A Modified LAVH to Reduce Urinary Tract Injuries: 102 Consecutive Case-series at Srinagarind Hospital, Khon Kaen University

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Objective: *To describe the technique and results of modified laparoscopically assisted vaginal hysterectomy (LAVH), especially, on the urinary tract injury.*
Material and Method: *One hundred two patients scheduled for modified LAVH between November 2007 and December 2010 were enrolled.*
Results: *The majority of patients were middle-aged. The median parity was two; 16 patients were nulliparous. Among the 39 patients who had undergone prior abdominal or pelvic surgeries, eight had a prior cesarean delivery. The majority of LAVH indication was leiomyoma with complications. The median uterine weight was 300 g (range 120 to 1,450 g). The median operating time was 105 min (range 50 to 365 min). One patient had repeated laparoscopic uterine artery electrocoagulation 12 hours after surgery. Two patients were re-admitted with pelvic inflammatory disease (PID) two to three weeks post-operatively. No bowel or urinary tract injuries were detected during intra- and post-operation.*
Conclusion: *The modified LAVH presented here was a technique that showed a low incidence of urinary tract injury.*

Keywords: *Hysterectomy, Laparoscopically assisted vaginal hysterectomy, Bladder injury, Ureteral injury, Laparoscopic hysterectomy*

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Laparoscopic hysterectomy is indicated as an alternative to laparotomy when the vaginal approach is potentially difficult due to an enlarged uterus or poor vaginal accessibility[1,2]. Laparoscopic hysterectomy (LH) is now widely accepted to result in less pain and an earlier return to work. Laparoscopically assisted vaginal hysterectomy (LAVH) is a vaginal hysterectomy that is assisted by laparoscopic procedures. The method combines the advantages of both laparoscopic and vaginal techniques. The laparoscopic approach is used only for electro-coagulation and for incisions of the round ligaments, uterine tubes and the infundibulopelvic or ovarian proper ligaments whether ovaries are going to be removed. Coagulation and incisions of the uterine arteries, as well as the rest of the procedure, are performed through a vaginal approach.

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Injury to the urinary tract involving the ureter and urinary bladder is a recognized complication of a hysterectomy given the close anatomic relationship between the genital and urinary structures. The incidence of urinary tract injuries during abdominal and pelvic surgery has been reported to be up to 5.1 percent[3-5]. LAVH appears to be associated with a higher risk of urinary tract injuries[6]. The frequency of injury after LAVH is on average 0.37-2.8 percent[7]. The majority of these injuries occur during the operations with reported rates for bladder injuries ranging from 0.2-1.8 percent and for ureteral injuries ranging from 0.03-1.5 percent[6,8-10]. Bladder injuries are more common than ureteral injuries[11,12]. Any pelvic pathology, such as acute or chronic inflammation, endometriosis, adhesions, or scarring from a previous cesarean section, may put the patient at increased risk during a LAVH[13-16].

The possible causes of urinary tract injury have mainly been ascribed to the laparoscopic procedure itself[7]. The route of a colpotomy may affect the rate of injury. In conventional LAVH, anterior and

posterior colpotomies are performed laparoscopically with monopolar electrosurgery after blunt dissection of the bladder and forceful retraction against the vesicocervical fascia. Dissection and electrical cutting techniques pose potential risks for bladder and ureteral injuries[17,18]. Vaginally approached anterior colpotomy, which is successfully performed with vaginal hysterectomy (VH), has been considered to be a safe technique for LAVH to prevent urinary tract injury[7,19]. The present case-series were described the technique of a modified LAVH with vaginally approached colpotomies and other technique specifics to reduce the rate of urinary tract injuries. Therefore, it may be used and evaluated by others.

