Clinical Obstetrics, Gynecology and Reproductive Medicine

Research Article

Feasibility of modified laparoscopic assisted vaginal hysterectomy for decreasing urinary tract complications

Hong Seok Choi and Yong Il Ji*

Department of Obstetric and Gynecology, Inje University, Busan, Korea

Abstract

Objective: To analyze the differences in the incidence of postoperative complications in the bladder and urinary system between patients who received modified laparoscopic-assisted vaginal hysterectomy (LAVH) and those who received classical LAVH to reduce bladder and urinary system complications.

Method: Patients who underwent LAVH for uterine disease at Inje University Haeundae Paik Hospital between March 2010 and June 2015 were included in this retrospective study. The incidence of postoperative urinary complications was compared between patients who received modified LAVH and those who received classical LAVH group.

Result: Among a total of 463 patients, there was no significant difference in the incidence of bladder complications between the classical LAVH group and modified LAVH group (9/234 vs. 4/229, P = 0.172). However, the incidence of intraoperative bladder injury was significantly different between the two groups (7/234 vs. 1/229, P = 0.035).

Conclusion: The incidence of intraoperative bladder injuries was significantly reduced in the patients who received modified LAVH.

Introduction

Hysterectomy is a common surgery performed in obstetrics and gynecology. Along with the recent development of laparoscopic devices, laparoscopic hysterectomy has been widely used [1]. A study by Müller *et al.* [2] showed the rapid decline of hysterectomy by laparotomy over time, which had been predominantly used until 2002, and a gradual increase in laparoscopic hysterectomy replacing the former. Laparoscopic hysterectomy is a surgical method mainly used for benign disease, particularly uterine myoma, adenomyosis, endometrial hyperplasia, and emmeniopathy. Laparoscopic hysterectomy is currently a preferred method due to reduced postoperative pain and a smaller scar compared to open hysterectomy [3]. Laparoscopic hysterectomy can be performed as laparoscopic-assisted vaginal hysterectomy (LAVH) and total laparoscopic hysterectomy (TLH). LAVH is a surgical method of intra-abdominally resecting the whole uterus using a laparoscope as follows. Suspensory ligament of the ovary, funnel pelvic ligament, and broad ligament are resected and the uterine corpus is dissected and resected with the surrounding tissues. In the next step, the uterine cervix is separated from the vagina, bladder, and the pouch of Douglas through the vagina in the same way as previous vaginal hysterectomy techniques. Then, the uterosacral and broad liganment are resected and the remaining uterine corpus tissues after ligation of the uterine artery are separated. As shown by not only retrospective blinded studies but also meta-analyses and numerous prospective studies, the advantage of this surgical method is that it has a shorter hospital admission period and reduced scarring and postoperative pain compared to laparotomy, and a shorter operation time, ease of operation on a large uterus, and less urinary system complications compared to TLH [4]. However, LAVH has a more difficult training process than TLH. In addition, according to a study by Horng *et al.* [1], classical LAVH has less overall urinary system complications but it is reported to have a higher incidence of bladder injury, such as intraoperative bladder injury or postoperative bladder fistula.

In TLH, the whole uterus is intra-abdominally resected from the uterine corpus to the uterine cervix through the abdominal cavity. Particularly in the process of separating the uterine cervix and vagina, circular separation from anterior to posterior requires a certain degree of space and visual scope. Thus, when the uterus is too big surgery is difficult, switching to LAVH is required in certain cases [3]. Urinary tract injury may occur on the region that is in contact with uterine artery, particularly when resecting the uterine cervix in a circle during TLH. Hence, urinary tract complications, which rarely occur in LAVH, have been reported to occur more frequently. In addition, the vagina and cervix are separated by galvanocautery, which has a higher chance of causing problems at the vaginal suture site. Hence, although LAVH has more advantages than other surgical methods, the high incidence of bladder injury can restrict the choices of surgical methods and make the training process more difficult. In this study, the surgical method was partially revised to reduce the risk of bladder injury in patients who received LAVH, and this modified method was compared with the classical method to examine whether it actually reduced the bladder-related complications and the risk of other complications. Therefore,

Correspondence to: Yong-Il Ji, Department of Obstetrics and Gynecology, Inje University Haeunade Paik Hospital, Busan, South Korea, Tel: 051-797-2020; Fax: 051-797-2030; E-mail: jyimdog@paik.ac.kr

Key words: *classical laparoscopic-assisted vaginal hysterectomy, modified laparoscopic-assisted vaginal hysterectomy, bladder complication*

Received: February 03, 2017; **Accepted:** February 14, 2017; **Published:** February 17, 2017

this study aimed to determine whether the modified LAVH is a safer surgical method with other advantages.

