ISSUE 59
AUTUMN 2022

BAMRR news

THE NEWSLETTER OF
THE BRITISH ASSOCIATION OF MR RADIOGRAPHERS

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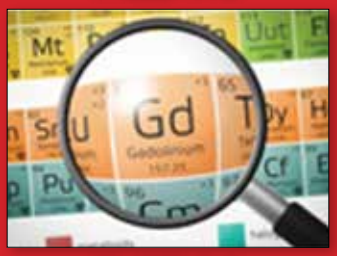

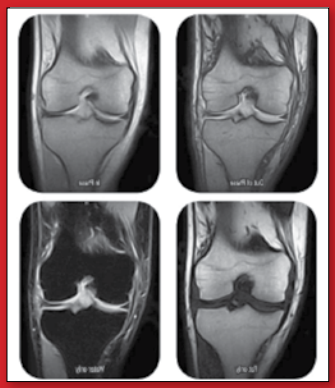

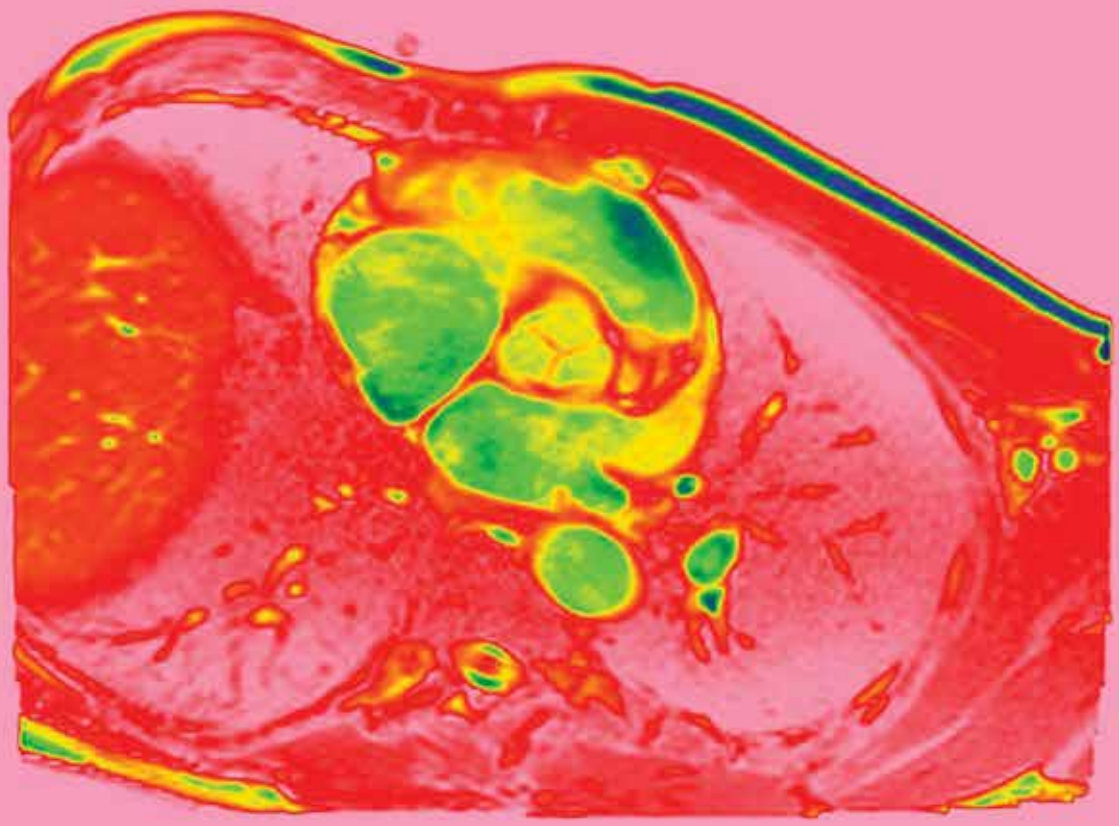

welcome

from your BAMRR PRESIDENT

Welcome to our newest board member Kath Norfield who joined the policy board back in February and has been a great help organising the annual BAMRR conference in Leicester.

What an exciting yet busy few months we have had here at BAMRR. With the lifting of most restrictions it has been lovely to finally get out and about; sharing our love of MRI and education with fellow colleagues around the country. At the beginning of May we had the opportunity to attend ISMRM (International Society of Magnetic Resonance in Medicine) in London. It was great to see so many current and past BAMRR members, BIR, SOR, SMRT members and Radiology colleagues from around the world. Stars of the day went to policy board members (Helen and Rachel) who were privileged to meet 2 fantastic Pod Caster Producers and feature in the podcast Zone3Podcast 'Take away and Wrap up' (streamed 19 June 2022 for anyone who missed this!) In addition, our Further MRI course was fully subscribed with over 50 delegates joining us in London towards the end of May.

Finally in June BAMRR hosted the educational sessions at UKIO Liverpool and again had a great turn out from attendees – our thanks go out to the fantastic speakers Dr Jane Belfield, Steven Jackson and Leonardos Papadopoullos for giving the fantastic lectures delivered. MR Safety week in July kept us all busy with the quizzes, podcasts and safety topics – please see the BAMRR website if you didn't catch these in July. MR Safety Week 25th - 29th July - DAY 5 - British Association of MRI Radiographers (bamrr.org)

We have our Introductory MRI course due to recommence in November 2022, finally after putting on hold for the last few years. See website for more details BAMRR Courses - British Association of MRI Radiographers

We look forward to seeing many of you at our forthcoming events.

Zoe Lingham
BAMRR President
linghamzoe@gmail.com

from your EDITOR

Welcome to the Autumn 2022 BAMRR News.

I have once again been generously supplied with interesting content for this edition of BAMRR news and for this I am very grateful. Without members and readers submitting articles the newsletter would be much less interesting, not to mention very tough for me to compile. I want it to be open and inclusive, both in terms of who submits pieces but also around what the various messages are seeking to share. Therefore if you have something to say or maybe an interesting case study, please consider sending it through to me. If you prefer, you could email me first to chat it through.

I believe BAMRR News is a really accessible and hopefully friendly resource whether you are a seasoned author of articles, or, taking your first steps in publishing. So if you are interested in getting involved please just drop me a message and we can discuss. Remember – it is your journal and I would welcome more of you being involved with it's content.

May your magnets keep cool in the warm weather.

