



ARAŞTIRMA / RESEARCH

Clinical results of laparoscopic hysterectomies: single center experience

Laparoskopik histerektominin klinik sonuçları: tek merkez deneyimi

Zeynep Öztürk İnal¹, Hasan Ali İnal^{1,2}

¹Konya Education and Research Hospital, Department of Obstetrics and Gynecology, Konya, Turkey

²Necmettin Erbakan University, Meram Medical Faculty, Department of Obstetrics and Gynecology, Konya, Turkey

Cukurova Medical Journal 2017;42(4):714-720

Abstract

Purpose: The aim of this study was to evaluate the clinical results of laparoscopic hysterectomy (LH).

Materials and Methods: In this retrospective study, the original files of 511 patients who underwent LH between January 2010 and December 2016 were analyzed. The following parameters were recorded and assessed according to the years studied: mean age, body mass index (BMI), parity, indications for surgery, uterine weight, operation duration, blood loss, duration of hospitalization, analgesic needs, and intra- and post-operative complications.

Results: The lowest LH rate was 10.14% in 2012, and the highest rate was 47.73% in 2016. Uterine myoma (31.51%) and menometrorrhagia (25.63%) resistant to medical treatment were the most common indications. There were no differences in terms of age, BMI, parity, blood loss, analgesic requirements, uterus weight, previous intra-abdominal surgery rate, laparoscopy to laparotomy conversion rate, and intra- or post-operative complications during the period assessed. However, operation time and hospital stay durations were significantly reduced after the first 3 years.

Conclusion: An emphasis on endoscopy training for gynecological surgeons, along with technological advances and the use of surgical techniques, has improved postoperative LH recovery, and the length of the required hospital stay has become shorter. LH should be the preferred surgical option in hysterectomy indications, as it is effective and safe for the patient.

Key words: Laparoscopic hysterectomy, operation duration, duration of hospitalization, complications.

Öz

Amaç: Bu çalışmanın amacı laparoskopik histerektominin (LH) klinik sonuçlarını değerlendirmektir.

Gereç ve Yöntem: Bu retrospektif çalışmada, Ocak 2010 ile Aralık 2016 arasında LH uygulanan 511 hastanın orijinal dosyaları incelendi. Yaş ortalamaları, vücut kitle indeksi (VKİ), doğum sayısı, ameliyat endikasyonları, uterus ağırlığı, operasyon süresi, kan kaybı, hastanede kalma süresi, analjezik ihtiyaçları, intraoperatif veya postoperatif komplikasyonlar kaydedildi ve yıllara göre değerlendirildi.

Bulgular: En düşük LH oranı %10.14 ile 2012 yılında, en yüksek oran %47.73 ile 2016 yılında idi. Medikal tedaviye dirençli uterin myom (%31.51) ve menometroraji (%25.63) en sık görülen endikasyonlardı. Değerlendirilen süre içerisinde yaş, VKİ, doğum sayısı, kan kaybı, analjezik gereksinimi, uterus ağırlığı, önceden karın içi cerrahi operasyon geçirme oranı, laparoskopiden laparotomiye dönüşüm oranı, intraoperatif veya postoperatif komplikasyonlar açısından fark yoktu. Ancak ameliyat süresi ve hastanede kalış süresi ilk 3 yıldan sonra önemli ölçüde azalmıştı.

Sonuç: Jinekolojik cerrahlar için endoskopi eğitimine, teknolojik gelişmelere ve cerrahi tekniklerin kullanımına verilen önem LH sonrası iyileşmeyi geliştirmiş ve hastanede kalış süresini kısaltmıştır. LH hasta için etkin ve güvenli olduğundan histerektomi endikasyonlarında tercih edilen cerrahi seçenek olmalıdır.

Anahtar kelimeler: Laparoskopik histerektomi, ameliyat süresi, hastanede kalış süresi, komplikasyonlar.

