Commentary

CLINICAL INVESTIGATION

Robotics and surgery

Abstract

Artificial Intelligence is the study of algorithms that enable robots to reason and conduct cognitive functions such as problem solving, object and word recognition, and decision-making. Imaging, navigation, and robotic intervention are all undergoing rapid technological advancements, which are altering surgical techniques. The use of imaging tools such as ultrasound, computed tomography, and Magnetic Resonance Imaging (MRI) before and during surgery allows for complicated surgical navigation and planning. Technological breakthroughs, such as the use of robots in surgery, have been used to detect tumour cells in the body. Much advancement to robots is now being researched and manufactured. Machine learning has surpassed logistic regression in the prediction of Surgical Site Infections (SSI) by creating non-linear models that integrate several data sources, including diagnoses, therapies, and test results. In many Artificial Intelligence (AI) applications, artificial neural networks based on biological nerve systems have grown increasingly significant.

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Introduction

Artificial Intelligence (AI) is a broad term that refers to the study of algorithms that allow machines to reason and perform cognitive skills such as problem solving, object and word recognition, and decision-making [1]. Advances in surgery have had a huge impact on the treatment of both acute and chronic illnesses, allowing people to live longer and longer lives. These developments are based on continuous technological advancements in diagnostic, imaging, and surgical instrumentation. Ultrasonography Computed Tomography (USCT), and Magnetic Resonance Imaging (MRI) are examples of pre and intra-operative imaging techniques that allow for complicated surgical navigation and planning, which is increasingly being paired with robotic assistance, can help to lessen surgical trauma. Advanced wearable and implantable sensors that support early release after surgery, increase patient recovery, and detect post-surgical problems early can also improve postoperative care [2].

Processing power has increased exponentially in the previous 15-20 years, with smaller and smaller form factors. Immersive technologies have grown widespread in and out of the operating room. Head tracking and motion control sets improve visualisation both before and during surgery, and as network connections improve the ability to do procedures remotely may become a reality. AI not only aids indirect treatment and management, but it also aids in the education of future surgeons by providing precise simulation situations [3].

Robotically assisted surgery is referred to as computer-assisted surgery. Technological development is the term for this process. It uses sensors to detect malignant cells. Disposable sensors are placed on the outside of the body yet come into contact with body fluids. Selecting a sensor might be simple if the application and qualities that need to be monitored are well understood. Many advancements to robots are now being researched and manufactured. This technology will benefit a large number of individuals, including the next generation. Artificial intelligence is the study of how to programme computers to accomplish things that humans now excel at [4].

Fields of Artificial Intelligence In Surgery

Machine learning

Machine Learning (ML) enables machines to recognise

patterns, learn, and predict future events. Computer programmes are traditionally written to do a certain goal (e.g., when the user clicks an icon, a new programme opens). Machine learning has outperformed logistic regression in the prediction of Surgical Site Infections (SSI) [5] by creating non-linear models that integrate several data sources, such as diagnoses, treatments, and test results. By analysing patterns of diagnostic and therapeutic data (including surgical resection) in the Surveillance, Epidemiology and End Results (SEER) cancer registry and comparing data to Medicare claims, machine learning with random forests, neural networks, and lasso regression can predict patient lung cancer staging [1].

Natural language processing

Natural Language Processing (NLP) focuses on enhancing a computer's ability to read the human language, and it's crucial for large-scale content analysis like EMR data, especially physicians' narrative documentation. NLP was used to automatically scan through EMRs for words and phrases in operative reports and progress notes that predicted anastomotic leaks in surgical patients after colorectal resections. The ability of algorithms to self-correct as datasets become more representative of a patient group might improve the utility of their predictions [1].

Artificial neural networks

A neural network is an interconnected group of nodes that functions similarly to the human brain's vast network of neurons. Some of the methodologies used to apply neural networks to the problem of learning are Hebbian learning, Holographic associative memory, and the relatively new topic of Hierarchical Temporal Memory, which models the architecture of the neocortex [4]. They're based on biological nervous systems and have become crucial in a variety of AI applications. Using clinical variables such as patient history, medications, blood pressure, and length of stay, artificial neural networks in combination with other machine learning approaches were able to predict in-hospital mortality after open abdominal aortic aneurysm repair with a sensitivity of 87%, specificity of 96.1%, and accuracy of 95% [6].

Application of robotics

In medicine, robotics is employed because it allows for unprecedented control and precision of surgical instruments in less intrusive procedures. They aren't fully autonomous robots capable of doing surgical procedures on their own, but they do lend a mechanical hand to surgeons. A human surgeon is required to operate and programme these devices. Remote control and voice activation are used to operate these surgical robots [6-8].

Limitations of Artificial Intelligence

Machine learning is a great way to find hidden patterns in data. It excels in detecting patterns and establishing relationships that earlier methodologies may miss, and researchers can use these discoveries to develop new clinical questions or ideas about surgical illnesses and treatment. However, there are costs and risks connected with the improper use of machine learning. Machine learning and other AI analyses are limited by the types and accuracy of data available. Built based on a "black box" design. While neural networks automated nature allows them to find patterns that people overlook, human scientists are left with limited ability to examine how or why such patterns were detected by the computer.

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