See you at conference (in person – yay!)

Matthew Benbow
BAMRR Editor

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twitter

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WELCOME from our sponsor GUERBET

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

Guerbet are proud to be sponsors of the BAMRR community and we are delighted that we are getting the opportunity to meet you all face-to-face again at the BAMRR courses and annual conference this year.

As MRI enthusiasts, we'd like to share with you our new website Innovation4MRI.com, Where you can find summaries of recent research findings, infographics and video interviews with leading academics as well as industry experts.

If you would also like any support with educational programmes or events please do get in touch with **uk.events@guerbet.com**.

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

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

Guerbet
Contrast for Life

Survey on generic implant safety procedures for MR

Do you approve patient scans for MR for certain classes of implants? If you do, then we want to hear from you!

The IPEM MR Special Interest Group and BAMRR have prepared a survey on the use of general implant safety policies and procedures for MRI (i.e. a policy whereby patient MR scanning is authorised without explicitly identifying the make and model of the patient implant).

We aim to determine how common this approach is, for which categories of implants or procedures these might exist for, and how sites have implemented them. This will inform subsequent policy guidance and best practice which we plan to publish in a paper on this topic. We estimate the survey will take between 15-20mins to complete; answers are optional.

We would like to hear from a single person from each site, ideally the superintendent or lead MR radiographers or MR Responsible Person (MRRP). We would like to ask that you as an MR lead could email relevant people in your local trusts and service level agreement partners, including private healthcare facilities in your area to complete the survey. This is with a view to maximising the breadth of completion of the survey to obtain as full a picture as possible across the UK.

The link to the survey is as follows:

https://www.smartsurvey.co.uk/s/MRIImplants/

Many thanks,

John McLean
on behalf of the IPEM/BAMRR GISP task and finish group

BAMRR Policy Board Members, Autumn 2022

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:

PRESIDENT
Zoe Lingham
Zoe.lingham@spirehealthcare.com

SOR REPRESENTATIVE
Alex Lipton
AlexL@sor.org

WEBSITE CO-ORDINATOR & PRESIDENT ELECT
Trudi Whitehead
trudi.whitehead@nhs.net

PAST PRESIDENT & SECRETARY
Lisa McBain
Lisa.McBain@hey.nhs.uk

SAFETY CO-ORDINATOR
Cath Mills
cath.mills@bmihealthcare.co.uk

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Kath Norfield
kath@norfield.co.uk

MEMBERSHIP SECRETARY
Niamh Cleary
niamh.cleary@siemens-healthineers.com

UKIO CO-ORDINATOR
Jill McKenna
Jill.McKenna@nuth.nhs.uk

TREASURER
David Reed
drbamrr8@gmail.com

COURSE CO-ORDINATOR
Rachel Watt
rachelwatt@nhs.net

NEWSLETTER EDITOR
Matthew Benbow
matthew.benbow@uhd.nhs.uk

COURSE CO-ORDINATOR
Helen Estall
helen.estall@uhl-tr.nhs.uk

Blood glucose monitoring patches

Cath Mills *BAMRR Safety Co-ordinator*

Previously BAMRR reported the introduction of a new type of blood glucose monitoring patch that allows non invasive blood glucose monitoring for patients.We reported on the Freestle Libra (manufacturer Abbott Medical) and since that update there are now several manufacturers making these for use in the UK.

Examples of these are the G6 (manufacturer Dexcom), Guardian connect (manufacturer Medtronic) and skin patches for use with these systems made by Sugarbeat and Omnipod.

Currently these patches are all MR Unsafe and must be removed prior to MRI.

SoR Joint Statement on Safety of Breastfeeding After Contrast Agent, January 2022

In January 2022 the SoR released a position statement for patients following research that showed there was lack of awareness amongst imaging teams about the most up to date evidence and guidance for breast feeding for patients who require contrast for CT/MRI.

Link to SoR joint statement-

SoR issues joint statement on safety of breastfeeding after contrast agent

Evidence indicates cessation of breastfeeding not required

Published: 25 January 2022 SoR

The Society has issued guidance to reassure patients after recent research showed a lack of awareness among imaging teams on the most up-to-date evidence and guidance for breast-feeding patients who require a CT or MRI with contrast.

The current Royal College of Radiologists (RCR) guidance published in 2019 relating to MR states:

While no special precaution or cessation of breastfeeding is required the continuation or cessation of breastfeeding for 24 hours should be at the discretion of the lactating mother in consultation with the clinician.

The SoR and RCR refer to the guidance published by The Royal Australian and New Zealand College of Radiologists (RANZCR) regarding CT contrast which says:

Cessation of breast feeding or expression and discarding of breast milk after iodinated contrast media administration are not required.

The Breastfeeding Network has summarised the advice of a number of expert organisations across the globe which is available on their website.

The very small potential risk associated with absorption of contrast medium is considered insufficient to warrant suspending breastfeeding for any period following iodinated contrast agent administration.

It is the view of the RCR and SoR that patients who wish to continue breastfeeding after being administered with contrast agent should be able to do so as there is no evidence of risk to the baby/child.

Position statement for patients

The Society of Radiographers (SoR) and the Royal College of Radiologists (RCR) are aware of conflicting opinions about whether patients who are administered with contrast agents – usually as part of a CT or MRI scan– can breast feed as part of their normal routine.

It is the view of both the RCR and the SoR that patients who wish to continue breastfeeding after being administered with contrast agent – usually given in advance of a CT or MRI scan – should be able to do so as there is no evidence of risk to the baby/child. If you have any concerns please, speak with your radiographer or radiologist.

https://www.sor.org/news/sor/sor-issues-joint-statement?fbclid=IwAR0SV4y2GaztTQPI9_LE-84VP1h8b7MYweSLP2V0nLn2EG8jgS_5Z7Ejjl8

Other resources for contrast safety:

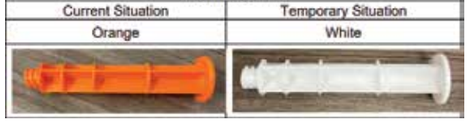
Current RCR guidance (2019)

https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr193-gadolinium-based-contrast-agent-adult-patients.pdf

Contrast News

Guerbet wrote to customers who use Dotarem pre-filled syringes earlier this year to inform them that from 30th March 2022 the pushrod colour would be temporaily changing from orange to white. It is due to their supplier experiencing issues with the orange colourant, and affects 10ml,15ml and 20ml pre-filled syringes. Geurbet assured it's customers ' this change does not have any impact on the product use, safety, and quality'.

