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Bridging Precision, AI, and Global Collaboration in MRI

It is both a privilege and a pleasure to introduce this RSNA 2025 edition of MAGNETOM Flash. MRI is currently experiencing a transformation, as precision engineering, artificial intelligence (AI), and global collaboration converge to create a more intelligent, efficient, and equitable imaging landscape.

AI has become integral to the MRI ecosystem, not only accelerating reconstruction and improving image quality, but also advancing clinical interpretation, quantitative analysis, and workflow automation. As healthcare systems face rapid growth in patient volumes, intelligent tools that extend expertise and sustain diagnostic excellence are becoming essential. Equally important is a shared commitment to validation and standardization, as this will ensure that emerging technologies are not only innovative but also reproducible and accessible.

The works presented in this edition exemplify this vision. From accelerated neuroimaging and oncologic precision mapping to musculoskeletal low-field applications, cardiovascular innovation, and standardized women's health protocols, each article shows how technology and collaboration will define the future of MRI.

Neurological imaging: Innovation improves speed, comfort, and quality

Neuro MRI continues to advance at an extraordinary pace, transforming how we approach speed, precision, and patient experience. A new generation of technologies are harnessing deep learning, optimized acquisition strategies, and ultra-high fields to redefine the boundaries of clinical neuroimaging.

The pursuit of faster imaging without compromise is central to this evolution [1]. Altmann et al. demonstrate how deep learning-based reconstruction (Deep Resolve) enables ultra-fast pediatric[1] brain MRI within seconds per plane. Diagnostic-quality imaging can now be achieved without sedation, addressing one of the most persistent challenges in pediatric neuroimaging. The impact is impressive: higher completion rates, fewer sedation-related risks, and a reduced reliance on CT for rapid checks when radiation exposure is a concern.

Beyond pediatrics, intelligent acceleration is revolutionizing everyday clinical workflows in neuro MRI [2]. Buxi and Sud illustrate how deep learning has redefined the concept of routine imaging through two-minute MRI protocols on the MAGNETOM Vida platform. By combining Deep Resolve with advanced acceleration techniques such as SMS and GRAPPA, they demonstrate that full neuro examinations can be completed in a fraction of the usual scan time while still maintaining diagnostic integrity. This evolution reflects a new clinical mindset: Rapid imaging no longer means reduced quality, but rather an optimized workflow, enhanced patient throughput, and a patient friendly imaging experience.

Vessel wall and perfusion imaging continue to push the frontiers of neuro MRI capabilities [3]. Fushimi et al. demonstrate the clinical power of DANTE-prepared T1-SPACE imaging for intracranial vessel wall visualization. The DANTE pre-pulse efficiently suppresses flowing blood signals while preserving static tissue, enabling high-resolution, isotropic 0.6 mm imaging that is compatible with compressed sensing and deep learning acceleration.

[1] MR scanning has not been established as safe for imaging fetuses and infants less than two years of age. The responsible physician must evaluate the benefits of the MR examination compared to those of other imaging procedures.

Similarly, Wang et al. show how ASL perfusion imaging can now be reliably performed at 7T through optimized labeling and readout schemes. The collaboration between USC and PLA General Hospital successfully mitigated field inhomogeneity, transverse relaxation penalties, and image distortions, producing high-resolution perfusion maps that reveal collateral flow patterns and even small perfusion deficits.

Finally, technological innovation in MRI is increasingly human-centered. Fernandes Arêas presents practical strategies for managing claustrophobic patients using the 0.55T MAGNETOM Free.Max. The ultra-wide 80 cm bore, the flexible coil design, and Deep Resolve preserve image quality even when the upper coil element is removed to help reduce anxiety [4].

Together, these advances mark a cohesive transformation in neuroimaging. Deep learning has redefined speed, UHF MRI has expanded diagnostic reach, and patient-centered design has made imaging more inclusive. The integration of these innovations moves neuro MRI toward a future where precision, comfort, and efficiency are inseparable – and where technology improves both the imaging and the experience of care itself.

Abdominal imaging: Translating technological advances into clinical practice

Abdominal MRI is experiencing a remarkable transformation – one that is being driven by synergistic advances in gradient technology, motion-robust acquisition, and intelligent reconstruction. This issue illustrates how these innovations are enhancing diagnostic precision, streamlining workflows, and expanding accessibility across a wide spectrum of abdominal diseases.

