profile of gadoteric acid did not show any specificity in children. Most of reactions are gastrointestinal symptoms or signs of hypersensitivity. Please consult the SmPC in relation to other side effects. **MARKETING AUTHORISATION HOLDER:** Guerbet B. P. 57400 F-95943 Roissy CdG Cedex France. **LEGAL CATEGORY: POM. MARKETING AUTHORISATION NUMBERS:** PL 12308/0016 (vials); PL 12308/0017 (PFS). **LIST PRICE:** 10 x 5ml vials £272.50, 10 x 10ml vials £440.20, 10 x 15ml PFS £569.10, 10 x 20ml PFS £666.50. **DATE OF REVISION OF TEXT:** March 2018.

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* Herborn CU, et al. Clinical Safety and Diagnostic Value of the Gadolinium Chelate Gadoterate Meglumine (Gd-DOTA). Invest Radiol 2007; 42:58-62.

For more information
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Adverse events should be reported. Reporting forms and information can be found at www.mhra.gov.uk/yellowcard. Adverse events should also be reported to Guerbet Laboratories Ltd, Avon House, 435 Stratford Road, Shirley, Solihull, B90 4AA. Tel: 0121 733 8542 Fax: 0121 733 3120 Email: uk.info@guerbet-group.com



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