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ORIGINAL RESEARCH

Medicine Science International Medical Journal

Medicine Science 2019;8(3):573-7

Robot-assisted surgical cases: A single center experience

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Received 24 January 2019; Accepted 13 February 2019
Available online 16.07.2019 with doi:10.5455/medscience.2019.08.9033

Abstract

The objective of this study is to present our experience with robotic surgeries in general surgery, urology, gynecology, and ear-nose-throat (ENT) departments.
Robotic surgery performed in cases from the Erzurum Regional Training and Research Hospital from February 2015 to July 2018 were retrospectively included in the study. Patient data, including age, gender, ASA score, underlying disease, smoking habits, type of surgery, invasive procedures (arterial cannulation, or central venous catheter), laparotomy requirement, anesthesia, surgery, discharge times, amount of bleeding, and intra- and post-operative complications were recorded from the digital database system and anesthesia hospital records during monitoring. A total of two hundred twenty-one patients were included. Of these 112 (50.6%) from urology, 53 (23.9%) from general surgery, 46 (20.8%) from gynecology, and 10 (4.5%) from ENT departments. The median age of the patients was 61 (17-91) years, and the male/female ratio was 1.9 (145/76). Most patients (63.3%) had ASA-II scores. Ten patients (4.7%) needed conversion to laparotomy. Mean duration of anesthesia and surgery was longest in general surgery procedures. Urology department patients had the longest time to discharge. The Trendelenburg position was used only during urology and gynecology operations. Hypotension was the most frequent intraoperative complication, and nausea was the most common postoperative complication. In general, both intra- and post-operative complications were mostly seen in the urology department. No intra- or post-operative complications were observed in ENT operations. Robotic surgeries are continuing to develop and evolve and be used in several disciplines. Presented properties and complications of robotic surgery reported in this study, may be helpful for anesthesiologists and surgeons.

Keywords: Colorectal cancer, hysterectomy, prostatectomy, robotic surgery, tonsillectomy

Introduction

Minimally invasive techniques have acquired growing importance in recent decades due to the technical advantages and patient comfort they provide in various types of surgery. Technological advances in medicine and surgery have made a definitive contribution to these procedures. Widely used laparoscopic procedures offer advantages such as less postoperative pain, and shorter recovery and hospitalization times.

However, conventional laparoscopies using two-dimensional imaging have a number of disadvantages compared to the three-dimensional technique, including the need for an assistant to control the camera, rigidity and all four degrees of motion, and a risk of tremor [1].

Robot-assisted surgery (RAS) is a recently improved innovation designed to enhance the proficiency and precision of surgeons in order to overcome the limitations of these disadvantages of traditional techniques. Following the development of the da Vinci surgical robot, the first surgical procedure was reported in March 1997 [2]. Since then, there have been various reports from different centers involving several types of surgery involving this system. Although shorter postoperative hospitalization and pain duration, faster healing, and better cosmetic results promote the use of RAS, increased costs, the absence of a sense of touch, the need for experience and specialist skills, and longer operation times can limit is application. The use of these devices started with cardiothoracic operations, followed by various other types of surgical procedure, such as cystectomy, nephrectomy, hysterectomy, cholecystectomy, splenectomy, colorectal surgeries, gastrectomy, thymectomy, pulmonary lobectomy, thyroidectomy, parathyroidectomy, arthroplasties, and transoral surgeries [3-7]. RAS has even been used in pediatric patients [8].

Even after taking the risks into account, RAS provides patient and surgeon comfort, as well as lower morbidity and mortality. In this study, we describe our experience of robotic surgeries in general surgery, urology, gynecology, and ear-nose-throat departments.

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This constitutes a new technique for the anesthesiologists and surgeons in our hospital.

Material and Methods

This retrospective study evaluates robotic surgery cases performed in general surgery, ENT, gynecology, and urology operating rooms in the Erzurum Regional Training and Research Hospital (ERTRH), Turkey, from February 2015 to July 2018. Patient data, such as age, gender, American Society of Anesthesiologists (ASA) score, underlying disease, smoking habits, type of surgery, invasive procedures (arterial cannulation, or central venous catheter), laparotomy requirement, duration of anesthesia, Trendelenburg, surgery, and discharge times, amount of bleeding, and intra- and post-operative complications were recorded from the digital database system and anesthesia records during monitoring.

