Impact of Body Habitus on Operative Difficulties during Extraperitoneal Laparoscopic Radical Prostatectomy

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Purpose: The aim of the present study was to investigate whether patients' body habitus affects the operative difficulties associated with extraperitoneal laparoscopic radical prostatectomy (LRP). Therefore, the associations between body habitus and perioperative outcomes of surgery, including bleeding, operative time, and resection margins, were evaluated.

Materials and Methods: Between August 2010 and July 2012, 40 consecutive patients with preoperative magnetic resonance imaging and abdominal X-ray examinations underwent extraperitoneal LRP for localized prostate cancer at our institution. The associations between anthropometric measurements and demographics of patients, operation duration, estimated blood loss (EBL), and resection margins were analyzed retrospectively. Multivariate analyses were performed, and $P < .05$ was considered significant.

Results: On multiple regression analysis, the view of the prostatic apex (VPA) was significantly associated with EBL ($P = .02$), and body mass index (BMI) was significantly associated with operative time ($P = .02$). On multiple logistic regression analysis, protrusion of the prostate into the bladder was significantly associated with positive resection margins ($P = .04$).

Conclusion: The findings of the present study suggest that poor VPA, protrusion of the prostate into the bladder, and high BMI were related to operative difficulties in extraperitoneal LRP. If operative difficulty is predicted preoperatively, it would be better to prepare blood for transfusion and/or special instruments (e.g. flexible scope), or switch to other therapeutic procedures.

Keywords: blood loss; surgical; laparoscopy; methods; operative time; prostatectomy; prostatic neoplasms; surgery.

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INTRODUCTION

Laparoscopic radical prostatectomy (LRP) for organ-confined prostate cancer (PCa) is mainly carried out via two distinct approaches, transperitoneal and extraperitoneal. Many papers have reported good outcomes and various technical modifications of LRP.[1-5] Since Raboy and colleagues first reported extraperitoneal LRP in 1997,[6] extraperitoneal LRP underwent further modifications and developments to become the first-line alternative for LRP.[7,8] Extraperitoneal LRP allows direct access to Retzius' space, avoiding potential intraperitoneal complications, such as bowel injuries, peritonitis, postoperative ileus, intraoperative bleeding, or intraperitoneal urine leakage.[8,9] Thus extraperitoneal LRP has the advantages of both open radical prostatectomy and minimally-invasive laparoscopic procedures.

However, extraperitoneal LRP has potential disadvantages, including a smaller working space, difficulty accessing the pelvis, and less luminosity, compared with the intraperitoneal approach.[10] Due to the small laparoscopic working space, we have previously experienced technical difficulties in performing extraperitoneal LRP. Such difficulties can result in increased operative time and/or the amount of bleeding. Indeed, a longer operative time increases the risk of an elevated creatine phosphokinase.[11] Additionally, increased bleeding may lead to conversion to open surgery and/or necessitate blood transfusion. Due to the small working space in extraperitoneal LRP, the body habitus of the patient, which includes factors such as body fat and skeletal structure around the prostate, is likely to affect perioperative outcomes. However, few studies have specifically assessed the perioperative outcomes of extraperi-

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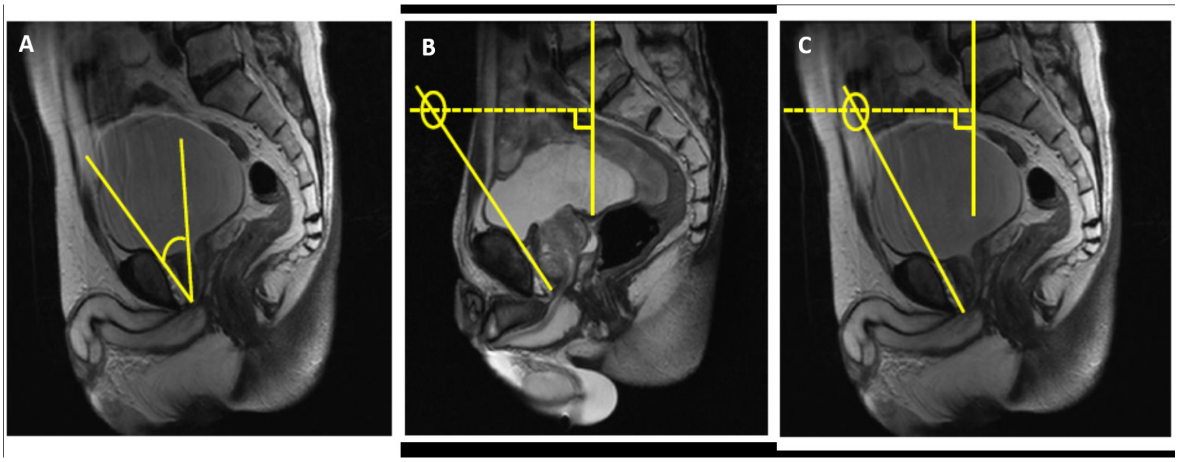

