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Letter to the Editor

The influence of artificial intelligence on neurological surgery and patient outcome

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Received: 25 April 2024
Accepted: 31 May 2024
Published: 21 June 2024

DOI
10.25259/SNI_321_2024

Quick Response Code:

Dear Editor,

INTRODUCTION

Artificial intelligence (AI) has evolved into a disruptive force in the neurosurgical field, transforming diagnosis, treatment planning, and surgical procedures, among other areas of neurosurgical practice. The application of AI in neurosurgery has enormous promise to enhance surgical results, care for patients, and stimulate new ideas in the specialty. Along with its revolutionary potential; however, the adoption of AI also brings an array of challenges and factors to consider.

BENEFITS OF INTEGRATION AI IN NEUROSURGERY

AI-driven tools can help with accurate surgical planning by producing virtual simulations, automated modeling, and full anatomical reconstructions using patient-specific data.[3] Neurosurgeons can now map out surgical approaches, examine complex brain structures, and anticipate possible problems before they even enter the operating room, which leads to more precise and customized treatment strategies.

AI robotics play a central role in intraoperative guidance. During surgery, neurosurgeons can greatly benefit from the assistance of real-time AI-assisted navigation tools, which may help them navigate intricate anatomical structures, recognize important landmarks, and prevent tissue damage.[5] AI technologies increase surgical precision and reduce the risk of complications while enhancing patient safety by superimposing preoperative imaging data onto the surgical area and providing real-time feedback.

AI enhances treatment by simplifying the creation and execution of personalized intervention techniques. Large volumes of patient data, including genetic data, medical histories, and imaging results, can be analyzed by AI algorithms to create individualized therapy plans that cater to the unique traits and preferences of each patient.[1] AI systems can enhance neurosurgical care by optimizing treatment outcomes, minimizing adverse events, and improving patient satisfaction through the integration of medical information with predictive analytics and machine learning strategies.

By integrating AI, neurosurgeons can conduct data-oriented research by taking advantage of machine learning algorithms and big data analytics to glean insightful information from enormous medical datasets.[2] AI-driven research enables the identification of novel biomarkers, the development of cutting-edge treatment approaches, and significant breakthroughs in neurosurgery by evaluating patterns, trends, and correlations among varied patient categories.

DRAWBACKS OF USING AI IN NEUROSURGERY

The flaws or limits that come with biased training data, computational complexity, or poor data quality could affect AI programs. Variations in imaging techniques, artifacts, and patient-specific characteristics can impact the accuracy and universality of predictions and recommendations powered by AI. This could result in false positives or negatives in clinical decision-making.

The use of AI in neurosurgery brings up significant ethical issues with patient privacy, security of data, informed consent, and accountability for algorithmic mistakes or unfavorable results. Ensuring patient safety and maintaining ethical integrity in medical procedures requires regulatory structures and ethical principles to tackle concerns pertaining to accountability, openness, and responsible utilization of AI technologies.

AI integration takes specific training and technological adjustments for neurosurgeons and other medical practitioners to integrate this technology into clinical operations. Organizational challenges may impede the extensive integration of AI in neurosurgery, reluctance to embrace change, and restricted access to training materials.[4] To address these issues, comprehensive educational programs and organizational assistance are required to enable the incorporation of technology.

The use of AI in neurosurgery comes with a high initial cost for facilities, software, hardware, and regular maintenance.[6] The implementation of AI systems in smaller or under-resourced medical centers may be hindered by resources, budgetary limitations, and differences in access to technology, which would worsen existing gaps in patient care and results.

The successful incorporation of AI in neurosurgical practice requires effective collaboration and communication between human physicians and AI technologies. The safe and efficient use of AI technologies in clinical settings can be ensured by considering feedback mechanisms, decision support interfaces, workflow integration, and human-machine interaction challenges. These challenges may include user interface design, interoperability, and human-AI interaction.

AI technology integration in neurosurgery presents both opportunities and challenges. According to this analysis, AI can assist with surgical precision, preoperative planning, and postoperative care. Nonetheless, there are issues with patient safety, ethical concerns, and the need for extensive training. To ensure that AI algorithms are dependable and safe in clinical settings, future research should focus on improving them. It is also important to consider ethical implications related to patient consent and data protection when using AI in neurosurgery. Collaboration among physicians, engineers, and ethicists is crucial to navigating these complex issues. To ensure the ethical and safe use of AI technology, this study suggests creating comprehensive training programs for surgeons and other medical professionals, as well as robust regulatory frameworks. Besides, continuous monitoring and assessment of AI systems are necessary to recognize and correct any potential hazards or biases. Although AI has the potential to transform neurosurgical practice entirely, it is necessary to ensure the smooth integration and identification of those obstacles to fully utilize it as a valuable tool for improving patient outcomes and advancing the field of neurosurgery.

CONCLUSION

AI is transforming neurosurgery by offering new possibilities for improving surgical accuracy, productivity, and patient outcomes. AI-powered tools are now assisting surgeons in preoperative planning, intraoperative navigation, and postoperative monitoring, making the procedures safer and more efficient. Surgeons can now access real-time data analytics and predictive modeling to develop individualized treatment plans and reduce complications. As AI technologies continue to evolve, they are expected to have an even greater impact on neurosurgery, promising new advancements in surgical techniques and patient care. Overall, the introduction of AI marks the start of a new era of imagination and evolution in neurosurgery.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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How to cite this article: Kashif M, Muthana A, Al-Qudah AM, Hoz SS. The influence of artificial intelligence on neurological surgery and patient outcome. Surg Neurol Int. 2024;15:211. doi: 10.25259/SNI_321_2024