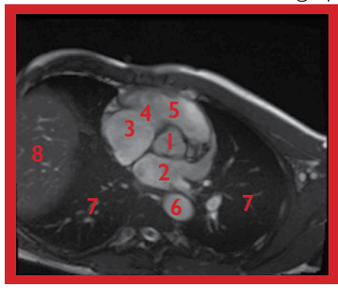
Push Rod Colour	
Current Situation	Temporary Situation
Orange	White



Cardiac MRI

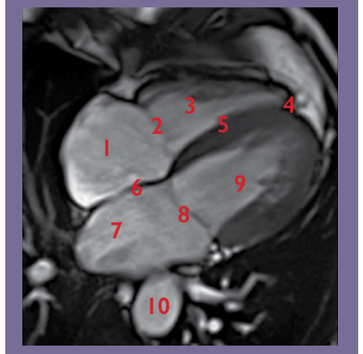
Cardiac MRI - Anatomy, Planes and Planning

Lauren Dakin *Senior Radiographer, Circle Health Group*



1 Aortic Valve
2 Left Atrium
3 Right Atrium
4 Tricuspid Valve
5 Right Ventricle
6 Descending Aorta
7 Lung
8 Liver

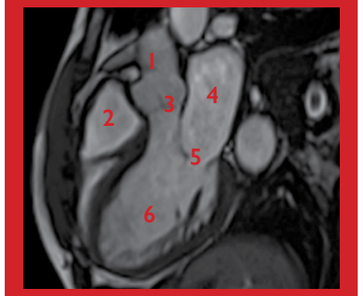
4 Chamber View



1 Right Atrium
2 Tricuspid Valve
3 Right Ventricle
4 Apex of Heart
5 Ventricular Septum
6 Atrial Septum
7 Left Atrium
8 Mitral Valve
9 Left Ventricle
10 Aorta

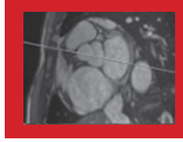
Planned by bisecting the left and right ventricle on the short axis (SA) image, angled to include the apex and though the mitral valve (Penguin)

3 Chamber View

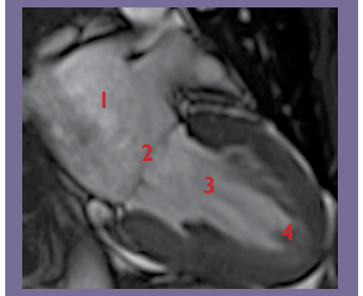


1 Ascending Aorta
2 Right Ventricle
3 Aortic Valve (closed)
4 Left Atrium
5 Mitral valve (open)
6 Left Ventricle

Bisecting the aortic root and LVOT (bisecting olaf)

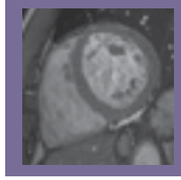


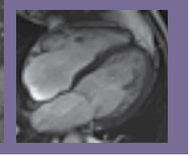
2 Chamber View



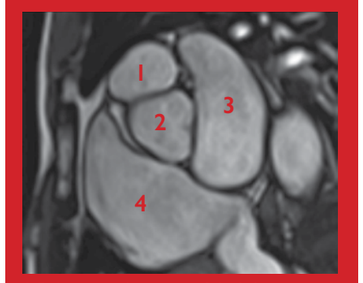
1 Left Atrium
2 Mitral Valve
3 Left Ventricle
4 Apex of Heart

Parallel to the insertion points on SA view, Bisecting the mitral valve through the Left atrium and ventricle on 4 chamber



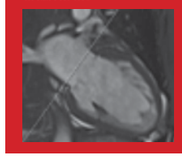


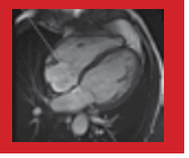
Short Axis Cut 1 of 12



1 Pulmonary Artery
2 Aorta
3 Left Atrium
4 Right Atrium

Perpendicular to the septum on 4 chamber and the cardiac wall on 2 chamber.





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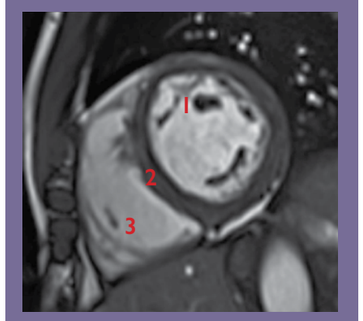
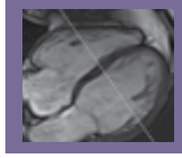
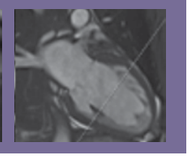
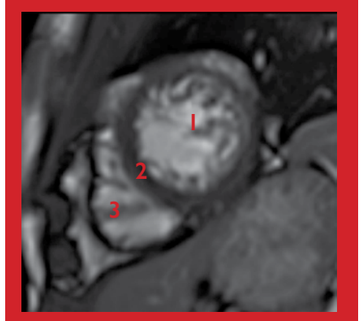


1 Left Ventricle
2 Ventricular Septum
3 Right Ventricle

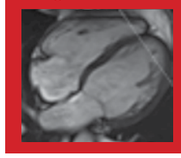




Short Axis Cut 10 of 12



1 Left Ventricle
2 Ventricular Septum
3 Right Ventricle



MRI Contrast Agents Past, Present and Future?

Helen Estall *Consultant Radiographer, University Hospitals Leicester*

The first use of gadolinium based contrast agent (GBCA) in a human was reported in the literature in 1981 and Magnevist was the first licensed GBCA in 1988. Since then, there have been over 600M doses world-wide and over 45M doses are administered annually; GBCAs are used in approximately a third of all MRI examinations.

Gadolinium

Gadolinium is a rare earth metal which is attached to a chelating agent; the chelating agent is a chemical compound which reacts with the metal ion to form a stable complex. Different GBCAs have different chelating agents and these prevent the toxicity of the gadolinium.

GBCAs shorten the T1 and T2 relaxation time, increasing the signal intensity of T1 weighted images and reducing the signal intensity of T2 weighted images. GBCAs have their strongest effect in T1 weighted imaging because they predominantly alter the T1 relaxation time of the tisasue in which they have accumulated; we are therefore seeing the effect of the GBCA rather than the GBCA itself on the image.