Figure 1. Body habitus assessed by magnetic resonance imaging and abdominal X-ray films.
A) Angle between the pubic bone and the prostate; **B)** View of the prostatic apex (good); **C)** View of the prostatic apex (poor).

toneal LRP related to the body habitus of patients.

The aim of the present study was to investigate whether patients' body habitus affects the technical difficulties that are associated with extraperitoneal LRP. Therefore, the associations between body habitus and technical difficulties were evaluated.

MATERIALS AND METHODS

Study Population

Between August 2010 and July 2012, 40 consecutive patients with preoperative magnetic resonance imaging (MRI) and abdominal X-ray examinations underwent extraperitoneal LRP for localized PCa at our institution. Forty patients were included as the maximum number because our institution introduced robot-assisted LRP after the end of the study. The transperitoneal approach was not used; only the extraperitoneal approach was used in the patients undergoing endoscopic surgery during the period of this study. Two patients whose surgery was converted to open surgery because severe adhesions had occurred in Retzius' space owing to previous inguinal hernia repair and one patient whose pathology was not diagnosed due to neoadjuvant hormonal therapy were excluded from the analysis. The institutional review board for research involving human subjects approved this retrospective analysis.

Operative Technique

With minor modifications, extraperitoneal LRPs were performed as previously described.[12-16] Briefly, a Hasson trocar (12 mm) was inserted through the paraumbilical incision for the rigid 30° endoscope that was held by the second assistant. The second trocar (12 mm) and third trocar (12 mm) were lateral to the rectus muscle, approximately 2 finger-breadths below the umbilicus on the right and left sides, respectively; the fourth trocar (5 mm) and fifth trocar (5 mm) were placed approximately 2 finger-breadths inside the right and left superior anterior iliac spines. In the present study, limited lymphadenectomy was performed in the external iliac vein and obturator area in all patients regardless of D'Amico risk

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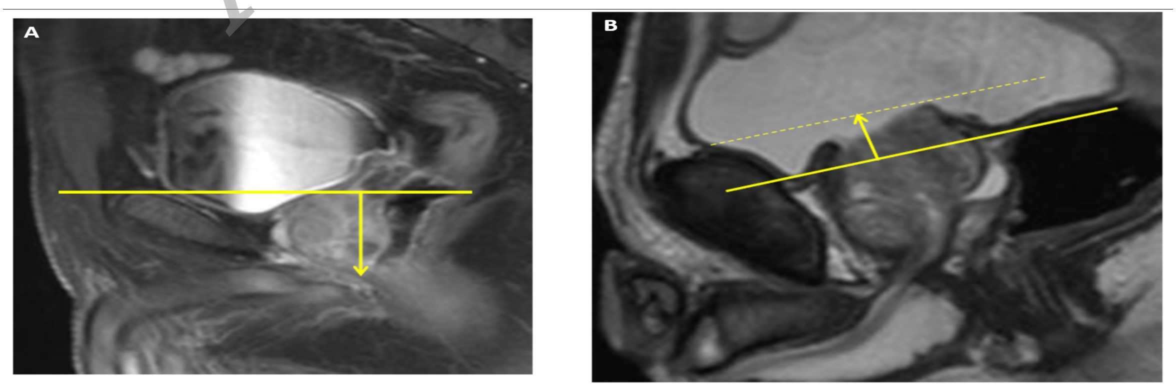

Figure 2. Body habitus assessed by magnetic resonance imaging and abdominal X-ray films. **A)** Depth of the prostatic apex; **B)** Protrusion of the prostate into the bladder.

