Int Urol Nephrol (2015) 47:1635–1641
DOI 10.1007/s11255-015-1088-8

UROLOGY - ORIGINAL ARTICLE

Postoperative pain and neuromuscular complications associated with patient positioning after robotic assisted laparoscopic radical prostatectomy: a retrospective non-placebo and non-randomized study

Elif Gezginci[1] · Orkunt Ozkaptan[2] · Serdar Yalcin[3] · Yigit Akin[4] · Jens Rassweiler[4] · Ali Serdar Gozen[4]

Received: 22 July 2015 / Accepted: 14 August 2015 / Published online: 2 September 2015

Abstract
Purpose To evaluate postoperative pain and neuromuscular complications associated with positioning after robotic assisted laparoscopic radical prostatectomy (RALP).
Methods Between September 2010 and June 2014, 534 patients who underwent RALP were evaluated. Patients were positioned in operating theater by operating room staff, and two independent urologists noted postoperative follow-up. Patient's demographic data, postoperative complications associated with positioning, pain score according to visual analogue scale, and hospital stay were recorded. Statistical analyses were performed and $p < 0.05$ was considered significant.
Results Postoperative pain and neuromuscular complications were observed in 54 (10.1 %) and 27 (5 %) patients, respectively. We found ASA, BMI, and comorbidities were significantly associated with postoperative pain levels in univariate analyses ($p = 0.01$, $p = 0.013$, and $p = 0.01$, respectively). Additionally, ASA, previous operations, and comorbidities were significantly associated with postoperative neuromuscular complications ($p = 0.04$, $p = 0.01$, and $p = 0.02$, respectively). According to statistical analyses, BMI < 30 and presence of an implant were significantly associated with postoperative pain in multivariate logistic regression analyses ($p = 0.010$ and $p = 0.033$, respectively). Additionally, having comorbidities was significantly associated with postoperative neuromuscular complications in multivariate analyses ($p = 0.04$).
Conclusions Patients with previous operations, comorbidities, and high ASA score are at risk of neuromuscular complications during RALP. Lower BMI and having an implant also lead to higher postoperative pain. Operating room staff and anaesthesia team should be very careful with patients undergoing RALP in steep Trendelenburg and low-lithotomy position.

Keywords Complications · Ergonomics · Pain · Robotics · Prostate cancer

Introduction

Robotic assisted laparoscopic radical prostatectomy (RALP) is recently used as a contemporary minimally surgical treatment option for organ-confined prostate cancer due to various benefits such as less blood loss, operation time, pain, hospital stay, and complication rate [1, 2]. Besides, RALP has positive effects on patients' outcomes [1]. On the other hand, low-lithotomy and steep Trendelenburg position during RALP can cause musculoskeletal complications that can affect comfort of patients during postoperative period [3]. Prolonged lithotomy with steep Trendelenburg position may cause orbital and conjunctival edema, injuries in brachial plexus and skin, rhabdomyolysis, compartment syndrome, deep venous thrombosis, etc. [3, 4]. Additionally, general anesthesia may install risks of muscle and nerve injuries [5]. All these above may lead to decrease in quality of life and late recovery after operation.

✉ Ali Serdar Gozen
asgozen@gmail.com; asgozen@yahoo.com

[1] School of Nursing, Gulhane Military Medical Academy, Ankara, Turkey

[2] Department of Urology, Avrasya Hospital, Istanbul, Turkey

[3] Department of Urology, Gulhane Military Medical Academy, Ankara, Turkey

[4] Department of Urology, SLK-Kliniken, University of Heidelberg, Am Gesundbrunnen 20-26, 74078 Heilbronn, Germany

However, there have been some published studies on these, but data on pain and neuromuscular complications after RALP are still lacking.

We here evaluated postoperative pain and neuromuscular complications (i.e., hip adduction, flexion weakness, pain or loss of sensitivity on upper and lower extremities), which are related to prolonged exposure to the steep Trendelenburg and low-lithotomy position during RALP.

Methods

Study design

This was both non-randomized and non-placebo study with retrospective view of prospective recorded data. We investigated patients' data between September 2010 and June 2014. There were 534 patients who underwent RALP at our institute. Our certificated cancer center approved the ethical statement of research involving human participants and also the statement of informed consents. Then, all patients provided signed consent forms and understood the operation and the study. The exclusion criterion was lack of follow-up data.