The majority of GBCAs are injected intravenously, they enter the intravascular compartment then infuse into the extravascular extracellular space and will not cross an intact blood brain barrier.

GBCAs can be ionic or non-ionic, based on their net charge in solution and linear or macrocyclic, based on their molecular structure.

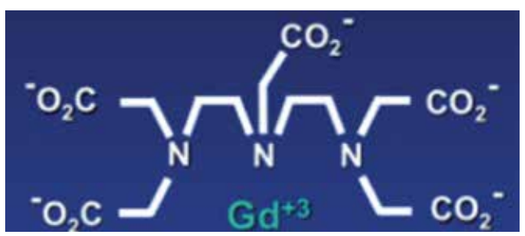
Ionic and non-ionic:

Ionic media can dissolve into charged particles when entering a solution, non-ionic particles cannot. Therefore ionicity is strongly related to osmolarity (the number of dissolved particles per litre of water). Non-ionic contrast agents have a lower osmolarity.

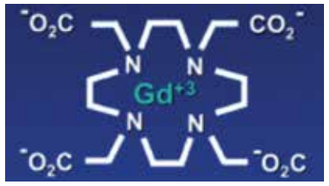
Non-ionic iodinated contrast agents are preferred, however, this does not necessarily apply to MRI GBCAs, this is mainly due to the low volume of contrast used in MRI. Both linear and macrocyclic agents can be either ionic or non-ionic.

Linear and Macrocyclic:

Structurally, GBCAs can be divided into linear or macrocyclic agents, the macrocyclic agents have the gadolinium ion trapped in a preformed cage-like structure and the linear agents have a longer molecular structure:



◆ Linear agent example



◆ Macrocyclic agent example

Due to concerns regarding potential free gadolinium toxicity and increased risk of NSF, some of the linear agents such as Magnevist were suspended for intravenous use in the EU in 2017. However, they are still licensed in the US for example, with some changes in the drug labelling

Brand Name	Chemical Name	Structure
Magnevist	Gadopentetate (Gd-DTPA)	Linear/Ionic
MultiHance	Gadobenate (Gd-BOPTA)	Linear/Ionic
Dotarem/Clariscan	Gadoterate (Gd-DOTA)	Macrocyclic/ionic
ProHance	Gadoteridol (Gd-HP-DO3A)	Macrocyclic/nonionic
Gadavist	Gadobutrol (Gd-BT-DO3A)	Macrocyclic/nonionic
Primovist	Gadoxetate (Gd-EOB-DTPA)	Linear/Ionic

Safety

Prior to 2006, MRI contrast agents were considered safe for all patients and many patients had MRI contrast agents intravenously rather than iodinated CT contrast to avoid contrast induced nephropathy (CIN).

Mild Adverse reactions of headaches, nausea and pain at the injection site have been reported at between 0.03 and 6%, with most reactions being transient. Severe anaphylactic reactions are extremely rare at approximately 1 in 100,000 doses.

Since its inception, MRI contrast has gone through two major safety crises, Nephrogenic Systemic fibrosis (NSF) and the discovery of gadolinium deposition in the brain.

NSF

NSF is a very rare disorder and is characterised by fibrosis of the skin, subcutaneous tissues and sometimes underlying skeletal muscle. The proliferation of fibrotic tissue can become systemic extending to other areas such as the pleura, pericardium and dura mater of the brain and cord. It was first recognised in 1997 and reported in the medical literature in 2000, confirmed cases have only occurred in patients with reduced renal function who received GBCA.

In 2007 the European Medicines Agency contra indicated linear GBCAs in patients with renal impairment. Very few new NSF cases have been reported since 2009 due to the use of more stable GBCAs, limiting their use in patients with renal failure and a reduced maximum dose of 0.1 mmol/kg.

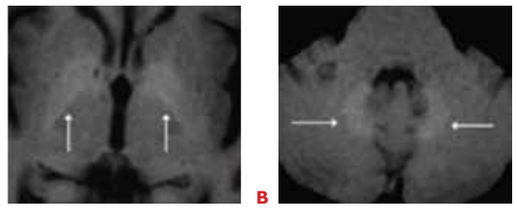
Patient forearm with thickened plaques of NSF:

Gadolinium Deposition

Gadolinium has been shown to be deposited in bone, liver, lung, kidney, heart, skin and the brain. The levels in bone can be 23 times higher than in the brain and it has been shown to be retained in bone for over 8 years.

In 2014 the first paper was published demonstrating a correlation between high signal in the globus pallidus and dentate nucleus on non-contrast T1 weighted images in patients with multiple prior scans with GBCAs with normal renal function. This was demonstrated predominantly with linear agents but there have been a few cases with macrocyclic agents as well. Multiple studies have yet to demonstrate any correlation between gadolinium deposition and any adverse clinical symptoms, but the Pharmacovigilance and Risk Assessment Committee (PRAC) recommended the suspension of several linear GBCAs including Magnevist (for IV use) in 2017 due to the deposition of gadolinium in the brain.

T1 weighted non contrast axial images demonstrating hyperintense signal in the globus pallidus (A) and dentate nucleus (B):



Environmental Impact

GBCAs are excreted via the kidneys, >90% after 24hrs in healthy pts and >95% in 72hrs. Several papers have discussed the impact of this on the water systems and it has been stated that 1000 tonnes of gadolinium oxide are deposited via waste water worldwide per annum. Only 10% of GBCAs are removed in water treatment plants allowing 90% to be distributed in surface water.

Possible Futures

There are three main areas of research in the search for either an alternative to GBCAs or to reducing the dose. The first is the use of Artificial Intelligence to reduce the dose required. There are Deep Learning (DL) algorithms that can increase spatial and contrast resolution, reduce the scan time, reduce artefacts such as truncation whilst maintaining the quantitative integrity of the image. Examples of these are GE Air Recon DL, Siemens Deep Resolve, Philips SuperRes and Canon AiCE. Synthesized DL using 90% less GBCA is promising but is still at the research stage. There is also research into training neural networks to recognise disruption to the blood brain barrier using T1 and T2 weighted images (and no contrast) to then predict where the enhancement would be.

The second is finding an alternative to gadolinium. Researchers are investigating the possibility of using another metal such as iron or manganese. 'AlternativesToGd' is a 3 year project to develop metal free, small endogenous molecules which are hyperpolarised for perfusion imaging or tissue-retention. This is a new technology that does not exist currently but is just one of the alternatives that are being researched.

