Retrospective Analyzing of Anesthesia Managements in Robotic Assisted Radical Prostatectomy Cases

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Abstract

Aim: In our study, we aimed to investigate anesthesia management, hemodynamic changes and complications that may occur due to steep trendelenburg, pneumoperitoneum and surgery in RARP patients operated in Akdeniz University School of Medicine, and to evaluate our initial results.

Methods: Patients who underwent RARP operation with the diagnosis of prostate adenocarcinoma by the Urology Clinic at Akdeniz University School of Medicine between January 2015 and February 2018 were evaluated retrospectively. Patient's demographic data, intraoperative hemodynamic and respiratory data, postoperative transfer sites, extubation times, post-extubation blood gas values, complications and discharge times were recorded. Obtained data were analyzed with IBM SPSS® 23.0 program.

Results: We found that mean age of the 131 patients included study was 62 years, and mean BMI was 27,6 kg/m^2. Also we found that 47 of patients were ASA-I, 69 of patients were ASA-II and 15 of patients were ASA-III. After general evaluation, it was seen that HR, SBP, DBP and MAP decreased significantly in intraoperative period in all patients. There was also a significant decrease in pH and increase in pCO_2 in patients due to pneumoperitoneum. In our study, we found that the most common postoperative complication was nausea and vomiting, and the second common was anastomotic leakage. However, none of our patients had a permanent complication.

Conclusions: In order to manage anesthesia in RARP, it is necessary to know the physiologic effects of trendelenburg position and pneumoperitoneum on the systems and physiological changes in old age.

Keywords: *Anesthesia, Robotic surgery, Prostatectomy*

1. Introduction

With the integration of advancements in technology into the field of medicine, diagnostic and treatment methods continue to evolve. Today, robotic-assisted surgical applications can be adapted to almost all surgical procedures. Among these, robotic-assisted radical prostatectomy (RARP) is the most frequently performed. RARP provides various advantages, such as facilitating micro-anastomosis in tight spaces through the movement capabilities of robotic arms, less bleeding, providing a more comfortable working area for the surgeon, along with other benefits offered by laparoscopic methods[1,2]. However, there are main disadvantages like the necessary steep Trendelenburg position, the implementation of pneumoperitoneum, and the long duration of surgery. Specifically, the deep Trendelenburg position and the added pneumoperitoneum have numerous physiological effects (on the cardiovascular system, respiratory system, central and peripheral nervous system, endocrine system, urinary system). In addition, the patient group on which RARP is applied generally consists of elderly patients with additional diseases. Considering all these effects, anesthesia management of RARP is quite a challenging process[3]. In this study, we aimed to analyze our anesthesia practices in RARP cases operated by the Urology Clinic at the Akdeniz University Faculty of Medicine Hospital, focusing on patient positioning, pneumoperitoneum, potential hemodynamic changes, and complications related to surgery, and to evaluate our preliminary results. Accordingly, we aimed to review the issues that should be considered during our anesthesia applications in RARP surgeries at our clinic.

2. Materials and methods

In this study, patients who underwent robotic-assisted radical prostatectomy (RARP) for the diagnosis of prostate adenocarcinoma at the Akdeniz University Faculty of Medicine between January 2015 and February 2018 were evaluated retrospectively. All patients were informed by the surgical and anesthesia teams before the operation, and necessary surgical and anesthesia consents were obtained. Following the acquisition of necessary permissions from

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the chief physician to examine hospital records and the ethical committee approval no. 156 dated 01.03.2017, data collection began. Patients' preoperative and postoperative examination records and laboratory data were accessed using the MIA-MED® program, which is the data database of Akdeniz University Hospital; intraoperative data were obtained by examining anesthesia monitoring forms for the operation. Also, records of the Anesthesia Intensive Care Unit (ICU) and Post-Anesthesia Care Unit (PACU) of Akdeniz University Hospital were reviewed for the data related to the patients' extubation.

In the preoperative evaluation, demographic data (age, weight, height, BMI), ASA classification, and presence of comorbid diseases (coronary artery disease, COPD/Asthma, hypertension, diabetes, others) were included.

