Advanced AI Methods for Dose Reduction in Interventional and Diagnostic Fluoroscopy

Elliot Berger, DO[1], Paul Grebe, MD[1], Christopher Lantz, OMS-III[2]
[1]Aurora St. Luke's Department of Interventional Radiology, Milwaukee, WI; [2]Des Moines University, West Des Moines, IA

Background

Dose reduction in radiologic procedures and exams is critical for providers and patients to prevent unnecessary radiation exposure. Artificial intelligence (AI) is increasingly becoming a prevalent part of the daily workflow in radiology. Best uses of AI in fluoroscopy are still being studied but may be useful in aiding in the goal of dose reduction. Patients undergoing several procedures can exceed a cumulative effective dose of 100 mSv or more[1]. AI offers the field of radiology a new landscape of tools to tackle the increasing use of traditional and CT fluoroscopy in interventional procedures.

Purpose

To provide an educational overview of how emerging AI technologies contribute to radiation dose optimization across CT and fluoroscopic imaging workflows.

Method: Literature Search

A broad review of current literature was conducted to identify key applications of AI related to radiation dose reduction in CT and fluoroscopy. Themes examined included AI-assisted patient positioning, acquisition optimization, automated region-of-interest selection, equipment performance monitoring, and AI-based reconstruction methods.

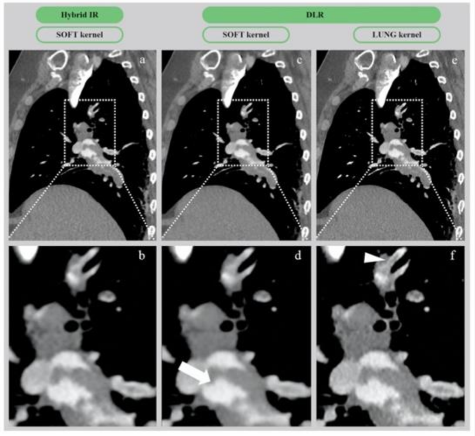

Image from Lenfant et. al showing visually the superiority of deep learning reconstruction while also decreasing patient dose[9].

Assessment of Current Practice

Current recommendations focus on the policy of "As Low As Reasonably Achievable" (ALARA). This is combined with the 3 basic protective measures of time, distance and shielding[2]. These factors that reduce exposure to patient and staff vary greatly depending on who is operating the equipment[3]. AI may eliminate user dependent variation in excess radiation dose. Areas that have a need to be addressed include AI assessment of scan planning, imaging workflows and protocols, quality assurance of imaging equipment, post-processing, and automatic collimation to areas of interest to reduce unnecessary exposure and scatter radiation.

AI Dose Reduction

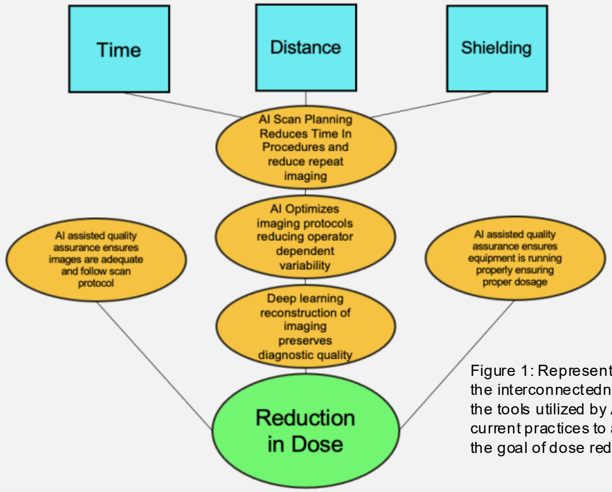

Figure 1: Representation of the interconnectedness of the tools utilized by AI and current practices to achieve the goal of dose reduction