The third main area of research is to change the structure of the GBCAs. One research group are looking at modifying the chemical structure by developing the use of four gadolinium ions (four chelates) in one molecule, so far this has proven to have increased relaxivity, higher stability and no release after 15 days. Another strategy is to increase the hydration number (interaction/exchange of gadolinium with surrounding water), with current GBCAs, there is only one site for water molecule exchange. Researchers are also looking at increasing the gadolinium payload per molecule. The aim is to have new GBCAs with higher stability, higher relaxivity and a requirement for a reduced dose, thereby decreasing the gadolinium footprint but still keeping the diagnostic value.

It has been estimated that it takes at least fifteen years of work to find and test new contrast agents and many of the above options will not be suitable or not be available for many years to come. It has been suggested that despite significant efforts in preclinical, translational and clinical research, the most likely next generation of MRI contrast agents will contain gadolinium, with a combination of contrast enhancement and image processing techniques being used to optimise diagnosis whilst minimising dose.

Fat Saturation on a Low Field MRI Scanner A Dedicated Solution for a Comprehensive Diagnosis

John Manchester *MRI Business Development Manager, Estate*

Introduction

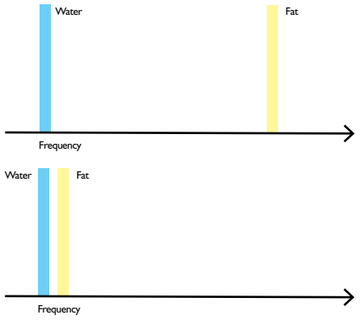
When performing an MRI examination of the knee, protocol recommendations almost always include PD FS (proton density, fat suppressed) weighted imaging in at least one plane due to its sensitivity to diagnose pathologies.

Site 1	Site 2	Site 3
Sagittal 3D PD FS	Transverse PD FS	Sagittal PD TSE
Sagittal T1 SE	Coronal PD FS	Sagittal PD FS
Transverse T2 TSE	Sagittal T1 SE	Coronal PD FS
Coronal PDFS (reformat from 3D)	Sagittal STIR	Transverse T1 SE
Sagittal T2*	Coronal T2 TSE FS	

◆ Figure 1 - Table showing example of different MRI Knee protocols from three sites

As shown in Figure 1, there is always some site-to-site variation in the blend of sequences involved to complete an MRI Knee protocol. However, one thing that you can see is commonplace throughout is the use of PD FS sequences.

When using high field MRI the use of this sequence poses no problem, but on lower field strength systems physics provides some constraints in trying to obtain true spectral fat suppression. This is because with lower Tesla magnets, the fat and water peaks are closer together meaning it becomes more troublesome to saturate out only the fat.



This problem has previously been overcome by using a combination of PD FSE (Proton Density weighted Fast Spin Echo) sequences with STIR sequences, and/or a T2 weighted sequence using the Dixon method of fat suppression.

The Dixon technique of fat suppression was first described by American physicist W Thomas Dixon in 1984, but due to technological limitations was prone to artefacts at that time and not really utilized until the early 2000's with improved technology (radiopaedia.org/articles/dixon-method).

The Dixon technique is based on chemical shift and has several advantages over other fat suppression techniques:

- More uniform fat suppression
- Can be combined with a variety if sequences
- Can be combined with a variety of image weightings
- Can provide images with and without fat suppression within a single sequence
- Shows the presence of microscopic fat and can also quantify this fat

One disadvantage that can occur when using the Dixon technique for fat suppression is the fat-water swapping artefact that can occur with less homogeneous magnetic fields.

The Dixon technique makes use of the differing precessional rates of fat and water molecules, such that they move between being in-phase and opposed-phase and this allows the mathematical combination of four separate echoes within a single imaging sequence.

These echoes are:

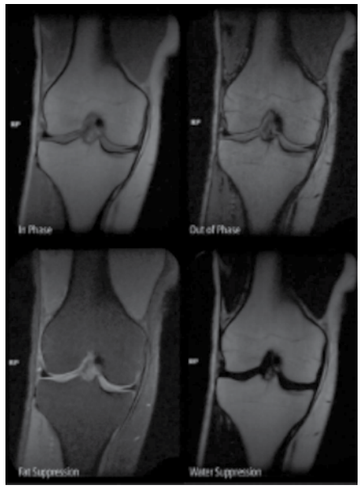
- In-Phase = water+fat
- Opposed-Phase = water-fat
- Fat only
- Water only
  (this can be used as a fat suppressed echo)

How to provide fat suppression at with a low field MRI

Esaote have managed to overcome the lack of a "true" PD FS sequence at lower field strengths by developing a new sequence called SPED. The SPED sequence utilises the Dixon technique of fat suppression on a spin echo sequence.

The SPED sequence is a spin echo type sequence that has two echoes. The echo times are calculated by software according to the resonant frequency and chemical shift between water and fat to produce the four echoes of the Dixon technique on a proton density (PD) weighted base sequence thus giving:

- An in-phase echo that is essentially a PD weighted image
- An out-of-phase echo that looks like a Gradient Echo
- A PD weighted fat suppressed echo
- A PD weighted fluid suppressed echo



◆ Figure 3 – Coronal SPED sequence of the knee showing all 4 echoes

Not only does the SPED sequence provide a low field alternative to the high field PD FS, but it can also be used to as an alternative to T1 FS (T1 fat suppressed) sequences at high field too by changing the repetition time of the sequence (TR). This provides a useful tool for pre and post gadolinium MSK studies.

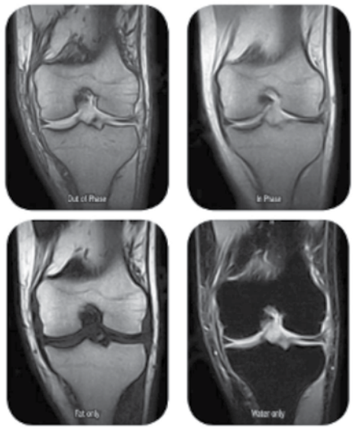
The advantages found when incorporating the SPED sequence into imaging protocols at lower field are:

- Provides good morphological information and fat suppression on PD or T1 weighted imaging
- Provides a higher resolution alternative to only performing STIR sequences as a fat suppressed sequence
- Used to identify pathologies sensitive to PD contrast such as ligament tears, fracture and oedema
- Gives 4 image echoes within 1 sequence – so a lot of additional information for one acquisition

An alternative or addition to the SPED sequence at low field is the STIR sequence. This sequence has the same qualities at high field in that it is sensitive to marrow and soft tissue pathology but can sometimes lack resolution compared to other MR sequences..

