Anesthetic Considerations With Telemanipulative Robot-Assisted Laparoscopic Cholecystectomy Using The Da Vinci System

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Citation

Abstract

Background:
A surgical telemanipulation system provides surgeons with tools to perform totally endoscopic laparoscopic surgery with several degrees of freedom of motion. The aim of this report is to identify the anesthetic considerations and the duration of surgery using the da Vinci operation robot for laparoscopic cholecystectomy.

Patients and Methods:
The computerized database (in the department of surgery) and the medical records of 14 patients who underwent robotic-assisted laparoscopic cholecystectomy with CO_2 insufflation under general anesthesia were studied. The study period covered one year from April 2003 until March 2004. Surgery and anesthesia times were identified.

Results:
The average time taken to set up the robot was 67 ± 6 minutes. The average surgical time was 207 ± 64 minutes. The average anesthesia time was 220 ± 10 minutes. The average recovery time was 12 ± 8 minuntes. The intraoperative average BIS figure was 43 ± 4. The hemodynamic data were within normal ranges. The intraoperative average heart rate and mean blood pressure readings were 67 ± 7 beat/min and 72 ± 8 mmHg respectively. The average intraperitoneal CO_2 insufflation pressure was 14 ± 6 mmHg. All patients tolerated the procedure well.

Conclusions:
We believe that with robot-assisted surgery the anesthesiologist has to modify the anesthetic technique to be compatible with prolonged surgical hours with minimal side effects. Also, the anesthesiologist has to understand the risks and the possibility of technical difficulties encountered with robot-assisted surgery. We think that the cost of the system presents a major limiting factor for its widespread use in the field of surgery.

INTRODUCTION

The introduction of laparoscopic surgery has many advantages to patients. These procedures are ultimately aimed at reducing patient morbidity, length of hospital stay and overall costs. The surgical telemanipulation system provides surgeons with tools to perform totally endoscopic laparoscopic surgery with several degrees of freedom of motion. Using the device, surgeons can manipulate small instruments, which are inserted through small incisions, while being away from the patient achieving many of the technical manoeuvres previously possible only with open exposure. Minimally invasive surgery is not a new concept. Laparoscopic cholecystectomy has been performed for almost twenty years. However, it has only been recently that technology has progressed to the point of allowing procedures to be performed using a telemanipulative system.

Robot cardiac surgery is now well established with better instrument control and improved performance versus standard "hands-on" surgical technique ([1],[2]). The use of robots in surgery presents the anesthesiologists with significant challenges and requires careful patient screening and intraoperative amangement to assure patient safety. The

da Vinci surgical robotic system was purchased by our institution in December 2002. Since that time, several surgical procedures were performed using the robot system. The aim of his report is to identify the anesthetic considerations and the duration of surgery using the da Vinci operation robot for laparoscopic cholecystectomy. To the best of our knowledge this is the first report on anesthetic considerations of robot-assisted laparoscopic cholecystectomy.

PATIENTS AND METHODS

The computerized database (in the department of surgery) and the medical records of 14 patients who underwent robotic-assisted laparoscopic cholecystectomy with CO2 insufflation under general anesthesia were studied (Fig 1).

Figure 1

Figure 1: da Vinci system

The study period covered one year from April 2003 until March 2004. The patients mean age was 39±10 years. The data retrieved were, the surgery start and finish times, anesthesia time, recovery time and the time taken to set up the robot. The surgery start time was defined as the time of skin incision. The surgery finish time was defined as the time of the last skin closure suture. Anesthesia time was defined as the time from induction of anesthesia until switching off the anesthetic gases. The recovery time was defined as the time from switching off anesthetic gases until patient response to verbal commands. The time taken to set up the robot was defined as the time from the start of assembling it by the technician until the moment of its readiness for surgery. Anesthesia for all patients was induced with i.v propofol 3mg/kg and sufentanil 0.1 mcg/kg

body weight. Endotracheal intubation was facilitated with i.v atracurium 0.5 mg/kg body weight. Maintainance of anesthesia was achieved with 1 MAC sevoflurane in 70% N2O/O2 mixture. Repeated doses of sufentanil and atracurium were given when required. Monitoring included: ECG, non-invasive blood pressure, tissue oxygen saturation, end-tidal CO2, nasopharyngeal temperature and neuromuscular junction monitoring. In addition, a bispectral index (BIS) monitor was used for monitoring the depth of anesthesia.

