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Medical Physicists in the Age of Artificial Intelligence: Educational Applications in MR Imaging Clinical Practice

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ABSTRACT

Artificial intelligence (AI) is rapidly transforming clinical magnetic resonance (MR) imaging, creating new opportunities and responsibilities for medical physicists. This educational session provides practical guidance on evaluating, implementing, and overseeing AI technologies in MR workflows. Topics include AI-assisted protocol optimization, workflow standardization, MR safety applications, accelerated image reconstruction, AI-specific artifact recognition, and quality assurance/quality control (QA/QC) strategies. Clinical examples demonstrate how AI can improve workflow efficiency, reduce scan times by more than 20%, and maintain or enhance diagnostic image quality, while highlighting the essential role of medical physicists in validating AI performance, managing AI-related artifacts, and establishing robust QA/QC programs. The session equips medical physicists with the knowledge and practical tools needed to safely and effectively lead AI integration into modern MR clinical practice.

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INTRODUCTION

Artificial intelligence (AI) is increasingly being integrated into clinical magnetic resonance (MR) imaging workflows, creating new opportunities and expanding the responsibilities of medical physicists. AI applications in MRI offer several important advantages, including accelerated image acquisition while preserving signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR), improved image quality, and reduced motion-related artifacts, leading to greater workflow efficiency and enhanced patient experience (1–4). As AI technologies become more prevalent in clinical practice, medical physicists play a critical role in evaluating algorithm performance, validating clinical implementation, ensuring patient safety, and developing quality assurance/quality control (QA/QC) programs. This educational program is designed to equip medical physicists with the knowledge and practical skills needed to assess, implement, and oversee AI technologies in MR imaging, with an emphasis on clinical workflow integration, artifact recognition, performance evaluation, and best practices for safe and effective AI adoption.

RESULTS

Clinical implementation of AI-guided MR workflows resulted in improved operational efficiency and enhanced image quality. Scan times were reduced by more than 20% while maintaining or improving diagnostic confidence (Fig.3). AI-assisted reconstructions introduced novel image features and artifacts, which were systematically identified and characterized by medical physicists, enabling clear differentiation between AI-related artifacts and traditional MR artifacts (Fig.4). In addition, medical physicists developed and implemented structured AI QA/QC programs to monitor performance, consistency, and safety of AI tools in routine clinical use.

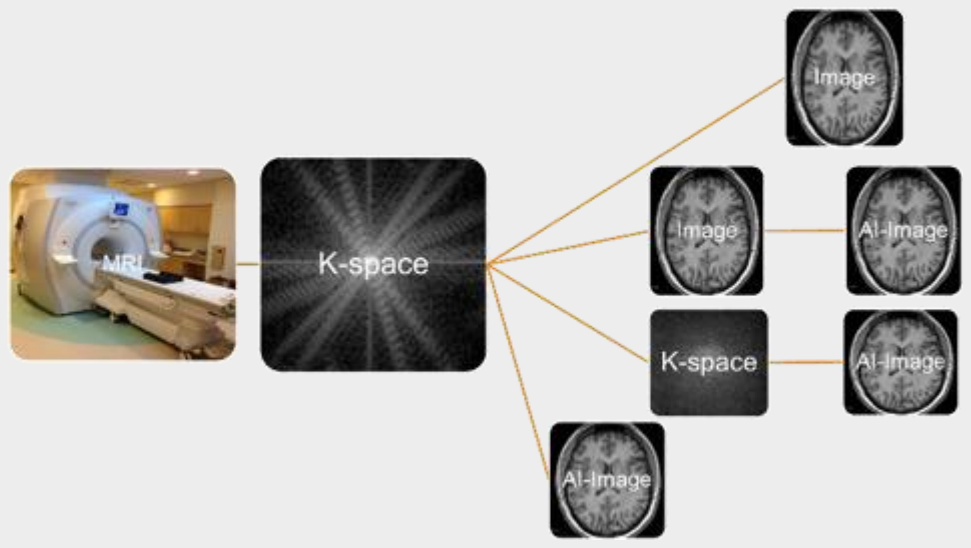

Fig.2. List of AI-assisted Reconstructions used in MR Imaging Clinical Practice for Shortening the Scanning Time while Improving the Image Quality.

