Implementation of robotic laparoscopic cholecystectomy in a university hospital

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Summary

Background: Robot surgery is a further step towards new potential developments in minimally invasive surgery. Surgeons must keep abreast of these new technologies and learn their limits and possibilities. Robot-assisted laparoscopic cholecystectomy has not yet been performed in our institution. The purpose of this report is to present the pathway of implementation of robotic laparoscopic cholecystectomy in a university hospital.

Methods: The Zeus® robot system was used. Experimental training was performed on animals. The results of our experimental training allowed us to perform our first two clinical cases.

Results: Robot arm set-up and trocar placement required 53 and 35 minutes. Operative time were 59 and 45 minutes respectively. The overall operative time was 112 and 80 minutes, respectively. There were no intraoperative complications. Patients were discharged from the hospital after an overnight stay.

Conclusion: Robotic laparoscopic cholecystectomy is safe and patient recovery similar to those of standard laparoscopy. At present, there are no advantages of robotic over conventional surgery. Nevertheless, robots have the potential to revolutionise the way surgery is performed. Robot surgery is not reserved for a happy few. This technology deserves more attention because it has the potential to change the way surgery is performed.

Key words: laparoscopic cholecystectomy; robot surgery

Introduction

Today, just over five years after the first systems reached the market, the feasibility of various laparoscopic procedures including transcontinental robot-assisted remote surgery (telesurgery) have been reported by centres with considerable expertise in the field of laparoscopy [1–3]. Nevertheless, it is not yet widely accepted partly due to the high costs of this technology. Robotic surgical systems are designed to make endoscopic procedures more precise. Successful robotic assistance has been reported in various clinical applications including cholecystectomy, anti-reflux procedures, gastroplasties, prostatectomy, nephrectomy, and gynaecological procedures and has also facilitated the performance of endoscopic cardiac surgery [4–6]. The introduction of a new technology leads to new terms, definitions and concepts. The terminology of the art are known: telepresence, the fundamental concept behind robotic surgery where the surgeon is present via signal transmission; motion scaling, a robotic function that reduces the size of a surgeon's hand movements, making them more precise; telementoring, long distance monitoring or assisting [7]. Laparoscopic cholecystectomy (LC) is routinely performed at our institution since 1989 but robot-assisted laparoscopic cholecystectomy has not yet been performed either in our institution or in Switzerland. However, numerous questions have arisen such as how long is training on an animal model necessary in order too be able to perform robot-assisted surgery on a human and what would patient acceptance a robotic system not currently used in our country be. The purpose of this report is to present the pathway of implementation of robotic laparoscopic cholecystectomy in a university hospital.

Methods

Robot

As part of a multispeciality project, the Zeus® robotic system was used and shared during several weeks by our department of surgery including cardiac surgeons, general surgeons and urologists. The purpose was to evaluate and study this new technology, as well as to assess the potential benefit of robot-assisted surgery. Training was performed on pigs (sus domesticus). During this time, we worked with engineers from Computer Motion®. The robotic arms are individually mounted on the operating table rails and can be adjusted to any location, leaving sufficient space for the attending surgeon. A variety of reusable 5 mm instruments can be connected to the robotic arms and introduced inside the abdomen through standard trocars. At the console, the surgeon controls the instrument handles and views the operative site on a monitor (3-D endoscopic image) (figure 1). With a computer interface, the surgical instruments replicate the surgeon's actions at the operative site in real time. The robotic instruments are activated by a footswitch on a pedal. The robot eliminates human hand tremor and allows the surgeon to scale his natural hand movements to micro-movements inside the body.

Figure 1

Operator and surgeon console.

Figure 2

Position of trocars.

Patients

We strictly two selected patients (two women, 43 and 78 year-old respectively) with symptomatic but non complicated gallstones representing the ideal cases for simple laparoscopic cholecystectomy. There was no dilatation of the common bile duct on preoperative ultrasonography. Preoperative blood tests of liver function were all in the normal range. After approval was obtained from the ethical committee and after obtaining informed consent from each patient, they were scheduled for robot-assisted laparoscopic cholecystectomy.

Operative technique

LC was performed using a three trocar technique (two trocars were used for robotic instruments and one for the scope), as we currently use in the standard procedure, with a pneumoperitoneum of 12 mm Hg. The patient is placed in a slight reverse Trendelenburg position for better visualisation of the gallbladder. The optimal placement of the robotic arms had to be determined in order to avoid crowding by the arm's volume and thus the position of the trocars differed slightly from the standard procedure. (Figure 2.) We used a Micro-Assist Double Action fenestrated grasper (cautery compatible) and a monopolar Micro-Assist cautery probe (Computer Motion®) to perform robot-assisted laparoscopic cholecystectomy. Intraoperative cholangiography was performed manually because the Olsen Clamp (Storz®) we use can not be connected to a robot arm.

