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ROBOTIC SURGERY – REALITY OR FANTASY?

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A b s t r a c t

The authors describe a new robotic system Da Vinci, his advantages and disadvantages, and possibilities for surgery. In the Czech Republic, a third robotic system Da Vinci has now been installed, after two hospitals in Prague (Na Homolce and Military Hospital).

K e y w o r d s

Laparoscopy, Robotic surgery

INTRODUCTION

Since 1921, when the Czech playwright Karel Capek introduced the notion and coined the term robot in his play *"Rossom´s Universal Robots"*, robots have taken on increasingly more importance both in imagination and reality. Today robots are used to perform highly specific, highly precise and dangerous tasks in industry and research, previously not possible with human work force. Robots have been routinely used to manufacture microprocessors used in computers, explore the deep sea, and work in hazardous environment. Robotics has now begun very slowly to participate in medicine. Dramatic developments in operative techniques in general surgery are rare (*1*). The latest revolution was the introduction of laparoscopy in general surgery. Since the early 1990s, laparoscopy has become a widespread technique and the results have improved continuously. Robotic-assisted surgery was introduced in the late 1990s with the objective to overcome the technical limitations of endoscopic surgery. Robotic surgery is a new and exciting technology which was developed to extend minimally invasive techniques. Currently, healthcare organisations have been using robot technology for thoracic, abdominal, pelvic, and neurological surgical procedures. Robotic surgical systems are most effective for operations in areas that are small and difficult to reach. Ideal indications for this new technology have yet to be established (*2*). The aim of our manuscript is to introduce this system and offer a literature review to provide an objective evaluation of this technology.

Advantages of Robot-assisted Surgery

Minimal invasive surgery reduces the amount of in-patient hospital days, reduces operative approach, decreases blood loss, decreases postoperative pain and infection (*4*). The advantages of robotic systems are many because they overcome many of the obstacles of laparoscopic surgery. They increase dexterity, restore proper hand-eye coordination and an ergonomic position, improve visualisation, eliminate hand tremors, allow greater technical precision. The surgical endo-wrist can articulate and rotate by 360 degrees, thus improving manoeuvring around organs and vessels (*4,5*). The endo-wrist simulates normal wrist movement. Telemanipulators offer a higher precision by down-scaling the surgeon's movements and by increasing the degrees of freedom of the instruments (*1*). In robotic-assisted surgery, a three-dimensional image is obtained, mimicking the natural surgical field with the added advantage of optical magnification. Telerobotics may influence laparoscopy in two ways. Firstly, the learning curve may become shorter and secondly, telerobotic-assisted laparoscopy should be more precise than the traditional laparoscopy. Another point is that telemanipulators allow operations from a distance. *Tewari et al.* have recently published a prospective nonrandomised study comparing telerobotic laparoscopic prostatectomy (Da Vinci, n= 200) with traditional laparoscopic prostatectomy (n= 100). They showed decreased blood loss, complication rate, length of hospital stay, and duration of catheterisation (*6*).

Disadvantages of Robot-assisted Surgery

There are several disadvantages of these systems. One of the biggest is absence of touch sensation and a very expensive price. *Costi et al.* have calculated the actual costs for the Da Vinci system in Belgium. The price of initial purchase, delivery and installation amounted to 1 258 262.5 Euro (*7*). They also described higher running costs for the robotic instruments and the necessary accessories in comparison to traditional laparoscopic instruments. In the Czech Republic the price is higher, close to 60 million Czech crowns. New technology requires a proper operating theatre and new extra staff to operate.

The da Vinci Robotic System (Surgical Intuitive, Inc., Mountain View, CA)

The da Vinci robotic system provides excellent three-dimensional vision as well as motility of endosurgical instruments (*8*). In the da Vinci system there are 3 essential components: a master console, where the operating surgeon sits, a four-armed robotic telemanipulators that is placed at the operating table, and a video system. The surgeon may use a fourth arm as an assistant. The master console consists of an image processing computer that generates a true 3-dimensional image with a very important depth of field, foot pedals to control electrocautery, a camera focus, instrument-camera arm clutches, and master control grips. The instruments provide 7 degrees of freedom (*2,9*). The surgeon is seated at the console inside the operating room and controls the movement of instruments and the camera by

telemanipulators (*Fig. 1*). The manufacturers train the surgeons on the technology. Each manufacturer has established special training sites in different locations throughout the United States and in Europe. The training involves the basics of picking up objects with robotic arms and operating on human and animal cadavers. The training requirement totals 40 hours or more before the surgeon is considered familiar with the technology. It is necessary to operate on 12 to 18 patients using the technology before they can feel comfortable and can perform the operation within the standard time. The mean time needed to set up the robotic system was approximately 15 minutes. According to *Ruurda et al.,* for a skilled endoscopic surgeon, having performed more than 100 endoscopic procedures, it was feasible to perform a laparoscopic cholecystectomy after less than 1 hour of in vitro training.

Fig. 1
Robotic system Da Vinci

The robotic system was installed in Brno on 13th April this year at the St. Anne's Faculty Hospital and consequently the Centre of Robotic–assisted Surgery was organised. There were 5 teams of specialists constituted (two surgeons and a nurse) in thoracic and abdominal surgery, urology, gynaecology, and vascular surgery. The First Department of Surgery was determined as the responsible department for the robotic programme in Brno.

CONCLUSION

Robotic technology offers many benefits over traditional minimal access techniques and has been proved safe and effective. Further research is needed to better define the optimal application of this technology. The future of telemanipulators in surgery will depend on whether patients will benefit from this technique or not. Robotic surgery is in its infancy. Many obstacles and disadvantages will be resolved in time and no doubt many other questions will arise.

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