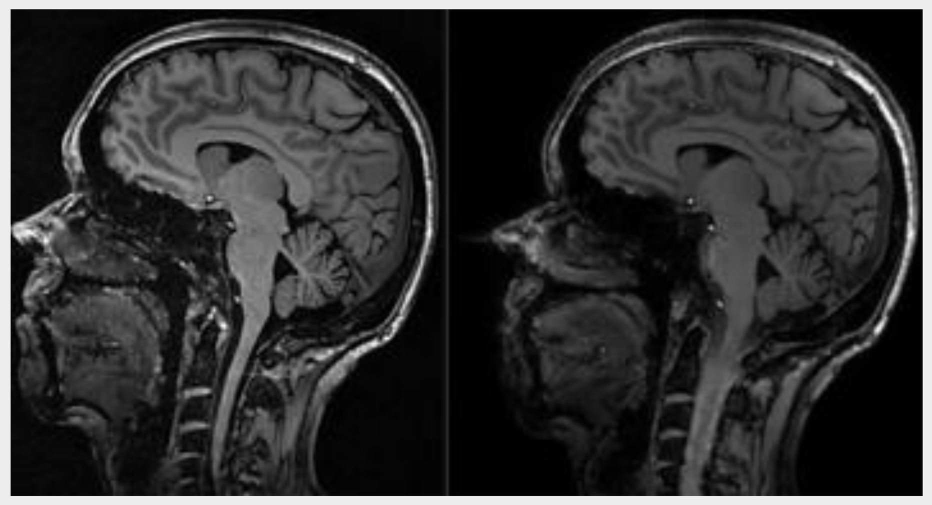

Fig.4. Side-by-side comparison of traditional and AI-assisted reconstructions, illustrating contrast variations and reconstruction artifacts.

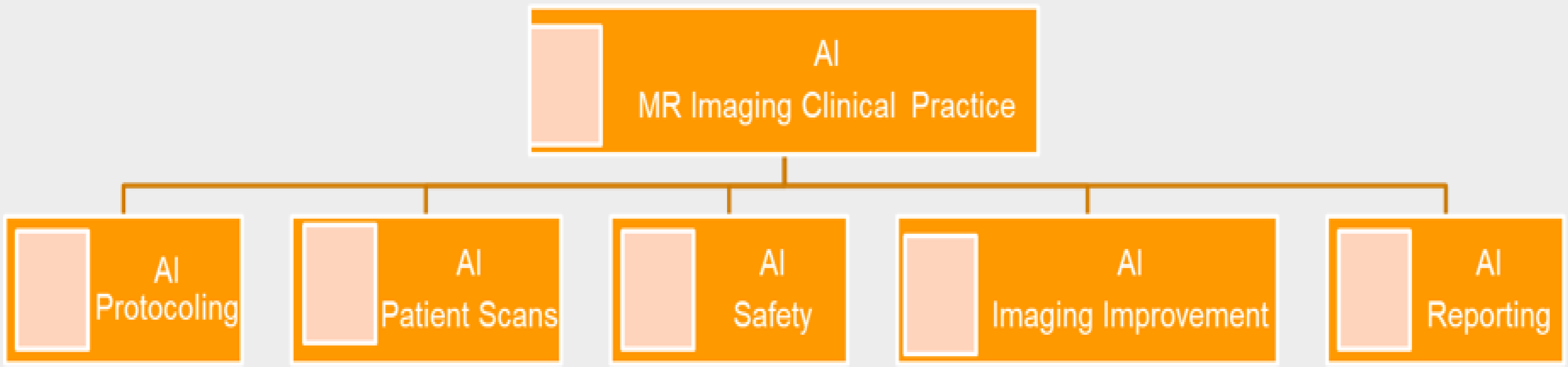

Fig.1. Artificial intelligence (AI) is increasingly integrated into clinical magnetic resonance (MR) imaging practice in protocoling, patient scans, safety, imaging quality improvement, and reporting

METHODS AND MATERIALS

This session will provide practical, education-focused guidance on AI applications in MR imaging from the medical physicist's perspective. AI has been applied in MR imaging including but not limited to educating technologists on AI-assisted protocol execution, remote scan optimization, and workflow standardization; instructing radiologists on AI-enabled protocol selection and customization; applying AI tools for automated implant identification and systematic MR safety assessment; and using AI-based reconstruction and acceleration methods to reduce scan time while preserving or improving diagnostic image quality (Fig.1, 2). The program will address the physicist's role in identifying AI-specific image artifacts, differentiating them from conventional MR artifacts, and developing comprehensive AI quality assurance/quality control (QA/QC) programs. Real-world clinical case studies and multidisciplinary educational workflows will be presented.