Material and Method

The present study enrolled of 102 consecutive patients who were scheduled for a hysterectomy at Srinagarind Hospital between November 2007 and December 2010. All patients presented with benign gynecological diseases and had a strong indication for hysterectomy that could not be surgically treated with a vaginal hysterectomy. The patients were preoperatively counseled on the risks versus benefits of this operation. The total operative time, actual uterine (included cervix) weight, estimated blood loss, intra- and post-operative major complications, especially in regards to urinary tract injuries were evaluated and recorded.

Operative procedure

Preoperatively, the patients were given a two-day liquid diet and a soapsuds enema for bowel preparation. During the operation, the patient was in a Trendelenburg position and the buttocks were positioned just over the table's edge, as is done during a conventional vaginal hysterectomy. A Foley catheter was inserted with a 5 ml inflated balloon and positioned for continuous drainage. After establishment of a pneumoperitoneum, a 5 to 10 mm cannula was inserted through a supraumbilical port to hold the optic camera. Next, two 5 mm cannulae were placed laterally in each lower quadrant and, in a four-puncture technique, a 5 mm cannula was placed approximately 2 inches below the umbilicus. Through a lateral cannula, the uterine screw (5 mm) was inserted between uterine fundus and the cornu to provide upward traction and allow for adequate exposure of adnexa and round ligament. A 5 mm pulse-modulating electrocoagulator and cutting device (Gyrus PK) was used, through the lower umbilical cannula, to coagulate and cut the round ligaments and the infundibulopelvic ligaments (whenever the ovary was to be removed). When the ovary was retained, the same technique was repeated to coagulate and cut the round ligaments, the proximal uterine tubes and the ovarian proper ligaments. The vesicouterine space was opened by extending the incisions from the upper portion of the broad ligament. Once the surgeon observed the shine of the bulging balloon, a pulse-modulating electrocoagulator, acting as a blunt dissector, was used to horizontally strip the loose alveolar tissue under the vesicouterine peritoneum at the superior portion of the reflection and was then used to cut to open the vesicouterine space. The laparoscopic part of the procedure was completed without pushing the bladder flap downward.

The vaginal operation was initiated with downward traction applied to the cervix. A circumferential incision was made in the vaginal epithelium in the mid-portion between the ectocervix and the fornix after local infiltration with diluted adrenaline solution (1:200,000) to minimize bleeding and plane separation. After anterior downward traction on the cervix, the posterior peritoneal reflection (cul-de-sac of Douglas) could be easily identified by observing the pneumo-bulging of the posterior cul-de-sac. The posterior incised fornix was grasped by Allis clamps. Then, the index finger was pushed into the space between the clamps and the cervix. The bulging peritoneum between the uterosacral ligaments was then opened with Metzenbaum scissors to expose the peritoneal cavity. An interrupted suture was placed to approximate the peritoneum and the posterior vaginal vault and thus provided hemostasis. The weighted speculum was placed into the posterior cul-de-sac.

The vesicouterine pouch (anterior cul-de-sac) was entered by using posterior downward traction on the cervix while the Allis clamps were used to lift the anterior incised vaginal fornix. The index finger was covered with a moistened 4 x 4 gauze sponge and pushed into the incision directed toward the uterus. The direction of the finger's force was tangential to the cervix and slowly advanced until the vesicouterine pouch was entered. Because the vesicouterine peritoneum had been cut previously, the anterior cul-de-sac could be easily entered without resistance. The leakage of intra-abdominal CO2 was also indicated that the pouch was entered. After the colpotomy had been performed, a curved Deaver or Heaney retractor was placed in the midline holding the bladder away from the operative field. With continued traction on the cervix, the cardinal and uterosacral ligaments were

identified and laterally clamped with Heaney clamps close to the cervix. The pulse-modulating electro-coagulator (Gyrus PK) was clamped between the Heaney clamps and the cervical tissue. The coagulated ligaments were then cut with Mayo scissors medially to the Heaney clamps. With medial traction on the clamps, the lateral side was then sutured with a Heaney stitch using a single 1-0 delayed absorbable suture and was then ligated. The tail of the suture was left for the vaginal vault suspension. The same processes were repeated on the other side. The anterior and posterior leaves of the broad ligament were clamped close to the uterus with Heaney clamps (the uterine vessel was also clamped), and were then coagulated and cut in the same way.