ERTRH local ethical committee approval was granted for the study (date: 19/04/2017, number: 2017/04-28).

Statistical analyses were performed on SPSS version 22.0 software (Statistical Package of Social Sciences Inc., Chicago, IL, USA). The Kolmogorov-Smirnov/Shapiro-Wilk tests were used to assess the distribution of variables. Mean±standard deviation was used to express normally distributed variables, while median values (minimum-maximum) were used to express non-normally distributed variables. Categorical variables were expressed as '%'.

Results

Two hundred twenty-one robotic surgeries (112 [50.6%] urology, 53 [23.9%] general surgery, 46 [20.8%] gynecology, and 10 [4.5%] ENT department) were performed during the study period. Patients' median age was 61 (17-91) years (Table 1). The youngest patient was operated in the ENT department, and the oldest in the general surgery department. The majority of patients were male, and most (63.3%) had ASA-II scores. Hypertension was the most frequent underlying disease. The distribution of types of surgical procedures is shown in Table 1.

Table 1. Demographic and pre-operative clinical characteristics of the 221 robotic surgery patients

	Urology (n=112)	General surgery (n=53)	Gynecology (n=46)	ENT (n=10)	Total
Age, years, median (min-max)	64.5 (49-77)	63 (19-91)	49 (30-64)	40 (17-71)	61 (17-91
Male/female ratio	112/0	26/27	0/46	7/3	145/76
ASA, n (%)					
I	0 (0)	24 (45.3)	35 (76.1)	9 (90)	68 (30.8)
II	102 (91.1)	27 (50.9)	10 (21.7)	1 (10)	140 (63.3)
III	10 (8.9)	2 (3.8)	1 (2.2)	0 (0)	13 (5.9)
Underlying diseases, n (%)					
Hypertension	19 (17.0)	15 (28.3)	6 (13.0)	1 (10)	41 (39)
Gastritis	5 (4.5)	7 (13.2)	5 (10.9)	1 (10)	18 (17.1)
Diabetes mellitus	11 (9.8)	3 (5.7)	4 (8.7)	-	18 (17.1)
COPD	11 (9.8)	5 (9.4)	-	-	16 (15.2)
CAD	7 (6.3)	1 (1.9)	-	-	8 (7.6)
Parkinson's disease	-	-	1 (2.2)	-	1 (0.9)
Epilepsy	-	-	1 (2.2)	-	1 (0.9)
Hypertiroidism	1 (2.2)	-	-	-	1 (0.9)
Alzheimer's disease	1 (2.2)	-	-	-	1 (0.9)
Smokers, n (%)	14 (12.5)	3 (5.7)	2 (4.3)	0 (0)	19 (8.5)
Types of surgery, n (%)	Prostatectomy, 99 (88.3) Pyeloplasty, 13 (11.7)	Colorectal cancer, 26 (49) Gastric cancer, 5 (9.4) Esophagus cancer, 3 (5.7) Obesity, 2 (3.8) Repair of diaphragmatic hernia, 2 (3.8) Surrenalectomy, 1 (1.9)	Hysterectomy, 46 (100)	Tonsillectomy, 10 (100)	-

ENT; ear-nose-throat, COPD; chronic obstructive pulmonary disease, CAD; coronary artery disease

Arterial cannulation was performed on all patients except for those in the ENT department (Table 2). Only 10 (4.7%) patients required laparotomy procedures. The mean duration of anesthesia and surgery was longest in general surgery department operations. Urology department patients had the longest times to discharge. The Trendelenburg position was used only during urological and gynecological operations.

Table 2. Intra-operative clinical characteristics of the 221 robotic surgery patients

	Urology	General surgery	Gynecology	Ear-nose-throat	Total
Invasive procedures, n (%)					
Arterial cannulation	112 (100)	53 (100.0)	46 (100.0)	0 (0)	211 (95.5)
CVC	26 (23.2)	53 (100.0)	20 (43.5)	0 (0)	99 (44.8)
Laparotomy requirement, n (%)	0 (0)	8 (15.1)	2 (4.3)	-	10 (4.7)
Duration of anesthesia, minutes, mean±SD	205.1±26.3	364.3±136.8	223.7±30.9	83.0±16.7	241.6±102.4
Duration of Trendelenburg, min, mean±SD	161.9±24.5	-	193.9±29.6	-	-
Duration of surgery, min, mean±SD	188.6±25.5	341.9±131.5	211.3±30.2	70.5±15.4	224.8±98.5
Amount of bleeding, mL, mean±SD	48.7±31.4	146.4±69.2	95.3±45.4	36.0±12.4	81.2±61.3
Time to discharge, days, mean±SD	7.1±1.9	5.8±2.7	3.0±0.3	1.7±05	5.7±2.6