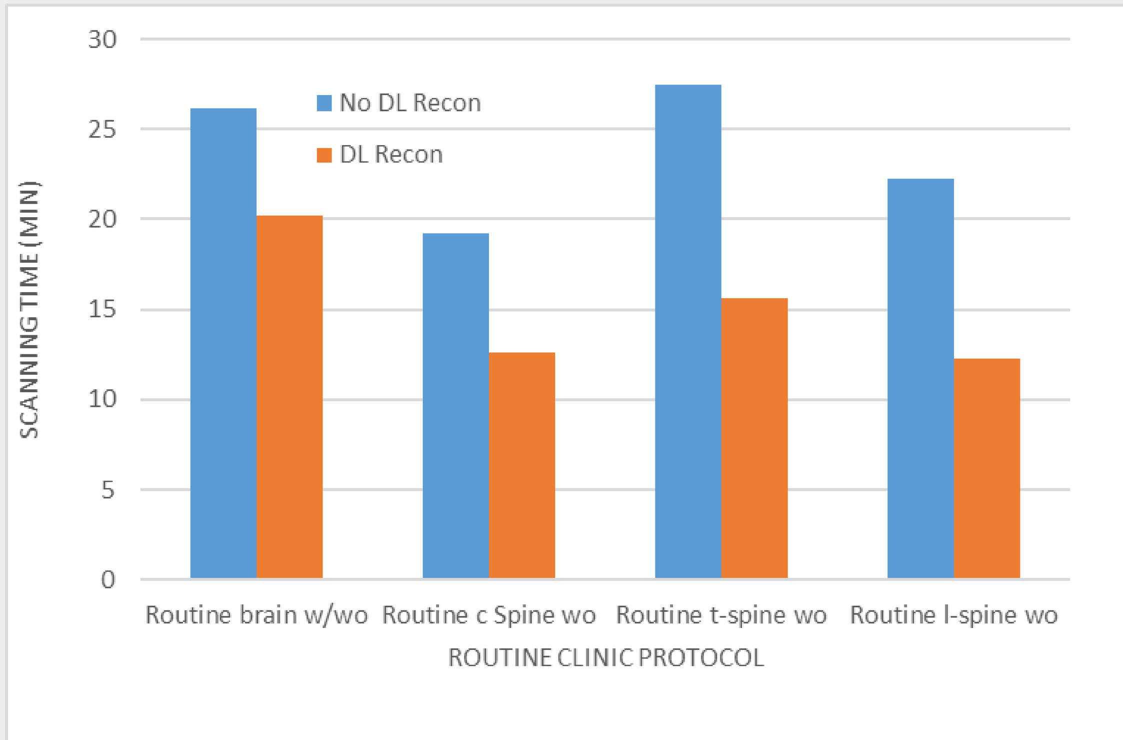

Fig. 3. MR scanning time reduction and efficient changes in MR workflow productivity after applying deep learning in clinical practice.

DISCUSSION

Successful AI implementation requires physicists to evaluate algorithm performance, validate clinical applications, ensure patient safety, and establish robust quality assurance/quality control (QA/QC) programs. Beyond technical oversight, medical physicists play a key educational role by training technologists and radiologists on AI-assisted workflow optimization, protocol selection, MR safety applications, and AI-based image reconstruction.
Clinical experience demonstrates that AI can reduce scan times by more than 20% while maintaining or improving diagnostic confidence.
However, AI-generated images may introduce novel artifacts and image features that require careful characterization and differentiation from conventional MR artifacts.
Through multidisciplinary collaboration and structured QA/QC processes, medical physicists are essential to the safe, effective, and sustainable integration of AI into routine MR imaging practice.

CONCLUSIONS

Medical physicists play a central education/leadership role in the integration of AI into MR clinical practice. By evaluating AI performance, managing AI-specific artifacts, and establishing robust QA/QC frameworks, physicists ensure that AI adoption leads to meaningful improvements in efficiency, image quality, and patient care. This education program equips medical physicists with the knowledge and tools needed to safely and effectively lead AI implementation in modern MR imaging.

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