The uterus was then removed through the vagina directly, either by wedge morcellation or by bivalving. The uterine vessel stumps were carefully checked for bleeding and then the vaginal vault was horizontally re-approximated. Continuous sutures were placed through the entire thickness of the vaginal epithelium with care taken to avoid entering the bladder anteriorly. The free end of ligamentous suture material was sutured and tied to the vaginal vault to support and prevent vaginal vault prolapse.

The pelvic cavity was laparoscopically re-inspected to ensure hemostasis. The abdominal wall puncture sites were then sutured. At the end of the operation, the removed uterus was weighed before being placed in formalin for histological evaluation. The Foley catheter was retained for 24 hours after surgery. The status of bowel movements, urinary symptoms, and abdominal pain were recorded during postoperative care. Patients were discharged from the hospital once no complications were observed and were followed at 1 week and 1 month postoperatively and annually thereafter. The vaginal vault and pelvis were inspected and palpated during follow-up visits. After returning home, patients could directly call the doctor if they were uncomfortable with their symptoms.

This modified LAVH technique had already been approved by the University Research Committee. The results were reported in term of range, median mean and standard deviation and frequency (%).

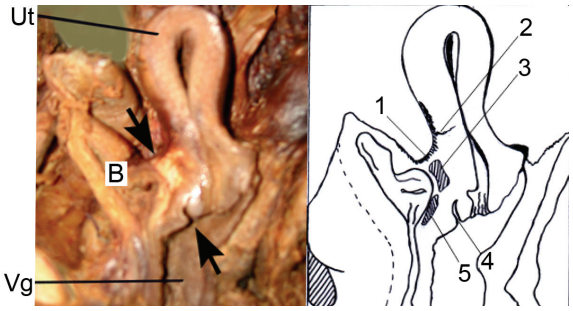

Fig. 1 Anterior colpotomy was performed at the area between the arrows. By starting from anterior fornix (4), the manipulation was extended to the vesicocervical space (3) and then extended upward to vesicouterine space and to the anterior cul-de-sac though the dissected vesicouterine peritoneal reflection (1). The cesarean section scar (2) was usually located superior to the bladder. In previous section patients, the careful vaginally anterior colpotomy had a lower rate of bladder injuries than vigorously pushing bladder flap downward in a laparoscopic approach (Ut = uterus, B = bladder, Vg = vagina, 5 = vesicovaginal space, this figure was created by the author)

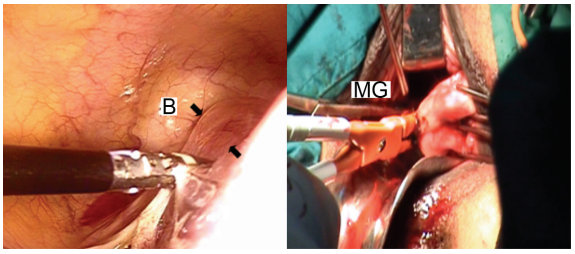

Fig. 2 (Left) The vesicouterine peritoneum were cut horizontally at the superior portion of the vesicouterine peritoneal reflection (area between the arrows) and positioning the bladder by focusing on the shiny bulge of the catheter balloon (B). (Right) The Heaney clamps were used as a metal guard (MG) during electrocoagulation of the uterosacral and cardinal ligaments

