Brief Communication
Revolutionizing patient care: the harmonious blend of artificial intelligence and surgical tradition

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Abstract: Surgery has undergone remarkable evolution over the past decades, propelled by unprecedented technological advancement. Despite these changes, the role of surgeons and their irreplaceable qualities remains pivotal. This article delves into the intersection of surgery and artificial intelligence (AI), underscoring the enduring significance of human expertise and values. The potential of AI to learn and improve over time holds great promise for enhancing various facets of surgery, including diagnostics, personalized treatment, preoperative planning, real-time support in the operating room, and comprehensive postoperative analytics of the outcome. However, it is essential to emphasize the continued importance of the surgeon's role to uphold universal surgical principles. This includes a commitment to minimalism and the use of evidence-based practice, ensuring optimal outcomes and standardized procedures. By recognizing the synergies between AI and traditional surgical approaches, we can navigate the evolving landscape of surgery to achieve the highest standards of patient care.

Keywords: Artificial intelligence, surgery, robotic surgery, endoscopy, surgical principles

Introduction

Surgeons find themselves in an unprecedented era. Just fifty years ago, our discipline appeared vastly different, and within these years, we have witnessed a truly transformative journey. The remarkable evolution of medicine during this time leaves us in awe. In earlier years, computers were absent from hospitals, and groundbreaking technologies such as CT scans or MRIs had not yet emerged. Neither robotic surgery nor genetic counseling was part of our medical landscape. Organ transplantations were in their nascent stages, and even then, young physicians believed they were witnessing the zenith of modern medicine [1]. Today's medical graduates may be surprised to know how physicians operated without the plethora of technology and resources available today. Over the last few decades, the field of surgery has undergone significant development. Endoscopy, initially introduced in gynecology, is now widely employed in most surgical disciplines. The exponential growth in scientific publications, coupled with access to big data, has facilitated groundbreaking insights that were once beyond our grasp. A promising emerging discipline, Natural Orifice Surgery (NOS), has revolutionized surgical approaches, allowing for scarless operations and enhancing overall patient outcomes [2]. It is awe-inspiring to witness how far we have come, embracing innovation and technological advancements that have allowed us to reach conclusions that were previously unattainable. We can only imagine what exciting developments the future will bring. Some surgical procedures have been replaced by alternatives such as focused ultrasound or proton therapy. Chemotherapy continues to improve, and the introduction of the immunotherapy which is still in progress has already shown promising results. The path of future surgical developments remains uncertain. Today, the use of surgical robots has become commonplace, and robots are in use in various surgical disciplines. Robotic systems with haptic sensations are offering also a sense of touch alongside visual control [3]. However, the term

'robotic' is misleading as these systems are rather slaves, following their masters' hand movements rather than planning and deciding for themselves.

Artificial intelligence and its role in surgery

AI has already been around for several decades, with its origins dating back to the mid-20th century. The term "artificial intelligence" (AI) itself was coined in 1956 during the Dartmouth Workshop, a seminal event that marked the beginning of AI as a field of study [4].

The first computer-assisted surgery (CAS) systems began to emerge in the early 80th of the last century. These systems helped guide surgical procedures using preoperative images and real-time data.

Some speculate that the AI's role in surgery will grow [5]. It might revolutionize the way surgical procedures are performed and improve the outcomes to unprecedented levels when robots guided by AI assume control. However, the idea remains a distant vision, mainly because AI is still dependent on existing knowledge, making it challenging to handle entirely unpredictable scenarios while case reports are continually being published. Autonomic robotic surgical systems cannot deal with unpredicted situations that never occurred before. It seems, therefore, that we, human surgeons, are here to stay.

Therefore, we have to find out what is expected from the usage of AI in the 21st century, and how it is poised to be a game-changer for the surgical disciplines.

One remarkable aspect of AI is its capacity to learn and improve continuously. AI systems accumulate data over time, refining their algorithms and gaining valuable insight. This ensures that future surgeries can benefit from the collective knowledge derived from past cases. Therefore, the reasons to promote AI today are as follows.

