

# AI and surgery — Skynet or a great opportunity?

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**B**y now, most of us have likely tried out some type of online experience with artificial intelligence (AI) algorithms. Even those of us who have no idea what is under the hood of this innovation can see the novelty in ChatGPT and DALL-E or similar tools. Generating answers to esoteric questions or novel artwork for presentations aside, the use of AI in surgery — both in clinical scenarios and on the research front — is becoming useful.

Artificial intelligence is loosely defined as algorithms that enable machines to perform what seem to be normal cognitive functions. Machine learning refers to algorithm-based modelling from sample data that train the evolution of the algorithm to make decisions without being explicitly programmed to perform that function. Reinforcement learning (RL) refers to machine-learning techniques that solve subtasks that are difficult to render in precise analytical models. In surgery, that may be minimizing robot soft tissue damage. Reinforcement learning algorithms are formatted based on policies learned from demonstrations instead of learning *de novo*. This reduces the time needed for the learning process. But can these algorithms and learning processes be used in current surgical practice?

Despite being an emerging technology, there are several areas in surgical care where AI may be of early help. For example, preoperative planning can be improved using historical cases, and AI can be implemented from registries with excellent data to train the models. Using historical data, the AI functions to choose optimal scenarios for future surgeries. Even before implementation of AI, surgical planning with navigation has improved through advanced imaging data. This has already been used for minimally invasive surgery combined with robotic assistance. Many studies have shown decreased surgical complications and improved outcomes. In the same vein, AI may be used to cut down on the number of unsuccessful surgeries by enabling early diagnosis and intervention with minimally invasive techniques; sepsis, arthritis, or vascular disease may be easy targets. The National Health Service in the UK has initiated a program called Accelerating Detection of Disease that will leverage big data and AI to develop solutions for the early detection and anticipation of illnesses in the UK.<sup>1</sup>

We are a little early for AI-driven intraoperative total care outside of optimization of current robotics. Complete robotic replacement of surgeons is a little way from reality, but assistance will be available very soon. Accurate tracking of tissue deformation is vital in intraoperative guidance and navigation in minimally invasive surgery. It currently could not be accurately modelled, but scientists have developed an online learning framework that attempts to track tissue deformation.<sup>2</sup> Minimally invasive procedures are increasingly being used with robotic assistance, and an AI augmentation could be possible. Machine learning helps identify critical insights and state-of-the-art practices by canvassing millions of data sets. Companies have performance-guided laparoscopic AI robots that provide information, such as tissue quality and size, back to surgeons.<sup>2</sup> At the same time, human skills are used for programming these robots by demonstration, where they modify behaviour by imitating operations conducted by surgeons. Certainly, in the tele-surgery field AI-assisted remote surgery would be a useful target. Surgeons could soon use surgical robots through a controlling AI program interface to perform surgery.

Although the permutations of helpful AI appear extensive, a warning on the innovation and research side is probably necessary. More specifically, using online AI tools would seem to be an easy way to deepen a patent search. Any patent search with AI algorithms in which proprietary information is used to determine patent novelty is dangerous. The act of any search, using information from your invention, means the idea is now in the public domain. This act would therefore invalidate some patent applications. A warning has also been sounded by several technology leaders on the rapid progress of AI systems to mimic human tasks. They have asked for a halt to progress in the language models in particular. It will be interesting to see if this warning will actually be heeded. It is an exciting area of growth for surgery and medicine in general, but to quote Sgt. Phil Esterhaus from *Hill Street Blues*, “Let’s be careful out there.”

**Edward J. Harvey, MD; Chad G. Ball, MD, MSc**

**Affiliations:** Coeditors-in-chief, *CJS*; the Department of Surgery, McGill University, Montreal, Que. (Harvey); and the Department of Surgery, University of Calgary, Calgary, Alta. (Ball).

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