Potential RF heating from patient identification wristbands: a phantom study

R.Nazareth, D.Price, & E.Cady

Medical Physics & Bio-Engineering, UCL Hospitals NHS Foundation Trust, London, UK

Background

A laser-printed patient identification (ID) wristband has previously been implicated in a serious radio-frequency burn in an anaesthetised patient undergoing MRI of the lumbar spine at 1.5T [1]. It was postulated that the iron-oxide containing ink in the wristband (possibly in combination with patient sweat) allowed the formation of an electrical current loop leading to a large temperature rise and the consequent severe thermal injury to the patient's wrist. UCLH plans to introduce similar ID wristbands.

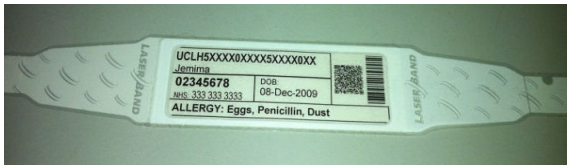


Figure 1: Sample laser-printed patient ID wristband to be used at UCLH

Aim

We used a phantom consisting of pork belly to attempt to replicate the burn incident as closely as possible to investigate the possible risks associated with the use of the new wristband.

Methods

The pork belly was folded and taped into a cylindrical shape representative of the wrist. Scanning was performed on a 1.5T Avanto system (Siemens Healthcare, Erlangen, Germany). A schematic of the experimental set-up is shown in Figure 2. A body loader and large bottle phantom were placed centrally in the bore of the scanner to mimic patient loading conditions. The pork belly phantom was placed on the patient bed 5cm from the edge of the magnet bore and level with the isocentre in the head foot direction - mimicking the position of the wrist for a supine patient undergoing a lumbar spine scan.

Temperature measurements were made with a fibre optic probe monitoring system designed for use in the MR environment (PalmSENSE sensor with Fluotemp, probe, Photon Control INC, Burnaby, BC, Canada). The fibre optic cable was passed through a waveguide from the sensor unit in the console room.

Methods (continued)

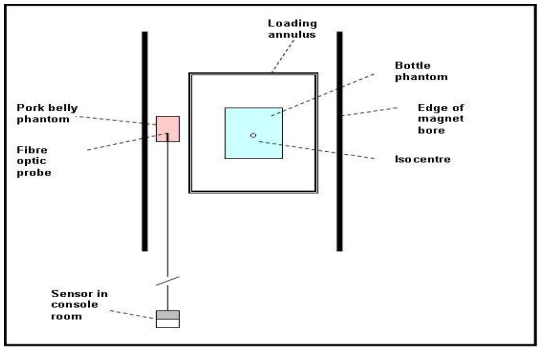


Figure 2: Schematic plan view of experimental set-up

Three sets of measurements were made;

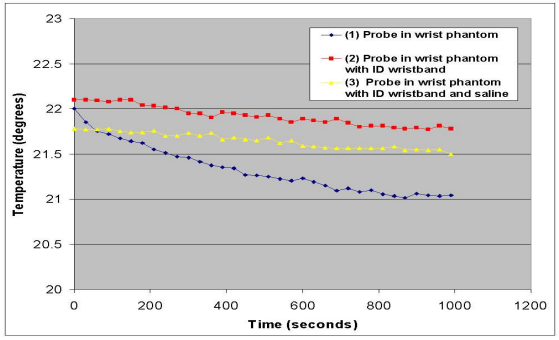
(1) with the temperature probe inserted vertically into a 4 cm deep incision in the surface of the pork-belly so that the tip of the probe was 1 cm from the lower surface.
(2) As **(1)** but with the wristband placed snugly around the phantom with the printed barcode lower-most. Therefore the tip of the probe inside the meat was 1 cm from the barcode
(3) as **(2)** but with a few drops of physiological saline between the wristband and the pork belly.

For each scenario the bottle phantom was scanned with a sagittal T1-weighted spin echo sequence designed for the lumbar spine (TR=656 ms/TE =10 ms/FOV=300 mm x 300 mm/matrix= 256 x 256, 4 averages, scan time = 17 mins). This scan had a high specific absorption rate (SAR) very similar to that used on the anaesthetised patient [1]. The indicated SAR was 99% of the limit for the IEC first operating level (4W/kg).

Results

The temperatures during scanning for the three experimental set-ups are shown in the Graph. There was no evidence of heating for any of the scenarios. In fact in each case there was a very small drift downwards (<1°C) in temperature during scanning probably due to changes in ambient temperature.

Results (continued)



Graph: Wrist phantom temperature during MRI for different experimental set-ups

Discussion

Skin burns are normally caused by accidental formation of closed conducting loops resulting in focal increase in temperature, even with standard MR imaging protocols operating within all current safety guidelines. Although no temperature increases were observed, the creation of an effective current loop may depend on a very specific set of circumstances that are very difficult to reproduce experimentally. For instance, the patient burn was produced using a 1.5T system by a different manufacturer and with a different in-built body transmitter coil. Furthermore, the patient was scanned for much longer than in our phantom study. Therefore it would be prudent to take precautions such as removing the wristband in the case of anaesthetised patients undergoing MRI and ensuring that patients feel no inhibition about reporting any discomfort during MRI. Our phantom did not exactly mimic a real wrist (e.g. no thermoregulation via active sweating or blood circulation, desanguinated tissue, and room rather than body temperature).

Further work under consideration includes studies of human wrists in vivo under carefully controlled safety conditions.

Reference

1 Jacob et al. Radiology 2010;254(3):846-50.