Jharkhand Surgical Chronicles
https://jhsurgicalchronicles.com

Techniques in Surgery

Revolutionizing Remote Surgery: The Impact of Artificial Intelligence on Peripheral Practice

Sunil Kumar[1]*, Saurabh Bokade

1 TATA main Hospital, Jamshedpur, IN
2 NKPSIMS & RC and LMH, Nagpur, IN

Received: 03 June 2024
Accepted: 25 June 2024

***Correspondence:**
Dr. Sunil Kumar
drsunil.jsr@gmail.com

INTRODUCTION

AI involves computers mimicking intelligent behaviour with minimal human involvement, often linked to robots, from the Czech term "robota" meaning forced labour machines. In medicine, AI is divided into virtual and physical realms. Virtual AI employs informatics like deep learning for managing data and aiding decisions in electronic health records. Physical AI encompasses robots aiding patients or surgeons and nano-robots for drug delivery.[1]

AI is a vast interdisciplinary field encompassing logic, statistics, psychology, neuroscience, and more. Strategic foresight in AI applications can shift workplace practices from reactive to proactive, aiding in addressing and mitigating negative impacts on worker safety and well-being.[2]

AI empowers computers to learn from data and mimic human thinking, revolutionizing healthcare with enhanced learning and decision support systems. This transformation affects clinical practice, research, and public health, underlining the crucial significance of privacy, data sharing, and genetic information.[3]

Professionals in the life sciences working with Artificial Intelligence (AI) and Machine Learning (ML) face growing pressure to accelerate algorithm development. These technologies focus on how computers can learn from data and emulate human cognitive processes. AI and ML enhance learning capabilities and provide decision support systems at a scale that is reshaping the future of healthcare. [4]

The fusion of artificial intelligence (AI) with geographic information systems (GIS) has given rise to GeoAI. This emerging field is becoming increasingly significant in health and healthcare, as geographic location plays a crucial role in both population and individual health. [5]

Despite the extensive literature highlighting the significant potential of artificial intelligence (AI), there are no reports demonstrating its effectiveness in enhancing patient safety in robot-assisted surgery (RAS). [6]

The growing need for AI-driven clinical decision support systems (CDSS) underscores the importance of AI-based clinical outcome prediction models. "Dr. Answer," an AI software for predicting outcomes in prostate cancer treated with radical prostatectomy, serves as an effective CDSS. It aids physicians in decision-making and helps patients understand and feel more confident about their treatment outcomes. [7]

The Dr. Answer AI project, developed using a biochemical recurrence (BCR) prediction model, serves as a clinical decision support system that assists physicians and patients in making informed treatment decisions during clinical follow-ups. [8]

Artificial intelligence also plays a significant role in thoracic surgery, aiding in diagnosis, pulmonary disease management, preoperative risk assessment, surgical planning, and outcomes prediction. [9]

While AI in colorectal surgery is currently in its early stages of development, the rapid progression of technologies suggests that it will likely become more integrated into everyday practice in the near future.[10]

Advancements in AI are set to enhance primary and acute care by improving the efficiency and accuracy of diagnosing ankle pathologies. This is particularly beneficial in cases where healthcare providers may lack extensive knowledge of complex orthopedic injuries. AI can bridge this knowledge gap, reduce costs, and shorten the time needed to interpret radiographic images, leading to quicker referrals, treatment plans, and surgical interventions. While AI is gaining traction in foot and ankle surgery, many models still need external validation. Currently, AI models excel at interpreting images but are less effective at making clinical predictions. To fully realize AI's potential in foot and ankle surgery, more research is needed across various topics, and models must be developed to deliver better performance and undergo thorough external validation.[11]

Artificial intelligence (AI) platforms have the potential to significantly transform brain tumor surgery, making it safer and more effective. AI can assist in deciding which patients are suitable for surgery, a critical consideration. Predicting survival for patients with central nervous system (CNS) tumors is challenging but crucial for patients and their families. AI multivariate programs can provide personalized predictions, enhancing patient-centered care. AI could revolutionize the management of brain tumor patients across all stages: pre-operative screening, diagnosis, treatment planning, intraoperative tissue and workflow analysis, and post-operative care, including outpatient and oncological follow-up. Additionally, AI might influence the creation of national guidelines and support brain tumor research and therapeutics, leading to improved clinical outcomes. However, these benefits may be offset by potential downsides, such as physician deskilling, job displacement, and the neglect of individual patient uniqueness. [12]

AI has seen extensive use in cardiology, but its adoption in surgical practice has been slower and more limited. In cardiac surgery, AI is still in its early stages but is rapidly advancing, influencing clinical decision-making to improve patient outcomes. Soon, machine-led algorithms, controlled by human oversight, are expected to take over most decision-making processes in cardiac surgery.[13]