The introduction of ultra-high-gradient 3T MRI with the MAGNETOM Cima.X (200 mT/m, 200 T/m/s) represents a major leap forward in pancreatic imaging. Zhu and colleagues demonstrate how this system, when combined with deep learning reconstruction for T2-weighted and diffusion-weighted imaging, achieves submillimeter resolution and sharper depiction of fine septations, mural nodules, and central stellate scars. These fine details are critical for precise diagnosis of serous cystadenoma, and of premalignant and malignant cystic lesions. In pancreaticobiliary imaging, MAGNETOM Cima.X provides unprecedented clarity in depicting ductal morphology and diffusion-restricted inflammatory patterns, offering non-invasive differentiation between IgG4-related disease and pancreatic cancer or cholangiocarcinoma. Moreover, the ability to monitor post-therapy changes through DWI introduces a new dimension of longitudinal disease assessment – linking diagnostic imaging with treatment response and surgical decision-making.

The growing emphasis on early detection is also redefining liver imaging. Choi highlights how abbreviated and non-contrast MRI protocols have emerged as efficient and reproducible tools for hepatocellular carcinoma (HCC) surveillance. These techniques, validated across multicenter trials, outperform ultrasound in sensitivity for early HCC while reducing operator dependency. By minimizing scan duration and eliminating contrast use, abbreviated MRI is now feasible as a tool for practical population-scale surveillance programs that combine diagnostic rigor with accessibility, which shows how simplification can drive precision [5, 6].

Progress in motion-tolerant acquisition is reflected in the evolution of GRASP MRI. Initially conceptualized more than a decade ago, GRASP integrates radial sampling, compressed sensing, and parallel imaging into a unified framework for free-breathing dynamic MRI [7]. Feng and colleagues show that the combination of flexibility and reliability is particularly valuable for patients unable to perform consistent breath-holds.

Quantitative MRI continues to enrich abdominal assessment by offering reproducible tissue biomarkers. Serai and colleagues extend magnetic resonance elastography (MRE) to pediatric kidney transplantation, demonstrating that renal stiffness measured by MRE correlates strongly with histological fibrosis and graft health [8]. This development brings us closer to noninvasive transplant monitoring, enabling early detection of rejection and fibrosis while reducing biopsy dependence.

These innovations reflect a cohesive movement toward precision and practicality. Abdominal MRI is evolving from a morphology-based modality to become a comprehensive quantitative ecosystem – one that captures structural, functional, and mechanical information in a single examination. The integration of high-performance gradient systems, deep learning reconstruction, and motion-robust dynamic imaging makes imaging workflows more reproducible, accessible, and patient-centered.
As these technologies mature, their impact will expand and redefine what is possible in abdominal radiology. They will improve early diagnosis, personalize follow-up, and democratize access to advanced imaging. This evolution shows how innovation grounded in clinical relevance translates into meaningful progress for patients and practitioners alike, building a strong foundation for the continued advancement of MRI across specialties.

MSK imaging: Technical breakthroughs and clinical value of 0.55T MRI

As the volume of musculoskeletal implant surgeries grows, the need for accurate diagnosis of implant-related[2] pathologies has become increasingly pressing. The two articles on the 0.55T MAGNETOM Free. Platform offer valuable insights into addressing this clinical challenge.

X-ray and CT imaging have long had limited utility in these cases, and while MRI is an alternative, traditional high-field systems (1.5T, 3T) are hampered by severe metal-induced artifacts, which undermine diagnostic accuracy [9, 10]. The 0.55T system directly targets this pain point. As shown in the work from ZEMODI in Bremen and the University of California, San Francisco (UCSF), the 0.55T system has unique advantages compared to high-field MRI systems when it comes to imaging metal implants. The 0.55T system leverages its inherent low-field-strength advantage to drastically reduce susceptibility artifacts around implants. Its wide-bore design also fills a practical gap, accommodating claustrophobic or overweight patients, who often face barriers to standard imaging, which adds real-world clinical value.

Overall, these findings show that the MAGNETOM Free. Platform is more than just a complement to high-field MRI. It expands the clinical toolkit, and moves post-musculoskeletal-implant care toward greater precision and inclusivity, all of which addresses unmet needs in current diagnostic workflows.