In the intraoperative evaluation, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), peripheral oxygen saturation (SpO_2), and End-tidal carbon dioxide ($EtCO_2$) values were recorded hourly from the time of the patient's intubation until the patient was removed from the operating room, using anesthesia monitoring forms (Dräger Infinity® Delta). Arterial blood gas data (pH, pO_2, pCO_2, lactate) were recorded immediately after arterial catheterization, hourly for the next two hours, and then every two hours. Arterial blood gas measurements were made with the Siemens Rapidlab® 1200 device available in our hospital. The amounts of crystalloid and colloid given to the patient during the intraoperative process, the amount of blood transfusion if performed, anesthesia time, and operation time were also recorded. The operation time was considered as the time from the initial skin incision to the moment when the robotic system was separated from the patient, and all skin incisions were sutured. The anesthesia time was considered as the time from the beginning of the induction of anesthesia until the patient was removed from the operating room. Since all evaluated patients were transferred to the intensive care unit or post-anesthesia care unit, extubation was not considered the end of anesthesia.

During anesthesia induction, 1mg/kg lidocaine, 5-7 mg/kg sodium thiopental, 2-10 mcg/kg fentanyl and 0.6 mg/kg rocuronium are administered. After intubation, invasive arterial monitoring and other monitoring procedures are performed if necessary. Immediately after induction, 10 mg metoclopramide and 50 mg ranitidine are administered. For anesthesia maintenance, sevoflurane is administered at a concentration of 1-2%, and remifentanil is administered as an analgesic at a dose of 0.5-2 mcg/kg/min. Muscle relaxant infusion is not administered. Gastric emptying is provided to all patients by inserting a nasogastric tube without positioning after induction.

According to the operation protocol, the patients were fixed in a supine position, with arms adducted on both sides and legs lateralized at approximately 45 degrees. The patient was given a 35-40 degree Trendelenburg position; Protective measures have been taken against nerve and organ damage. Pneumoperitoneum is created by insufflation of CO_2 to an intra-abdominal pressure of approximately 12±3 mmHg.

Mechanical ventilation was provided with a Dräger Primus® anesthesia workstation. Patients are routinely ventilated in VCV mode, 50% air - 50% oxygen mixture, 3 l/min fresh gas flow, 8 ml/kg tidal volume, 12 respiratory rate, 5 cmH2O PEEP pressure, 1:2 inspiration:expiration (I:E) ratio and with a maximum peak pressure of 40 cmH2O. Ventilation settings were changed to keep $EtCO_2$ 30-40 mmHg throughout the operation.

Regarding to postoperative data, the location where the patient was transferred after the operation (ICU or PACU), the time of extubation after transfer, arterial blood gas data (pH, pO_2, pCO_2, lactate) taken one hour after extubation, any postoperative complications developed (nausea-vomiting, peripheral nerve damage, vision loss, subcutaneous emphysema, compartment syndrome, infection, anastomotic leak, etc.), and discharge times were noted.

2.1. Statistical Analysis:

For statistical analysis, the descriptive statistics of the data used mean, standard deviation, minimum, maximum, median, frequency, and ratio values. Significance tests used include Student's T test for the analysis of quantitative data, Paired samples T test for the analysis of repeated measures, and the Mann Whitney U test and Wilcoxon Matched-Pairs test for the evaluation of categorical data. Analyses were conducted using the IBM SPSS® 23.0 program. A $p<0.05$ value was considered statistically significant.

3. Results

The study included 131 patients with an average age of 62.9±6.5 years, average body weight of 83.2±10.3 kg, average height of 1.73±0.05 meters, and average Body Mass Index (BMI) of 27.7±3.2 kg/m^2. The average duration of anesthesia was found to be 322.1±73.1 minutes and surgical time was 270.7±69.4 minutes (Table 1).

HR, SBP, DBP, MAP, $EtCO_2$, and SpO_2 values were obtained for the patients at the time of pre-induction of anesthesia (0th hour) and each hour intraoperatively until the end of the operation. To statistically evaluate the changes in the obtained data, 0th hour data were compared separately with data from 1st, 2nd, 3rd, 4th, 5th, and 6th hours (Table 2).

At the same time, arterial blood gas (ABG) data (pH, pO_2, pCO_2, and lactate) were obtained during the intraoperative period of the patients. Again, ABG data were compared to the 0th hour at 1st, 2nd, 4th, and 6th hours respectively (Table 3).