Although LAVH has more advantages than other surgical methods, the incidence of bladder injury is high, which can restrict the choices of surgical methods and make the training process more challenging. To reduce bladder and urinary system complications in patients who receive LAVH, this study aimed to perform a novel surgical technique that complemented the existing method, and analyze the differences in the incidence of bladder, urinary system and other complications.

Subjects and methods

Patients who underwent LAVH for uterine disease at one University Hospital between March 2010 and June 2015 were included in this study. The modified surgical method has been performed since 2013, and the differences in surgical methods were verified from the surgical records. The classical and modified methods were both performed by the same surgeon. In the previous method, the whole uterus is separated during intra-abdominal surgery using a laparoscope and the cervix and bladder are separated. Then, when the anterior boundary of the vagina-cervix is determined (Figure 1A, B), vaginal hysterectomy was initiated.

Prior to the introduction of the modified technique conducted in this study, various forms of LAVH have been introduced by numerous other studies to avoid the shortcomings of classical LAVH. The method introduced by Lee *et al.* [5] used a Biswas uterovaginal elevator and was developed for easier manipulation of the uterus, which enhances anteroposterior manipulation of the uterus and retraction and makes securement of the visual scope and dissection easy, thereby complementing the shortcomings of the classical method.

In addition, the method introduced by Song *et al.* [6] only used a laparoscope until the dissection of the appendages, which is the step prior to the dissection of the uterus and bladder, and then switching to vaginal hysterectomy. Then, by suturing the vaginal fornix differently from the classical method, it focused on preventing vaginal vault prolapse.

In the surgical method used in this study, the vagina and cervix are resected only on the anterior side without extension to the uterine artery on both sides after the vagina-cervix boundary is determined, similarly to TLH. Later, when the surgery is performed through the vagina, it can be proceeded by checking the anterior boundary of the bladder and vagina (Figure 1C, D).

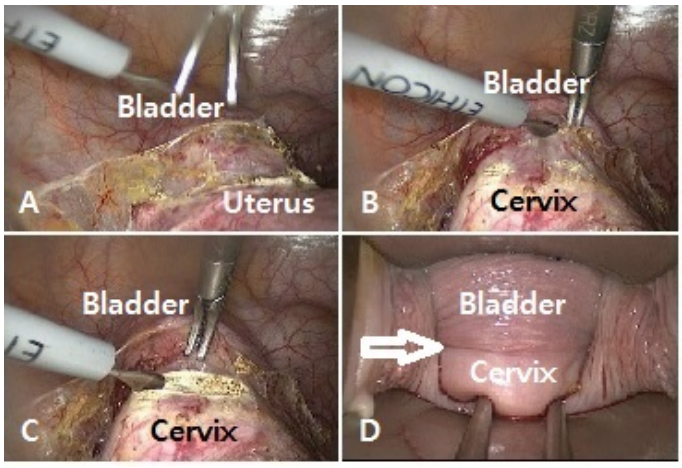

Figure 1. Modified laparoscopic-assisted vaginal hysterectomy (LAVH) operation due to uterine disease. A) Bladder serosa cutting, B) Separate bladder and cervix, C) Anterior colpotomy, D) Vaginal view of modified LAVH, (arrow: transverse incision beginning point).

Bladder injury was largely divided into two categories for the analysis: laparoscopic injury that occurred while using a laparoscope, and intraoperative injury that occurred during vaginal hysterectomy after using a laparoscope, which also induced cases undergoing restoration surgery or receiving cystoscopy or other urological treatment due to the suspicion of postoperative bladder injury. The incidence of these two bladder complications was compared between the classical LAVH patients and modified LAVH patients. For other complications, the incidence of wound complications at the anastomosis site that could be caused by the resection of anterior vagina using galvanocautery, and other complications of the urinary system and intestinal tract, was compared.