Table 1. Patients' characteristics and perioperative outcomes.*

Variables	Values
Age, years	68 (55 - 75)
PSA, ng/mL	8.9 (4.1 - 35.8)
Prostate volume, cm3	45 (20 - 90)
Gleason score	7 (6 - 9)
Operative time, min	339 (191- 594)
Estimated blood loss, mL	895 (200 - 2300)
pT2: ≥ pT3, no.	23:14
Positive resection margin rate, no. (%)	35 (37)

* Data are presented as median (range).

classification. The endopelvic fascia was then exposed and incised. The puboprostatic ligament was sectioned, and the dorsal vein complex (DVC) was ligated with an X-stich using 2-0 polyglactin suture (VICRYLTM CT-1).[14] The bladder neck was then transected, and the prostate was pulled anteriorly to incise the retrotrigonal layer. The ampullae and seminal vesicles were identified and dissected free. Upward traction of the ampullae and seminal vesicles exposed Denonvilliers' fascia, which could then be incised sharply, exposing the anterior surface of the rectum. The prostate pedicles were dissected with a harmonic or bipolar scalpel. The DVC was then incised. The prostate remained attached only to the urethra and its surrounding structures. High mobility of the prostate allowed the urethra to be transected without damaging the urethral sphincter. After the prostate and seminal vesicles were removed, reconstruction of the bladder neck and urethral anastomosis was performed using a running 2-0 poliglecaprone suture (MONOCRYLTM UR-6) around a 20-F Foley catheter. The neurovascular bundle was not preserved in the present cohort in which the emphasis was on cancer control rather than erectile dysfunction, because no patients wanted neurovascular bundle preservation. The role of the Rocco stitch[17] for posterior reconstruction of Denonvilliers' fascia in terms of earlier continence recovery is encouraging but still controversial.[18] Therefore, in the present study, posterior reconstruction was not performed to simplify the operative procedures. Additionally, intussusception of the bladder neck[19] was not performed due to the technical challenges of the laparoscopic approach. Extraperitoneal LRP was performed by two surgeons (T.Y. and N.H.). Both surgeons had considerable experience performing laparoscopic surgeries, such as radical nephrectomy, nephroureterectomy, donor nephrectomy, pyeloplasty, and so on. T.Y. had performed about 300 laparoscopic surgeries, and N.H. had performed about 250 cases. In addition, both surgeons were board-certified in urological laparoscopy by the Japanese Endoscopic Surgical Qualification System. This system checks the surgeons' skills related to laparoscopic surgery through review of their own unedited video recordings of their operations. Because the examination pass rate is only about 50%, certification by the Japanese Endoscopic Surgical Qualification System guarantees the skills of laparoscopic surgeons. However, with respect to extraperitoneal LRP, 58 cases had been performed by the end of the study, and the two surgeons shared the cases equally. There were no differences in terms of amount of bleeding, operative duration, and positive surgical margin rate between the two surgeons (data not shown). Hence, they were equally skillful with regard to performing LRP.

Evaluation of Operative Difficulty

Operative time, estimated blood loss (EBL), and positive resection margins were recorded as surrogate markers of operative difficulty.

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Table 2. Associations among patients' characteristics, imaging assessment of body habitus, and estimated blood loss or operative time. Univariate analysis using simple regression analysis.

		EBL		Operative Duration	
	Mean ± SD	c.c	*P* Value	c.c	*P* Value
EBL, mL	1059 ± 570	-----	-----	.50	.001
Operative time, min	365 ± 83	.50	.001	------	-----
BMI, kg/m^2	23.6 ± 2.8	.16	.32	.52	.0007
Prostate volume, cm^3	29.6 ± 18.3	.24	.17	.02	.88
Angle pubic bone and prostate, degree	38.1 ± 0.9	.27	.62	.42	.008
Depth of prostatic apex, cm	3.7 ± 0.6	.27	.09	.11	.51
Area of pelvic entrance, cm^2	138 ± 15	-.11	.48	.05	.74

Abbreviations: EBL, estimated blood loss; SD, standard deviation; BMI, body mass index: c.c.; correlation coefficient.

Table 3. Associations among patients' characteristics, imaging assessment of body habitus, and estimated blood loss or operative time. Univariate analysis using simple regression analysis. Univariate analysis using the Mann-Whitney *U* test.

	no.	EBL (mL)	*P* Value	Operative Time (min)	*P* Value
View of the prostatic apex			.002		.04
Good	31	943 ± 523		353 ± 83	
Poor	6	1679 ± 398		429 ± 55	
Protrusion of the prostate			.33		.09
Yes	11	1200 ± 509		401 ± 94	
No	26	1002 ± 592		351 ± 76	

Abbreviation: EBL, estimated blood loss.