All RALP procedures were performed on the same surgical table (MAQUET Medical Systems, Wayne, NJ, USA) and Da Vinci Robotic surgery system (DaVinci® S Intuitive Surgical, Inc., Sunnyvale, CA, USA). Additionally, Tempur material was used as surgical table's mattress.

Data consisted of patients' age, body mass index (BMI), comorbidities, previous operations, presence of any implant, operation time, American Society of Anesthesiologists (ASA) score, postoperative complications associated with positioning, pain score with visual analogue scale (VAS), and hospital stay. All complications were assessed according to modified Clavien classifications [6].

Patient positioning

At the start of the operation, all patients were positioned under general anesthesia. Patients' positions were adjusted by operating room staff that is consisted of surgeons and urology fellows under supervision of experienced mentors of the clinic. The patient was placed in lithotomy position and his legs were separated in flexion and abduction. Patient's arms were positioned as adducted parallel to his body, in supine position. Thereafter, patient's body was tilted 15°–20° downward in a steep Trendelenburg position. His head was lifted up nearly 15°–20° and a shoulder support was used to prevent sliding during operation and better fixation [7]. We were very careful not to make brachial plexus compression. Protective silicon pads were placed for head, elbows, wrists, shoulders, ankles, and heels to prevent sliding and neuromuscular complications [8]. The pressure points of body and lower extremities had been well supported via adequately comfortable pads and supporting instruments (Fig. 1). Therefore, we aimed to prevent

Fig. 1 The patient is positioned in steep Trendelenburg and low-lithotomy position. Supportive pads are placed for preventing complications associated with positioning

postoperative neuromuscular complications and pain associated with positioning [4].

Positioning obese patients and patients who had any bone implant might be problematic [9]. Thus, we were more careful with positioning those patients before RALP.

Brief description of the procedure

The DaVinci® robotic surgery system (DaVinci® S Intuitive Surgical, Inc., Sunnyvale, CA, USA) was used, and all patients were positioned after undergoing general anaesthesia.

A standardized 6-port placement configuration was used as we described before [6]. After positioning, retroperitoneal space was created by blunt finger dissections through a subumblical incision. A 10-mm ballon trocar (Herloon, BBraun, Aesculap AG, Tuttlingen, Germany) was used for creating adequate space in extraperitoneal area, a 12-mm trocar was placed, and other trocars were placed under direct vision in a "W" shape manner; two 8-mm robotic trocars, two 11-mm assistant trocars, and an extra 6-mm assistant trocar were placed on the suprapubic area [7]. Pneumo-extraperitoneum was provided by CO_2 insufflation (maximum gas pressure, 15 mmHg; maximum gas flow, 30 mL/s) [7].

Then, DaVinci® robotic surgery system was docked between the legs of the patient. The patient cart base is located at the base of operating table. The height of working robotic arm was set according to safety rules. If it was deemed necessary to avoid patient's legs from hitting the arms during movements, patient's legs were lowered. Operating room lights and equipments are drawn aside [10].

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) for Windows 16.0 (SPSS Inc., Chicago, IL) was used for statistical analysis. Chi-square test was used to compare postoperative pain and neuromuscular complications. Independent predictors for postoperative pain and neuromuscular complication were analyzed with univariate logistic regression analysis. Multivariate analyses were used for confirmation data. Independent variables were determined. $p \leq 0.05$ was considered significant.

Results

Data of 534 RALP patients were evaluated. Mean age was 65.2 ± 7.3 years, and mean BMI was 27.3 ± 3.8 kg/m^2. Mean ASA score was 2.2 ± 0.6. Mean operative time was 198.8 ± 43.7 min with mean hospital stay 9.8 ± 1.7 days. Calculated mean pain score was 3.6 ± 1.2. All these findings are summarized in Table 1.