CVC; central venous catheter, min; minutes, mL; milliliter, SD; standard deviation

Hypotension was the most frequent intraoperative complication encountered during robotic surgeries, followed by metabolic acidosis and bradycardia (Table 3). No respiratory acidosis, pulmonary and laryngeal edema, or lingual or buccal nerve damage were seen in any departments. Nausea was the most frequent postoperative complication after robotic surgeries, followed by hypoxia and metabolic acidosis (Table 3). No cardiac or respiratory arrest, laryngospasm, myocardial ischemia, or visual disturbance were seen in any department postoperatively. Both intra- and post-operative complications were most common in the urology department. No intra- or post-operative complications were encountered in ENT operations.

Table 3. Complications encountered intra- and post-operatively during robotic surgery, n (%)

	Urology (n=112)	General surgery (n=53)	Gynecology (n=46)	Total
Intra-operative complications				
Hypotension	11 (9.8)	8 (15.1)	7 (15.2)	26 (11.8)
Hypertension	4 (3.6)	0 (0)	0 (0)	4 (1.8)
Bleeding	0 (0)	1 (1.9)	1 (2.2)	2 (0.9)
Tachycardia	4 (3.6)	0 (0)	0 (0)	4 (1.8)
Bradycardia	12 (10.7)	0 (0)	0 (0)	12 (5.4)
Myocardial ischemia	1 (0.9)	0 (0)	0 (0)	1 (0.9)
Hypoxia	0 (0)	1 (1.9)	2 (4.3)	3 (1.4)
Metabolic acidosis	8 (7.1)	3 (5.7)	2 (4.3)	13 (5.9)
Facial edema	9 (8.0)	0 (0)	0 (0)	9 (4.1)
Conjunctiva edema	11 (9.8)	0 (0)	0 (0)	11 (5.0)
Lingual edema	3 (2.7)	0 (0)	0 (0)	3 (1.4)
TOTAL	63 (0.56)	13 (0.24)	12 (0.26)	88 (0.39)*
Post-operative complications				
Hypoxia	7 (6.3)	4 (7.5)	2 (4.3)	13 (5.9)
Metabolic acidosis	5 (4.5)	3 (5.7)	2 (4.3)	10 (4.5)
Respiratory acidosis	1 (0.9)	2 (3.8)	1 (2.2)	4 (1.8)
Nausea	18 (16.1)	4 (7.5)	4 (8.7)	26 (11.8)
Vomiting	7 (6.3)	1 (1.9)	1 (2.2)	9 (4.1)
Bradycardia	5 (4.5)	0 (0)	0 (0)	5 (2.3)
Tachycardia	1 (0.9)	0 (0)	0 (0)	1 (0.5)
Hypotension	2 (1.8)	2 (3.8)	2 (4.3)	6 (2.7)
Hypertension	2 (1.8)	0 (0)	0 (0)	2 (0.9)
Delirium	2 (1.8)	0 (0)	0 (0)	2 (0.9)
TOTAL	50 (0.44)	16 (0.30)	12 (0.26)	78 (0.35)*

*, total number of complications was calculated in 221 patients

Discussion

This study presents the clinical characteristics of patients undergoing robotic surgeries in the general surgery, urology, gynecology, and ear-nose-throat departments from the anesthesiologist perspective. It appears probable that RAS may develop into a standard procedure as experience increases and concerns decrease.