Table 1

Demographic data of the patients

Age	62.9±6.5
Weight (kg)	83.2±10.3
Height (m)	1.73±0.05
BMI (kg/m^2)	27.7±3.2
Anesthesia Duration (min)	322.1±73.1
Surgical Duration (min)	270.7±69.4
Comorbidities (n:85)	Hypertension (61.2%) Diabetes Mellitus (32.9%) Coronary Artery Disease (23.5%) Asthma/COPD (10.6%) Other (15.3%)
American Society of Anesthesiologist (ASA) Classification	ASA I (35.9%) ASA II (52.6%) ASA III (11.5%)

COPD: Chronic obstructive pulmonary disease

Various data evaluated during the intraoperative and postoperative periods of the patients are provided in Table 4. It was found that none of the patients included in the study developed respiratory insufficiency (pO_2<60 mmHg or pCO_2>50 mmHg) after extubation. It was also found that none of the patients had postoperative peripheral nerve damage, vision loss or compartment syndrome, which could potentially occur due to RARP, until discharge.

The average day of hospital discharge postoperatively for the patients was found to be 5.9±2.6 days. However, there are prolonged hospital stays of 23 days for one patient due to a postoperative infection, and 15 and 20 days for two patients due to postoperative anastomotic leakage. Therefore, these patients were removed, and the average day of discharge was recalculated and found to be 5.6±1.6 days.

Table 2

Hemodynamic and respiratory data and intraoperative changes

	SBP	p value¶	DBP	p value¶	MAP	p value¶
0th hour	144.7±19.9		90.2±13.4		108.2±14.7	
1st hour	120.0±16.0	*0.000	73.8±10.4	*0,000	89.3±11.5	*0.000
2nd hour	121.1±11.3	*0.000	75.5±9.2	*0,000	90.7±9.2	*0.000
3rd hour	123.8±12.0	*0.000	76.7±10.7	*0,000	92.4±10.3	*0.000
4th hour	124.5±12.1	*0.000	77.5±10.5	*0,000	93.1±9.4	*0.000
5th hour	120.8±11.9	*0.000	76.6±9.3	*0,000	91.3±9.4	*0.000
6th hour	119.3±11.1	*0.000	76.1±8.9	*0,000	90.4±8.8	*0.000
	HR	p value¶	SpO_2	p value¶	$EtCO_2$	p value¶
0th hour	77.9±12.8		99.08±1.05		30.88±3.15	
1st hour	70.9±10.0	*0.000	99.06±1.03	0.719	31.70±3.15	*0.001
2nd hour	69.4±9.9	*0.000	99.08±1.20	1.000	32.16±2.95	*0.000
3rd hour	69.8±9.9	*0.000	99.19±1.03	0.204	31.83±3.23	*0.002
4th hour	70.3±10.3	*0.000	99.24±0.95	*0.044	31.52±3.20	0.064
5th hour	69.9±9.5	*0.000	99.29±1.04	*0.013	30.93±3.17	0.303
6th hour	70.0±10.3	*0.001	99.36±0.94	*0.021	29.90±3.12	0.185

* $p<0.05$, ¶ Compared to basal value

Table 3

ABG parameters and intraoperative changes

	pH	p¶	pO_2	p¶	pCO_2	p¶	Lactate	p¶
0th hour	7.45±0.03		181.5±69.6		33.1±3.6		1.24±0.43	
1st hour	7.43±0.05	*0.000	161.9±55.5	*0.000	36.5±4.9	*0.001	1.22±0.40	0.363
2nd hour	7.39±0.05	*0.000	167.8±47.9	*0.020	37.1±4.9	*0.000	1.24±0.44	0.981
4th hour	7.38±0.05	*0.000	169.5±50.5	0.069	36.7±5.5	*0.000	1.24±0.51	0.864
6th hour	7.39±0.06	*0.000	172.1±41.3	0.506	35.1±5.3	0.118	1.35±0.61	0.172

* $p<0.05$, ¶ Compared to basal value

Table 4

Intraoperative and postoperative data

Av. Intraoperative Fluids Administered (ml)	•Balanced Crystalloid (3419±776.6) •Colloid [Gelatin Polysuccinate] (600±210.8)		
Amount of Blood Transfusion (n:1)			2 Units
Effect of Learning Process	Patient no 1-66	Patient no 67-131	p Value
Anesthesia Dur. (min)	364.4±73.6	279.1±40.4	***0.000****
Surgical Dur. (min)	311.8±68.3	229±39.4	***0.000****
Postoperative Condition	Post-Anesthesia Care Unit (n:110) Intensive Care Unit (n:21)		
Av. Extubation Time (min)			104.7±38.4
Complications	•Nausea-Vomiting (8.4%) •Anastomotic Leakage (2.3%) •Subcutaneous Emphysema (2.3%)		

