The effect of prostate weight on the outcomes of laparoscopic radical prostatectomy

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OBJECTIVE

To evaluate the effect of prostate weight on perioperative, functional and oncological outcomes after laparoscopic radical prostatectomy (LRP).

PATIENTS AND METHODS

Between January 2003 and January 2006, 327 patients had LRP by one surgeon, 193 of whom were available for analysis. Patients were stratified into three groups on the basis of pathological prostate weight, i.e. ≤30, 30–75 and ≥75 g. Perioperative, oncological and functional (continence and potency at 1 year) outcomes were compared among the three groups.

RESULTS

Of the 193 patients the prostate was ≤30 g in 18 (9%), 30–75 g in 131 (68%) and ≥75 g in 44 (23%); the mean prostate weight was 27, 49 and 98 g in the three subgroups, respectively. At presentation, 144 patients (75%) had T1c disease, 159 (82%) were potent and 187 (97%) were continent. Unilateral nerve-sparing was done in 37 (19%) and bilateral in 114 (59%) patients. The three subgroups were comparable in age, body mass index, preoperative prostate-specific antigen level, preoperative Gleason score, clinical stage, operative duration, length of hospital stay, duration of catheterization, biochemical recurrence and continence after LRP. In the patients with a prostate of ≤30 g there was a higher incidence of positive margins (39% vs 16% vs 27%; $P = 0.03$) and inferior 1-year potency (47% vs 75% vs 79%; $P = 0.04$), respectively. Estimated blood loss increased with increasing prostate size (204 vs 256 vs 340 mL; $P = 0.01$).

CONCLUSIONS

Prostate size has no effect on continence or biochemical recurrence at 1 year after LRP, but affects intraoperative blood loss, potency and surgical margins. More patients with a longer follow-up are needed to confirm these findings.

KEYWORDS

prostate weight, radical prostatectomy, laparoscopy, outcomes

INTRODUCTION

Laparoscopic radical prostatectomy (LRP) was introduced in 1992 [1] and the procedure gained popularity towards the turn of the last century [2]. The introduction of PSA screening has led to the increased detection of organ-confined prostate cancer, with improved oncological outcomes [3]. Interestingly, as the detection of impalpable organ-confined cancer has increased, the mean prostate volume at diagnosis has also increased [4]. This could be due to the effect of BPH on serum PSA levels, resulting in the selection of men with larger prostates for biopsy [4].

A large prostate might limit treatment choices, as patients are often rendered unsuitable for radiation therapy. Large glands might be associated with increased vascularity and blood loss during surgery. It has been postulated that larger prostates could be associated with an increased incontinence rate, possibly because the large gap between the bladder and urethra after removing a large prostate could result in tension on the anastomosis [5].

The impact of prostate volume in series of open radical retropubic prostatectomy (ORP) was reported previously [6,7], but to our knowledge, only two studies have assessed the effect of prostate size on the outcomes after LRP [5,8]. However, these studies have some limitations, as they mainly examined the perioperative and short-term outcomes after LRP.

Thus the primary aim of the present study was to assess the effect of prostate weight on the oncological and functional outcomes at 1 year after LRP, i.e. surgical margin status, biochemical recurrence, continence, and erectile function. The secondary outcome measures were operative duration, estimated blood loss (EBL), length of hospital stay (LOS) and duration of catheterization after LRP.

TABLE 1
The overall baseline demographics of the 193 patients, and the perioperative, biochemical and functional outcomes

Variable	Value
Mean (SD, range)	
BMI, kg/m^2	27 (3.6, 15–40)
age, years	59 (6.4, 44–73)
preop PSA level, ng/mL	5.8 (3.0, 1.0–15.8)
Biopsy Gleason score	6.2 (0.49, 6–8)
n (%):	
Biopsy Gleason score	
6	146 (76)
7	45 (23)
8–10	2 (1)
Clinical stage	
T1c	144 (75)
T2a	43 (22)
T2b	6 (3)
Potent before LRP	
Yes	159 (82)
No	34 (18)
Continent before LRP	
Yes	187 (97)
No	6 (3)
LRP	
Mean (SD, range)	
operative duration, min	243 (67.5, 135–505)
EBL, mL	268 (159.7, 75–800)
days to catheter removal	8 (6.9, 2–30)
LOS, h	38 (18.2, 18–113)
n (%):	
use of TRUS	58 (30)
Nerve-sparing	
unilateral	37 (19)
bilateral	114 (59)
none	42 (22)
PLND	
Yes	112 (58)
No	81 (42)
Biochemical recurrence	4 (3)
Continent 1 year after LRP	182/187 (97)
Potent 1 year after LRP	117/159 (74)

PATIENTS AND METHODS

Between January 2003 and January 2006, 327 patients had a transperitoneal LRP by one surgeon (I.S.G.). Patients with previous hormonal therapy (33), an inadequate follow-up and/or incomplete functional data (101), were excluded from the analysis. This resulted in 193 evaluable patients. The transperitoneal LRP technique was reported previously [9].

