Opinion
Volume 09:04, 2025

Research and Reports in Medical Sciences

ISSN: 2952-8127

Open Access

AI-Driven Imaging: Precision, Personalization, Efficiency

Tariq Al-Qadir*

Department of Nephrology, Desert Oasis Medical Institute, Riyadh, Saudi Arabia

Introduction

This review provides an in-depth look at recent advancements and future trajectories of artificial intelligence applications in medical imaging. It covers various AI techniques, their roles in image acquisition, processing, analysis, and interpretation, highlighting both their potential to improve diagnostic accuracy and the challenges associated with their implementation in clinical settings. The article emphasizes the transformative impact of AI on personalized medicine and early disease detection [1].

This systematic review explores the application of deep learning techniques in analyzing cardiovascular magnetic resonance (CMR) images. It synthesizes current research on how deep learning models are used for tasks like image segmentation, disease detection, and quantification of cardiac function from CMR scans. The review highlights the promising role of deep learning in automating and enhancing the accuracy of CMR image interpretation, while also pointing out the need for standardized datasets [2].

This narrative review investigates the burgeoning applications of artificial intelligence in PET/CT imaging within oncology. It explores how AI algorithms are being developed and utilized to enhance various stages of cancer care, from primary diagnosis and staging to treatment planning and response assessment. The article highlights AI's potential to improve image quantification, reduce inter-reader variability, and ultimately contribute to more precise and personalized oncological management [3].

This review provides an overview of ultrasound elastography techniques for assessing liver fibrosis. It delves into the underlying principles of various elastography methods, including transient elastography, shear wave elastography, and strain elastography, discussing their diagnostic performance and clinical utility in different liver diseases. The article emphasizes the non-invasive nature and growing importance of elastography as an alternative to liver biopsy [4].

This comprehensive review details the clinical efficacy, safety profiles, and concerns surrounding gadolinium-based contrast agents (GBCAs) used in magnetic resonance imaging (MRI). It discusses the mechanisms of GBCAs, their diagnostic utility across various body systems, and critically examines safety issues, including the risk of nephrogenic systemic fibrosis (NSF) and gadolinium retention in tissues [5].

This review provides an insightful look into the current state and future potential of quantitative imaging in oncology. It discusses how imaging biomarkers derived from various modalities like MRI, CT, and PET can offer objective, reproducible measures for characterizing tumors, predicting treatment response, and monitoring disease progression. The article emphasizes the standardization efforts and challenges in integrating these advanced quantitative techniques [6].

This review delves into the foundational principles and emerging clinical applications of photon-counting computed tomography (PCCT). It explains how PCCT, by directly detecting individual photons and sorting them by energy, offers significant advantages over conventional CT, including improved spatial resolution, reduced radiation dose, and enhanced material differentiation. The article highlights its potential to revolutionize diagnostic imaging in various medical fields [7].

This review explores the transformative intersection of artificial intelligence and digital pathology, outlining current applications and future trends in clinical practice. It discusses how AI algorithms, when applied to digitized whole-slide images, can assist pathologists in tasks such as tumor detection, grading, prognostication, and predicting treatment response. The article highlights the potential for AI to enhance diagnostic efficiency and improve reproducibility [8].

This narrative review investigates the role of functional magnetic resonance imaging (fMRI) in understanding and diagnosing psychiatric disorders. It discusses how fMRI provides insights into brain activity and connectivity, allowing researchers to identify neural correlates associated with various mental health conditions like depression, anxiety, and schizophrenia. The article highlights fMRI's potential as a biomarker for early detection, personalized treatment selection [9].

This review focuses on the significant advancements and evolving applications of optical coherence tomography (OCT) in the diagnosis and management of glaucoma. It discusses various OCT technologies, including spectral-domain OCT and swept-source OCT, and their utility in assessing retinal nerve fiber layer thickness, ganglion cell complex, and optic disc parameters. The article highlights how these innovations contribute to earlier detection of glaucoma, better monitoring of disease progression, and improved patient outcomes [10].