References

1. Li X, Hirsch JA, Rehani MM, Ganguli S, Yang K, Liu B. Radiation Effective Dose Above 100 mSv From Fluoroscopically Guided Intervention: Frequency and Patient Medical Condition. *AJR Am J Roentgenol*. 2020;215(2):433-440. doi:10.2214/AJR.19.22227
2. Guidelines for alara – as low as reasonably achievable. Centers for Disease Control and Prevention. Accessed April 4, 2026. https://www.cdc.gov/radiation-health/safety/alara.html.
3. Nachiappan AC, Horn GL, Spann SC, et al. Operator radiation dose reduction during fluoroscopic interventional procedures. *J Am Coll Radiol*. 2015;12(5):527-530. doi:10.1016/j.jacr.2015.01.001
4. Lesaunier A, Khlaut J, Dancette C, Tselikas L, Bonnet B, Boeken T. Artificial intelligence in interventional radiology: Current concepts and future trends. *Diagn Interv Imaging*. 2025;106(1):5-10. doi:10.1016/j.diii.2024.08.004
5. Bang J, Hough M, Hawes R, Varadarajulu S. Use of Artificial Intelligence to Reduce Radiation Exposure at Fluoroscopy-Guided Endoscopic Procedures. *The American Journal of Gastroenterology*. 2020; 115 (4): 555-561. doi: 10.14309/ajg.0000000000000565. https://oce-ovid-com.dmu.idm.oclc.org/article/00000434-202004000-00014/PDF
6. Sakakura, Yuya, Kenichi Kono, and Takeshi Fujimoto. "Real time artificial intelligence assisted carotid artery stenting: a preliminary experience." *Journal of NeuroInterventional Surgery* 17.4 (2025): 410-414.
7. Tracey J, Moss L, Ashmore J. Application of synthetic data in the training of artificial intelligence for automated quality assurance in magnetic resonance imaging. *Med Phys*. 2023;50(9):5621-5629. doi:10.1002/mp.16361
8. Larson DB, Boland GW. Imaging Quality Control in the Era of Artificial Intelligence. *J Am Coll Radiol*. 2019;16(9 Pt B):1259-1266. doi:10.1016/j.jacr.2019.05.048
9. Lenfant M, Chevallier O, Comby PO, et al. Deep Learning Versus Iterative Reconstruction for CT Pulmonary Angiography in the Emergency Setting: Improved Image Quality and Reduced Radiation Dose. *Diagnostics (Basel)*. 2020;10(8):558. Published 2020 Aug 4. doi:10.3390/diagnostics10080558
10. Clement David-Olawade A, Olawade DB, Vanderbloemen L, et al. AI-Driven Advances in Low-Dose Imaging and Enhancement-A Review. *Diagnostics (Basel)*. 2025;15(6):689. Published 2025 Mar 11. doi:10.3390/diagnostics15060689 https://pmc.ncbi.nlm.nih.gov/articles/PMC11941271/Meta analysis

Literature Results

AI contributes to dose reduction through several mechanisms:

- Improved patient positioning and scan/path planning: AI can reduce unnecessary repeat scans by guiding correct patient alignment[4].
- Targeted fluoroscopy exposure: AI-enabled fluoroscopy systems can automatically select and expose only the pathology-containing region, lowering dose to adjacent tissues and reducing overall exposure[5].
- Optimization of imaging workflows: AI-driven decision support tools can help refine imaging protocols and standardize practices, reducing operator-dependent variability by redirecting the operator if instruments vary from a predetermined path[6].
- Quality assurance and equipment monitoring: AI can help identify performance degradation early and assist in maintaining optimal system functionality before it is noticed by technologists[7]. AI can also assure consistent quality of images and scan protocols which ultimately limits excessive dose[8].
- Integration into reconstruction and post-processing: Deep learning-based CT reconstruction can significantly reduce dose while preserving diagnostic quality, supporting safer protocols across both CT and fluoroscopy[9,10].

Conclusion

AI represents a meaningful advancement in radiation protection strategies for both CT and fluoroscopy. By improving scan planning, patient positioning, ROI targeting, and equipment quality assurance, AI addresses several modifiable contributors to excess radiation exposure. As these technologies continue to evolve, AI is poised to become an essential component of modern imaging safety and education.