INTRODUCTION

Hysterectomy is one of the most frequently performed global gynecological operations for

indications such as dysfunctional uterine bleeding, uterine myoma, uterovaginal prolapse, endometriosis, adenomyosis, pelvic pain, and gynecological cancers.¹ In 1998, laparoscopic

Yazışma Adresi/Address for Correspondence: Dr. Zeynep Öztürk İnal, Department of Obstetrics and Gynecology, Konya, Turkey. E-mail: zeynephafiza@gmail.com

Geliş tarihi/Received: 24.01.2017 Kabul tarihi/Accepted: 27.03.2017

hysterectomy (LH) was defined as another specific technique, alongside the two separate methods of vaginal hysterectomy (VH) and abdominal hysterectomy (AH).² In addition to technological advances, such as those made regarding light sources, optics, and cameras, the improvements in surgical techniques, and the associated learning curve, have increased the performance rate of LH from 10% in the 1990s to 40% nowadays.^{3,4}

The choice of hysterectomy method may be affected by the surgeon's experience, the surgical indication, the size and weight of the uterus, or a history of earlier abdominal surgery.⁵⁻⁷ The advantages of LH are a shorter hospital stay, less blood loss, faster recovery, a more rapid return to daily activities, a reduced need for postoperative analgesics, and the avoidance of a large abdominal surgical incision; its disadvantages are a longer intra-operative period and the required learning curve for the surgeon.^{5,8,9}

Although previous studies have recommended the avoidance of conventional AH in cases where VH is not applicable, many gynecologists still prefer AH. However, LH, in which the intra-pelvic and intra-abdominal anatomy are rather well explored may be preferred instead of AH.^{3,5,10} In addition, as technology and surgical experience have improved, it has become possible to perform laparoscopic lymphadenectomies concurrently with LH.⁸ In the present study, our aim was to evaluate the clinical results of LH performed at our hospital between 2010 and 2016.

MATERIALS AND METHODS

After obtaining the necessary ethical permission from the education planning and coordination board of Konya Training and Research Hospital (reference number: 2016-12-10), the original files and surgical report records of 511 patients who underwent LH operations between 01 January 2010 and 31 December 2016 were retrospectively screened.

Prior to surgery, informed consent for gynecological operations had been obtained for future use. The inclusion criteria for LH was uterine size ≤ 16 weeks gestation (16 cm long), and exclusion criteria were uterine size ≥ 16 weeks gestation and comorbid cardiac or pulmonary diseases resulting in contraindication for the lithotomy and Trendelenburg positions. The gynecological

operations were performed by two senior gynecologists and their colleagues, and the following parameters were recorded: the distribution of LH by years, surgery indications, mean patient age, BMI, parity, uterine weight, operation duration, blood loss, duration of hospitalization, analgesic requirements, conversion from laparoscopy to laparotomy, surgical procedures performed concurrently with LH, and intra- or post-operative major and minor complications.

Blood loss during surgery was estimated according to blood volume aspirated by the suction machine during surgery, excluding liquid used for washing. The time between the first incision from the umbilicus to carrying out the sutures of the trocar entry sites was calculated. In accordance with previous studies, complications were assessed in two separate groups, as follows: major complications (bladder injury, ureteral injury, bowel injury, blood transfusion, cuff dehiscence, thromboembolism, and vascular injury) and minor complications (pelvic hematoma, urinary tract infection, vaginal cuff infection, wound dehiscence, wound infection, and postoperative ileus).

Pre-surgery preparation

Patients who were to undergo hysterectomy were admitted to the hospital 1 day before their scheduled operation, and a standard preoperative assessment (cell blood count, coagulation tests, electrocardiography, and posterior-anterior pulmonography) was performed, together with abdominal and transvaginal ultrasonography to estimate uterine size. Prophylactic intravenous antibiotics (cefazolin 2 g) as premedication were administered by a gynecologist to all patients, approximately 30 minutes before surgery. A bladder catheter was inserted prior to the surgical procedure, and this was withdrawn 8–12 hours after the operation. Antithrombotic prophylaxis was performed according to the recommendations of the American College of Obstetricians and Gynecologists and the American College of Chest Physicians.

Surgical procedure

After induction of general anesthesia via endotracheal intubation, each patient was placed in the dorsal lithotomy position and draped, and a uterine manipulator was inserted in the cervix. An

orogastric tube was temporarily placed by an anesthesia technician, in order to promote the emptying of gastric contents from the stomach.