Table 1 Demographic, perioperative, and postoperative data of patients

Age	65.2 ± 7.3
BMI (kg/m^2)	27.3 ± 3.8
ASA score	2.2 ± 0.6
Operation time (min)	198.8 ± 43.7
Hospital stay	9.8 ± 1.7
Postoperative pain score	3.6 ± 1.2

BMI body mass index, *ASA* American Society of Anesthesiologists

Neuromuscular complications and pain, which are associated with positioning, were observed in 81 patients (15.1 %). Neuromuscular complications were paresthesia, numbness, and weakness. Postoperative pain was observed in 54 patients (10.1 %), and neuromuscular complications were also observed in 27 patients (5.1 %) (Table 2).

Pain associated with postoperative position was observed in 54 patients (10.1 %). The locations were as follows: 1 neck pain, 13 back pain, 4 shoulder pain, 4 rib pain, 3 hip pain, 3 inguinal pain, 1 sacral pain, 5 lumbar pain, 9 upper leg pain, 12 lower leg pain, 6 knee pain, 6 foot pain, 2 arm pain, and 2 hand pain. Neuromuscular complications (paresthesia, numbness, and weakness), which are associated with positioning, were also observed in 27 patients (5.1 %) as follows: 5 patients experienced loss of sensation in hip, 4 patients in knee, 8 patients in upper leg, 6 patients in lower leg, 6 patients in hand, and 14 patients in foot (the most often one) (Table 2). Neuromuscular complications and/or pain was observed in some of the patients, in different localizations at the same time. All these complications, which needed additional drugs and/or physiotherapy, were of Clavien grade 1.

Comparison of age, ASA score, BMI, implant, operation time, comorbidity, previous operation with postoperative pain is presented in Table 3. ASA score, BMI, and comorbidity were significantly associated with postoperative pain in univariate analyses ($p = 0.01$, $p = 0.01$, and $p = 0.01$, respectively; Table 3). Comparison of age, ASA score, BMI, implant, operation time, comorbidity, previous operation with postoperative neuromuscular complication associated with positioning is presented in Table 4. ASA score, previous operation, and comorbidity were significantly associated with postoperative neuromuscular complication in the univariate analysis ($p = 0.04$, $p = 0.01$, and $p = 0.02$, respectively; Table 4).

Multivariate logistic regression analyses showed that postoperative pain was significantly associated with BMI < 30 kg/m^2 and presence of bone implants ($p = 0.01$ and $p = 0.03$, respectively; Table 5). Besides

Table 2 Position-related pain and neuromuscular complications in different localizations

Pain	Number of patients
Back pain	13 (2.43 %)
Upper leg pain	9 (1.68 %)
Lower leg pain	6 (1.12 %)
Knee pain	6 (1.12 %)
Foot pain	6 (1.12 %)
Lumbal pain	5 (0.93 %)
Rib pain	4 (0.74 %)
Groin pain	3 (0.56 %)
Hip pain	3 (0.56 %)
Arm/elbow pain	2 (0.37 %)
Hand pain	2 (0.37 %)
Sacral pain	1 (0.18 %)
Neck pain	1 (0.18 %)
Neuromuscular complications	
Loss of sensation in foot	14 (2.62 %)
Loss of sensation in upper leg	8 (1.49 %)
Loss of sensation in lower leg	6 (1.12 %)
Loss of sensation in hand	6 (1.12 %)
Loss of sensation in rib	5 (0.93 %)
Loss of sensation in knee	4 (0.74 %)

Table 3 Comparison of age, American Society of Anaesthetists score, body mass index, having implant, operation time, comorbidity, previous operation according to postoperative pain

	Pain *n*, %	Without pain *n*, %	*p* value
Age <65 years	23, 4.3 %	200, 37.4 %	0.9
Age ≥65 years	31, 5.8 %	280, 52.4 %	
ASA 1	8, 1.4 %	34, 6.3 %	0.01*
ASA 2	24, 4.4 %	312, 58.4 %	
ASA 3	22, 4.1 %	132, 24.7 %	
ASA 4	0	2, 0.3 %	
BMI (kg/m^2) < 30	35, 6.5 %	382, 71.5 %	0.01*
BMI (kg/m^2) ≥ 30	19, 3.5 %	98, 18.5 %	
Previous operation	26, 4.8 %	168, 31.4 %	0.057
Without previous operation	28, 5.2 %	312, 58.4 %	
With implant	4, 0.7 %	14, 2.6 %	0.08
Without implant	50, 9.3 %	466, 87.2 %	
Operation time ≤3 h	18, 3.3 %	188, 35.2 %	0.4
Operation time >3 h	36, 6.7 %	292, 54.6 %	
With comorbidity	42, 7.8 %	291, 54.4 %	0.01*
Without comorbidity	12, 2.2 %	189, 35.5 %	

