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ORIGINAL PAPER

Urodynamic changes following laparoscopic versus vaginal hysterectomy

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Summary *Objective: To compare urodynamic changes before and after hysterectomy (laparoscopic vs. vaginal approach) for benign gynecological diseases.*
Patients and methods: A total of 90 women with a mean age of 56.36-years were enrolled in this study between August 2019 and April 2021. They were divided into two equal groups (45 patients each). Group, I had a vaginal hysterectomy, and Group II had a laparoscopic hysterectomy. All patients were assessed clinically using ICIQ-FLUTS questionnaire and a urodynamic study before and six months after surgery.
Results: Both vaginal and laparoscopic hysterectomy did not significantly change the maximum flow rate, voiding time, and average flow rate. The increase in residual urine volume in group I was not significant (p = 0.129), as was in Group II (p = 0.217). All the modifications, however, were within permissible limits. According to the cystometry result, volume at initial sensation rose in both groups after surgery, with no statistically significant difference (p = 0.364). After both forms of hysterectomy, maximum bladder capacity did not vary considerably. Preoperatively, all study participants exhibited no overactivity of the detrusor muscle; nevertheless, following surgery, overactivity was noted in 9 patients after vaginal hysterectomy compared to three patients after laparoscopic hysterectomy, and all the alterations were within a clinically acceptable range. In addition, the ICIQ-FLUTS score was not significantly different between the study groups.
Conclusions: According to the urodynamic study, hysterectomy for benign uterine conditions, whether vaginal or laparoscopic, did not adversely affect urinary bladder function.

KEY WORDS: *Hysterectomy; Uroflowmetry; Urodynamic.*

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INTRODUCTION

Hysterectomy is the most common gynecological surgical operation (1). More than 90% of hysterectomies were done for benign conditions. The most common indication of hysterectomy are leiomyomas and dysfunctional uterine bleeding (2). Hysterectomies are performed with different routes, either vaginally, abdominally, or laparoscopically. Laparoscopic and vaginal hysterectomy are minimally invasive approaches with short hospitalization time and fast recovery comparable to open abdominal hysterectomy (3). Vaginal hysterectomy, when feasible, is associated with good outcomes and is the most cost-effective approach to hysterectomy (4). The influence of simple hysterectomy on the lower urinary tract is still debated. However, hysterectomy disrupts the local nerve supply to the pelvic organs and interrupts the anatomical relationship. It has been postulated that the function of the pelvic organs may be adversely affected (5). Thus, the function of the pelvic organs, mainly the urinary function, should be considered when deciding the optimum route of hysterectomy (6).
Urodynamics is a study that assesses the lower urinary tract function and attempts to reproduce the patients' symptoms to provide a pathophysiological explanation. In principle and reality, the clinicians use urodynamic testing results to direct therapy, whether surgical, medical, or behavioral, alone or in combination. Some of the current approaches are water-filled, ambulatory, and video urodynamic. Urodynamics analyses the functional anatomy of the bladder, urethra, or both, and their reaction to filling, storing, and voiding, regardless of the method used (7). Urodynamic testing is essential in urogynecology because it provides objective descriptions of incontinence and voiding dysfunction (8). Therefore, the objectives of this study were to analyze the urodynamic changes before and after laparoscopic and vaginal hysterectomy.

PATIENTS AND METHODS

Between August 2019 and April 2021, 90 cases presenting to in-patient departments of the Authors' institute were enrolled in this study. The ethics review committee approved the study protocol. All patients signed informed consent forms detailing the operation and potential risks. Patients were divided into two groups of equal size: Group I: with a mean age of 59.16-year-old (ranging between 51-66), underwent a vaginal hysterectomy. Group II with a mean age of 54.72-year-old (ranging between 47-59) underwent laparoscopic hysterectomy. The route of traditional minimally invasive surgery was chosen by the designated surgeon, with vaginal hysterectomy as the first choice, followed by laparoscopic hysterectomy. Our study included all patients undergoing hysterectomy for benign gynecological diseases. We excluded all patients with a history of diabetes mellitus,