A vertical incision (1 cm) was made in the umbilicus of each patient while in the supine position. The patient was then lifted with laundry clamps and a 10 mm trocar was inserted via the closed method. Following observation with a 0° telescope in the peritoneal cavity, the abdomen was inflated with CO₂ to 15 mmHg pressure. An additional two ancillary trocars (a 10 mm trocar for the right mid-abdomen and a 5 mm trocar for the left mid-abdomen) were then placed. Intra-abdominal pressure was maintained at 12–13 mmHg by an automatic insufflator during the surgical procedure. The patients were then placed in the Trendelenburg position in order to begin the operation. The intra-abdominal organs (liver, bowel, uterus, and adnex) were checked prior to surgery. Any adhesions between the uterus and the adnex were divided using blunt and sharp dissections.

Advanced bipolar electrocoagulation (LigaSure™, Covidien Company, MA, USA) and ultrasonic energy (Harmonic) were used as energy modalities. Both round ligaments were ligated, cauterized, and then cut. The anterior peritoneum of the broad ligament was then dissected toward the infundibulopelvic ligament, which was then ligated, cauterized, and cut via LigaSure, after which the bladder was dissected from the lower uterus. Following ligation, cauterization, and cutting of the bilateral uterine vessels with LigaSure, the parametrial tissue surrounding the cervix was separated.

A circumferential colpotomy was performed via a uterine manipulator, excluding the ligamentum uterosacrale, uterus and adnex were removed through the vagina. The vaginal cuff was closed with a running absorbable suture. In some cases, a drainage tube was inserted to remove washing liquid and gas.

Statistical analysis

Statistical analyses were performed using the SPSS 15.0 for Windows (SPSS, Chicago, IL, USA). Normal distribution of data was assessed using the Kolmogorov–Smirnov test. Continuous variables are presented as mean - SD, and intragroup differences were investigated using one-way ANOVA. Categorical variables were expressed as number (percentage). Differences between

categorical data were evaluated using chi-square or Fisher's exact tests. Statistical significance was assumed with a probability of 0.05.

RESULTS

The percentage distributions and indications of LH according to the years are shown in Table 1. It can be observed that the LH percentage had increased in 2016 (47.73%) in comparison to 2010. There was no difference in the distribution of indications according to year ($p > 0.05$). These indications were as follows: symptomatic uterine myoma (161; 31.51%), menometrorrhagia resistant to medical treatment (131; 25.63%), endometriosis (60; 11.76%), chronic pelvic pain (36; 7.04%), uterine uterovaginal prolapse (54; 10.56%), adnexal masses (37; 7.24%), and tubo-ovarian abscesses (32; 6.26%).

The preoperative patient characteristics and outcome measures are summarized in Table 2. There were no differences in terms of age, BMI, parity, preoperative Hb and postoperative Hb levels, blood loss, analgesic requirements, uterus weight, previous intra-abdominal surgery rate, conversion rate from laparoscopy to laparotomy, and intra- or post-operative complications over the years. Although there was no statistically significant difference in terms of operation time and duration of hospitalization in the first 3 years, these periods significantly decreased after the first 3 years ($p < 0.05$).

Oophorectomy was performed as a concurrent surgical procedure in 484 (94.72%) patients, while anterior colporrhaphy was carried out in 47 (9.19%) patients, posterior colporrhaphy in 39 (7.63%), vaginal vault suspension in 23 (4.49%), and anal sphincteroplasty in five (0.98%) patients (Table 3). Anal sphincteroplasty was a surgical indication in five patients prior to planned surgery.

The rate of major and minor complications was 2.16% and 0.99%, respectively. The rate of total complications was 3.15% (Table 4). Statistical comparison according to years was not performed, since the complication rates were very low. Of the major complications, five patients required blood transfusions; three patients had bowel injury; two patients had bladder injury, and one patient had cuff dehiscence. Of the minor complications, three patients had urinary infections, one patient had a pelvic hematoma, and one patient experienced post-operative ileus.