Uterine diseases included in the surgery were uterine myoma, adenomyosis, carcinoma of the uterine cervix, and abnormal uterine bleeding diagnosed with benign tumor from postoperative histological examination. Patients who received laparotomy regardless of malignant disease or bladder injury were excluded from the study. Using IBM SPSS statistical software (version 18) for statistical analysis, chi-square test was used to comparatively analyze the two groups. Because crossover analysis could not be performed when the expected frequency was smaller than 5, Fisher's exact test was performed to examine the significance.

Results

A total of 517 patients planned to receive LAVH. Among them, 30 patients who switched to laparotomy regardless of intraoperative bladder injury and 24 patients diagnosed with malignant uterine disease in the histological examination were excluded. In total, 463 patients received classical LAVH due to non-malignant uterine disease, 234 of which received classical LAVH and 229 received modified LAVH (Figure 2).

Comparison of the classical LAVH and modified LAVH patient groups showed that patients aged between 40 and 49 had the highest ratio in both groups and, for diagnosis, uterine myoma exhibited a significantly higher ratio than adenomyosis or endometrium disease in both groups. In addition, 37 and 45 patients from each group had a history of cesarean section, respectively (Table 1).

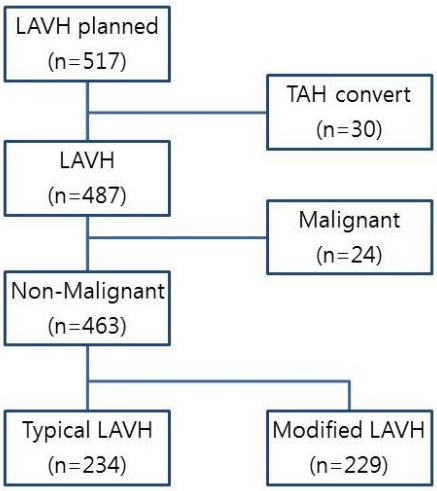

Figure 2. Flow of study participants.

Table 1. Characteristics of laparoscopic-assisted vaginal hysterectomy surgery (LAVH) for uterine disease.

Characteristics	Classical LAVH (n = 234)	Modified LAVH (n = 229)	P-value
Age	48.4 ± 6.8	47.6 ± 4.3	0.105
Diagnosis			
Uterine myoma	150	146	†NA
Uterine adenomyosis	33	34	NA
Endometrial disease	5	7	NA
Carcinoma in situ	43	38	NA
Other	3	4	NA
Previous C-section			
Yes	37	45	NA
No	197	184	NA

Age outcomes are mean ± S.D; tested by Student's t test.
To calculate the P-values, Chi-square test was used when n>5, Fisher's exact test was used when n≤5.
†NA: Not available

Table 2. Complications between classical laparoscopic-assisted vaginal hysterectomy (LAVH) and modified laparoscopic-assisted vaginal hysterectomy

Complications	Classical LAVH (n = 234)	Modified LAVH (n = 229)	Odds ratio	P-value	Total (n = 463)
Bladder injury	9 (3.8%)	4 (1.7%)	2.25	0.172	13 (2.8%)
Intraoperative injury	7 (3.0%)	1 (0.4%)	7.03	0.035	8 (1.7%)
Perforation	3 (1.3%)	0 (0.0%)	1.99	0.086	3 (0.6%)
Laparoscopy-insertion injury	2 (0.9%)	3 (1.3%)	0.64	0.635	5 (1.1%)
Ureter injury	0	0	†NA	NA	0
Wound infection	4 (1.7%)	1 (0.4%)	3.96	0.185	5 (1.1%)
Vesicovaginal fistula	0	0	NA	NA	0
Bowel injury	0	0	NA	NA	0

To calculate the P-values, Chi-square test was used when n>5, Fisher's exact test was used when n≤5.
†NA: Not available

Comparing the incidence of complications in the classical LAVH and modified LAVH patient groups indicated that, among a total of 463 patients, the complications of intestinal tract injury, ureteral injury, and vesicovaginal fistula did not occur in both patient groups. However, 13 patients (2.8% of total) had bladder injury and 5 patients (1.1% of total) exhibited surgical site infection.