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neurological disorders, previous urological pelvic surgery, previous caesarian section, and urinary tract infection. All the procedures were carried out while the patient was sedated. A reusable umbilical or 12-mm port (*Xcel; Ethicon Endo-Surgery, Inc., Somerville, NJ*) for the optics and three assistant ports, either three 5-mm or two 5-mm plus one 10-mm port in the lower quadrants, were used for laparoscopic hysterectomy. The vaginal hysterectomy was done conventionally. All study participants were subjected to detailed history taking, complete clinical examination, routine preoperative investigation. ICIQ-FLUTS (*International Consultation on Incontinence Modular Questionnaire on Female Lower Urinary Tract Symptoms*) (9), and Urodynamic evaluation (cystometry and uroflowmetry) were obtained before and six months after surgery.

Statistical analysis

Data were analyzed using *Statistical Program for Social Science* (SPSS) version 18.0. Quantitative data were expressed as mean ± *stander deviation* (SD). Qualitative data were expressed as frequency and percentage. The following tests were done: independent-samples T-test of significance when comparing two continuous means. Paired t-test: t = mean's difference between pre and post. The chi-square (x2) test of significance was applied to compare proportions between two qualitative factors. Pearson's correlation coefficient (r) test was employed for data correlation. P-value (probability): statistical significance was defined as less than 0.05, and highly significant was defined as less than 0.01.

Results

Demographic Data of both groups

The cohorts were comparable regarding patients' demographics (p > 0.05) (Table 1).

Postoperative evaluation of the urinary symptoms in both studies groups

Post-operative frequency was noticed in 18 and 9 patients of groups 1 and 2 respectively (p = 0.32). Urgency occurred in 10 and 6 patients of groups 1 and 2 respectively (p = 0.39). Urge incontinence occurred in 9 and 6 patients of groups 1 and 2 respectively (p = 0.37). No other symptoms were noticed in both groups. In group I, the mean preoperative ICIQ-FLUTS score was 0.64 (range between 0 and 2, median-0), and the postoperative mean was 1.5 (range between 0 and 6, median = 0) with a significant p-value (p < 0.001). In group II, the mean preoperative ICIQ-FLUTS score was 0.33 (range between 0 and 2, median = 0) and the mean postoperative score was 0.82 (ranged between 0 and 6, median = 0) with a significant p-value (p = 0.014). There was no statistically significant difference between groups 1 and 2 regarding preoperative and postoperative ICIQ-FLUTS scores (p = 0.1 & 0.11, respectively).

Changes in Urodynamic parameters in the two studied groups before and after surgery

According to results of cystometry, volume at first sensation rose after surgery in both groups, with insignificant p-value between pre-and postoperative volumes (p = 0.372 and p = 0.364) for groups 1 and 2, respectively (Table 2). After both forms of hysterectomy, maximum bladder capacity did not vary considerably (Table 3). Preoperatively, no detrusor muscle overactivity was found in either group; however, after surgery, overactivity was observed in 9 patients in the vaginal hysterectomy group compared to three patients in the laparoscopic hysterectomy group (Table 4).

Changes in Uroflowmetry parameters in the two groups before and after surgery: According to uroflowmetry measures, vaginal hysterectomy reduced the maximum flow rate and increased voiding time not significantly and laparoscopic hysterectomy did not affect either.

Table 1.
Demographic data of both groups.

	Group I n = 45		Group II n = 45			t-test	
Parameters	**Mean**	**± SD**	**Mean**	**± SD**	**Mean difference**	**t**	**P value**
Age (years)	59.16	3.68	54.72	4.15	2.43	2.402	0.059
Weight (Kg)	70.02	7.86	69.17	6.92	1.68	0.873	0.388
Parity	2.73	0.79	3.10	0.75	-0.07	-0.338	0.734

t = Independent t-test.