◆ Figure 4 showing sagittal STIR sequence of the knee (left) and corresponding SPED sequence (right) - this shows the fluid sensitivity of the STIR but superior resolution of the SPED.

The final option for fat suppression on Esaote MRI systems is called an XBone sequence. The XBone sequence utilises the Dixon technique of fat suppression on a gradient echo sequence. This sequence offers the possibility of changing the flip angle to obtain either T1 or T2 weighted imaging by changing it from around 90o (for T1) to lower than 45o (for T2). The scan time for the XBone is typically quicker than for STIR imaging but provides a higher signal/noise ratio (SNR).

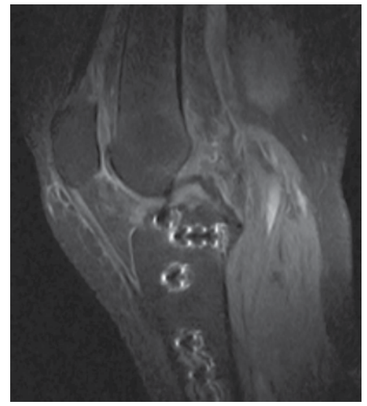


◆ Figure 5 - Coronal T2 weighted XBone sequence of the knee showing the 4 echoes

Discussion on image quality

A recent study entitled "Diagnostic performance of DIXON sequences on low-field scanners for the evaluation of knee joint pathology" by Bellisari, Bruno et al (Acta Biomed 2021, Vol 92, Supplement 5) was performed using 40 patients undergoing knee scanning on a 0.25T Esaote G-Scan and 1.5T GE Signa to evaluate the diagnostic accuracy based on image reading and SNR between high and low-field MRI.

This study found that both the diagnostic accuracy and SNR was comparable between the high field systems using the PD FS sequences and the low field system using the SPED (PD Dixon technique) sequence. The additional bonus of the low field found during this study was that for patients with metal implants the artefact produced by the high field system was much greater than those produced at lower field.



◆ Figure 5 - example of metal in situ on sagittal SPED sequence in Knee on Esaote G-Scan

Conclusion

In conclusion due to technological advancements and improved software and hardware, low field MRI scanners can now comprehensively provide a high standard of fat saturated imaging that is comparable with that which is achieved on higher field systems with the "standard" PD FS sequence.

This can be provided through either Spin Echo Dixon (SPED) sequence alone, or a combination of this with STIR and Fat Sat Dixon (XBone) sequences.

These technological advancements and innovative sequence design means that as more time passes the stigma attached to low field scanning and image quality is being removed and the gap in resolution between these systems and high field system is becoming increasingly narrower.

HBN06

Rachel Watt *BAMRR course coordinator*

What are Health Building Notes?

Health Building Notes (HBN) give "best practice" guidance on the design and planning of new healthcare buildings and on the adaptation/extension of existing facilities. They provide information to support the briefing and design processes for individual projects in the NHS building programme.

Care-group-based HBN's provide information about a specific care group or pathway but cross-refer to HBN's on generic (clinical) activities or support systems as appropriate.

Core subjects are subdivided into specific topics and classified by a two-digit suffix (-01, -02 etc), and may be further subdivided into Supplements A, B etc.

All HBN's are supported by the overarching Health Building Note 00 in which the key areas of design and building are dealt with.

From the table below, Diagnostics falls under **HBN06**

Health Building Note number and series title	Type of Health Building Note
Health Building Note 00 - Core elements	Support system based
Health Building Note 01 - Cardiac care	Care group based
Health Building Note 02 - Cancer care	Care group based
Health Building Note 03 - Mental health	Care group based
Health Building Note 04 - In-patient care	Generic activity based
Health Building Note 05 - Older people	Care group based
Health Building Note 06 - Diagnostics	Generic activity based
Health Building Note 07 - Real care	Care group based
Health Building Note 08 - Long term conditions/long stay care	Care group based
Health Building Note 09 - Children, young people and maternity services	Care group based
Health Building Note 10 - Surgery	Generic activity based
Health Building Note 11 - Community care	Generic activity based
Health Building Note 12 - Out-patient care	Generic activity based
Health Building Note 13 - Decontamination	Support system based
Health Building Note 14 - Medicines management	Support system based
Health Building Note 15 - Emergency care	Care group based
Health Building Note 16 - Pathology	Support system based

There are also Health Technical Memoranda (HTM)- these give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare (for example medical gas pipeline systems, and ventilation systems).

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building. All HBN's should be read in conjunction with the relevant parts of the HTM series.

Background

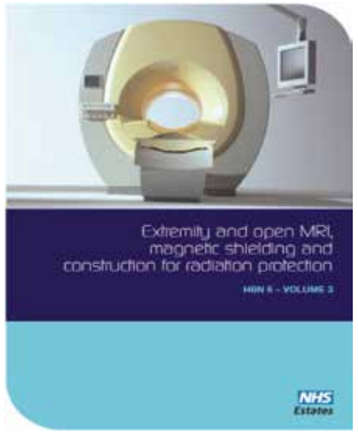
When I was designing my first MRI unit, I turned to NHS Estates Health Building Note 6- Supplement 1- Accommodation for MRI installations, which was written in 1994.

Even then, way back in 2006, the document was outdated, as it spoke about a "high field system of 0.5T" and was thoroughly impractical in terms of throughput and service requirements.

I was frustrated that many MRI departments were being built based on these guidelines, as MRI project teams and architects followed them religiously, when they were no longer fit for purpose.

Health Building Note 6 Supplement 1

Accommodation for magnetic resonance imaging



Having repeatedly highlighted this and campaigned to get them updated, I was delighted when NHS England and NHS Improvement finally agreed to start working on an update in 2019.

How has BAMRR been involved?

I have been actively involved representing BAMRR and the Society and College of Radiographers in updating the document via attending meetings in London (pre-Covid) and then via MS Teams meetings in post Covid times.

Unfortunately like many other projects, the timescale for the update has been severely hampered by Covid. However, it is due to be released shortly.

In conclusion:

I am hopeful the new HBN-06 document will offer up-to date guidance that is relevant to current day working and will result in a safer, more efficient and pleasant working environment for staff and improved experience for patients.

