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ABSTRACT

HDR brachytherapy procedures performed at our institution, including both prostate and cervical cancer treatments, routinely require patients to remain positioned on the Zephyr HDR transfer system during CT and MRI imaging. These imaging sessions typically last approximately 25–30 minutes, and no skin injuries have been reported in association with the transfer system during these procedures. In one reported incident, a patient undergoing a 1.5T MRI simulation under anesthesia had prolonged contact between the right lateral thigh and a metallic side rail of the Zephyr transfer system and remained in contact for approximately –30 minutes. This event was documented and subsequently evaluated.



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A Case of MRI Induced Thermal Injury during HDR Prostate Brachytherapy: Physics Considerations, and Safety Lessons

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INTRODUCTION

A recent case is presented to emphasize an important safety consideration associated with the MR-conditional hover-based Zephyr patient transfer system. While the system enables smooth and efficient patient transfers without disrupting the position of needles or applicators, its use during MRI examinations on a 1.5 Tesla scanner may pose a risk of severe thermal injury under certain conditions. This case highlights the potential hazard and underscores the importance of implementing appropriate safety precautions, adhering to manufacturer guidelines, and ensuring careful patient positioning and monitoring to minimize the risk of MRI-related heating and associated complications.

METHODS AND MATERIALS

Using the Zephyr HDR system, patients can be transferred safely and efficiently between CT imaging on the Biograph PET/CT scanner, magnetic resonance imaging (MRI) on the Toshiba 1.5 Tesla scanner. The MRI protocol for HDR brachytherapy at our center comprises three complementary imaging sequences: T2 mVOX (T2-weighted Multi-Voxel Acquisition), FE 3D SSFP (Field-Echo Three-Dimensional Steady-State Free Precession), and T2 FSE 2D (T2-weighted Fast Spin Echo Two-Dimensional Acquisition). These sequences provide high-resolution soft-tissue visualization and clear delineation of the target volume, surrounding organs at risk, and the implanted brachytherapy applicators, facilitating accurate contouring and treatment planning. The MRI examination typically requires approximately 30 minutes to complete. Throughout the scan, the patient remains in the lithotomy position on the Zephyr HDR system, allowing the treatment position to be maintained consistently from imaging through treatment delivery. This standardized workflow enhances procedural efficiency while supporting the geometric accuracy required for image-guided HDR brachytherapy.

RESULTS

Radiofrequency (RF) plays a critical role in MRI imaging. While RF energy is essential for image formation, it can also cause tissue heating leading to thermal injury. A patient has gone through MRI imaging for an HDR procedure. Patient was placed on lithotomy position on Zephyr HDR system. During follow up patient reported redness of right lateral thigh.

Rt. Lateral thigh wound, Due to MRI RF Burn,



Around more than 100 prostate and cervical cancer patients have gone through HDR treatment involving CT scanning and MRI imaging. After the procedure one patient was observed with skin burns on right lateral thigh which was in contact with metallic stirrups during MR imaging on the 1.5 Tesla scanner. Patient did not feel any pain being under the influence of anesthesia. This skin burn case was reported to hospital risk management team, The vendor and FDA.

Rt. Lateral thigh wound progression/regression over time.



DISCUSSION / CONCLUSIONS



Patient position at Zephyr table with and without insulating material between the rail and table. transfer.

Although the Zephyr system provides robust needle stabilization and enables accurate, reproducible HDR brachytherapy delivery, the potential for MRI-induced radiofrequency (RF) thermal injury remains an important safety consideration. This underscores the need for continued design optimization to minimize RF-induced heating while preserving mechanical stability and treatment accuracy. Until such engineering refinements are implemented, institutional safety protocols need to be established to mitigate the risk of MRI-related thermal injury. These include preventing direct patient contact with conductive or metallic components, such as stirrups, through careful patient positioning, insulation of potential contact points, and verification of patient-device interfaces before MRI acquisition. Collectively, these measures minimize the risk of RF-induced thermal burns while maintaining the accuracy and reproducibility of MRI-guided HDR brachytherapy.

RECOMMENDATIONS

- Ensure the patient wears metal-free clothing and remove all unnecessary metallic objects.
- Use appropriate insulation to prevent skin-to-skin contact, conductive loops, and direct contact with RF coils or conductive materials.
- Follow all MR Safe/MR Conditional requirements and manufacturer instructions.
- Continuously monitor the patient and stop the scan immediately if any heating, burning, tingling, or unusual sensations are reported.

REFERENCES

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