Artificial intelligence robotic as future surgeon in the aging society

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ABSTRACT

Introduction: A major change in surgical profession has been brought by the combination of surgical robots with the advancing artificial intelligence (AI) technology. Robotic surgery offers greater precision, smaller incisions, faster recovery, and improved visualization, enhancing both patient outcomes and surgeon performance. This sparks interest in patient care and skilled surgeons as we are approaching aging society with the demand of working beyond the age of expected retirement. This study aims to review the advantages and disadvantages of AI Robotic as surgeon and role in the aging society. **Materials and Methods:** A scoping review approach was conducted using literature from scientific databases including PubMed, Google Scholar and Science Direct. Thirty-one research papers for the purpose of defining an AI robotic surgeon in medical fields as well as its advantages and disadvantages were screened based on the keywords over the last 20 years. Only 16 papers were suitable and selected for analysis. **Results:** The da Vinci Surgical System is a prominent example of an AI-powered robotic surgeon. It comprises three main components: a surgeon's console, a surgical cart with robotic arms and end-effectors, and a vision cart. The system is operated by a real surgeon who controls the robot through manipulators, enhancing the surgeon's dexterity, hand-eye coordination, posture, and visual precision. This technology streamlines surgical procedures, reduces operation time, and minimizes the patient's exposure to anesthesia. As a result, it promotes faster recovery, reduced postoperative pain, and fewer complications due to its high accuracy. Despite its benefits, the system is not fully autonomous and still requires a skilled human operator. Surgeons must undergo specific training to safely and effectively use the robotic interface, which can pose challenges, especially due to resistance from those accustomed to traditional surgical techniques. Additionally, ongoing development and integration of AI in surgical systems lead to higher costs, making it financially challenging for many healthcare institutions. Nevertheless, AI-assisted robotic surgery offers a promising future. It enhances surgical accuracy, safety, and overall productivity while improving patient outcomes such as reduced hospital stays, minimal blood loss, and fewer surgical incisions. AI can also assist in instrument positioning and precise manipulation, which reduces physical strain on the surgeon and supports better surgical performance. Importantly, for an aging surgical workforce, AI robotic systems provide valuable assistance. By reducing physical fatigue and enhancing cognitive support, these systems allow older surgeons — especially those over 60 — to safely continue practicing and maintain high standards of care. However, for full utilization, surgeons must understand AI fundamentals and how to integrate this technology into clinical practice. **Conclusion:** In summary, while not without limitations, AI-powered robotic surgery represents a major advancement in surgical care. Its ability to assist human surgeons, especially in complex procedures and among older practitioners, is revolutionizing surgical outcomes and expanding the future of minimally invasive surgery.

Keywords: Artificial intelligence, robotic, surgeon, ageing