Patient data maintained prospectively in our LRP registry were analysed for this study, with Institutional Review Board approval. The following data were extracted from the database: patient age, body mass index (BMI), preoperative PSA level, clinical cancer stage, biopsy Gleason score, preoperative erectile function status, preoperative continence status, operative duration, EBL, use of TRUS during surgery, nerve-sparing technique, pelvic lymph node dissection (PLND), LOS, duration of catheterization, positive surgical margin (PSM) status, and biochemical recurrence, continence and erectile function status at 1 year after LRP.

Prostate weight is reported as the weight of the gross specimen, as determined by the pathologist. Focal PSM was defined as the presence of one focus of cancer cells at the inked margin. Extensive PSM was defined as the presence of multiple foci of cancer cells over a large area at the inked margin. Cancer volume was defined as 'low' when the tumour volume was <0.5 mL, 'medium' when 0.5–2.0 mL and 'extensive' when >2.0 mL. Biochemical recurrence was defined as a PSA level of >0.2 ng/mL after LRP. Continence after surgery was defined as being pad-free, according to a validated symptom questionnaire. Erectile function was considered normal (potent) after LRP if the Sexual Health Inventory for Men (SHIM) score was ≥22 in patients who were previously potent (SHIM score ≥ 22) [10].

The 193 evaluable patients were stratified according to prostate weight into three

TABLE 2 Perioperative outcomes, and the functional and oncological outcome, stratified by prostate weight

Variable	≤30 g	30–75 g	≥75 g	P
Mean (SD)				
prostate weight, g	26 (2.8)	49 (10.1)	98 (19.3)	0.89
EBL, mL	204 (102.6)	256 (146.5)	340 (207.3)	0.01
LOS, h	39 (21.3)	34 (14.1)	41 (19.1)	0.12
op. duration, min	240 (76.3)	240 (67.2)	256 (64.6)	0.42
catheterization, days	7.3 (4.8)	8.4 (7.4)	8.6 (5.5)	0.09
Functional and oncological				
n (%):				
potent	7/15	83/110 (75)	27/34 (79)	0.04
potent after UNS	1/3	14/23 (61)	8/11	0.47
potent after BNS	6/10	60/82 (73)	15/22 (68)	0.65
continent	16/17 (94)	125/128 (98)	41/42 (98)	0.69
PSM	7/18 (39)	21/131(16)	12/44 (27)	0.03

(U)(B)NS, (unilateral) (bilateral) nerve-sparing.

TABLE 3
The pathological data

Variable	Value
Mean (SD, range) pathological Gleason score	6.7 (0.53, 6–9)
n (%)	
Pathological Gleason score	
≤6	49 (25)
7	140 (73)
8–10	4 (2)
Final pathological stage	
pT2	134 (70)
pT3a	51 (26)
pT3b	8 (4)
Cancer volume	
low	56 (29)
medium	104 (54)
extensive	33 (17)
Mean (SD, range) specimen weight, g	58 (26.1, 20–164)
≤30	18 (9)
30–75	131 (68)
≥75	44 (23)
PSM	40 (21)
focal	29 (15)
extensive	11 (6)
in patients with TRUS used	6 (10)
Extracapsular extension	58 (30)
Seminal vesicle involvement	8 (4)

groups, i.e. small prostate, ≤30 g; moderate, 30–75 g; and large, ≥75 g. Data for continence and erectile function after LRP were prospectively collected and recorded on self-administered questionnaires during the follow-up. Outcomes were analysed using a one-way ANOVA single-factor test, with $P < 0.05$ considered to indicate statistical significance.

