

MR-Safety and Compatibility of Silver Based Wound Dressings at 7T

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Introduction

Silver containing products are, for decades, an integral part of topical wound care for burn patients [1], [2]. These products are designed to be applied to the wound and left in place until the wound is closed. The package inserts for silver based burn wound dressings assert their lack of MR compatibility and recommend their removal prior to any MRI procedures, although there is no clear evidence to support this recommendation. Repeated dressing removal is associated with a disruption of the wound bed which may delay wound healing, increased patient pain, analgesia use, anxiety, and stress. The purpose of this study was to determine whether silver based wound dressings are compatible with MRI imaging by investigating if ultra high field MRI and silver based dressings produce either increased body surface temperature and/or caused distortions in the resulting MR image.

Material and Methods

On three isolated hind limbs of euthanized pigs, wounds were created in the porcine skin with a scalpel. The depth of the wound varied from superficial skin wound to the surface of the fascia of the muscle. Three standard silver containing burn wound dressings (1) AQUACEL[®] Ag, ConvaTec, Princeton, NJ, (2) Acticoat[®], Smith & Nephew, Inc., London, England, and (3) Silverlon[®], Argentum Medical, LLC., Willowbrook, IL, were placed in a dry application on the wounds. Four fiberoptic temperature probes of a Luxtron 790 Fluoroptic Thermometer (Luxtron Corp., Santa Clara, CA) were placed in four different locations [(A) on the superficial skin wound, (B) on the deep fascial wound and two under the wound dressing: (C) in an area with a superficial skin wound and (D) in an area with a deep fascial wound). The limbs were scanned in 7T whole body MR scanner (Achieva, Philips Medical Systems, Cleveland, OH, USA) using standard MRI sequences (Table 1). The temperature in the four locations was recorded every 20 seconds. Afterwards, water was applied to the dressings and after 15 minutes residence time another series of scans was obtained of the wet application on the wounds. All MR images were graded independently for distortion.



Figure 1 a) Placement of the silver containing wound dressing on a porcine skin wound. b) Experimental setup of the Luxtron 790 Fluoroptic Thermometer and the fiberoptic cables in the 7T.

Table 1 MRI sequences and measurement parameters used to scan pig limbs with silver containing wound dressings at 7T

MR Sequence	TR [ms]	TE [ms]	Matrix	FOV [mm]	Slice thickness [mm]
Survey	7.8	4.9	256x128	250	10
T2W TSE	5500	80	448x434	240	2.5
T2W FLAIR	6500	88	400x399	240	3
T2 TSE IR	4000	9	512x507	240	2
DT SSH	2887	93	96x95	240	4
T1W IR TSE	2000	20	400x315	230	4

Results

All three examined silver containing wound dressings didn't increase the surface temperature of porcine skin wounds significantly when the rf-sequences of Table 1 were used to scan the pig limbs at 7T. The maximum temperature increase of 0.2°C, for areas covered with the wound dressings, was similar to areas without wound dressings, and was within the measurement accuracy of fiberoptics thermometer. The dry and wet application of the silver containing wound dressings at 7T showed no temperature differences during the MRI exam. Image distortions in all images were graded as minimal by two independent readers (Figure 2).

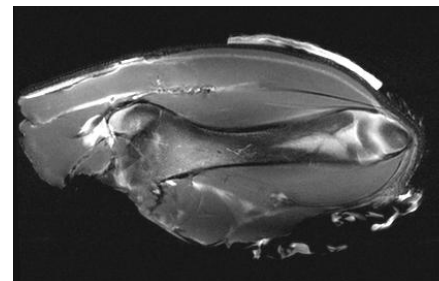


Figure 2 Representative 7T MR image of a pig hind limb with a wound in the porcine skin covered with a silver containing wound dressing (AQUACEL[®] Ag) acquired with a T₂W TSE sequence.

Conclusion

The maximum measured temperature increases of the skin with silver containing wound dressings are within the allowed temperature-rise guidelines of The Food and Drug Administration (FDA) [3]. Based on these results, all tested wound dressings are both safe and compatible with MRI at 7T in the animal model. We believe, therefore, that these Silver containing wound dressings would also be safe in humans. This could be confirmed with human in-vivo studies in the future.

References

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