Results

The majority of patients were middle-aged with a normal body mass index. Patient characteristics and indications for surgery are detailed in Table 1. The median parity was two (range, 0-7), and 16 patients were nulliparous. Thirty-nine patients had prior abdominal or pelvic surgeries with eight having had a prior cesarean delivery. The indication for LAVH was leiomyoma with complications secondary to menorrhagia, dysmenorrhea, or pressure effects unresponsive to medical management in 80.39 percent of patients. The median operating time was 105 min (range 50 to 365 min). The median operating time for the last 12 cases was 85 min (range 60 to 135 min), and the median estimated blood loss was approximately

Table 1. Demographic and intraoperative variables of patients undergoing modified LAVH (n = 102)

Demographic and intraoperative variables	n
Age*	44.85± 5.7
Parity+	2 (range, 0-7)
Body mass index+ (kg/m^2)	23 (range, 17-33.2)
Prior surgery	
Cesarean delivery	8 (7.84 percent)
Tubal resection	23 (22.55 percent)
Adnexal surgery	2 (1.96 percent)
Appendectomy	5 (4.90 percent)
Cholecystectomy	1 (0.98 percent)
Indications for hysterectomy	
Leiomyoma with complications	82 (80.39 percent)
Adenomyosis	15 (14.71 percent)
Endometriosis	7 (6.86 percent)
CIN III	2 (1.96 percent)
Ovarian tumor (some patients had more than one indication)	1 (0.98 percent)
Procedure	
LAVH	79 (77.45 percent)
LAVH + unilateral oophorectomy	13 (12.75 percent)
LAVH + bilateral oophorectomies	10 (9.80 percent)
Uterine weight (G)+	300 (range, 120-1,450)
Estimated blood loss (mL)+	200 (range, 50-1,200)
Operating time (min)+	105 (range, 50-365)
Last 12 cases operating time (min)+	85 (range, 60-135)

* Mean (± standard deviation)
+ Median (range)

200 mL. The median uterine weight was 300 g (range 120 to 1450 g). No bowel injuries were detected. One patient (0.98%) had been repeated laparoscopic uterine artery electrocoagulation in 12 hours after surgery. Two patients (1.96%) readmitted with pelvic inflammatory disease (PID) at two and three weeks, respectively, after their operations. Both had good results after using parenteral antibiotics followed by oral antibiotics for two weeks.

No bladder or ureteral injuries were noted during intra- and early postoperative care. No bladder or ureteral injuries were reported during follow-up.

Discussion

Laparoscopically assisted vaginal hysterectomy is now regarded as an effective technique for managing benign uterine disease with clear benefits of shorter hospital stays, less post-operative pain, negligible scars, and a quick return to normal activity and work[20]. However, this procedure can depend on many factors such as gynecological disease, patients' health status, and experiences of the gynecologist[21]. The most common complication of LAVH is a urinary tract injury with a frequency reported between 0.37 and 2.8 percent[6,7,10]. A high incidence is usually restricted to a surgeon's first 100 cases[20]. Because of the close anatomical relationship of the urinary tract and the reproductive organs, vigorous manipulation, electrothermal damage and inappropriate dissections are various explanations for these injuries. Possible causes have been ascribed to the laparoscopic procedure itself[7]. It is imperative that the surgeon has a thorough knowledge of pelvic anatomy and strict adherence to fundamental surgical principles will help prevent urinary tract injuries.

This modified LAVH technique was designed according to the anatomy of pelvic structures in order to reduce the incidence of the urinary tract injury by minimizing of vigorous manipulation and electrothermal damage. The technique comprises (1) cutting the vesicouterine peritoneum horizontally at the superior end of the reflection while the bladder was positioned by focusing on the shiny bulge of the catheter balloon, (2) using a vaginal approach for the

colpotomies and (3) using Heaney clamps as a metal guard during electrocoagulation of the uterosacral, cardinal and broad ligaments (containing the uterine arteries).