Echocardiography is crucial for diagnosing and managing cardiovascular disease, requiring precise and reliable assessments for effective clinical decision-making. However, diagnostic errors remain a significant challenge. AI has the potential to enhance the analysis and interpretation of medical images, taking them to a new level of accuracy and reliability compared to previous algorithms.[14]

Machine learning (ML) has achieved success in various healthcare fields, but its application in bariatric surgery remains limited. In bariatric surgery, ML is mainly used to predict postoperative complications and weight loss. Despite this limited scope, ML algorithms have demonstrated promising abilities in forecasting surgical outcomes in bariatric procedures. [15]

For aspiring surgeons engaged in remote practice, artificial intelligence stands as a valuable asset. The advancement of robotic and microrobotic surgical platforms is enriching surgical training and refining technical performance. [16]

AI plays a crucial role in decision-making, especially in scenarios with complex treatment options. Accurate predictions from AI models can significantly impact patient and provider behavior by offering objectivity amid uncertainty. Wijnberge et al. used AI to forecast intraoperative hypotension, resulting in fewer episodes and reduced time-weighted hypotension. Similarly, Shimabukuro et al. implemented a machine-learning tool for sepsis prediction, leading to shorter ICU stays and lower in-hospital mortality rates. Successful integration of AI decision support requires alignment with digital workflows and redefining their role in surgical care beyond clinical trials. AI can be implemented in the Enhanced Recovery after Surgery (ERAS) pathway post operatively.[17]

Artificial intelligence (AI) is increasingly utilized in clinical medicine, particularly in surgery where machine learning algorithms serve as decision aids for risk prediction and intraoperative tasks like image recognition and video analysis. Despite its promise, the implementation of AI in surgery warrants careful consideration due to potential pitfalls for hospital systems and surgeons. [18]

Artificial intelligence (AI), particularly natural language processing (NLP), has surged in popularity. ChatGPT, a chatbot utilizing NLP, excels in generating natural conversations. Its medicine integration holds immense potential for healthcare delivery. While studies have assessed ChatGPT's accuracy in self-diagnosis, there's still a gap in research concerning its precision and recommendation of medical consultations. [19]

With the rise of artificial intelligence (AI), machines are now able to perform complex tasks with impressive results. In medicine, machine learning (ML), a key subset of AI, is poised to become an essential part of daily practice. Physicians should familiarize themselves with ML and AI, understanding that these technologies are meant to enhance their work rather than compete with them.Machine learning (ML) requires vast amounts of data to be effective. In medicine, safeguarding patients' personal data is crucial. An example of this concern is the Royal Free London Trust's collaboration with DeepMind, where patient data were handed over without proper safeguards. Millions of individuals in the dataset had not given consent or been informed before their data were transferred to Google DeepMind. This incident highlights the importance of stringent data protection measures in medical AI applications.[20]

All machine learning (ML) algorithms are based on statistical theory to construct mathematical models. Since ML is a probabilistic process, users should expect some degree of error rather than absolute certainty in the results. Therefore, defining acceptable margins of error is essential before starting ML projects. Clinicians are trained to err on the side of caution, especially when there is a potential for serious outcomes, even at the cost of diagnostic accuracy. Machines, however, do not adjust their behavior in the same way and struggle to recognize changes in context, leading to repeated errors. They also lack common sense and broad real-world knowledge. Medical care combines art and science, and machines are unlikely to easily master the nuances of history-taking and physical examinations performed by experienced practitioners. Given these challenges, full machine autonomy in medicine is unlikely in the foreseeable future. However, while physicians are not expected to be replaced, the practice of medicine will undoubtedly evolve with the influence of AI and ML, particularly deep learning, in ways yet to be fully understood.[21]

REFERENCES

Pavel Hamet, Johanne Tremblay. Artificial intelligence in medicine. Metabolism. 2017 Apr: 69S:S36-S40. doi: 10.1016/j.metabol.2017.01.011

John Howard. Artificial intelligence: Implications for the future of work. Am J Ind Med. 2019 Nov; 62(11):917-926. doi: 10.1002/ajim.23037

Nariman Noorbakhsh-Sabet, Ramin Zand, Yanfei Zhang , Vida Abedi. Artificial Intelligence Transforms the Future of Health Care. Am J

Med. 2019 Jul;132 (7):795-801. doi: 10.1016/j.amjmed.2019.01.017

Kamlesh Kumar, Prince Kumar, Dipankar Deb, Mihaela-Ligia Unguresan, Vlad Muresan. Artificial Intelligence and Machine Learning Based Intervention in Medical Infrastructure: A Review and Future Trends. Healthcare (Basel). 2023 Jan 10;11(2):207. doi: 10.3390/healthcare11020207