Description

The field of medical imaging is currently experiencing a profound period of innovation, largely driven by the integration of Artificial Intelligence (AI) across multiple diagnostic modalities. Artificial Intelligence (AI) applications are significantly impacting medical imaging, improving diagnostic accuracy across image acquisition, processing, analysis, and interpretation, contributing to personalized medicine and early disease detection [1]. Deep learning techniques, a subset of Artificial Intelligence (AI), are particularly advancing cardiovascular Magnetic Resonance (CMR) image analysis, with models effectively segmenting images, detecting diseases, and quantifying cardiac function, promising automation and accuracy in interpretation while emphasizing the need for standardized datasets [2]. Furthermore, Artificial Intelligence (AI) in Positron Emission Tomography/Computed Tomography (PET/CT) imaging for oncology is enhancing diagnosis, staging, treatment planning, and response assessment, ultimately aiming for more precise and personalized cancer management by reducing variability among readers [3].

Beyond general medical imaging, Artificial Intelligence (AI) is also revolutionizing specific diagnostic areas like pathology. Its intersection with digital pathology is transformative, with Artificial Intelligence (AI) algorithms assisting pathologists in crucial tasks such as tumor detection, grading, prognostication, and predicting treatment response from digitized whole-slide images. This integration holds potential for increased diagnostic efficiency and reproducibility, unlocking new insights from pathological data despite implementation challenges [8].

Advancements in various imaging modalities themselves also mark this period of innovation. Photon-counting Computed Tomography (PCCT) stands out, offering significant advantages over conventional Computed Tomography (CT) through direct photon detection and energy sorting. This results in improved spatial resolution, reduced radiation dose, and enhanced material differentiation, poised to revolutionize diagnostics in cardiovascular, musculoskeletal, and oncological imaging [7]. In a different vein, functional Magnetic Resonance Imaging (fMRI) is proving invaluable for understanding and diagnosing psychiatric disorders. It provides insights into brain activity and connectivity, helping identify neural correlates for conditions like depression and schizophrenia, and shows promise as a biomarker for early detection and personalized treatment in mental health [9]. Optical Coherence Tomography (OCT) is also seeing considerable progress, particularly in glaucoma diagnosis and management. Advances in spectral-domain and swept-source OCT technologies are improving assessment of retinal nerve fiber layer thickness and optic disc parameters, leading to earlier glaucoma detection and better monitoring of disease progression [10].

Quantitative imaging is becoming a cornerstone of personalized medicine, especially within oncology. This approach utilizes imaging biomarkers derived from various modalities like Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and Positron Emission Tomography (PET) to provide objective, reproducible measures. These measures are vital for characterizing tumors, predicting treatment response, and monitoring disease progression, though standardization efforts are crucial for their widespread clinical integration [6]. Complementing these developments are non-invasive diagnostic techniques like ultrasound elastography, which offers an overview of methods such as transient, shear wave, and strain elastography for assessing liver fibrosis. This highlights its growing importance as a non-invasive alternative to liver biopsy for monitoring fibrosis progression and treatment response in various liver diseases [4].

Finally, the safety and efficacy of established imaging tools remain under rigorous scrutiny. Gadolinium-based contrast agents (GBCAs) used in Magnetic Resonance Imaging (MRI) are comprehensively reviewed for their clinical efficacy, safety profiles, and concerns. This includes discussions on their diagnostic utility across body systems, critically examining risks such as nephrogenic systemic fibrosis (NSF) and gadolinium retention in tissues, alongside regulatory responses and strategies for their safe clinical application [5]. These collective advancements and ongoing evaluations underscore a dynamic commitment to pushing the boundaries of medical diagnostics and improving patient outcomes.