Table 1. Distribution of laparoscopic hysterectomy according to the years (n(%))

Years n (%)	Myoma uteri	Resistant metroragia	Cronic pelvic pain	Uterovaginal prolapse	Adnexial masses	Tuboovarian abscess	Endometriosis	p
2010 52 (17.10%)	17 (32.7)	13 (25.0)	5 (9.6)	5 (9.6)	3 (5.8)	3 (5.8)	6 (11.5)	0.437
2011 58 (16.48%)	18 (31.0)	17 (29.3)	4 (6.9)	6 (10.3)	4 (6.9)	3 (5.2)	6 (10.3)	
2012 35 (10.14%)	11 (31.4)	9 (25.7)	2 (5.7)	4 (11.4)	3 (8.6)	2 (5.7)	4 (11.4)	
2013 55 (13.52%)	17 (30.9)	14 (25.5)	4 (7.3)	6 (10.9)	5 (9.1)	3 (5.5)	6 (10.9)	
2014 88 (26.99%)	30 (34.1)	22 (25.0)	6 (6.8)	10 (11.4)	6 (6.8)	5 (5.7)	9 (10.2)	
2015 86 (29.05%)	27 (31.4)	21 (24.4)	6 (7.0)	8 (9.3)	7 (8.1)	6 (7.0)	11 (12.8)	
2016 137 (47.73%)	41 (29.9)	35 (25.5)	9 (6.6)	15 (10.9)	9 (6.6)	10 (7.3)	18 (13.1)	
Total 511 (100%)	161 (31.5)	131 (25.6)	36 (7.0)	54 (10.6)	37 (7.2)	32 (6.3)	60 (11.7)	

Table 2. Preoperative patient's characteristics and outcome measures according to years (n(%))

n=511	2010 (52)	2011 (58)	2012 (35)	2013 (55)	2014 (88)	2015 (86)	2016 (137)	p
Age (years)	50.27±2.69	49.17±2.95	49.71±3.87	49.29±4.12	49.42±4.24	51.09±5.84	51.03±5.01	0.055
BMI (kg/m ²)	27.13±5.68	28.88±6.87	28.60±6.50	26.95±3.50	26.89±3.28	27.34±3.70	26.92±3.45	0.060
Parity	2.69±1.16	2.76±1.09	2.69±1.15	2.82±1.17	2.70±1.16	2.73±1.02	2.63±1.05	0.612
Operation time (minutes)	112.61±17.7 2 ^{1,2,3,4}	107.62±14.24 5,6,7,8	105.17±14.52 9,10,11	97.72±14.21 1,5	96.60±19.2 8 ^{2,6,9}	94.93±14.63 3,7,10	93.16±19.14 4,8,11	<0.001*
Preoperative Hb (gr/L)	11.56±1.63	11.08±1.96	11.86±1.67	11.75±2.08	11.81±1.88	11.77±2.04	11.87±1.83	0.214
Postoperative Hb (gr/L)	10.84±1.46	10.69±1.78	10.62±1.61	10.08±1.81	10.46±1.76	10.65±1.81	10.85±1.48	0.124
Blood loss (ml)	168.46±69.4	166.12±7.10	150.08±59.92	158.72±68.94	150.56±61.45	146.33±55.53	144.52±56.17	0.118
Hospital stay (days)	2.81±0.84 1,2,3,4	2.62±0.79 5,6,7,8	2.54±0.78 9,10,11	2.18±0.72 1,5	2.02±0.45 2,6,9	2.00±0.70 3,7,10	1.97±0.72 4,8,11	<0.001*
Analgesic needs (days)	3.54±1.46	3.47±1.08	3.31±1.34	3.38±1.09	3.34±1.44	3.19±1.27	3.03±1.25	0.158
Uterus weight (g)	235.87±72.9 2	257.33±42.47	240.29±61.51	223.09±55.77	241.53±56.20	251.34±97.12	284.14±72.90	0.158
Previous intraabdominal surgery n(%)	6 (11.5)	7 (12.1)	5 (14.3)	9 (16.4)	15 (17.0)	14 (16.3)	33 (24.1)	0.329
Conversion rate n(%)	2 (3.84)	1 (1.72)	1 (2.86)	1 (1.82)	1 (1.14)	-	-	-