MRI Technique

MRI was performed using a 1.5-T whole-body magnetic resonance scanner (Signa; General Electric Medical Systems, Milwaukee, Wisconsin, USA). At 1 h before MRI, all patients were instructed to empty the bladder and drink 1-2 glasses of water, and they were then asked to try to empty their bowels.[20] When the patients felt accumulation of urine in the bladder, they were examined in the supine position, using the body coil for excitation and a pelvic phased array coil (Signa). Axial fast spin-echo proton density-weighted imaging was performed using the following parameters: repetition time (TR), 1400 ms; echo time (TE), 22.8 ms; echo train length (ETL), 5; slice thickness (ST), 4 mm; interslice gap, 0.4 mm; field of view (FOV), 20 cm; matrix, 320 × 224; and three excitations. Coronal and sagittal T2-weighted fast recovery fast spin echo imaging was performed with the following parameters: TR, 3500 ms; TE, 102 ms; ETL, 11; ST, 4 mm; interslice gap, 0.4 mm; FOV, 20 cm; matrix, 320 × 256; and two excitations.

Parameters Assessed

MRI and abdominal X-ray films were reviewed by a blind reviewer (A.H.) to assess the image for anatomic parameters. To evaluate whether the viewing field of the prostatic apex was good or poor during surgery, the following three parameters were evaluated, as mentioned below. First, the angle between the prostate and pubic bone was defined by the angle between the prostatic urethra and the posterior side of the pubic bone in the mid-sagittal plane of the MRI (**Figure 1A**). Second, the view of the prostatic apex (VPA) was defined as the intersection point between the tangent line passing though the prostatic apex and the posterior side of the pubic bone and the perpendicular line from the promontory of the pelvis in the mid-sagittal plane of MRI.[21] Good VPA was defined as a position with the intersection point outside the body (**Figure 1B**). Poor VPA was defined as a position with the intersection point inside the body (**Figure 1C**). Third, depth of the prostatic apex was defined as the craniocaudal distance from the most proximal margin of the symphysis pubis to the level of the distal margin of the prostatic apex as measured on the mid-sagittal plane of MRI (**Figure 2A**).[22,23]

Because a large median lobe in the prostate is one of the risk factors for poor perioperative outcomes during robot-assisted laparoscopic radical prostatectomy (RARP),[24] the presence or absence of protrusion of the prostate into the bladder was evaluated. If the tip of the prostate protruded to the base of the urinary bladder in the sagittal plane of MRI, protrusion of the prostate into the bladder was considered present (**Figure 2B**).[25]

To evaluate the working space during surgery, the area of pelvic entrance was calculated using the following formula: area of pelvic entrance (cm^2) = transverse diameter (cm) × true conjugate (cm) (**Figure 3**), where transverse diameter was the longest distance of the il-

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Table 4. Associations among patients' characteristics, imaging assessment of body habitus, and estimated blood loss or operative duration. Multivariate analysis using multiple linear regression analysis.

	EBL		Operative Time	
	β	*P* Value	β	*P* Value
BMI	-.19	.27	.35	.02
View of the prostatic apex	-.35	.02	.03	.81
Angle of the prostate and pubic bone	-.05	.74	-.16	.31
Protrusion of the prostate	.002	.98	.16	.24

Abbreviations: EBL, estimated blood loss; BMI, Body mass index; β, standard partial regression coefficient.

Table 5. Associations among patients' characteristics, imaging assessment of body habitus, and resection margin. Univariate analysis using the Mann-Whitney *U* test.

	RM (-) (n = 25)	RM (+) (n = 12)	*P* Value
EBL, mL	987 ± 635	1198 ± 404	.28
Operative time, min	350 ± 80	396 ± 84	.10
BMI, kg/m^2	23.5 ± 2.9	23.7 ± 2.6	.78
Prostate volume, mL	32.5 ± 20.9	24.6 ± 11.6	.23
Angle between the prostate and pubic bone, degree	37.4 ± 9.3	39.4 ± 9.9	.54
Depth of the prostate apex, cm	3.7 ± .6	3.7 ± .6	.87
Area of pelvic entrance, cm^2	138 ± 14	138 ± 15	.97

Abbreviations: RM, resection margin; EBL, estimated blood loss; BMI, body mass index.

io-pectineal line (**Figure 3A**), and the true conjugate was the distance from the promontory of the pelvis to the dorsal side of the pubic bone (**Figure 3B**).[21]

Statistical Analysis

All values are presented as means ± standard deviation or medians. A two-sided Mann-Whitney *U* test or a chi-squared test was used to determine significant differences in binary variables. The correlations between continuous variables were investigated by simple regression analysis using Spearman's rank correlation coefficient. Multivariate analyses were performed using multiple linear regression and multiple logistic regression to identify the risk factors associated with operative difficulties. *P* values < .05 were considered significant. Analyses were performed with Stat View version 5.0 software (Abacus Concepts, Berkeley, CA, USA).