Table 2.
Comparison between group I and group II as regard first sensation.

First sensation	Group I		Group II			t-test	
	Mean (ml)	**± SD**	**Mean (ml)**	**± SD**	**Mean difference**	**t**	**P value**
Pre	167.78	24.81	169.43	22.26	-2.00	- 4.379	0.364 NS
Post	178.00	14.98	179.90	15.19	-3.50	- 0.904	0.372 NS
P value	0.6		0.67				

Table 3.
Comparison between group I and group II as regard cystometric bladder capacity.

Cystometric bladder capacity (ml)	Group I		Group II			t-test	
	Mean (ml)	**± SD**	**Mean (ml)**	**± SD**	**Mean difference**	**t**	**P value**
Pre	518.13	25.32	514.00	25.72	3.33	0.505	0.618
Post	477.00	100.19	486.31	65.93	-33.33	- 1.515	0.297
P value	0.1		0.16				

Table 4.
Relation between group I and group II as regard post-operative presence of detrusor muscle over activity.

Post-operative	Groups				Total	
Presence of detrusor muscle over activity	Group I		Group II			
	No.	**%**	**No.**	**%**	**No.**	**%**
-ve	36	80.00	42	93.33	78	86.667
+ve	9	20.00	3	6.67	12	13.333
Total	45	100.00	45	100.00	90	100.000
x2	5.455					
P value	0.020					

The laparoscopic group had a higher average flow rate, while the vaginal group had a lower average flow rate (Table 5). The increase in residual volume after vaginal hysterectomy was modest (p = 0.129), as was the increase in residual urine after laparoscopic hysterectomy (p = 0.217) (Table 6). All the modifications, however, were within permissible limits.

Changes in pre- and postoperative abdominal detrusor leak point pressure in both groups

No detectable changes in pre-and postoperative abdominal detrusor leak point pressure in group 2. Only six patient of group 1 has decreased their postoperative abdominal detrusor leak point pressure to less than 60 cm H_2O.

Discussion

To improve life expectancy in women, it is essential to know the long-term adverse outcomes of surgical interventions (10, 11). We designed this study to analyze the effects of laparoscopic versus vaginal hysterectomy on the lower urinary tract symptoms and functions using urodynamic studies and try to detect if the type of operation (whether vaginal or laparoscopic hysterectomy) will affect postoperative lower urinary tract functions or not. The relation between the urinary symptoms and the urodynamic parameters was evaluated pre and postoperatively.

Table 5.
Uroflowmetry parameters in the two studied groups before and after surgery.

	Group I n = 45		Group II n = 45	
	Pre-operative	Post-operative	Pre-operative	Post-operative
Voided volume (ml)	264.5 ± 48.7	274.7 ± 60.8	274.8 ± 58.2	284.5 ± 56.9
P value	0.156		0.157	
Maximum flow rate (ml/sec)	26.4 ± 5.3	24.3 ± 5.2	25.7 ± 4.8	27.2 ± 4.6
P value	0.068		0.069	
Voiding time (sec)	50.4 ± 11.5	61.1 ± 9.9	48.8 ± 8.6	46.4 ± 9.5
P value	0.059		0.061	
Average flow rate (ml/sec)	7.5 ± 2.2	6.7 ± 1.3	6.5 ± 1.7	8.8 ± 2.7
P value	0.063		0.067	

Table 6.
Residual urine volume in both groups.