In this technique, the vesicouterine pouch (anterior cul-de-sac) was entered via a vaginal approach though fibrous tissue within the vesicocervical space. The length of the vesicocervical space along the cervical wall is approximately 3 cm (Fig. 1). Careful dissection at the entrance to the lower portion of the vesicocervical space is a safe technique, and the frequency of bladder injuries was reported to be relatively low[17,22]. Horng et al[7] reported that vaginally approached colpotomies in LAVH had a lower rate of bladder injuries (0.37%) than a laparoscopic approach (3.38%), which is consistent with our report and others[17]. During a vaginally approached anterior colpotomy, Chang WC et al[23] reported a modified technique for cases with dense lower uterine adhesions. First, the lateral windows of the vesicocervical and vesicouterine spaces were opened with blunt finger dissection. Next, an index finger was then swept medially to define the margin of the midline adhesions and dissection was performed under direct vision and finger guidance. In the present report, the lower vesicocervical fibrous tissue was carefully dissected in the direction of the uterus, a tangential force was applied to the cervix and slowly continued to advance. Because the vesicouterine peritoneum had already been laparoscopically dissected, the anterior cul-de-sac was then easily entered without resistance.

Instead of dissecting the bladder flap and pushing downward, as performed in a typical LAVH, in this technique the laparoscopic part was stopped after the transverse dissecting of the vesicouterine peritoneum without vigorous downward manipulation to prevent bladder injury, especially in previous cesarean section patients. In women with histories of a cesarean delivery, the odds ratios for bladder injuries are 7.50 for LAVH and 1.26 for TAH[24]. The lower uterine cesarean and peritoneal scars are usually located at the middle portion of vesicouterine space. After the surgeon refocused on the bladder position relative to the bulging catheter balloon, dissection of the vesicouterine peritoneum near the upper end of the reflection is an easy and safe procedure and was usually performed superior to the uterine scar and the bladder. O'Hanlan KA et al[25] suggested CO_2 cystosufflation to identify and circumscribe the bladder margins to prevent bladder injury.

Ureteral injuries are less common than bladder injuries. The incidence of ureteral injury after LAVH is 0.03-1.5 percent[19]. After passing under the uterine artery, the ureter travels inferiorly and anteriorly in the ureteral canal at a distance of about 1.5 cm from uterine cervix. During pelvic surgery, this area is one of the most common sites of ureteral injury[26-28]. In the using of electrocoagulator on the uterosacral, cardinal and broad ligaments, injury to the ureter can also be caused by thermal damage associated with the coagulation of these structures. The uncontrolled spread of tissue desiccation could spread (above 60°C) up to 10 mm from the tip of the instrument[29-32]. Khampitak K et al[33] reported that thermal spread could be limited by a metal guard. To reduce the risk of ureteral injury upon completion of the colpotomy, Heaney clamps were introduced into the pouch of Douglas and the vesicouterine pouch, respectively, and were then clamped on the uterosacral and cardinal ligaments close to the uterine cervix. Then, the pulse-modulating electrocoagulator was applied between the Heaney clamps and the cervical tissue, which the Heaney clamped was used as a metal guard to prevent ureteral thermal damage.

The uterine artery reaches the side of the uterus between the two layers of the broad ligament and ascends in a tortuous manner that divides into 12-15 arcade arteries along the inner side of the broad ligament as it enters the uterine myometrium. Ureteral injuries occur commonly at the level of the uterine artery[22,34]. To protect the ureter, the uterine artery was cut close to the uterine corpus. The technique begins at the lower portion of the broad ligament containing the main arcade artery until reaching the upper portion of the broad ligament, which contains some small arcade arteries. The upper portion can be identified by hooking or palpating from below by the surgeon's index finger. When the upper portion of the broad ligament was considered to be difficult for vaginal access, especially in cases of a very large uterus, it was also coagulated and cut close to the uterus via a laparoscopic approach, which was an effective and safe technique[10].