Kamel Boulos MN, Peng G, VoPham T. An overview of GeoAI applications in health and healthcare.Int J Health Geogr. 2019 May 2; 18(1):7. doi: 10.1186/s12942-019-0171-2

Andrea Moglia, Konstantinos Georgiou, Evangelos Georgiou, Richard M Satava, Alfred Cuschieri. A systematic review on artificial intelligence in robot-assisted surgery. Int J Surg. 2021 Nov:95:106151.doi: 10.1016/j.ijsu.2021.106151

Mi Jung Rho, Jihwan Park, Hyong Woo Moon, Chanjung Lee, et al.Dr. Answer AI for prostate cancer: Clinical outcome prediction model and service. PLoS One. 2020 Aug 5;15(8):e0236553.doi: 10.1371/journal.pone.0236553

Jihwan Park , Mi Jung Rho, Hyong Woo Moon, Jaewon Kim, et al. Dr. Answer AI for Prostate Cancer: Predicting Biochemical Recurrence Following Radical Prostatectomy. Technol Cancer Res Treat. 2021 Jan-Dec:20:15330338211024660. doi: 10.1177/15330338211024660

Valentina Bellini, Marina Valente, Paolo Del Rio, Elena Bignami. Artificial intelligence in thoracic surgery: a narrative review. J Thorac Dis. 2021 Dec;13(12):6963-6975.doi: 10.21037/jtd-21-761

A Spinelli , F M Carrano, M E Laino , M Andreozzi, et al. Artificial intelligence in colorectal surgery: an AI-powered systematic review. Tech Coloproctol. 2023 Aug;27(8):615-629. doi: 10.1007/s10151-023-02772-8

AbhishekVaish , FilippoMigliorini , RajuVaishya . Artificial intelligence in foot and ankle surgery: current concepts. Orthopadie (Heidelb). 2023 Dec;52(12):1011-1016. doi: 10.1007/s00132-023-04426-x

Simon Williams, Hugo Layard Horsfall, Jonathan P Funnell , John G Hanrahan et al. Artificial Intelligence in Brain Tumour Surgery-An Emerging Paradigm. Cancers (Basel). 2021 Oct 7;13(19):5010. doi: 10.3390/cancers13195010

Mohamad Bashir, AmerHarky. Artificial Intelligence in Aortic Surgery: The Rise of the Machine. SeminThoracCardiovasc Surg. 2019;31(4):635-637.doi: 10.1053/j.semtcvs.2019.05.040

Kenya Kusunose , Akihiro Haga , Takashi Abe, MasatakaSata .Utilization of Artificial Intelligence in Echocardiography. Circ J. 2019 Jul 25;83(8):1623-1629. doi: 10.1253/circj.CJ-19-0420

Mustafa Bektaş, Beata M MReiber, Jaime Costa Pereira 3, George L Burchell. Artificial Intelligence in Bariatric Surgery: Current Status and Future Perspectives. Obes Surg. 2022 Aug;32(8):2772-2783. doi: 10.1007/s11695-022-06146-1

Tyler J. Loftus. Introduction to the Artificial Intelligence in Surgery Series. Surgery. 2021 Apr;169(4):744-745.doi: 10.1016/j.surg.2020.09.021

Jeremy Balch, Gilbert R Upchurch Jr , AzraBihorac, Tyler J Loftus. Bridging the artificial intelligence valley of death in surgical decision-making. Surgery. 2021 Apr;169(4):746-748. doi: 10.1016/j.surg.2021.01.008

Majed El Hechi, Thomas M Ward, Gary C An, Lydia R Maurer. Artificial Intelligence, Machine Learning, and Surgical Science: Reality Versus Hype. J Surg Res. 2021 Aug:264:A1-A9. doi: 10.1016/j.jss.2021.01.046

TomoyukiKuroiwa, Aida Sarcon , Takuya Ibara, Eriku Yamada. The Potential of ChatGPT as a Self-Diagnostic Tool in Common Orthopedic Diseases: Exploratory Study. J Med Internet Res. 2023 Sep 15:25:e47621. doi: 10.2196/47621

Powles J, Hodson H. Google DeepMind and healthcare in an age of algorithms. Health Technol

(Berl). 2017;7(4):351-367. doi: 10.1007/s12553-017-0179-1

Jordan Zheng Ting Sim, MBBS, Qi Wei Fong, MBBS, Weimin Huang, PhD and Cher Heng Tan. Machine learning in medicine: what clinicians should know. Singapore Med J. 2023 Feb;64(2):91-97.doi: 10.11622/smedj.2021054