Editorial

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New surgical robots on the horizon and the potential role of artificial intelligence

After many years of monopoly with the amazing Da Vinci system, Intuitive Surgical finally faces some market competition from international companies vying to occupy the surgical robotics space with their own versions of next generation robots [1]. Open consoles, lighter instruments, and greater portability will be recurring themes in these systems. There is even renewed interest in automation which goes back nearly 30 years to the days of John Wickham. The STAR robot can suture bowel better than a human hand but without human interference. Based on the concept of supervised autonomous suturing, it amalgamated 3-dimensional imaging and sensors (near-infrared fluorescent/NIRF tags) to partake in intestinal anastomosis of a pig [2]. The Revo-i, a Korean robot, has completed the first clinical testing in 17 patients undergoing Retzius sparing robotic assisted radical prostatectomy (RARP). It is a fine example of honest reporting where even in experienced hands, three patients underwent blood transfusion and the positive margin rate was 23% [3].

The new machines have the potential to reduce the cost of robotic surgery to be similar to that of laparoscopy although the initial hardware outlay may still be substantial. Cambridge Medical Robotics from the UK have plans to introduce newer costing models which go beyond just the hardware and cover maintenance, instruments and even assistants as a comprehensive package. This may make robotics attractive to multidisciplinary expansion in the east, amongst high volume open and laparoscopic surgeons. For example, in eastern India where prostate cancer is rare but rather aggressive in those who get it, lower costs could encourage a greater acceptance of robotic surgery. Data from the Vattikuti Foundation shows that there are currently 60 Da Vinci systems in India with about half the surgeons being urologists and RARP the commonest procedure. An audit of a contemporary series of RARPs from Kolkata in mainly high risk prostate cancer showed a biochemical recurrence free survival of 75% at 5 years and 90% continence. While cohesive multidisciplinary team building will reduce costs, it is likely that the application of Markov modelling will determine the medium term cost-effectiveness of robotic surgery in the developing world.

While cost may dominate the headlines, the two other aspects in the world of new robots that are causing excitement are artificial intelligence (AI) and faster digital communication. The era of surgical AI has commenced although the concept is not new, going back to genius of Alan Turing, who with his decoding skills had a major impact on the outcome of World War II. Fashionable as it may sound, AI may well be the driving force of the future, digitising surgical practice.

AI is the superset dealing in myriad complex computer programs designed to fulfil a target by executing decisions. As such it is akin to human intelligence with examples like visual perception, speech recognition and language translation. Machine learning (ML) is a subset of AI, using the decision making computer algorithms to grasp and respond to specific data. For example, a prostate recognition algorithm could make the machine learn whether a given image is that of a prostate cancer or not, thus reducing the variability in magnetic resonance imaging readings by radiologists. Artificial Neural Networks specifically Deep Learning, Graphic Processing Units and unlimited data storage capacities have revolutionised modern day ML systems, making the executions faster, cheaper and more powerful than ever. The video recordings of surgeons performing RARP can now be converted through a black box into Automated Performance Metrics and demonstrate surprising findings in that not all high volume surgeons are necessarily those with the best outcomes [4].

Verb Surgical is a joint venture between Johnson & Johnson's medical equipment division Ethicon and Google's life sciences division Verily. It has recently designed its first

digital surgery prototype, boasting of leading-edge robotic capabilities and best-in-class medical device technology. Robotics, visualisation, advanced instrumentation, data analytics and connectivity are its prime pillars.

IBM's Watson also looks forward to being an intelligent surgical assistant. It is a harbinger of unlimited medical information, using natural language processing to clarify a surgeon's doubts. It is currently being used to analyse electronic medical records and sequence tumour genes with the goal of formulating more personalised treatment plans.

Surgery may be further democratised by low latency ultrafast 5G connectivity. The Internet of Skills could make remote robotic surgery, teaching and mentorship easily accessible, irrespective of the location of the expert surgeon [5].

In summary the three buzz words for the future of robotic surgery are–cost, data and connectivity. The impact of these developments on patient care are being watched with considerable interest.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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