Bladder injury occurred in 9 cases (3.8%) from the classical LAVH group and 4 cases (1.7%) from the modified LAVH group (p value = 0.172). Surgical site infection occurred in 4 cases (1.7%) from the classical LAVH group and 1 case (0.4%) from the modified LAVH group (p value = 0.185). Among bladder injury complications, intraoperative bladder injury occurred in 8 cases (1.7%) from the total patients with 7 cases (3.0%) from the classical LAVH group and 1 case (0.4%) from the modified LAVH group (p value = 0.035). Bladder perforation occurred in 3 cases (0.6%) from the total patients, of which all 3 cases (1.3%) were from the classical LAVH group and none from the modified LAVH group (p value = 0.086). Bladder injury caused by laparoscopic technique occurred in 5 cases (1.1%) from the total patients with 2 cases (0.9%) from the classical LAVH group and 3 cases (1.3%) from the modified LAVH group (p value = 0.635) (Table 2).

In addition, comparing patients with a history of cesarean section who could possibly develop bladder adhesion and injury showed that no bladder complications were observed in 37 patients who received classical LAVH and 45 patients who received modified LAVH. Furthermore, other complications, such as surgical site infection or intestinal tract and ureteral injury, did not significantly increase in both groups.

Discussion

LAVH has been widely used since Reich et al. first introduced laparoscopic hysterectomy in 1989, which accelerated the development of surgical techniques and led to the emergence of LAVH [7]. As laparoscopic surgical techniques have been rapidly developed worldwide recently, laparoscopic hysterectomy is performed not only on patients with benign gynecological disease but also on those diagnosed with malignant gynecological disease [8]. Hence, the percentage of patients receiving laparoscopic hysterectomy is gradually increasing compared to the percentage of patients receiving open hysterectomy [9]. However, despite the constant development of laparoscopic surgical techniques, the risk of bladder complication remains high [10]. Bladder complications include intraoperative bladder injury and postoperative vesicovaginal fistula. The probability of bladder complications occurring in LAVH is between 0.02% and 8.3%, and it is the most common complication of LAVH. Its incidence is higher than that of other surgical methods, such as open hysterectomy or vaginal hysterectomy [10-13].

In this study, bladder complications occurred in 13 of 463 patients who received LAVH, accounting for 2.8% of the incidence. This is because pressing the bladder below pubovesical cervical fascia and vesicocervical ligament with a strong force using a laparoscopic surgical device in the process of LAVH weakens the bladder wall and can cause laceration [10]. Moreover, bladder injury predominantly occurs upon approach from the vaginal orifice to the inner peritoneum during LAVH [14]. In contrast, ureteral injury complication is reported to have a low incidence in LAVH, ranging from 0% to 2% [15,16]. In a study by Shin et al. [3], comparison of urinary system complications between 96 patients who received TLH and 72 patients who received LAVH demonstrated a total of 2 cases of urinary system injury. One was ureteral injury in the TLH group (0.6%) and the other was bladder injury in the LAVH group (0.6%).

The reason why LAVH is widely used despite the high incidence of bladder injury complications is its high preference in patients due to a reduced hospital stay, fast recovery, lower postoperative pain, and lower incidence of overall complications compared to open hysterectomy [17-20]. Meanwhile, because surgical manipulation through the vagina is reduced in TLH compared with LAVH, the incidence of surgical wound infection is relatively lower and the length of the vagina can be maintained to be greater extent during surgery. Furthermore, all the structures in the pelvic cavity can be visualized through a laparoscope during surgery, thus the incidence of postoperative vaginal prolapse is lower [21].

However, because a laparoscope is used during the entire process of uterine resection, separation of the uterine cervix from the vagina requires circular resection along the whole section of the pelvic cavity. Because this requires sufficient operative space and visual scope, surgery performance is difficult when the uterus is particularly large. The incidence of ureteral injury is high at the contact site of the uterus and uterine artery, particularly during anterior and posterior circular resection of the uterine cervix.

In addition, circular resection from the vagina to the uterine cervix is performed by galvanocautery in TLH, which can trigger extensive tissue damage due to heat and delay the recovery time of the vaginal formix. Hence, there is a risk of postoperative vaginal vault dehiscence before its full recovery [22]. However, there is a reduced chance of such a problem in LAVH. It is reported that the complication of vaginal vault dehiscence has the highest incidence in TLH at 1.35% and relatively

low incidence in LAVH at 0.28% [23].