Diagnostics and personalized treatment

Using AI in analyzing vast amounts of patient data as well as the medical literature allows it to provide diagnoses and personalized treatment plans. With machine learning algorithms,

AI can identify patterns that might elude even the most experienced surgeons. This ensures that patients will receive tailor-made treatment, enhancing patient safety. AI will certainly shape the future of the currently developing personalized medicine [6].

Preoperative planning

By integrating a patient's medical history, imaging data, and predictive analytics, AI enables surgeons to strategize and simulate surgical procedures, which is already done in orthopedic surgery. This minimizes surprises, leading to improved surgical outcomes and reduces risks [7].

Assistance in the operating room

One of the most significant advantages of using AI in surgery is its real-time assistance during operations. Augmented reality and surgical robots, guided by AI algorithms, can assist surgeons, providing precise and steady movements, and minimizing possible errors [8].

Analytics and postoperative care

AI algorithms can predict post-surgical complications, enabling to intervene early and prevent potential issues, and assisting with the planning of postoperative management [9].

With each surgical procedure, AI systems accumulate more data, refining their algorithms and gaining valuable insights. Future surgeries will benefit from this collective knowledge.

The future of surgery is undoubtedly intertwined with the continuous development of AI, and will undoubtedly become an indispensable tool. Human expertise, however, will remain irreplaceable, although using AI can pave the way for safer, precise, and optimal surgical interventions.

The surgeon in the 21st century

With these developments, the question arises: what is expected from a surgeon in the 21st century? Certainly, not every graduating physician can or should become a surgeon, as becoming one requires manual dexterity alongside the mental ability and physical stamina necessary for this demanding discipline, in the

era of advanced technical developments. As before, even in the AI era, he or she is expected to possess the human qualities required for effective interaction with patients. Additionally, having medical knowledge is crucial to ensuring optimal surgical indications and using controlled training, as is already done today with the use of surgical simulators.

There are universal surgical principles that apply to all surgical disciplines. Every surgical intervention should adhere to Leonardo da Vinci's principle: "Nothing missing, nothing superfluous", along with Mies van der Rohe's dictum: "Less is more".

Surgery should always be considered the last option of treatment. If surgery is necessary, the optimal approach should be chosen, whether open, endoscopic, or robotic. Each surgical procedure should follow evidence-based methods [10]. Standard surgical procedures should be used not just to achieve optimal outcomes, but also to enable comparisons with other institutions and surgeons, and enable valid meta-analyses. Standardization extends also to the selection of energy sources for hemostasis and the choice of suture material, including the size of needles used [11]. It is essential to minimize the amount of suture material left behind as more suture material may lead to a greater foreign body reaction.

Patient preparation, handling of surgical tools during the operation, and specimen management should follow accepted unified methods, such as the World Health Organization (WHO)'s safe surgery saves lives' [12].

The principle of minimalism dictates that whenever possible, suturing should be done in a single layer rather than using two layers, as supported by evidence-based studies. Additionally, layers that can regenerate themselves, such as the peritoneum, can be left open [13].

Surgeons must stay updated on ongoing developments in their field. Safety should be ensured through strict protocols, and surgical outcomes should be analyzed concerning the specific surgical steps done. Therefore, it is optimal for surgical reports to be standardized, utilizing questionnaires with multiple-choice checklists rather than relying solely on dictated or written free-form descriptions.

Needless to say, despite the recent developments, the importance of the doctor-patient relationship, the ability to listen, and human values and warmth should always remain in the background.

Conclusions

Advancements in surgery have been nothing short of extraordinary, changing from open surgery to endoscopy, robotic systems, natural orifice surgery, and the introduction of artificial intelligence. The possibilities seem boundless; however, it is crucial to strike a balance between embracing AI and preserving the fundamental principles essential for a skilled surgeon. The human touch, empathy, and dedication will forever remain indispensable qualities in surgery. As we venture into an ever-evolving future, let us continue to uphold these principles while embracing the endless potential that artificial intelligence and other advancements bring.

Disclosure of conflict of interest

None.

Abbreviations

NOS, Natural Orifice Surgery; CAS, Computer-Assisted Surgery; AI, Artificial Intelligence; WHO, World Health Organization.

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