RESULTS

The baseline demographics are outlined in Table 1; most patients (76%) had a Gleason score of 6 and 75% were diagnosed with clinical T1c disease. Functionally, 159 patients (82%) were potent and 187 (97%) were continent. The mean (SD, range) operative duration was 243 (67.5, 135–505) min and the EBL was 268 (159.7, 75–800) mL. TRUS guidance was used in 58 patients (30%), a unilateral nerve-sparing procedure in 37 (19%) and a bilateral procedure in 114 (59%). Complications occurred during LRP in five patients (inferior epigastric artery injury in two, dorsal vein bleeding in three) and after LRP in 12 (blood transfusion in three, prolonged ileus in three, prolonged drainage in three, facial oedema in one, severe diarrhoea in one, and atelectasis in one). The overall perioperative, biochemical and functional data are also detailed in Table 1.

Perioperative outcomes stratified by prostate weight are shown in Table 2; the mean prostate weight was 27, 49 and 98 g in the three subgroups, respectively. There was a statistically significant difference in mean EBL among the three subgroups, with a trend to more blood loss with increasing prostate weight ($P = 0.01$). However, the mean LOS, operative duration and duration of catheterization were similar.

The pathological data are shown in Table 3; the mean Gleason score after LRP was 6.7 and 134 patients (70%) had pT2 disease on final pathology, with 104 having a 'medium' cancer volume (54%). The mean prostate gland weight on final pathology was 58 g. Stratified by weight, 18 patients (9%) had a small, 131 (68%) had a moderate and 44 (23%) had a large prostate. PSM were present in 40 patients (21%), and were focally positive in 29 (15%) and extensively positive in 11 (6%). TRUS navigation reduced the overall PSM rate to 10% ($P = 0.03$).

Functional and oncological outcomes stratified by prostate weight are also shown in Table 2; the potency rate at 1 year was evaluated in 159 previously potent patients, where 15 (9%) had small, 110 (69%) had moderate and 34 (22%) had large prostates. Stratified by prostate size, seven of 15 patients with small prostates were potent at 1 year after LRP, vs 83 (75%) with moderate vs 27 (79%) with large prostates ($P = 0.04$). However, a subset analysis of patients who had nerve-sparing procedures (unilateral or bilateral) showed no significant difference among the groups. Overall, 182 (97%) of 187 patients continent before LRP were continent

TABLE 4 Studies of the effect of prostate size on EBL, continence, potency and PSM, with the authors' explanation of the findings

Study	No. of patients	Approach	EBL	Continence	Potency	PSM
Present	193	Laparoscopic	Higher in LP Increased vascularity	No correlation	Better in LP Clear definition of prostate contour; precise anatomical dissection of NVB	Higher in SP Indistinct tissue planes around small fibrous prostates LP more likely to have biopsy, leading to diagnosis of more indolent tumours
[5]	400	Laparoscopic	No correlation	No correlation	No correlation	Higher in SP LP had more biopsies leading to diagnosis of more indolent tumours
[8]	62	Laparoscopic	No correlation	NA	NA	No correlation
[6]	440	Open	NA	No correlation	No correlation	No correlation
[7]	1024	Open	Higher in LP Increased vascularity	No correlation	No correlation	Higher in SP Prostatovesical and prostato-urethral junctions less distinct in SP
[11]	375	Robotic	No correlation	No correlation	No correlation	Higher in SP No explanation

SP, small prostate; LP, large prostate; NA, not available; NVB, neurovascular bundle.

at 1 year afterward. Notably, the mean (range) age of incontinent patients was 60 (52–67) years and the mean prostate weight was 70 (44.5–103.5) g. There was a biochemical recurrence in only four patients (3%) at 1 year, and therefore reliable intergroup comparisons could not be made. Half of the patients with biochemical recurrence had PSM after LRP and their mean prostate weight was 43 (39–49) g. In those with a small prostate there was a high incidence of PSM (39% vs 16% vs 27%; $P = 0.03$).

DISCUSSION

Several studies have analysed the effect of prostate volume on the functional and oncological outcomes after ORP, but only two studies evaluated the effect of size on the outcomes of LRP. One of these studies comprised 62 patients, where large prostates were defined as being >50 g, but with no detailed analysis of functional outcomes. Prostate size had no significant effect on PSM, operative duration, EBL or LOS [8]. The other LRP study had included many patients (400), but the functional outcomes were limited by direct patient interview at follow-up appointments, rather than the use of a validated function questionnaire. Larger prostates (≥75 g) were associated with fewer PSM, while blood loss, LOS and catheterization were unaffected by prostate size [5]. A recent study [11] evaluated the effect of prostate weight on outcomes after robotically assisted laparoscopic prostatectomy (RALP). The authors reported a trend of increasing PSM in smaller glands, while perioperative outcomes (operative duration, EBL, transfusion rate, LOS, catheterization), sexual function and continence, were not affected by prostate weight [11].