Using modified LAVH, which revised a few items of the existing LAVH, this study aimed to reduce bladder complications and examine whether the modified LAVH significantly decreased the incidence of bladder complications. A total of 9 out of 234 patients who received classical LAVH had bladder complications, which corresponded to an incidence of 3.8%, which is consistent with previous study reports. The incidence of bladder complications was 1.7% in the modified LAVH group, demonstrating a decrease to some extent, but there was no statistical significance when compared with the incidence of bladder injury in previous methods.

Among bladder injury complications, the incidence of bladder complications caused by intraoperative damage was significantly different between the two groups. This suggests that the modified LAVH can be performed in a safer manner and, although laparoscopic training is a difficult process, it can be recommended as an easier technique to learn during training.

However, comparative analysis of the incidence of surgical site infection showed that there was no significant difference between the two groups. Although modified LAVH had galvanocautery on the anterior vaginal fornix to a greater degree, it did not increase the incidence of surgical site infection. When conducting hysterectomy, the risk factors increasing the incidence of bladder complications include history of pelvic surgery, history of gynecological surgery, severe adenomyosis, multigravida, and large uterus [24].

Among them, our study aimed to additionally examine whether a history of cesarean section acts as a risk factor for the incidence of bladder complications. However, there was no incidence of bladder complications in the group with a history of cesarean section in this study. Thus, we could not determine its effect on the incidence of bladder complications.

This is the biggest study introducing a new LAVH that revised and modified the existing surgical method in order to reduce the high incidence of bladder complications in LAVH and comparatively analyze its effects. However, selection bias may occur when conducting a retrospective study and the incidence of complications was low in both the experimental and control groups, which could be a limitation of this study.

Numerous studies have recently been conducted to reduce the incidence of bladder complications in LAVH, including the introduction of a way to firmly spread the vaginal space using a manipulator, and a technique to generate a window through the vaginal space that can pass through the anterior pouch of Douglas [25].

Thus, we expect that new kinds of surgical methods that are better than the existing ones will be developed and attempted in further studies in order to reduce the incidence of bladder complications in LAVH. A large-scale study conducted over a long time will verify this.

Conclusion

Although the modified LAVH attempted in this study did not statistically reduce the incidence of bladder and urinary system complications compared to the classical LAVH, it reduced the incidence of bladder injury during vaginal surgery, among complications of bladder and urinary system caused by surgery, and did not increase surgical site infection and other complications. Therefore, we propose that the modified LAVH is a safe surgical method that can replace the existing method.

Acknowledgements and funding

This work was supported in part by Inje University Research Fund.