* $p<0.05$

4. Discussions

The number of cases undergoing RARP is increasing every day due to its superiority over open prostatectomy[4,5]. The deep Trendelenburg position and pneumoperitoneum necessary for RARP to be performed have various effects on organ systems and hemodynamic systems[2,3,6,7]. In our study, we found a statistically significant decrease in HR, SBP, DBP, and MAP parameters at all intraoperative hours compared to the basal value in the comparison we made to see the hemodynamic effects of the deep Trendelenburg position and pneumoperitoneum. Two studies investigating the cardiac and respiratory effects of RARP operations found that MAP increased when Trendelenburg and pneumoperitoneum started, but began to decrease over time and significantly dropped below the basal MAP value[7,8]. Danic et al.[9] found a statistically significant decrease in HR and MAP after Trendelenburg and pneumoperitoneum in their retrospective study of 1500 cases related to anesthesia management in RARP operations. MAP generally increases with the start of Trendelenburg and pneumoperitoneum, but decreases over time and can drop below the basal value at the end of surgery. In our study, unlike other studies, we believe that the likely reason for MAP values being lower than the basal value at all compared time intervals is that while other studies, being prospective, divided the time intervals into moments like before Trendelenburg, the moment of Trendelenburg, 5 minutes after Trendelenburg, 15 minutes later, 60 minutes later, our study was retrospective, so we were not able to access these time intervals. Therefore, we compared the preoperative value with the intraoperative 1st hour, 2nd hour, 3rd hour, and so on. In our study, to observe the effects of the deep Trendelenburg position and pneumoperitoneum on the respiratory system and gas exchange, no statistically significant difference was found between the patients' basal SpO_2 values and the 1st hour, 2nd hour, and 3rd hour SpO_2 values. However, the SpO_2 values at the 4th, 5th, and 6th hours were found to be statistically significantly higher than the basal SpO_2 value. Despite these statistically significant SpO_2 elevations, there has been no change in amounts that have clinical importance. Lebowitz et al.[10] found no statistically significant difference between the SpO_2 values at preoperative and during the start and continuation of Trendelenburg in their study to examine gas exchange in RARP operations. Similarly, Bozkırlı et al.[11] also found no statistically significant difference between SpO_2 values. When $EtCO_2$ values were compared in our study, the 1st, 2nd, and 3rd hour intraoperative $EtCO_2$ values were statistically significantly higher than the basal $EtCO_2$ value, while no statistically significant difference was found between the 4th, 5th, and 6th hour $EtCO_2$ values and the basal $EtCO_2$ value. Kadono et al.[7] showed that $EtCO_2$ values statistically increased with the addition of pneumoperitoneum and the Trendelenburg position and returned to basal values with desulfation, and they also found no correlation between the degree of Trendelenburg and $EtCO_2$ values. Lestar et al.[12], in a study examining the effects of the Trendelenburg position in RARP cases, found that $EtCO_2$ values were statistically significantly higher than the basal value from the beginning of pneumoperitoneum to the end of the operation, despite the absence of acid-base anomaly and stable pCO_2 values. In our study, similar to $EtCO_2$ values, patients' 1st, 2nd, and 4th hour intraoperative pCO_2 values were found to be statistically significantly higher than the basal pCO_2 value. The 6th hour pCO_2 value was higher than the basal pCO_2 value, but no statistically significant elevation was found. As expected, with the increase in pCO_2 values, the patient's intraoperative pH values at all hours were found to be statistically significantly lower than the basal pH value. In addition, it was also seen that no patient developed a serious acid-base balance disorder. Only the decrease in pO_2 values at the 1st and 2nd hours intraoperatively were found to be statistically significant. Lebowitz et al.[10], in a study to examine gas exchange in RARP operations, reported that with pneumoperitoneum and the Trendelenburg position, pO_2 values significantly decreased, pCO_2 values significantly increased, and the decrease in pO_2 value could be due to ventilation/perfusion mismatch and possibly interstitial pulmonary edema. They also reported that none of their patients developed hypoxemia or clinically/radiologically evident atelectasis. In our study, we found that an average of 3419±776.6 ml of crystalloid fluid was given to patients during the intraoperative period. Piegelar et al.[13], in a study examining the outcomes of fluid management in patients undergoing RARP surgery, reported similar results to ours, stating they used an average of 3600 ml of fluid intraoperatively. They also found that the risk of anastomotic leakage increased as the amount of fluid used increased, and that the amount of bleeding was independent of the type of crystalloid or colloid used. Ono et al.[14], in an observational study of patients undergoing RARP surgery, reported that an average of 2750 ml of fluid was given during the intraoperative period. Ozgen et al.[15], in a study conducted on patients undergoing RARP procedure, similarly to our study, found that there was no statistically significant change in lactate at any time during surgery. Oksar et al.[16], in a prospective study on RARP patients, divided their patients into two groups as pH<7.35 and pH>7.35 and found no significant change in terms of lactate between the two groups. Similarly, in our study, in parallel with the findings in the literature, it was found that there was no significant lactate elevation at any time period.