Groups	Time of testing	Residual urine volume (ml) Mean (ml)	± SD	Paired differences Mean (ml)	± SD	Paired sample t-test t	P value
Group I	Pre	54.10	7.58		1.29	4.81	0.129
	Post	57.32	5.58	3.28			NS
Group II	Pre	50.73	3.97	1.41	1.03	3.776	0.217
	Post	52.13	3.01				NS

Residual urine volume (ml)	Group I Mean (ml)	± SD	Group II Mean (ml)	± SD	Mean difference	t-test t	P value
Pre	54.10	7.59	50.73	3.97	-1.33	- 0.854	0.396 NS
Post	57.32	5.58	52.13	3.01	2.54	3.507	0.082 NS

Many studies compared abdominal and vaginal hysterectomy. *Polat et al.* (2016) (12) underwent a physiological assessment of bladder, urethra, and anorectum on 26 women before hysterectomy, six weeks, and six months afterward. They reported that after a hysterectomy for benign disease, some women experience a considerable increase in rectal and bladder sensitivity. The alterations lasted for six months, but they weren't linked to any changes in rectal or vesical motor activity being not necessarily related to the onset of urinary or gastrointestinal problems. After a total hysterectomy, they ruled out local damage, infection, and edema as plausible causes of the pelvic organs' increased sensitivity. They concluded that the cause of the increase in rectal and vesical sensitivity seen in some women after vaginal and abdominal hysterectomy is unknown; it's possible that removing a major pelvic organ and its related nerve supply changes the gating of sensations from nearby organs. *Heydari et al.* (13) reported no noticeable changes in urinary bladder capacity or urethral functions after the operation. They focused on urodynamic measures before and after abdominal and vaginal hysterectomies. They discovered a statistically significant decrease in maximum cystometric capacity and a decline in bladder compliance following abdominal extra-fascial and vaginal hysterectomies. Both findings are linked to a deterioration in the detrusor muscle's musculoelastic characteristics due to edema and surgical damage. However, they concluded that the decrease in capacity and compliance had little clinical significance. They found no evidence that a hysterectomy caused involuntary detrusor contractions or incontinence. After the hysterectomy, urethral competence was unaltered, and there was no rise in stress incontinence. A second study included 36 women undergoing total hysterectomy; preoperative complaints were observed in 58.3% of patients, although only 38.9% had urodynamically confirmed impairment. Seventy-five percent of women were symptomatic after hysterectomy, with another 30.6 percent developing a urodynamic abnormality. They concluded that total hysterectomy is linked to a higher subjective and objective incidence of vesicourethral dysfunction (14). *El-Toukhy et al.* did a study that looked at the effects of various hysterectomy procedures, including total abdominal, vaginal, laparoscopic, and subtotal. They looked at 187 women between the ages of 29 and 73 who had a hysterectomy for various reasons. Urinary symptoms occurred less frequently (p = 0.01) six months following surgery, whereas urodynamic investigations remained unaltered.

Furthermore, regardless of the hysterectomy technique employed, the patients reported significantly reduced rates of stress incontinence (p = 0.005) and urgency (p = 0.03) than before the procedure. They concluded that subtotal hysterectomy, whether performed abdominally, vaginally or laparoscopically, has no negative impact on urine function six months following surgery (15).

In our study, according to pre-and postoperative urodynamic studies in both groups, all changes were within the clinically acceptable range. Thus, we can say that urodynamic stud-

ies showed no clinically significant effect of vaginal or laparoscopic hysterectomy on bladder function and capacity. Some studies suggest a rational and credible anatomical explanation for why a subtotal hysterectomy may not have a negative impact on pelvic organ function. The nerve content of the uterosacral and cardinal ligaments differs along their length, with much more nerve content in the middle two lateral thirds, closer to their origin at the pelvic side wall than in the medial third, closer to their insertion into the uterine body and cervix. The ligaments, and hence the nerves, are split extremely close to the uterus and cervix during a subtotal hysterectomy. As a result, only the nerves that innervate the uterus and cervix are disrupted, whereas those that innervate the bladder and rectum are unaffected (16).

Conclusions

Hysterectomy for benign uterine condition, whether vaginal or laparoscopic, did not adversely affect urinary bladder function. According to uroflowmetry and cystometry, hysterectomy for benign uterine conditions, whether vaginal or laparoscopic, did not adversely affect urinary bladder function. Thus, we did not recommend depending on the effects of hysterectomy on bladder functions as a matter of preference of the vaginal or laparoscopic type of the operation.

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