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Assessing the safety and compatibility of silver based wound dressings in a magnetic resonance environment

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ABSTRACT

Introduction: Silver dressings are an integral part of the management of burn patients. Package inserts assert a lack of compatibility and safety with magnetic resonance imaging (MRI) and recommend removal prior to any MRI procedure, although there is no clear evidence to support this recommendation. Dressing removal is associated with increased pain, anxiety, stress, and analgesia use. This study was to determine whether these products produce MRI image distortion or if the agitation of the silver particles generates enough heat which might produce further skin damage.

Methods: Hind limbs from euthanized pigs were used in a 7 T MRI scanner with three standard silver wound dressings. Images were obtained with both dry and wet dressings. Temperature was assessed before and during MRI by probes inserted between the dressing and skin. Images were independently reviewed by a radiologist and MR physicist for distortion.

Results: None of the dressings exhibited significant temperature increases nor produced significant distortion that influenced imaging quality.

Conclusion: Our data suggests silver containing wound dressings do not cause a significant increase in dressing temperature or image distortion and thus their removal is not warranted for clinical MRI examinations.

1. Introduction

The use of silver in wound dressings has increased over the years due to the well documented antimicrobial properties that silver and silver compounds exhibit [1–5]. Current warning labels for dressings containing silver indicate their removal prior to any types of imaging procedures, specifically magnetic resonance imaging (MRI) implying that they are not safe or compatible in a magnetic resonance (MR) environment. Discussions with representatives from various manufacturers indicated that these recommendations are not based on any specific studies that they or other organizations have conducted. This opens the possibility that such a recommendation may not be warranted in the clinical setting.

This warning appears to be based on some of the earliest studies conducted on dental metals and metal implants, many of which contained silver or silver alloys. These studies demonstrated clinically significant distortions in the resultant

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images from MRI procedures due to the metals, potential movement of metal implants, and possible skin surface temperature increases. No consensus on the types of metals that could result in such problems was reached, indicating the importance of individual testing of each metal implant regardless of the type of metal used [6–9].

Although rare, thermal heating of ferromagnetic particles from tattoos or permanent cosmetics resulting in significant patient discomfort necessitating the stoppage of the MR imaging procedure was documented in the past [10–12]. Thus it is important to rule out the possibility of silver containing wound dressings increasing in temperature during MR procedures which can potentially cause local tissue damage and patient discomfort.

The importance of MRI usage in patient care coupled with the warnings indicated on silver based dressings produces a potentially preventable amount of disturbance to the wound site. It has been well documented that dressing changes result in increased pain for the patient leading to increased analgesia use, anxiety, and stress [13,14]. In addition, replacement of wound dressings prior to recommended removal dates incurs added waste and cost to institutions [15].

It is vital to determine if the product insert warnings about the use of silver containing dressings during MRI are valid. There are no studies in the literature to support this warning. Only a recent abstract which looked at three silver based wound dressings from a specific manufacturer, indicated minor temperature increases in the dressings along with no distortion to the image of a conventional MRI procedure. The authors indicated that these results cannot be extended past these three specific products, which magnifies the need for further research on the safety and compatibility of silver containing wound dressings in a MR environment [16].

The Food and Drug Administration defines MR safe when a device presents no additional risk to the patient but may affect the quality of the imaging procedure. The label of MR compatible is given when a device has been demonstrated to neither significantly affect the quality of the diagnostic information nor have its operations affected by the MR device [17].

This study provides a starting point for further investigation on the usage of silver based dressings. Most notably, the dressings used in the previous study contained silver compounds such as silver sulfadiazine, silver thiosulphate, and silver zirconium phosphate while other products use pure silver ions. In addition, no distinction was made between a wet or dry application of the dressing.

The objective of this study was to determine whether three commonly used silver containing wound dressings used in burn treatment will result in any increases in wound dressing temperature and/or image distortion during a MR imaging procedure. This study was approved by the Ohio State University Animal Use Committee.

2. Methods

Three hind limbs from euthanized pigs were studied in an ultra high field 7 T MRI scanner (Philips Medical Systems, Cleveland, OH). The hind limbs were harvested approximately 5 h prior to MR procedures and were kept at room temperature (18–20 °C) indoors without light exposure during this time. A square measuring approximately 5 in. by 5 in., with subdivided quadrants with portions superficially excised using a Weck blade, was marked on the exterior portion of each limb (see Fig. 1).

Three of the most commonly used wound dressings at our institution were tested (see Table 1).

A series of six standard MRI sequences (Localizer, T_2-weighted TSE, T_2-weighted FLAIR, T_2-weighted IR TSE, Single Shot DTI, T_2-weighted IR TSE) were used in the experiment and run concurrently. The scans differed in terms of T_1 and T_2 weighting as well as specific absorption rates. A diffusion weighted sequence was also chosen to see if fast switching gradients interfered with the silver in the dressings.

Temperature was assessed using a Luxtron 790 Fluoroptic Thermometer (Luxtron Corp., Santa Clara, CA). Probes were affixed on the porcine surface for the control sections and placed between the dressing and porcine surface for the experimental sections.

Dressings were first applied to the limb in a dry application and the limb was scanned the 7 T MRI scanner. Water was then applied to the dressings allowing 15 min for the temperature to stabilize after which another series of scans were run.

The images for each set of scans were graded individually on a 0 to 4 scale, in which a 0 rating corresponded with an image without any distortion present and a four signified that the image is unusable. An image receiving a 0–3 grade was considered clinically useful. The overall grade given to a series of images was based on the worst graded image of that series. Clinically, if any particular image was significantly distorted (grade 4), the clinical radiologist would have the choice of ignoring that particular image or repeating the

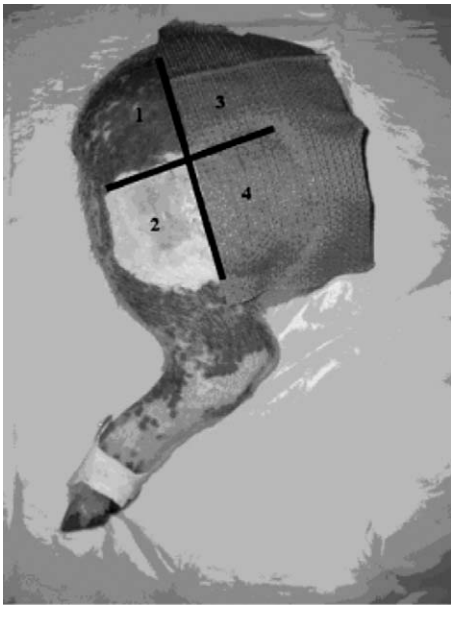

Fig. 1 – (1) Control with skin. (2) Control without skin. (3) Experimental with skin. (4) Experimental without skin.