How you can help too....

As an adjunct to this, a multi-disciplinary working party has started on developing more detailed guidance for the planning, installation and decommissioning of new MRI units in the UK.

Again, I have been fortunate to be actively representing BAMRR and the Society and College of Radiographers.

Other groups involved include:

- British Institute of Radiology
- Institute of Physics and Engineering in Medicine
- Siemens
- Philips
- GE
- MHRA

This further documentation will be hosted on the IPEM website and linked in the HBN-06 document as a source for further information.

I know everyone is really busy but if you could spare a few minutes to respond to this, we would be really grateful.

MR Installation Issues Questionnaire

To help with drafting guidance for new MRI installations, we would like to invite you to share your experiences of things that were missed when planning new MRI installations that subsequently led to problems during use.

We would like to include anonymous examples of these within the guidance where appropriate.

Responses will be treated confidentially and not published with site/manufacturer identifiable information.

Please outline the basic details of the MR installation

- Scanner type
- Patient profile
- Installation type (e.g., new build/ upgrade of existing site)
- Please explain the issue(s) that occurred.
- What were the consequences in terms of economic costs, delays, service quality or safety?
- How could these problems have been avoided?

Thank you

Rachel Watt

(On behalf of the Planning and Acceptance of new MRI installations Working Party - IPEM/SOR/ BAMRR)

Please send replies to my email address below

rachelmikado@hotmail.com

UK to change to non-toxic ammunition

Cath Mills *BAMRR Safety Co-ordinator*

Due to the toxic nature of lead the UK is currently transitioning away from the use of lead shot in ammunition with an increasing number of people using steel shot. This change has come about due to the publication of the UK REACH restriction dossier for lead ammunition by the Health and Safety Executive (HSE).

'The proposed restrictions stand to impact all 600,000 live quarry shooters and the estimated four million target and air rifle shooters in Great Britain' (The British Association for Shooting and Conservation statement on proposed lead ammunition restrictions).

Non-toxic steel shot has magnetic properties.

MHRA guidelines on metallic foreign bodies state 'The presence of metallic objects such as bullets, pellets, shrapnel, concealed body piercing, rings, shot etc., or other types of metallic fragments, in particular ferromagnetic objects, is a particular hazard both external and internal to the body'. *(Section 4.11.8 Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use, Feb 2021).*

There is currently no specific MR safety guidance on the topic of accidentally ingested shot which is why raising awareness about the current changes to ammunition is important.

References:

1. UK REACH restriction dossier for lead ammunition by the Health and Safety Executive (HSE) https://consultations.hse.gov.uk/crd-reach/restriction-proposals-004/
2. The British Association for Shooting and Conservation (BASC) statement on proposed lead ammunition restrictions https://basc.org.uk
3. *MHRA Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use* (Feb 2021)

Guidance for the Fire Service on the risks and hazards of an MRI Unit

The following information is extracted from a comprehensive learning resource devised to assist MRI units when developing content for their standard operating procedures (SOPs). To read the full document visit www.mrisafetymatters.com

Barbara Nugent *Radiographer/MRI Safety Matters® training and events manager, European MRSO/MRMD course and ABMRS exam organiser*

Guidance for MRI staff

To assist with developing SOP content, see sections relating to dealing with a fire and emergencies in MRI units in the MHRA Safety Guidelines: https://www.gov.uk/government/publications/safety-guidelines-for-magnetic-resonance-imaging-equipment-in-clinical-use

Guidance for the fire service

For the purposes of this article, we will focus on what guidance would be helpful for the fire service.

Role-based online MR safety training is now available which contains a section on how to deal with emergencies. Available at: https://www.e-lfh.org.uk/programmes/mri-safety/ .These are free to NHS staff or available for anyone else, such as the fire service, for a small fee via: https://www.eintegrity.org/news/eintegrity-launches-new-mri-safety-programme.html

Putting the MHRA recommendations into practice for fire crew training – first alert the fire service to where MRI scanners are located

Pre-planning and gathering of operational intelligence (OI) is essential for the fire service to identify all potential hazards and to produce an incident response plan. However, OI can only be achieved if they are made aware of any MRI unit in their area. If they are not informed, they will not be able to develop an appropriate plan. They must also be made aware of the location of any mobile scanners.

The Fire Service have some national guidance related to the risks and hazards of MRI units

The fire service have access to national operational guidance on MRI scanners and cryogenic materials which provides some basic understanding of the main risks. However, training local fire service personnel on the specific risks and hazards is a useful way of improving their MRI safety knowledge. Familiarisation visits will introduce them to the layout and conditions they are likely to encounter when responding to incidents and help them to understand how to mitigate the risks.

On-site training is useful, but it will not reach all fire crews

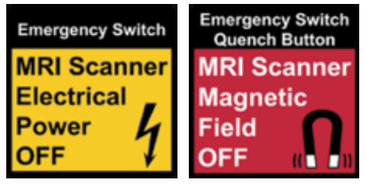
As per MHRA 5.6.3 - It is strongly recommended that sites invite the local fire service, via the hospital fire officer, to visit the MR unit in order to familiarise themselves with the local situation. Consider providing on-site training for local fire crews. Multiple visits may have to be arranged to account for shift patterns and new starts though. At a minimum, a local fire service officer in association with the hospital/organisation's fire officer will carry out an initial OI inspection to identify the specific hazards and control measures relating to the site with annual reviews. Providing further assistance to the fire service in the form of written guidance or recording a training session may prove to be a more practical resource for the fire crews than relying on department visits.

Training points to emphasise when addressing fire crews:

1. *Supervised access of the Controlled Access Area (CAA) is normally required*
   Emphasise the risk of death or severe injury if they are allowed unsupervised access. Fire personnel should only enter the CAA having received relevant MRI safety training and/or understanding the information provided in the fire box (see point no. 14).
2. *A warning notice for fire crews is placed on the entry point to the CAA*
   As per MHRA 5.6.3 - Warning notices must be provided. Consider luminescent text so that the warning may be seen in the dark. MRI Safety notices, such as the example in Figure 1, can be downloaded from: https://www.ipem.ac.uk resources/mri-safety-notices-magnetic resonance-imaging/ .Be aware that fire crews are trained to get through doors and windows and have the equipment to do so. Unless pre-warned and made aware of the risks posed by superconducting magnets, they may not adhere to any notice. If they are dealing with a fire in which they need to access the door they will do so. They need to know where the demarcation zones/restricted areas are for their safety. Unless they understand the dangers of entering the MRI scan room, relying on warning signs as the only deterrent is unrealistic.