ASA American Society of Anaesthetists, *BMI* body mass index

* Statistically significant *p* value

these, comorbidity and previous operations were higher in patients whose BMI < 30 kg/m^2. In addition, we found that postoperative pain was higher in patients with bone implants. Comorbidity was also significantly associated with postoperative neuromuscular complications in the multivariate analyses ($p = 0.04$; Table 5).

Discussion

Trendelenburg position has been widely used in order to keep away abdominal viscera from surgical structures with gravity effect [11], while lithotomy position has been used to provide surgical access to deep structures in the pelvis in RALP [1]. However, this position can cause physiologic changes in these patients. Studies noted postoperative neuromuscular complications, such as nerve and extremity injuries including brachial plexus neuropraxia, related to steep Trendelenburg position for prolonged operation time during RALP [11–17]. Akhavan et al. [18] reported neuromuscular complications associated with patient positioning during RALP. Wen et al. [3] reported costs of neuromuscular complications. In the present study, we evaluated postoperative neuromuscular complications and pain associated with positioning during RALP. In addition, we investigated benefits of appropriate surgical table, mattress (Tempur), paddings, and protective materials for reducing neuromuscular complications associated with positioning.

We found that the incidence of postoperative neuromuscular complications was associated with positioning in 27 patients (5.1 %) who underwent RALP. The comparison of neuromuscular complications in published studies with those in the present study is summarized in Table 6. The back pain, which is associated with positioning, was the most observed pain type. Additionally, the most common neuromuscular complication was loss of sensation in foot (in 14 patients, 19.7 %). Koc et al. [19] reported neuropathy in lower extremity for 5 (1.3 %) of 377 patients within first 7 days after RALP on a split-leg table. Mills et al. [9] reported neuromuscular complications related to positioning at a rate of 6.6 % in 22 of 334 patients who underwent robotic assisted laparoscopic urological surgeries. Besides these, Wen et al. [3] represented their complications of RALP series in terms of positioning at a rate of 0.4 % in 249 of 61,656 patients. Our results were in line with reports above. The patient positioning during RALP can result in various complications like position injuries. It is very important to avoid complications of positioning. Thus, operating room staff should be careful when they are positioning patients before RALP.

Koc et al. [19] reported complications of positioning associated with prolonged operation time. This was because of more exposure to nerve compression during prolonged operations. Additionally, Mills et al. [9] agreed with this report and revealed that when operation time was shorter than 240 min, positioning injuries might not occur. In our

Table 4 Comparison of age, American Society of Anaesthetists score, body mass index, having implant, operation time, comorbidity, previous operation with position-related postoperative neuromuscular complications

	Postoperative neuromuscular complications *n*, %	Without postoperative neuromuscular complications *n*, %	*p* value
Age <65 years	32, 5.9 %	191, 35.7 %	0.5
Age ≥65 years	39, 7.3 %	272, 50.9 %	
ASA 1	9, 12.7 %	33, 7.1 %	0.04*
ASA 2	35, 49.3 %	303, 65 %	
ASA 3	27, 38 %	125, 26.6 %	
ASA 4	0, 0	2, 0.4 %	
BMI (kg/m^2) < 30	51, 9.5 %	370, 69.2 %	0.1
BMI (kg/m^2) ≥ 30	20, 3.7 %	93, 17.4 %	
Previous operation	35, 6.5 %	159, 29.7 %	0.01*
Without previous operation	36, 6.7 %	304, 56.9 %	
With implant	4, 0.7 %	14, 2.6 %	0.2
Without implant	67, 12.5 %	449, 84 %	
Operation time ≤3 h	25, 4.6 %	182, 34 %	0.3
Operation time >3 h	46, 8.6 %	281, 52.6 %	
With comorbidity	53, 9.9 %	280, 52.4 %	0.02*
Without comorbidity	18, 3.3 %	183, 34.2 %	