RESULTS

The baseline characteristics of the patients and their perioperative outcomes are shown in **Table 1.** All MRI examinations were performed successfully and resulted in high-quality images; thus, complete datasets were obtained for 37 patients. Both univariate and multivariate analyses showed associations between body habitus and perioperative outcomes, as follows (**Tables 2-7**). Tables 2-4 presents the associations among patients' characteristics, image assessment of body habitus, and estimated blood loss or operative time. Tables 5-7 presents the associations among patients' characteristics, imaging assessments of body habitus, and resection margin.

The VPA was significantly associated with EBL on multiple regression analysis (*P* = .02) (**Table 4**). BMI was significantly associated with operative duration on multiple regression analysis (*P* = .02) (**Table 4**). Protrusion of the prostate into the bladder was significantly associated with positive resection margins on multiple logistic regression analysis (*P* = .04) (**Table 7**).

Table 6. Associations among patients' characteristics, imaging assessment of body habitus, and resection margin. Univariate analysis using the chi-square test.

	RM (-)	RM (+)	*P* Value
View of the prostatic apex			.37
Good	21	10	
Poor	3	3	
Protrusion of the prostate			.01
Yes	4	7	
No	20	6	
T classification			.3
≤ pT2	17	7	
pT3	7	6	

Abbreviation: RM, resection margin.

DISCUSSION

Although the experience of the surgeon may be a more decisive factor affecting surgical outcome, one cannot completely exclude the impact of a patient's physique on the technical difficulty of performing extraperitoneal LRP due to the small working space. Whereas several reports have demonstrated an association between anthropometric measurements and perioperative outcomes in various modalities of radical prostatectomy,[21-23,26-28] there is only one report specifically on extraperitoneal LRP by Nam and colleagues.[29] They evaluated two parameters assessed by MRI, i.e. the amount of protrusion of the pubic symphysis in the pelvis and the depth of the prostatic apex, as anthropometric measurements, and they concluded that the depth of the prostatic apex is significantly associated with operative difficulties. In the present study, to acquire more information about the associations between patients' body habitus and operative difficulties, several parameters from multiple view-

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Table 7. Associations among patients' characteristics, imaging assessment of body habitus, and resection margin. Multivariate analysis using multiple logistic regression analysis.

	OR	95% CI	*P* Value
EBL	1.0	.99 - 1.02	.43
Operative duration	1.0	.99 - 1.00	.55
BMI	1.0	.7 - 1.4	.97
View of the prostatic apex -good	.81	.07 - 8.98	.86
Angle between the prostate and pubic bone	1.05	.94 -1.29	.36
Protrusion of the	.11	.01 -.96	.04

Abbreviations: OR, odds ratio; CI, confidence interval; EBL, estimated blood loss; BMI, body mass index.

points, such as the positional relationship between the prostate and pelvic anatomical features and the working space during surgery, were evaluated.

The VPA is a parameter that was developed to evaluate the physical relationship between the gradient or protrusion of the pubic bone and the prostatic apex in retropubic radical prostatectomy (RRP).[21] In their study, poor VPA was significantly associated with EBL, which was consistent with the present study. Therefore, the VPA might be a valuable parameter in preoperatively estimating EBL not only in RRP, but also in extraperitoneal LRP. When we dissected the prostate apex during extraperitoneal LRP, we sometimes found that the rigid laparoscope was in contact with the forceps due to the smaller working space than with intraperitoneal LRP. This situation resulted in insufficient visualization of the prostate apex, leading to risks of increased bleeding and/or positive surgical margins of the prostatic apex. On the other hand, with the flexible laparoscope, it was easy to avoid contact with the forceps. As a result, use of a flexible scope was considered to achieve better visualization than with a rigid scope. Although the association between the VPA and the working space was not evaluated in the present study, we consider that the flexible scope was useful for providing better visualization when the VPA was poor.

