Artificial Intelligence in Surgery: A practice with precision

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What becomes luxury today becomes routine tomorrow, so is Artificial intelligence (AI). First coined by John McCarthy,[1] AI has been a subject of fascination. In a simple definition, it is a calculation or an interpretation of a huge amount of numerical data or algorithm to create a form of intelligence to accomplish an intellectual task. AI has the ability to reason and perform cognitive functions such as problem-solving, object and word recognition, and decision-making,[2] which is why we call it intelligence. With its implication in multiple fields, there is an ever-growing implication of AI in surgery too. Hence surgeons need to have a fundamental knowledge of AI to understand how it may impact the surgical outcome and what future AI holds for surgeons. However, in one of the recent IRCAD (Research Institute against Digestive Cancer) webinars, a survey revealed that 75% of surgeons did not know the fundamentals of AI concepts.[3] Is it due to the complexity of the technique to apply in surgical practice or due to unavailability or reluctance?

AI deals with four core branches – Machine learning, Deep learning or artificial neural networks, Natural language processing, and Computer vision. Machine learning (ML) enables machines to learn and make predictions by recognizing patterns that may be imperceptible to humans performing manual analyses. With the help of multiple algorithms working together, ML may outperform to calculate predictions with more accuracy than conventional statistics.[4] Deep learning (DL) networks are neural networks comprised of many layers and are able to learn more complex and subtle patterns than simple one or two-layer neural networks. Natural Language Processing (NPL) is a computer's ability to understand human language which is helpful in electronic medical records. Computer vision makes machines understand images and videos to recognize the objects and scenes as perceived by humans. It is especially used for computer-aided diagnosis, image-guided surgery and virtual colonoscopy and may play a role in decision making in surgery with precision.

With this advanced ensemble, AI can be used to identify anatomy within the surgical field with better visual perception. Amin Madani et al used semantic segmentation to identify surgical anatomy during laparoscopic cholecystectomy to provide real-time guidance and minimize the risk of adverse events.[5] There is a decrease in error rate in recognizing cancer-positive lymph nodes from 3.4% to 0.5% by pathologists using AI.[6] AI can assist surgeons and radiologists in reducing the rate of lumpectomy by 30% in patients whose breast needle biopsies are considered high-risk lesions but ultimately found to be benign after surgical excision.[7] Hence with help of ML and DL, AI can play an active role in diagnosis, preoperative planning, intraoperative decision making, and post-operative care to help surgeons perform better and be accurate. Robotic surgery, a fantasy for all surgeons, is a form of AI; advancement may lead to the power of robots to do autonomous action in the future soon.

But even with the seemingly huge merits of AI, there is always a limitation of AI too because it depends upon the accuracy of available data and the paucity of data that can alter the predictions made by AI. Systematic biases in clinical data collection can affect the type of pattern AI recognizes or the prediction it may make.[8] Hence we need to critically evaluate the prediction generated by AI and interpret the data in a clinically meaningful way. Hence, a fear that AI not only outperforms but potentially out-thinks its creators in the future may not apply. However, surgeons should constantly involve in clinical data registries to make them more reliable with close association with data scientists. There is a role of surgeons to supervised learning to make machines learn ML algorithms to predict a diagnosis or outcome of surgery.

With expanding use of AI, we should be aware of its clinical implication in surgical practice and embrace it with a purpose to the advantage of surgeon's practice with precision.

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