In the present study, we evaluated the functional outcomes with validated questionnaires in 193 patients. We excluded patients operated during our early experience, as LRP requires prolonged training (50–100 cases) [12]. Patients with <1 year of follow-up were also excluded. Of 327 patients who had LRP between January 2003 and January 2006, we excluded those with neoadjuvant hormonal therapy and an incomplete follow-up or functional data.

We used pathological specimen weight as a measure of prostate size [13]. There is no consensus about stratification according to prostate size; we based our categorization on previous studies [6,14,15] to classify a small prostate as ≤30 g, moderate as 30–75 g and large as ≥75 g. We found no effect of prostate size on LOS and the duration of catheterization. The most common intraoperative complication associated with ORP is blood loss; the EBL was significantly and directly related to the prostate volume in ORP studies. In our experience the mean overall EBL was 268 mL. Contrary to the findings of other LRP [7,8] series of the effect of prostate size, there was a significant association between EBL and gland size in the present study; larger glands might be associated with increased blood loss possibly because of increased vascularity.

El-Feel *et al.* [12] reported significantly longer surgery in patients with large prostates during LRP. Contrary to these findings, we found no relationship between operative duration and prostate weight. The operative duration is probably more dependent on factors such as surgeon experience, whether or not PLND is performed, and the quality of nerve sparing.

During LRP for large prostates, some technical issues could affect the outcomes. The space between the prostate apex and urethra might be difficult to visualize, resulting in a short urethral stump for the anastomosis. We found no effect of prostate size on the return to continence, and the present study confirms the findings of other reports [8,16–18] in this regard. The overall PSM rate was 39%, 16% and 27% for small, moderate and large prostates, respectively. Secin *et al.* [19] reported similar findings; a prostate volume of ≤30 g was associated with a greater risk of PSM after LRP. This could be attributed to the possibility of indistinct tissue planes around small fibrous prostates. We agree with Chang *et al.* [5], who reported that larger prostates had smaller tumour volumes, probably because these glands had more biopsies taken and were possibly diagnosed with more indolent tumours. Notably, when we used intraoperative TRUS navigation the overall PSM of 21% decreased to 10%, commensurate with the findings of Ukimura *et al.* [20].

The present minimum follow-up was 12 months, in contrast to other LRP studies that evaluated the effect of prostate size over a shorter period. We found a 3% rate of biochemical recurrence at 1 year. These low values could be attributed to the type of PSM, which were focal in 15% and extensive in 5%. Focal PSM are unlikely to contribute to biochemical recurrence at 1 year of follow-up, and these results should be validated over the long-term.

It has been postulated that in larger prostates the neurovascular bundles are displaced posteriorly and might be obscured by the prostate, making them prone to injury [21]. The present results do not support this hypothesis; the potency rates were 79%, 75% and 47% at 12 months for large, moderate and small prostates, respectively ($P = 0.04$). This could possibly be due to a better definition of the prostate contour in men with larger prostates, allowing more precise anatomical dissection of the neurovascular bundle. As expected, potency was better with bilateral nerve-sparing (71%) than unilateral nerve-sparing (61%; $P = 0.31$). When stratified by prostate size there was no significant difference in potency outcomes based on unilateral or bilateral nerve sparing. Table 4 [5–8,11] shows the present results compared with other LRP, ORP and RALP studies of the effect of prostate size on EBL, continence, PSM and potency.

The limitations of the present study are inherent in its retrospective nature. In addition, there were fewer patients with the extremes of prostate weight than in those with a moderate prostate, limiting the power of the study. Nevertheless, our results represent a comprehensive evaluation of the effect of prostate weight on the perioperative, functional and oncological outcomes after LRP in a large group of patients.

In conclusion, prostate size had no effect on operative duration, LOS, duration of catheterization, continence and biochemical recurrence at 1 year after LRP. The mean EBL was significantly higher with larger prostates. Contrary to previous findings, potency was better in men with larger prostates; PSM were more common with smaller prostates. More patients and a longer follow-up are needed to confirm these findings.

CONFLICT OF INTEREST

None declared.

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Abbreviations: **(L)(O)RP**, (laparoscopic) (open) radical prostatectomy; **BMI**, body mass index; **EBL**, estimated blood loss; **PLND**, pelvic lymph node dissection; **PSM**, positive surgical margins; **LOS**, length of hospital stay; **SHIM**, Sexual Health Inventory for Men; **RALP**, robotically assisted laparoscopic prostatectomy.