

# MR safety week topic

## RF Burns



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### Burns in MRI

Radiofrequency (RF) burns are one of the risks associated with patients who are undergoing MRI. The latest updated guidance from the MHRA (2021) states that burns are the most often reported MRI adverse incident in England.

Extract from MHRA current guidance:

*The main safety issues for radiofrequency (RF) fields used in MR are thermal heating leading to heat stress induced current burns and contact burns. At all frequencies, induced currents will lead to power dissipation within the body's tissues, which in turn will lead to accumulation of energy with time and a rise in body temperature. At frequencies above 0.1 MHz heating effects predominate and this has a major consequence for magnetic resonance imaging. The RF field distribution is not uniform – inhomogeneity increases with increasing field strength, and depends on coil design. Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use 13/86 Absorption of energy from radiofrequency fields used in MR results in the increased oscillation of molecules and the generation of heat. If this occurs in human tissue, a compensatory dilation of blood vessels results in an increase in blood flow and the removal of the excess heat, which is dissipated mainly through the skin. The electromagnetic and thermal characteristics of different organs and parts of organs will differ. The eyes are an example of organs that have very little blood flow. In fact, the lens of the eye has none, and therefore takes time to disperse thermal energy. The testes are organs separated from the main volume of the body and are regarded as heat sensitive. Normally their temperature is a few degrees below body temperature. A rise of 1°C is generally acceptable to a normal healthy person. The actual temperature rise at any time will depend on the balance between the energy absorbed and the energy transferred from the region of the body concerned. The ambient temperature, air flow, clothing and humidity all play a major role in the rate of dissipation. The lower the ambient temperature and the lower the humidity, the greater the transfer.*

### *Contact burns*

*The radiofrequency field will induce currents in conductors and can raise their temperature significantly. Burns to volunteers and patients from contact with such metallic objects can be avoided by careful positioning and set up within the bore of the magnet. Examples of causes are contact with metal in clothing, coils, coil leads, ECG connectors and oxygen monitor probes.*

### *Induced current burns*

*Induced current burns are frequently not immediately sensed by the patients. As such, patients typically cannot warn the radiographer of discomfort or pain prior to thermal damage.*

There have been many reports to the MHRA of burns that have occurred when the arms or the legs have been positioned in such a way as to create a conductive loop pathway.

## Safe practice advice to avoid burns caused by RF heating

### Patient screening prior to MRI

Careful screening prior to MRI can significantly reduce the risk of a burn

- U Patient clothing – always change patients into hospital gowns where possible. This ensures safety and will also avoid artefacts. Some fabrics in clothing can contain conductive fibres. The MHRA recommend appropriate hospital clothing should be worn that does not contain metallic fibres, labels, pockets, buttons or fasteners, nor should it inhibit heat loss.

### Scan positioning and setup

Patient comfort and patient safety are paramount in MRI. It is important to take time to ensure the patient is comfortable as it will lead to greater compliance during their scan. With regard to patient safety, the prevention of burns is the major concern. Poor positioning of the patient and associated cables, leads and sensors, have been the cause of many burns reported to the MHRA. Electrical burns may not be painful immediately as they can start to cause tissue damage at temperatures as low as 43°C.

- U ensure that sufficient insulation is placed between the cable and the patient if contact cannot be avoided
- U do not loop conductive cables or allow cables to cross one another
- U do not pass cables diagonally across the patient
- U ensure that cables run parallel to the bore of the magnet and as close to the centre of the bore as possible
- U ensure that cables do not touch the bore of the magnet
- U ensure that cables exit the bore of the magnet as close to the centre as possible
- U ensure that the patient's skin does not touch the bore of the magnet, or come within 1 cm of touching, transmitting RF coil elements. Use insulation such as the foam pads provided by the MR manufacturer if necessary
- U ensure that no conductive loops form with any parts of the patient's body ie avoid skin-to-skin contact. Foam pads can be placed between the thighs, between the arm or hand and the trunk and between the ankles to avoid the formation of any conductive loops
- U ensure that sensors are placed outside the scanning area whenever possible, as well as away from RF coils
- U Foam pads, 1–2 cm thick, should be used to insulate the patient from cables, the bore and between limbs.

### Communication with the patient during the scan

- U ensure that the patient is instructed to inform staff immediately if they feel any focal warming
- U if the patient is unconscious or for any reason unresponsive ensure that the sites of all sensors are regularly checked for any evidence of heating
- U The use of clothing or blankets as a form of insulation is not recommended. The MHRA recommends the use of foam pads, 1–2 cm thick, to insulate the patient from cables, transmitting RF elements, the bore and between limbs.

### Other important considerations

- U Have a pathway in place for managing suspected burns. As part of safety week BAMRR have created a suggested procedure – PDF download available
- U Have a risk assessment in place, template available from British Institute of Radiology: *Risk assessment for heating* [https://www.bir.org.uk/media/291810/ra\\_4\\_heating.pdf](https://www.bir.org.uk/media/291810/ra_4_heating.pdf)
- U ensure that regular checks for damage are made on all coils, cables and leads for damage and do not use if damage is seen
- U Use only high impedance leads; fibre optic leads are preferred
- U Staff should be appropriately trained, and experienced MR Authorised person should review screening form with the patient they should understand issues for potential hazards within the MR Environment
- U ensure that you are familiar with and follow the manufacturer's instructions This includes using only the monitoring equipment, ECG wires, leads, electrodes and accessories recommended by the MR system manufacturer
- U All suspected RF burns should be documented on local incident reporting system
- U Report all RF burns to the MHRA via the yellow card system

(Reference: MHRA Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use, Feb 2021)



Example of RF burn



Example of RF burn associated with tattoo



Example of RF burn – ECG pad not identified and removed during screening process



Example of RF burn- skin to skin contact inner thigh