In the present study, protrusion of the prostate into the bladder was significantly associated with positive surgical margins. In RARP, as well as in the present study, protrusion of the prostate into the bladder was significantly associated with positive surgical margins of the prostatic base.[30] It is thought to be related to the fact that protrusion of the median lobe is considered to add technical difficulty during division between the prostate and bladder in both RARP and LRP.[30] As a result, when we operated on patients with protrusion of the median lobe, we had a tendency to dissect incorrect planes between the prostate and its surrounding tissues. Hence, the positive surgical margin rate was increased both in RARP and LRP. If protrusion of the median lobe is identified on preoperative MRI, surgeons should pay more attention to dissecting between the prostate and its surrounding tissues, and, if possible, change to the transperitoneal approach, which might make it easier to dissect between the prostate and its surrounding tissue than with the extraperitoneal approach owing to the larger working space, or they may add novel surgical procedures, such as a "rescue stitch" retracting the large median lobe anteriorly out of the bladder lumen.[31]

The present study demonstrated that BMI was independently associated with operative duration, which was in accordance with previous studies of LRP and RARP.[32,33] Theoretically, obesity could further exacerbate the limited working space and obscure anatomic landmarks due to a large amount of fat. Hence, careful surgical dissection may be needed to avoid injury to the pelvic viscera. In addition, it would take more time to remove fat debris in Retzius' space. As a result, the op-

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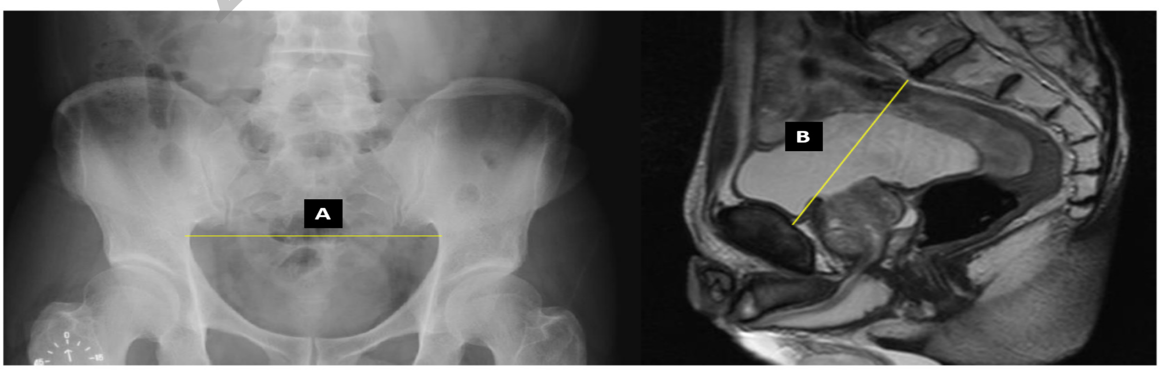

Figure 3. Area of pelvic entrance: **A)** transverse diameter; **B)** true conjugate.
Area of pelvic entrance (cm^2) = Transverse diameter (1) (cm) × True conjugate (2) (cm)

erative duration may increase due to a large amount of fat.

Several limitations of the present study must be considered. First, the current study was retrospective in nature and included a small sample size. It may have been underpowered to identify associations between patients' characteristics and operative difficulties. Second, the potential for intra-observer error during radiological measurement should not be overlooked. Third, although they had performed many laparoscopic surgeries, the surgeons had less experience with extraperitoneal LRP. Ahlering and colleagues reported that, based on the learning curve, achieving mastery of LRP is assumed to require 40 to 60 cases for a skilled laparoscopic surgeon.[34] Judging from the paper by Ahlering and colleagues, our experience might be insufficient for complete mastery of extraperitoneal LRP. Yao and colleagues reported that a large prostate and a narrow and deep bony pelvis are associated with operative difficulties with robot-assisted LRP only for novice surgeons.[35] However, the association between operative outcomes and pelvic dimensions has disappeared for experienced surgeons. Thus, insufficient experience may affect surgical outcomes. Therefore, the present data might be especially helpful to institutions in the introduction period of LRP or to novice surgeons attempting LRP. However, the impact of body habitus on operative difficulties during extraperitoneal LRP might decrease with surgical experience, as in the report by Yao and colleagues.

In conclusion, the findings of the present study suggest that poor VPA, protrusion of the prostate into the bladder, and high BMI were related to operative difficulties in extraperitoneal LRP. If operative difficulty is expected preoperatively, it would be better to prepare blood for transfusion and/or special instruments (e.g. flexible scope), switch to the transperitoneal approach, or add novel surgical procedures.

CONFLICT OF INTEREST

None declared.

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