ASA American Society of Anaesthetists, *BMI* body mass index

* Statistically significant *p* value

Table 5 Multivariate logistic regression analysis of postoperative pain and neuromuscular complications

	p value
Postoperative pain	
BMI < 30 kg/m^2	0.01*
Presence of implant	0.03*
Postoperative complication	
Presence of comorbidity	0.04*

BMI body mass index

* Statistically significant *p* value

Table 6 Comparison of neuromuscular complication rate in published studies and the present series, after robotic assisted laparoscopic surgeries

References	Rate of neuromuscular complications (%)
Wen et al. [3]	4
Mills et al. [9]	6.6
Mattei et al. [15]	35
Koc et al. [19]	1.3
Present series	5

study, mean operation time was 195 min and this was not statistically associated with postoperative neuromuscular complications and pain. Our results were not in line with studies above; this might be the reflection of appropriate operation time in RALP. We strongly believe that operation time may be shortened by surgical experience. Thus, neuromuscular complications and higher rate of pain can be prevented.

The ASA score has been used to evaluate patients' risk factors and physical status [9]. In our study, mean ASA score was "2" and this was statistically associated with postoperative pain. In addition, this was significantly associated with postoperative neuromuscular complications. Mills et al. [9] reported that higher ASA score was associated with positioning complications. Our results were similar to their results. In case of higher ASA score, surgeons should consider potential positioning complications. However, this should be investigated in detail in another study.

Comorbidity has another negative impact on operation outcomes [1, 9]. According to our findings, postoperative neuromuscular complications were observed 1.79 times more in patients who had comorbidities (higher ASA). Wen et al. [3] reported significantly increased incidence of eye, nerve, compartment syndrome, during RALP with patients who have comorbidities. Preoperative assessment of comorbidity can be a pathfinder for minimizing neuromuscular complications related to positioning. There is no doubt that obesity is another comorbidity and this can cause complication during positioning [1, 9]. We found that postoperative pain was more in patients with BMI > 30 kg/m^2. This was statistically significantly associated with obesity. On the other hand, multivariate logistic regression analyses showed postoperative pain was more observed in patients whose BMI was lower than 30 kg/m^2. This may be due to the fact that obese patients' adipose tissue may help to support muscle and joints during RALP. Nevertheless, it is an important risk factor as obesity may negatively affect postoperative patient outcomes [1, 9].

Chitlik [1] revealed that previous operations could be one of the position-related risk factors during RALP. However, there has been a widespread opinion among surgeons that if a patient had previous operation, the patient can have another operation. We do not agree with Chitlik [1]. However, it is important to know previous operation history of a patient who would undergo RALP. Moreover, patients with previous bone implant history may be at risk of complications associated with positioning. We could demonstrate this point in statistical analyses. However, more evidence-based studies are needed for accurate results on this issue.

The present study has some limitations. At the first, we used retrospective pattern for data analyses. Additionally, although we used VAS for pain evaluation, there may be differences in pain perception among patients. On the other hand, there was no patient with permanent sequelae in follow-up period. All complications were managed by medications and physical therapies. However, this can be a subject of another study. We focused on neuromuscular complications [18]. Lastly, we would like to make a note that the mean hospital stay is 9.8 days in our series. This is related to health system in our community, and not mostly related to complications.

Nonetheless, our study is unique in the published literature, in which postoperative pain and neuromuscular complications after RALP were evaluated with multivariate analyses. Protective precautions should be considered in terms of using appropriate surgical table with mattress, paddings, and protective materials for reducing neuromuscular complications associated with positioning considering patients' bone implants and previous neuromuscular diseases. BMI < 30 kg/m^2 and having previous implants were risk factors for pain after RALP, and having comorbidity was associated with neuromuscular complications.

Conclusions

Patient positioning during RALP may result in postoperative complications. Patients who have comorbidities and operative history, notably with implants, can be at an increased risk of postoperative neuromuscular complications and pain after RALP. Patients who have high ASA score may be at a greater risk of positioning complications. Operating room staff should be careful to minimize postoperative complications associated with positioning, specifically in case of steep Trendelenburg and low-lithotomy position. Protective precautions should be taken into account during RALP to avoid complication associated with positioning.