RAS has led to a new era in urological procedures. It has been shown to be superior to other methods, especially in procedures involving reconstruction. The majority of the RAS cases in this study were prostatectomy, the preferred method for improving overall survival in prostate cancer [9]. The mean duration of surgery in this study was approximately three hours, a figure similar to that reported in Awad et al.'s review [10]. Urological procedures require the lithotomy position, in addition to abdominal insufflation. Trendelenburg positioning results in various changes in hemodynamic, pulmonary, renal, ocular, and other systems. Robotic prostatectomy was reported to be associated with a lower transfusion rate compared to the open approach in one large population study [11]. In this study, although urological procedures resulted in a lower amount of bleeding compared to other departments, no comparison could be made with a control group of traditional surgery patients. Most of the post-operative complications encountered during the study period were gastrointestinal symptoms, such as nausea and vomiting, in agreement with previous studies [12,13].

Hysterectomy was the only procedure performed in the gynecology department. This can be carried out using laparotomy, laparoscopy, or vaginal techniques. Some authors have expressed doubts about the role of RAS in gynecology. The use of robotic-assisted hysterectomy has recently gradually increased, and perioperative complications are generally similar to those in the traditional laparoscopic approach for benign diseases [14]. RAS has been reported to be faster compared to traditional laparoscopy in patients with endometrial cancer, although surgical outcomes and complication rates are similar [15]. Vaginal cuff hematoma or bleeding has been reported as the most common perioperative complication in hysterectomy, and was particularly frequent in this study [14]. Conversion to laparotomy was required in 4.3% of cases in this study, higher than in previous reports of RAS used for both benign diseases and endometrial cancer surgeries [14,15]. The surgery time reported by Mäenpää [15] for RAS during hysterectomy, bilateral salpingo-oophorectomy, and pelvic lymphadenectomy was shorter than that in the present study. Time to discharge was also shorter than in our study, which was attributed to more experienced surgeons and lower complication rates.

Gynecological and urological RAS procedures in particular in this study were performed using several different positions and conditions to facilitate operative exposure. Pneumoperitoneum created through abdominal insufflation, and a steep Trendelenburg position in addition to the lithotomy position, allow surgeons to access and visualize the urogenital organs. However, these can also result in various hemodynamic consequences, such as increased cerebral and intraocular pressure [16, 17]. Hemodynamic complications, such as hypo- and hypertension, bradycardia and tachycardia were also among the most common findings in the present study.

The general surgery department performed RAS due to a wide range of indications, the most important being colorectal cancer. RAS permits multiple procedures, such as fundoplication, gastric bypass, cholecystectomy, tumor resection, and colorectal resection. Previous studies have shown similar, or even better outcomes with RAS compared to other modalities and a trend towards a lower rate of conversion to open surgery [18]. Robotic surgeries involve higher costs, but can provide lower estimated blood loss, a shorter length of stay, and less physical stress and mental strain for the surgeon [19]. Additionally, long term outcomes of RAS, such as disease-free survival, all-cause mortality, and recurrence-free survival, are comparable to those of conventional laparoscopy in patients with colorectal cancer [20]. Durations of anesthesia and surgery were longest in the general surgery department, although this was a heterogeneous group. Variable (shorter or longer) operation times compared to alternative procedures have been reported in the previous literature [21,22]. The rate of conversion to open surgery was higher in this study than in previous reports [23, 24]. These studies have also reported similar complications to those in this study.

Tonsillectomy was the only procedure performed in the ENT department in this study. In general, RAS helps to avoid a disfiguring facial scar, a large external incision, malocclusion of the jaw, and increased blood loss [25]. No major intra- or post-operative complications were registered in this research, in agreement with previous studies [26].

Some limitations should be considered when interpreting our results. First, it was difficult to compare our findings with those of previous studies, since indications for the procedures performed during the study period were not determined. Additionally, our study involved a largely adult population, which limits the generalization of the data to the pediatric age group. Nonetheless, our results can represent a point of reference for centers similar to ours when initiating and organizing RAS and associated procedures.

Conclusion

In conclusion, with the increasing number of centers offering RAS and patients undergoing it, anesthesiologists and surgeons should be more familiar with the characteristics and complications of such procedures. Not only considerations regarding the preparation and management of these patients, but also understanding the potential outcome are of crucial importance. The findings of this study may be instructive for anesthesiologists and surgeons.

Competing interests
The author confirms that this article content has no conflict of interest.

Financial Disclosure
All authors declare no financial support.

Ethical approval
ERTRH local ethical committee approval was granted for the study (date: 19/04/2017, number: 2017/04-28).

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