Cardiovascular imaging: Advancing cardiovascular and neurovascular MRI through technical innovation

Significant advancements have been made in CMRI, particularly by optimizing imaging protocols to improve diagnostic efficacy for patients with implantable cardiac devices.[2] Wideband black-blood LGE imaging effectively reduces hyperintensity artifacts, significantly improving the visualization of myocardial scars. This advancement is crucial for accurately diagnosing and managing cardiovascular diseases in patients with ICDs – a population that continues to grow due to the rising prevalence of heart failure and arrhythmias.

Women's health: Optimized protocols for uterus and ovaries guided by ESUR recommendations

Shagalov and Roccia present a practical and anatomically grounded framework for uterine and ovarian MRI, guided by the European Society of Urogenital Radiology (ESUR) recommendations [12, 13]. Their work exemplifies how consensus-based guidance can be transformed into standardized, reproducible, and time-efficient clinical practice.

By merging guideline-based standardization with intelligent acceleration, the authors provide a model for accessible, high-quality pelvic MRI across practice environments. Their contribution encapsulates the broader message of this issue: Precision, (artificial) intelligence, and collaboration together make advanced imaging both efficient and equitable.

Access to care: Expanding equity through mobile and resilient MRI

Expanding global access to MRI requires both greater system portability and operational resilience. Christensen presents a timely and comprehensive overview of mobile MRI as a dynamic and evolving solution to one of healthcare's most persistent challenges: geographic inequality. Christensen looks beyond mere mobility to highlight critical innovations such as helium-free systems and power-save modes, which tackle core operational and environmental limitations of traditional MRI [14]. The integration of AI and remote scanning – rightly emphasized as a game-changer – further enhances the model's viability by centralizing expertise and streamlining workflows.

Complementing this approach, Sharma et al. address another critical barrier: unreliable infrastructure [15]. By enabling automatic recovery after power interruptions without the need for helium refills or specialized engineering support, systems with DryCool technology challenge the conventional dependence on a stable power grid. DryCool technology increases the feasibility of sustainable imaging in challenging settings.

These innovations represent a dual-front strategy for addressing healthcare inequality: Mobile MRI units overcome geographical barriers by bringing imaging capabilities directly to patients, while technologies such as DryCool technology address infrastructural vulnerabilities that can immobilize a scanner even when it is in place.

Conclusion

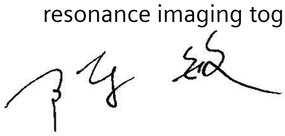
As we look ahead, the promise of MRI lies both in technical sophistication and in our shared responsibility to make these innovations clinically meaningful and globally accessible. From ultra-fast neuroimaging to AI-driven abdominal diagnostics, from low-field musculoskeletal solutions to sustainable mobile MRI systems, the progress reflected in this issue highlights our field's continuous, collaborative evolution.

True innovation in MRI is not achieved in isolation. It thrives in collaboration, validation, and shared purpose. Through initiatives like RSNA and MAGNETOM Flash, we continue to foster this spirit of cooperation, connecting engineers, scientists, and clinicians worldwide. The result is a growing ecosystem where intelligence and empathy go hand in hand, and technology improves not just performance, but patient care itself.

I extend my deepest gratitude to all contributors and readers, whose passion is the driving force of this evolu-

[2]The MRI restrictions (if any) of the metal implant must be considered prior to patient undergoing MRI exam. MR imaging of patients with metallic implants brings specific risks. However, certain implants are approved by the governing regulatory bodies to be MR conditionally safe. For such implants, the previously mentioned warning may not be applicable. Please contact the implant manufacturer for the specific conditional information. The conditions for MR safety are the responsibility of the implant manufacturer, not of Siemens Healthineers.

tion. May this edition inspire continued dialogue and discovery as we shape the next era of magnetic resonance imaging together.



Professor Min Chen

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Editorial Note

I am very happy to welcome André Fischer as Associate Editor. André brings extensive experience in cardiovascular and neurological MRI, and I am delighted that he will join me in shaping the future of *MAGNETOM Flash*.

Please join me in welcoming him to the team.
Antje Hellwich

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