Acknowledgments The abstract of the present study was presented at the 16th European Association of Urology Nurses (EAUN) Meeting, 21 March 2015, Madrid, Spain.

Compliance with ethical standards

Conflict of interest The authors have no conflict of interests.

References

1. Chitlik A (2011) Safe positioning for robotic-assisted laparoscopic prostatectomy. AORN J 94:37–45
2. Ghazi A, Scosyrev E, Patel H, Messing EM, Joseph JV (2013) Complications associated with extraperitoneal robot-assisted radical prostatectomy using the standardized Martin classification. Urology 81:324–331
3. Wen T, Deibert CM, Siringo FS, Spencer BA (2014) Positioning-related complications of minimally invasive radical prostatectomies. J Endourol 28:660–667
4. Fumo MJ, Hemal AK, Menon M (2006) Robotic assisted radical prostatectomy. In: Naito S, Hirao Y, Terachi T (eds) Endourological management of urogenital carcinoma. Springer-Verlag, Tokyo, pp 175–193
5. Lopes CM, Galvão CM (2010) Surgical positioning: evidence for nursing care. Rev Lat Am Enfermagem 18:287–294
6. Dindo D, Demartines N, Clavien PA (2004) Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 240:205–213
7. Gözen AS, Akin Y, Akgul M, Yazici C, Klein J, Rassweiler J (2014) A novel practical trocar placement technique for extraperitoneal laparoscopic and robotic-assisted laparoscopic radical prostatectomy in patients with lower midline abdominal incisions. JLAST 24:417–421
8. St-Arnaud D, Paquin M (2008) Safe positioning for neurosurgical patients. AORN J 87:1156–1168
9. Mills JT, Burris MB, Warburton DJ, Conaway MR, Schenkman NS, Krupski TL (2013) Positioning injuries associated with robotic assisted urological surgery. J Urol 190:580–584
10. Pick DL, Lee DI, Skarecky DW, Ahlering TE (2004) Anatomic guide for port placement for DaVinci robotic radical prostatectomy. J Endourol 18:572–575
11. Awad H, Santilli S, Ohr M, Roth A, Yan W, Fernandez S, Roth S, Patel V (2009) The effects of steep trendelenburg positioning on intraocular pressure during robotic radical prostatectomy. Anesth Analg 109:473–478
12. Kalmar AF, Foubert L, Hendrickx JF, Mottrie A, Absalom A, Mortier EP, Struys MM (2010) Influence of steep trendelenburg position and CO_2 pneumoperitoneum on cardiovascular, cerebrovascular, and respiratory homeostasis during robotic prostatectomy. Br J Anaesth 104:433–439
13. Choi EM, Na S, Choi SH, An J, Rha KH, Oh YJ (2011) Comparison of volume controlled and pressure-controlled ventilation in steep trendelenburg position for robot-assisted laparoscopic radical prostatectomy. J Clin Anesth 23:183–188
14. Natalin RA, Landman J (2010) Positional and neuromuscular complications of laparoscopic and robotic urologic surgery. In: Ghavamian R (ed) complications of laparoscopic and robotic urologic surgery. Springer, New York, pp 35–41

15. Mattei A, Di Pierro GB, Rafeld V, Konrad C, Beutler J, Danuser H (2013) Positioning injury, rhabdomyolysis, and serum creatine kinase-concentration course in patients undergoing robot-assisted radical prostatectomy and extended pelvic lymph node dissection. J Endourol 27:45–51
16. Phong SV, Koh LK (2007) Anaesthesia for robotic-assisted radical prostatectomy: considerations for laparoscopy in the Trendelenburg position. Anaesthesiol Intensive Care 35:281–285
17. Weber ED, Colyer MH, Lesser RL, Subramanian PS (2007) Posterior ischemic optic neuropathy after minimally invasive prostatectomy. J Neuroophthalmol 27:285–287
18. Akhavan A, Gainsburg DM, Stock JA (2010) Complications associated with patients positioning in urologic surgery. Urology 76:1309–1316
19. Koc G, Tazeh NN, Joudi FN, Winfield HN, Tracy CR, Brown JA (2012) Lower extremity neuropathies after robot-assisted laparoscopic prostatectomy on a split-leg table. J Endourol 26:1026–1029