Results

Animal training

Two staff surgeons experienced in laparoscopy each spent a whole day learning to manipulate the Zeus® robotic system under direct supervision with the assistance of an engineer from Computer Motion®. Each of us then had the opportunity to practice various laparoscopic robot-assisted procedures with a special interest in laparoscopic cholecystectomy in a pig model. Five robot-assisted cholecystectomies were performed without complications and no major technical problems were encountered. Mean operating time on the pig was 22 minutes (range: 16–42).

Clinical experience

The results of our experimental training were encouraging and allowed us to go on to perform our first clinical cases. Robot arm set-up and trocar placement required 53 minutes and 35 minutes in the first and second procedure respectively. The robot-assisted laparoscopic cholecystectomy itself was performed in 59 minutes in the first and in 45 minutes in the second procedure. The overall operative time was 112 and 80 minutes, respectively including intraoperative cholangiography. There were no intraoperative complications. Intraperitoneal and trocar site infiltration with bupivacaine was performed. Standardised post-operative analgesic/anti-inflammatory drugs were prescribed (tramadol 3×50 mg/d – mefenamic acid 3×500 mg/d). Pathological examination of the specimens documented the presence of chronic cholecystitis in both cases. The patients were discharged from the hospital after an overnight stay (less than 24 hours). Neither of the patients was subsequently readmitted and both patients presented no complications 6 months after the operation.

Discussion

Robot surgery is further step towards new potential developments in minimally invasive surgery. Surgeons must keep abreast of these new technologies and learn their limits and possibilities. There are now several reports documenting safety and feasibility of robotic surgery in humans [7–10]. Therefore for our purposes and advancement, we decided to evaluate the Zeus® Robotic Surgical System (especially involved in this program were the cardiac and general surgeons and urologists). As every unit has its own budget, the total rental costs were shared. Among the different robotic systems available, the Zeus® robotic system was chosen for two reasons. Firstly, for financial reasons, as renting this robot was two folds cheaper than that of the Da Vinci™ Surgical System (Intuitive Surgical®). The second reason was a purely logistical problem as the patient-side cart of the da Vinci™ Surgical System is too high and would not fit into the experimental operating room because of its low ceiling. Our experience confirmed that robotic laparoscopic cholecystectomy was safe but had no obvious advantages for the patients and had recovery times similar to those of standard laparoscopy. Further, as pointed out by others, we totally agree that the system enables increased levels of endoscopic precision, dexterity and surgeon ergonomic comfort. It is also capable of eliminating human hand tremor and allows the surgeon to scale his hand movements to micro-movements inside the body. A further advantage is the voice-controlled camera positioner that eliminates the need for a member of the surgical staff to manually control the camera and provides stability for visualisation of the surgical field. Costs are a major issue today. The financial burden (approximately $ 1 million for the Zeus® robotic system) is only the initial investment. The additional cost of upgrading this rapidly evolving technology must also be taken into account.

In conclusion, even though there are no clinical trials available verifying the potential advantages of robotic over conventional surgery, robots have the potential to revolutionise the way surgery is performed [1]. Future applications would allow integration of pre- or intraoperative computer images and allow further technological advances, such as the computer assisted virtual reality imaging described by Marescaux [1, 8, 9]. The question is not do we really need it but it should be considered a developmental step to performing more complex surgical procedures and achieving further technological advances.

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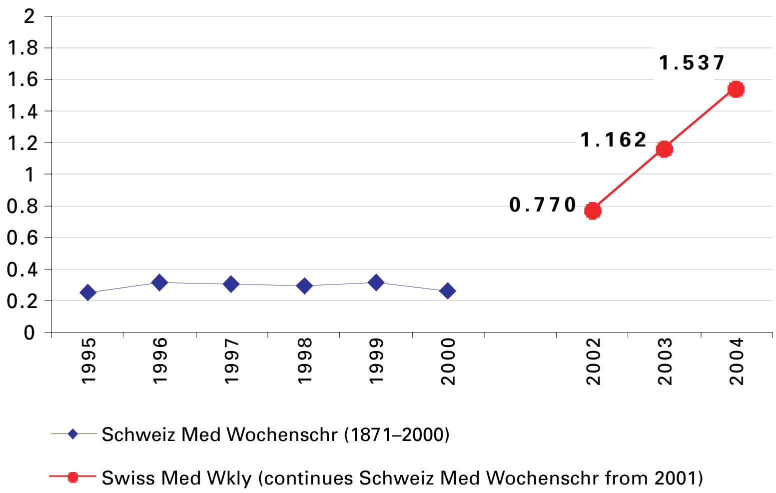

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