References

1. Horng SG, Huang KG, Lo TS, Soong YK (2004) Bladder injury after LAVH: a prospective, randomized comparison of vaginal and laparoscopic approaches to colpotomy during LAVH. *J Am Assoc Gynecol Laparosc* 11: 42-46. [Crossref]
2. Müller A, Thiel FC, Renner SP, Winkler M, Häberle L, et al. (2010) Hysterectomy-a comparison of approaches. *Dtsch Arztebl Int* 107: 353-359.[crossref]
3. Shin JW1, Lee HH, Lee SP, Park CY (2011) Total laparoscopic hysterectomy and laparoscopy-assisted vaginal hysterectomy. *JSLS* 15: 218-221. [crossref]
4. Johnson N, Barlow D, Lethaby A, Tavender E, Curr L, et al. (2005) Methods of hysterectomy: systematic review and meta-analysis of randomised controlled trials. *BMJ* 330: 1478. [crossref]
5. Lee ET, Wong FW, Lim CE (2009) A modified technique of LAVH with the Biswas uterovaginal elevator. *J Minim Invasive Gynecol* 16: 755-760. [crossref]
6. Song T, Kim TJ, Kang H, Lee YY, Choi CH, et al. (2011) A review of the technique and complications from 2,012 cases of laparoscopically assisted vaginal hysterectomy at a single institution. *Aust N Z J ObstetGynaecol* 51:239-243. [Crossref]
7. Reich H, DeCaprio J, McGlynn F (1989) Laparoscopic hysterectomy. *J Gynaecol Surg* 5: 213-216.
8. Holloway RW, Finkler NJ, Pikaart DP, Bigsby GE 4th, DeNardis SA, et al. (2007) Comparison of total laparoscopic and abdominal radical hysterectomy for patients with early-stage cervical cancer. *Obstet Gynecol* 110: 1174. [crossref]
9. David-Montefiore E, Rouzier R, Chapron C, Darai E (2007) Surgical routes and complications of hysterectomy for benign disorders: a prospective observational study in French university hospitals. *Hum Reprod* 22: 260-265. [Crossref]
10. Ostrzenski A, Ostrzenska KM (1998) Bladder injury during laparoscopic surgery. *ObstetGynecolSurv*53: 175-180. [crossref]
11. Meikle SF, Nugent EW, Orleans M (1997) Complications and recovery from laparoscopy-assisted vaginal hysterectomy compared with abdominal and vaginal hysterectomy. *Obstet Gynecol* 89: 304-311.
12. Mäkinen J, Johansson J, Tomás C, Tomás E, Heinonen PK, et al. (2001) Morbidity of 10 110 hysterectomies by type of approach. *Hum Reprod* 16: 1473-1478. [crossref]
13. Härkki-Sirén P, Sjöberg J, Tiitinen A (1998) Urinary tract injuries after hysterectomy. *Obstet Gynecol* 92: 113-118. [crossref]
14. Johns DA, Diamond MP (1994) Laparoscopically assisted vaginal hysterectomy. *J Reprod Med* 39: 424-428. [crossref]
15. Ostrzenski A, Radolinski B, Ostrzenska KM (2003) A review of laparoscopic ureteral injury in pelvic surgery. *Obstet Gynecol Surv* 58: 794-799. [crossref]
16. Karaman Y, Bingol B, Gunenc Z (2007) Prevention of complications in laparoscopic hysterectomy: experience with 1120 cases performed by a single surgeon. *J minim Invasive Gynecol* 14: 78-84. [Crossref]
17. Lenihan JP Jr, Kovanda C, Cammarano C (2004) Comparison of laparoscopic-assisted vaginal hysterectomy with traditional hysterectomy for cost-effectiveness to employers. *Am J Obstet Gynecol* 190: 1714-1720. [crossref]
18. Muzii L, Basile S, Zupi E, Marconi D, Zullo MA, et al. (2007) Laparoscopic-assisted vaginal hysterectomy versus minilaparotomy hysterectomy: a prospective, randomized, multicenter study. *J Minim Invasive Gynecol* 14: 610-615.
19. Schindlbeck C, Klauser K, Dian D, Janni W, Friese K (2008) Comparison of total laparoscopic, vaginal and abdominal hysterectomy. *Arch Gynecol Obstet* 277: 331-337. [crossref]
20. Johnson N, Barlow D, Lethaby A, Tavender E, Curr L, et al. (2005) Methods of hysterectomy: systematic review and meta-analysis of randomised controlled trials. *BMJ* 330: 1478. [crossref]
21. Lee PI, Lee YT, Lee SH, Chang YK (1996) Advantages of Total Laparoscopic Hysterectomy. *J Am Assoc Gynecol Laparosc* 3: S24-25. [crossref]
22. Hur HC, Guido RS, Mansuria SM, Hacker MR, Sanfilippo JS, et al. (2007) Incidence and patient characteristics of vaginal cuff dehiscence after different modes of hysterectomies. *J Minim Invasive Gynecol* 14: 311-317. [crossref]
23. Clarke-Pearson DL, Geller EJ (2013) Complications of hysterectomy. *Obstet Gynecol* 121: 654-673. [crossref]

24. Cosson M, Lambaudie E, Boukerrou M, Querleu D, Crépin G (2001) Vaginal, laparoscopic, or abdominal hysterectomies for benign disorders: Immediate and early postoperative complications. *Eur J Obstet Gynecol Reprod Biol* 98: 231-236. [Crossref]

25. Chang WC, Hsu WC, Sheu BC, Huang SC, Torng PL, et al. (2008) Minimizing bladder injury in laparoscopically assisted vaginal hysterectomy among women with previous cesarean sections. *Surg Endosc* 22: 171-176.