No clinical urinary tract complications were attributed to this technique, no cystotomy occurred while entering the vesicouterine pouch, and no ureteral injuries occurred after ligament and uterine artery cauterization. The strength of the present study lies in the fact that the same technique was performed by a single surgeon. However, a postoperative cystoscopy would have been a good procedure to

evaluate silent urinary tract injuries[28]. To reduce the limitation of the descriptive study, the randomized controlled trial was also recommended to reduce selective bias in the next study. The authors advise to compare between this technique and the conventional LAVH for statistical analysis and accurate conclusion.

Conclusion

The modified LAVH with vaginally approached colpotomies and other technique specifics that was mentioned in the present article could result in low urinary tract injuries. Therefore, they may be used and evaluated by others.

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Potential conflicts of interest

None.

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การผ่าตัดมดลูกทางช่องคลอดโดยใช้กล้องส่องช่วย โดยวิธีดัดแปลงเพื่อลดภาวะการเกิดอันตรายต่อระบบทางเดินปัสสาวะ: รายงานผู้ป่วยผ่าตัด ใน โรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่น จำนวน 102 ราย

โกวิท คำพิทักษ์, ยุทธพงศ์ วีระวัฒนตระกูล, อมรรัตน์ สุโพธิ์เคน, กนก สีจร

วัตถุประสงค์: *เพื่อบรรยายวิธีการผ่าตัดและรายงานผลการผ่าตัดมดลูกทางช่องคลอดโดยใช้กล้องส่องช่วย โดยเฉพาะภาวะแทรกซ้อนต่อระบบทางเดินปัสสาวะ*

วัสดุและวิธีการ: *รวบรวมข้อมูลจากผู้ป่วยจำนวน 102 ราย ที่เข้ารับการผ่าตัดมดลูกทางช่องคลอดโดยใช้กล้องส่องช่วย โดยวิธีดัดแปลงเพื่อลดภาวะแทรกซ้อนต่อระบบทางเดินปัสสาวะ ณ โรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่น ตั้งแต่ ปี พ.ศ. 2550-2553*

ผลการศึกษา: *ผู้ป่วยส่วนใหญ่อยู่ในวัยกลางคน ค่ามัธยฐานจำนวนบุตร 2 คน ผู้ป่วยจำนวน 16 คน ไม่เคยมีบุตรมาก่อน ผู้ป่วยที่เคยมีประวัติผ่าตัดทางช่องท้องหรือช่องเชิงกราน มีจำนวน 39 คน โดยในจำนวนนี้มี 8 คน เคยผ่าตัดคลอดมาก่อน ข้อบ่งชี้ในการผ่าตัดครั้งนี้ ส่วนใหญ่จากภาวะแทรกซ้อนของเนื้องอกมดลูกชนิด leiomyoma ค่ามัธยฐานน้ำหนักมดลูกที่ผ่าตัดได้ 300 กรัม (ช่วง, 120-1,450 กรัม) ค่ามัธยฐานระยะเวลาผ่าตัด 105 นาที (ช่วง, 50-365 นาที) ผู้ป่วยจำนวน 1 คน ต้องเข้ารับการส่องกล้องเพื่อจี้หลอดเลือดแดงมดลูกอีกครั้ง ใน 12 ชั่วโมงภายหลังผ่าตัด และผู้ป่วยจำนวน 2 คน ต้องเข้ารับการรักษาภายในโรงพยาบาลอีกครั้งด้วยภาวะติดเชื้อในช่องเชิงกราน ในสัปดาห์ที่ 2 และ 3 ภายหลังการผ่าตัด ไม่พบภาวะแทรกซ้อนต่อลำไส้และระบบทางเดินปัสสาวะในระหว่างและหลังผ่าตัด*

สรุป: *การผ่าตัดมดลูกทางช่องคลอดโดยใช้กล้องส่องช่วยโดยวิธีที่ทำการดัดแปลงขึ้น ให้ผลการรักษาที่ดี โดยพบอุบัติการณ์ของภาวะแทรกซ้อนต่อระบบทางเดินปัสสาวะต่ำ*