RESULTS

The average time taken to set up the robot was 67±6 minutes. the average surgical time was 207±64 minutes. The average anesthesia time was 220±10 minutes. The average recovery time was 12±8 minutes. The intraoperative average BIS figure was 43±4. The hemodynamic data were within normal ranges. The intraoperative average heart rate and mean blood pressure readings were 67±7 beat/min and 72±8 mmHg respectively. The average intraperitoneal CO2 insufflation pressure was 14±6 mmHg. All patients tolerated the procedure well.

DISCUSSION

The King Khalid University Hospital in Riyadh was the first institution in Saudia Arabia and possibly in the middle east to purchase the da Vinci system. Robotic surgery has added new dimensions to minimally invasive surgery. Hand movements in the console are naturally and intuitively transmitted to the robot instruments. Very delicate surgery can be perfectly performed using robot technology. Seven degrees of freedom of instruments are allowed using the robot which is much better than the surgeon hands in conventional surgery [3]. The short learning curve is easily acquired with accuracy using the robot. The high quality 3D virtual operating field and stable camera platform allow for gentle and precise dissection and suturing. The system was successfully used for partial posterior fundoplication surgery [4]. The robot has allowed for various complex surgical procedures to be performed, namely thymectomy [5]. We previously described an anesthetic technique for thymectomy in myasthenia gravis using video-assisted surgery with favorable outcome [6,7]. Currently, there is increasing interest in using the robot system for thymectomy surgery in our hospital. Early reports in cardiac surgery with robot suggested that completely endoscopic approaches for different cardiac operations are feasible [8,9]. However, robotic surgery presents many challenges to the

anesthesiologists.

Anesthesiologists will have to develop new methods of patient care as well as proper screening of patients preoperatively. In our experience a number of technical issues have been faced. For example: during surgery with the use of the large robot system access to the patient became difficult. Therefore, i.v access should be secured prior to surgery. Endotracheal tubes should be properly checked and fixed. All monitoring and contact electrodes should be properly placed as there will be no access during robot surgery to check their position or modify their placement sites. One more technical issue we faced during robot-assisted thoracic surgery was the pressure exerted by one arm of the robot on the double-lumen tube, which has led to kinking of it. The problem was to reach the patient face from underneath the drapes and correcting the tube position. Similarly, in robot-assisted laparoscopic surgery (besides the known physiological effects of CO_2 pneumopertoneum) [10] patient positioning will have to be very carefully done to avoid injury to pressure points [11]. In this paper, we have reported prolonged surgery which presents a real challenge to anesthesiologists. Therefore, we have used BIS monitor in order to avoid excess use of anesthetic drugs and hence prolonged recovery secondary to prolonged surgery. In a recent report, intraoperative BIS monitoring was recommended to prevent awareness during anesthesia [12]. In pediatrics, the da Vinci is not adopted because the robot is very large and the instruments are 5mm of size [13]. New devices will be developed in the future. The cost of the system and instruments is another limiting factor for the development of this technology which cannot be actually developed for economical reasons in children [14].

CONCLUSIONS

In conclusion, we believe that with robot-assisted surgery the anesthesiologist has to modify the anesthetic technique to be compatible with prolonged surgical hours with minimal side effects. Also the anesthesiologist has to understand the risks and the possibility of technical difficulties encountered with robot-assisted surgery. We think that the cost of the system presents a major limiting factor for its widespread use in the field of surgery.

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