◆ Figure 1 IPEM Notice

3. *Fire crews must understand why the magnet must be quenched if they intend to enter the scan room*
   As per MHRA 5.6.3 Access: Ideally, only MR AUTHORISED PERSONNEL should enter the MR ENVIRONMENT unless the magnetic field has been fully quenched or turned off. Superconducting magnet systems: The magnet must be quenched if the emergency services wish to enter the MR ENVIRONMENT with ferromagnetic equipment.
   It's vital that fire crews are made aware that if they access the scan room the scanner will still be at field unless a manual quench is performed. It needs to be emphasized that even though the unit will only be staffed during clinical hours the magnet will be on all the time. How and when the decision to quench the magnet is made should be covered in the SOP. How fire crews are alerted to whether the scanner has been quenched or not should also be detailed.
4. *Risk of projectile injury if any ferromagnetic items enter the scan room*
   The scan room poses a huge risk if fire crews enter, and the scanner has not been quenched. They must be made aware of the hazards that the fringe field can pose if ferrous objects, such as fire extinguishers, axes, crowbars, thermal imaging cameras, radios and breathing apparatus become projectiles. Any personal locators may be affected by the magnetic field too.
5. *Risks to fire crews if entering the scan room with contraindicated implants*
   Explain the risk of death or severe injury posed to anyone with certain implants. In a fire situation there would be no time to screen the fire crew for MRI safety. It is therefore crucial that any fire personnel with any MRI contra indications should not enter the CAA. As the magnetic fringe field may stretch beyond the scan room, the CAA should be cordoned off with warning signs. Fire crews should be warned, for example, of the dangers to anyone who has a pacemaker on the roof space. This area may be considered part of the CAA. There are also risks to anyone standing close to an external quench pipe should the magnet quench.
6. *The importance of communicating to the fire crews if the magnet has been quenched*
   If fire crews must enter the scan room and no MRI personnel have manually quenched the magnet, they must be made aware that the magnet is still at field. If there's a quench button outside the scan room, they must be told how to find and activate that quench button rather than attempt to enter the scan room to press it. (see notes 12 and 13).
7. *Fire crews must be instructed in how to identify where the scan room, control room, equipment room and emergency buttons are located*
   As well as supplying a floor plan to locate the scan room, fire crews should be made aware that they can view the scan room from the "control room" and that electrical stop buttons and quench buttons are usually located in the control room.
   The location of the "equipment room" should be made known as this area can also pose a danger: it houses high voltage power switches, meaning there is a higher risk of a fire occurring there. The equipment room may also contain gas cylinders. Both the electrical isolation switch for the three phase power supply and the water isolation switch can also be found in the equipment room.
8. *As well as providing floor plans, use other descriptors to find rooms more easily*
   Fire crews may have to use torchlights to see. It's best to locate rooms in other terms, such as how many doors they would pass through and approximate distances.
9. *The importance of identifying emergency switches or buttons*
   Fire crews need to differentiate between a quench button and an electrical isolation button. Fire personnel will always seek to isolate the electricity before tackling a fire. Consider placing luminescent signs indicating where buttons are (see IPEM examples of warning notices in Figure 2).



◆ Figure 2 IPEM notices designed to indicate location of emergency switches/buttons

The variety of buttons complicates the identification process (see Figure 3). Buttons should be labelled and located on the floor plan but consider providing a coloured image of all the electrical isolation/ stop button(s) or switches and directions to their location too. Emphasise that electrical stop buttons or isolation switches do not remove the magnetic field.

How to assist the fire service to identify the scanning unit, scan room and electrical stop and quench button(s)

Discuss with fire service officers the best way to have their crews learn about the risks of attending a fire in the MRI unit. Consider ways they could locate the scanner and any quench and electrical stop buttons as well as where any piped gasses may be located.

◆ Figure 3 Images showing the variety of emergency buttons that the fire teams may be faced with

10. *Showing where MR Conditional fire extinguishers are located*
    As per MHRA 5.6.3 Fire: It is recommended that MR_CONDITIONAL extinguishers are provided within the controlled access portion of the MR suite.
    Describe why there should be MR Conditional fire extinguisher(s) within the CAA and how they can be identified by their label and why if they attempt to enter the scan room and use any other type of fire extinguishers, these "MR Unsafe" extinguishers could become projectiles.
11. *Make fire crews aware of the wire mesh in the control room window*
    It should also be made clear that it is very difficult to break the glass between the control room and the scan room in case they think they could extinguish a fire in the scan room from the control room. Explain that the glass contains mesh as part of the faraday cage. The faraday cage also blocks all signals from communication systems within the scan room.
12. *Activating a quench can be dangerous*
    Fire crews would not normally expect to have to quench the magnet. They would expect the MRI staff to have done that if required. It must be emphasized that activating a quench can result in a serious risk to life. Ensure that a warning sign (see Figure 4) explaining the dangers of cryogen gasses is displayed near any quench pipes.

◆ Figure 4 Quench pipe warning notice

Emphasise that no scanner manufacturer can guarantee that their quench system will work safely. The quench could result in helium in the scan room (for further explanation of the dangers associated with the quench read the full article).

13. *It takes time to demagnetize the scanner*
    If training fire crews on how to quench the magnet is considered, what the training entails should be detailed in the SOP. The approximate time that it would take to de magnetize the scanner once the quench button has been activated and the risks of residual magnetism should also be stated (seek scanner manufacturer's advice).
14. *Fire crews need critical information to be available for them*
    When responding to a fire, fire crews will have little time to read copious information in guidance documents. However, succinct information regarding floor plans and unit layout could be placed within a "fire box" (see Figure 5) at the entrance to the unit or a location communicated by switchboard to the fire service.

Installation of a fire box should be agreed with the local hospital fire officer who would liaise with the fire service to see if this is a practical plan. The contents of the fire box should be agreed. Suggested contents are: Floor plans; emergency telephone contact details of appropriate MRI staff and the local Fire Officer; details of how to access the CAA; photographs of relevant buttons and switches with their location and how to identify individual rooms.

To comment on this article please contact: www.mrisafetymatters.com.

◆ Figure 5 Typical example of a fire box that could store essential documents for the fire service arriving at the entrance to the MRI unit

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