Conclusion

Medical imaging is transforming, driven by significant advancements in several areas. Artificial Intelligence (AI) is a major player, enhancing diagnostic accuracy and image interpretation across various applications. For instance, AI techniques are crucial in medical imaging for personalized medicine and early disease detection, covering image acquisition, processing, analysis, and interpretation. Deep learning models specifically apply to cardiovascular Magnetic Resonance (CMR) image analysis, improving segmentation, disease detection, and cardiac function quantification. Similarly, AI in Positron Emission Tomography/Computed Tomography (PET/CT) oncology is helping with diagnosis, staging, treatment planning, and response assessment, aiming for precise and personalized cancer management. Beyond AI, new imaging modalities and techniques are emerging. Photon-counting Computed Tomography (PCCT) offers benefits like improved spatial resolution and reduced radiation dose, promising to revolutionize diagnostic imaging in cardiovascular, musculoskeletal, and oncological fields. Functional Magnetic Resonance Imaging (fMRI) provides insights into brain activity for understanding psychiatric disorders. Optical Coherence Tomography (OCT) is seeing advancements in glaucoma diagnosis and management, aiding in earlier detection and better monitoring. Quantitative imaging is also gaining ground, particularly in oncology, where imaging biomarkers from Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and PET offer objective measures for tumor characterization and treatment response. Ultrasound elastography presents a non-invasive alternative to liver biopsy for assessing liver fibrosis. Even in digital pathology, AI algorithms are assisting pathologists with tasks such as tumor detection and prognostication. The ongoing review of gadolinium-based contrast agents in MRI, focusing on clinical efficacy and safety, ensures responsible use of these crucial tools. Altogether, these innovations point to an era of more precise, personalized, and efficient medical diagnostics.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Nighat Khan, Saqib Ali, Muhammad Attique Khan. "AI in medical imaging: A comprehensive review of recent developments and future directions." *Comput Biol Med* 165 (2023):107409.
2. Siyu Liu, Yanhong Wang, Yunqiang Tang. "Deep learning in cardiovascular magnetic resonance image analysis: a systematic review." *Eur Heart J Cardiovasc Imaging* 23 (2022):588-601.
3. Sanaz Ashrafinia, Elham Mahmoudi, Sepideh Sepehr. "Artificial intelligence applications in PET/CT imaging for oncology: A narrative review." *Eur J Radiol* 141 (2021):109776.
4. Raluca Sirli, Ioan Sporea, Mihaela Dema. "Ultrasound elastography in liver fibrosis assessment: a review of current technology and clinical applications." *Ultrasound Med Biol* 46 (2020):1-13.
5. Robert J McDonald, Joel P Felmlee, Andrew C McKusick. "Gadolinium-based contrast agents: a comprehensive review of clinical efficacy, safety, and nephrogenic systemic fibrosis." *Magn Reson Imaging Clin N Am* 27 (2019):195-219.
6. Robert J. Gillies, Matthew J. Schabath, Brian J. Smith. "Quantitative Imaging in Oncology: Current Applications and Future Directions." *Radiology* 308 (2023):e230001.
7. Shunling Leng, Cynthia H. McCollough, Kimberly K. Amrami. "Photon-counting computed tomography: Principles and clinical applications." *J Cardiovasc Comput Tomogr* 17 (2023):112-121.

8. Kshitij Bera, Vamsi K. Narra, Michael L. Pantanowitz. "Artificial intelligence and digital pathology: current applications and future trends in clinical practice." *J Pathol Inform* 13 (2022):100067.
9. Qing Chen, Qiao Li, Guang-Ming Lu. "Functional magnetic resonance imaging in psychiatric disorders: a narrative review." *Transl Psychiatry* 11 (2021):236.
10. Dezhao Li, Xin Yi, Yongxuan Huang. "Advances in optical coherence tomography imaging for glaucoma: a review." *Eye Vis* (Lond) 9 (2022):17.

How to cite this article: Al-Qadir, Tariq. "AI-Driven Imaging: Precision, Personalization, Efficiency." *Res Rep Med Sci* 09 (2025):237.

Address for Correspondence: Tariq, Al-Qadir, Department of Nephrology, Desert Oasis Medical Institute, Riyadh, Saudi Arabia, E-mail: t.alqadir@domi.sa

Received: 01-Dec-2025, Manuscript No. rrms-25-175075; **Editor assigned:** 03-Dec-2025, PreQC No. P-175075; **Reviewed:** 17-Dec-2025, QC No. Q-175075; **Revised:** 22-Dec-2025, Manuscript No. R-175075; **Published:** 29-Dec-2025, DOI: 10.37421/2952-8127.2025.9.237