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Editorial

The Role of Artificial Intelligence in Urology Practice

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HIGHLIGHTS

- Artificial intelligence includes a set of game-changing techniques and technologies in different industries including healthcare.
- The rising complexity, heterogeneity, variety, and volume of healthcare data leads artificial intelligence techniques to massively be applied to the field of medicine.
- Urology as a broad sub-field of medicine can improve its workflow in all areas of diagnosis, treatment, and prognosis by using advanced artificial intelligence. techniques.

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ABSTRACT

Almost all medicine practices, including diagnosis, treatment, and prognosis of different diseases, need human attention to be precisely performed. As the number of parameters for medical decision-making increases, medical practices become error-prone, time-consuming, and cumbersome, leading to the quality degradation of decision-making procedures. This situation gets severe when most patients need to be considered in routine medical practices. As a science and engineering discipline, Artificial intelligence offers a wide variety of techniques to analyze various medical data with high accuracy and speed. Furthermore, the output of AI systems assists physicians as a second opinion in diagnosing the disease, optimal planning of the treatment procedure, and precise prediction of treatment response. Similar to many sub-fields of medicine, using AI techniques in the practice of urology is becoming prevalent. Therefore, various complex urological disorders can be diagnosed and treated; thanks to AI techniques. Therefore, great attention should be paid to the role of artificial intelligence in urology.

Keywords: Machine Learning; Deep Learning; Computer-Aided Diagnosis; Computer-Aided Detection; Urology Practice

Editorial: Artificial Intelligence (AI) as a multidisciplinary approach is the science and engineering of building intelligent machines capable of performing tasks that typically require human intelligence. The emergence of fast-growing AI-related techniques and technologies revolutionized many businesses, including

healthcare management. In other words, the practice of medicine is rapidly changing in all fields of diagnosis, treatment, and prognosis. As the number of involved parameters and factors in medical decision-making processes is vast, conclusive decision making becomes a more complex task that needs expertise, focus, and attention. The advent of AI-based tools compen-sates for the lack of focus and attention in vital decision-making procedures. In addition, with the emergence of advanced radiology, genetic, proteomic, metabolic, and pathological data, AI-based computational methods are mandatory to extract meaningful and useful patterns from these complex unstructured data to support physicians for decision making.

Furthermore, AI allows eliminating some expensive and life-threatening procedures such as un-necessary biopsies in different stages of diseases. Urology as a broad major in medicine is not an exception. Therefore, many practices, such as urolithiasis, pediatric urology, uro-oncology, uropathology, uroradiology, and renal transplant, are potentially changing using advanced AI tools and techniques (1, 2, 3, 4). Among great AI techniques, machine learning is gaining more attention for modeling and analysis of medical data. Moreover, Deep Learning as a branch of machine learning can perform modeling as an end-to-end learning machine without any feature engineering, especially in cases with complex unstructured data (5).

AI models, usually embedded in computer-aided detection/diagnosis systems, can diagnose and detect different urological disorders and diseases via the knowledge they learned from historical medical records. These systems support urologists in complex and life-changing decision-making processes, especially in diagnosing urological cancers. Prostate cancer is one of the most common urological cancer that beneficiary from AI to be precisely diagnosed. AI can analyze magnetic resonance images of the prostate gland to contour the gland, characterize its tissue, and grade cancer (6). Accurate tumor detection, grading, and staging in bladder cancer are possible by analyzing non-invasive imaging data without the need for any invasive biopsy (7, 8, 9). Histopathological images of urological organs can be automatically analyzed to improve diagnostic accuracy in cancer detection and grading (10). More interestingly, AI allows discriminating complex clinical situations, e.g., differentiating Gleason score six from 7; and distinguishing clear cell Renal Cell Carcinoma (RCC) and papillary RCC with a promising accuracy (11, 12).

AI facilitates the diagnosis of urological disease after the appearance of symptoms and allows early diagnosis before the symptoms start or the disease spreads. This allows high-risk warning people and designing different screening programs in the very early stages of the disease. Early detection of RCC (13) and kidney stones (14) are examples of urological disorders which AI can perform.The AI techniques used in the diagnoses processes can be transferred to the treatment processes to prevent over/under treatment. In other words, accurate, personalized treatment planning based on patient-specific data can be suggested by AI models. Accurate volume measurement and localization of both urological organs and urological tissue abnormalities allow monitoring disease progression over time. Moreover, calculating the exact amount of radiation dosage and drug selection in the treatment procedure is determined by AI models.

AI techniques can also be employed to predict urological conditions' results accurately. Precise prediction of treatment response, recurrence, and survival allow urologists to know their practices' results in advance.

Conclusions

As a complementary technology, AI is attempting to change urology practice nowadays, thanks to health information services. AI-powered urologists can rapidly make complex and non-linear medical decisions in cases of noisy, complex, heterogeneous, and incomplete data. Therefore, false diagnoses and other medical errors will be reduced. AI techniques attempt to explain their decision (how the disease patterns and correlations are found) to support urologists more rationally. Moreover, high quality, high quantity, variety, and density of medical data improve the performance of AI models. Finally, it is highly recommended that urologists, uro-radiologists, uropathologists, and uro-oncologists use AI techniques to improve their performance in challenging diagnosis, prognosis, and treatment planning conditions.

Authors' contributions

HH designed the work and wrote the manuscript. AAA and HSR revised the manuscript critically. All authors reviewed and edited the manuscript.

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Abbreviations

AI Artificial intelligence
RCC Renal cell carcinoma

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Author (s) biosketches

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