When we divided the patients included in our study into two groups considering surgical experience, we found that in the initial surgeries where experience was low, both anesthesia time and surgical duration were statistically significantly longer. In three separate studies related to the learning process in RARP procedure conducted by Raman, Ou, Pouget et al.[17-19], it was observed that as the surgeon's experience increased, the operation time significantly shortened. The most important factor affecting surgical time is the surgeon's experience.[6] These times may vary depending on the experience of the operation team.[13,14,20] In the postoperative period, only 16 of our patients (12.2%) developed complications related to anesthesia or surgery. The most common complications were nausea - vomiting, followed by vesicoureteral anastomotic leakage and subcutaneous emphysema. Danic et al.[9], in their study on patients who underwent RARP operation, reported that the most common postoperative complications were nausea-vomiting and abdominal distention. Piegelar et al.[13] found postoperative nausea - vomiting at a low incidence (1.1%) after the RARP procedure. In addition, Raman et al.[17], in their study on patients undergoing RARP operation, reported that complications developed in 4 patients, which were ileus, small bowel obstruction, and ureteral stricture. In our study, we observed that our patients were discharged on average 5.6±1.6 days postoperatively. In most of the literature, the average discharge day after RARP is seen to be between 1-2. [9,17,21,22] In contrast, Pradere et al.[13] found the average discharge day after RARP to be 3.9 days; Piegelar, Mortevazi et al.[20,23] found the average discharge day after RARP to be 8 days. There seems to be significant differences between centers in terms of discharge days. This difference is thought to be due to being discharged with or after the removal of the Foley catheter. It was observed that all the patients in our study were discharged after the Foley catheter was removed.

5. Conclusions

As seen in our study, RARP procedures are usually performed in older patients and in those with comorbidities. Our study showed that in anesthesia management of patients undergoing RARP, it is necessary to know and carefully manage the physiological effects of the steep Trendelenburg position and pneumoperitoneum on organ systems. Prospective studies are needed to identify the hemodynamic, respiratory or other physiological changes that may be encountered in the anesthesia management of robotic surgical procedures and to identify potential complications.

Statement of ethics

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by Akdeniz University Faculty of Medicine Ethics Committee. (2018--70904504) Thesis number: 539125-2018 https://tez.yok.gov.tr/UlusalTezMerkezi/TezGoster?key=as2oTjW5jfr9IKSvmCdJYm_Cb6RsDR9xPYsQINfEaAvvg6vJmgwj2B5gVOlU_sNR

Conflict of interest statement

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References

1.Lee JR. Anesthetic considerations for robotic surgery. Korean J. Anesthesiology. 2014;b66:b3-11. https://doi.org/10.4097/kjae.2014.66.1.3
2.İzdeş S. Robotik cerrahide anestezi. Anestezi Dergisi. 2012;20(2):63-72.
3.Richard LH, Alan DK, Richard DU. Anesthetic challenges in robotic-assisted urologic surgery. Reviews in Urology. 2013; 15(4): 178-84.
4.Daniyal M, Siddiqui ZA, Akram M, et al. Epidemiology, etiology, diagnosis and treatment of prostate cancer. Asian Pac J Cancer Prev. 2014; 15(22): 9575-8. https://doi.org/10.7314/APJCP.2014.15.22.9575
5.Onaca M, Nita G, Manu M, et al. Retroperitonel laparoscopic radical prostatectomy. Chirurgia. 2018; 113(4): 542-50. https://doi.org/10.21614/chirurgia.113.4.542
6.Gainsburg DM. Anesthetic concerns for robotic-assisted laparoscopic radical prostatectomy. Minerva Anestesiologica. 2012; 78: 596-604.
7.Kadono Y, Yaegashi Y, Machioka K, et al. Cardiovascular and respiratory effects of the degree of head-down angle during robot-assisted laparoscopic radical prostatectomy. Int J Med Robotics Comput Assist Surg. 2013; 9: 17-22.

https://doi.org/10.1002/rcs.1482
8.Falabella A, Moore-Jeffries E, Sullivan MJ, et al. Cardiac function during steep Trendelenburg position and CO2 pneumoperitoneum for robotic-assisted prostatectomy: a trans-oesophageal Doppler probe study. Int J Med Robotics Comput Assist Surg. 2007; 3: 312-5.
https://doi.org/10.1002/rcs.165
9.Danic M, Chow M, Gayload A, et al. Anesthesia consideration for robotic-assisted laparoscopic prostatectomy: a review of 1500 cases. J Robotic Surg 2007; 1: 119-23.
https://doi.org/10.1007/s11701-007-0024-z
10.Lebowitz P, Yedlin A, Hakimi AA, et al. Respiratory gas Exchange during robotic-assisted laparoscopic radical prostatectomy. Journal of Clinical Anesthesia. 2015; 27: 470-5.
https://doi.org/10.1016/j.jclinane.2015.06.001
11.Bozkırlı F, Bedirli N, Akçabay M. Efects of steep trendelenburg position and pneumoperitoneum on middle ear pressure in patients undergoing robotic radical prostatectomy. Turk J Medi Sci. 2017; 47: 295-9.
https://doi.org/10.3906/sag-1601-113
12.Lestar M, Gunnarsson L, Lagerstrand L, et al. Haemodynamic perturbations during robot-assisted laparoscopic radical prostatectomy in 45 degrees trendelenburg position. Anaesthesia and analgesia. 2011; 113(5): 1069-75.
https://doi.org/10.1213/ANE.0b013e3182075d1f
13.Piegeler T, Dreessen P, Schlapfer M, et al. Impact of intraoperative fluid management on outcome in patients undergoing robotic-assisted laparoscopic prostatectomy-a retrospective analysis. Eur J Anaesth Intensive Care. 2011; 28(6): 1-6.
https://doi.org/10.1097/00003643-201106001-00256
14.Ono N, Nakahira J, Nakano S, et al. Changes in cardiac function and hemodynamics during robot-assisted laparoscopic prostatectomy with steep head-down tilt: a prospective observational study. BMC Res Notes. 2017; 10: 341-5.
https://doi.org/10.1186/s13104-017-2672-z
15.Ozgen US, Ozveren B, Kilercik M, et al. Ischmeia modified albumin: does it change during pneumoperitoneum in robotic prostatectomies? Int. Braz. J Urol. 2016; 42(1): 69-77.
https://doi.org/10.1590/S1677-5538.IBJU.2014.0677
16.Oksar M, Akbulut Z, Ocal H, et al. Robotic prostatectomy: the anesthetist's view for robotic urological surgeries, a prospective study. Rev Bras Anestesiol.2014; 64(5): 307-13.
https://doi.org/10.1016/j.bjan.2013.10.009
17.Raman JD, Dong S, Levison A, et al. Robotic radical prostatectomy: operative technique, outcomes, and learning curve. JSLS. 2007; 11: 1-7.
18.Ou YC, Yang CR, Wang J, et al. Learning curve of robotic-assisted radical prostatectomy with 60 initial cases by asingle surgeon. Asian J Surg. 2011; 34(2): 74-80.
https://doi.org/10.1016/S1015-9584(11)60023-7
19.Pouget L, Nouhaud FX, Blah M, et al. Interest of surgical companionship during the training periof of robot-assisted radical prostatectomy. Prog Urol. 2017; 27(5): 297-304.
https://doi.org/10.1016/j.purol.2017.01.005
20.Mortevazi A, Hermanns T, Hefermehl LJ, et al. Continuous low-dose aspirin theraphy in robotic-assisted laparoscopic radical prostatectomy does not increase risk of surgical hemorrhage. J of Laparoendoscopic and Advanced Surgical Techniques. 2013; 23(6): 500-5.
https://doi.org/10.1089/lap.2013.0013
21.Gainsburg DM, Wax D, Reich DL, et al. Intraoperative management of robotic-assissted versus open radical prostatectomy. JSLS 2010;14(1):1-5.
https://doi.org/10.4293/108680810X12674612014266
22.Nowfar S, Kopp R, Palazzi-Churas K, et al. Initial experience with aspirin use during robotic radical prostatectomy. J of Laparoendoscopic and Advanced Surgical Techniques. 2012; 22(3): 225-9.
https://doi.org/10.1089/lap.2011.0388
23.Pradere B, Peyronnet B, Seisen T, et al. Impact of anticoagulant and antiplatelet drugs on perioperative outcomes of robotic-assisted partial nephrectomy. J.Urol. 2017; 99: 118-22.
https://doi.org/10.1016/j.urology.2016.09.009