* statistically significant (1=2010 vs 2013), (2=2010 vs 2014), (3=2010 vs 2015), (4=2010 vs 2016), (5=2011 vs 2013), (6=2011 vs 2014), (7=2011 vs 2015), (8=2011 vs 2016), (9=2012 vs 2014), (10=2012 vs 2015), (11=2012 vs 2016)

Table 3. Concomitant surgical procedures performed with laparoscopic hysterectomy (n(%))

Year / n	Oophorectomy	Anterior colporaphy	Posterior colporaphy	Paravaginal repair	Vaginal vault suspension	Anal sphincteroplasty
2010 / 52	48 (92.30)	5 (9.61)	2 (3.85)	2 (3.85)	1 (1.93)	-
2011 / 58	51 (87.93)	6 (10.34)	3 (5.17)	3 (5.17)	2 (3.44)	1 (1.72)
2012 / 5	33 (94.28)	4 (11.42)	2 (5.71)	2 (5.70)	1 (2.85)	-
2013 / 55	52 (94.54)	5 (9.09)	4 (7.28)	2 (3.64)	2 (3.64)	1 (1.82)
2014 / 88	84 (95.45)	8 (9.10)	9 (10.23)	4 (4.54)	3 (3.40)	-
2015 / 86	82 (95.36)	7 (8.13)	8 (9.30)	4 (4.65)	3 (3.49)	1 (1.16)
2016 / 137	132 (96.35)	12 (8.75)	11 (8.02)	6 (4.38)	5 (3.65)	2 (1.46)
Total / 511	484 (94.72)	47 (9.19)	39 (7.63)	23 (4.49)	18 (3.52)	5 (0.98)

Table 4. Intraoperative and postoperative complications according to years (n(%))

n=511	2010 (52)	2011 (58)	2012 (35)	2013 (55)	2014 (88)	2015 (86)	2016 (137)	Total
Major complications	6	3	1	-	1	-	-	11(2.16%)
Bladder injury	1	1	-	-	-	-	-	2
Ureteral injury	-	-	-	-	-	-	-	-
Bowel injury	2	1	-	-	-	-	-	3
Blood transfusion	2	1	1	-	1	-	-	5
Cuff dehiscence	1	-	-	-	-	-	-	1
Tromboembolism	-	-	-	-	-	-	-	-
Vascular injury	-	-	-	-	-	-	-	-
Minor complications	3	2	-	-	-	-	-	5 (0.99%)
Pelvic hematoma	1	-	-	-	-	-	-	1
Urinary tract infection	2	1	-	-	-	-	-	3
Vaginal cuff infection	-	-	-	-	-	-	-	-
Wound dehiscence	-	-	-	-	-	-	-	-
Wound infection	-	-	-	-	-	-	-	-
Postoperative ileus	-	1	-	-	-	-	-	1

DISCUSSION

In this retrospective study, we assessed the clinical results of 511 LH operations performed between January 2010 and December 2016 at a single tertiary referral center. Throughout this period, we observed that the rate of LH increased, while there were no differences in terms of age, BMI, parity, blood loss, analgesic requirements, uterus weight, previous intra-abdominal surgery rate, conversion rate from laparoscopy to laparotomy and intra or post-operative complications over the years, length of operation time and hospital stay were reduced at the end of the first 3 years.

Hysterectomy is a surgical treatment on which gynecological surgeons frequently rely to address a large variety of conditions, including life-threatening diseases and abnormal uterine bleeding, as well as pregnancy and disease prevention. Although the indications for hysterectomy have not changed, numerous gynecological surgeons have long-preferred the abdominal and vaginal route; however, the use of alternative methods has recently begun to increase¹¹. The advances in endoscopic surgery toward the end of the 1990s, and the increase in training on how to perform this technique, has meant that LH has begun to be more frequently preferred^{12,13}. In the present study, we observed that the rate of LH increased over the years examined.

Although the advantages of LH have gradually become increasingly apparent, the technique is still not being widely used, due to inadequate technical equipment and the lack of trained surgeons and assisting health personnel^{6,11}. If LH is to become a routine surgical procedure for use in hysterectomies in our clinic, we believe that gynecological surgeons should receive a greater amount of training, as well as encouragement to gain experience. In addition, they should use and apply the instruments and surgical techniques introduced as a result of technological advances, and patients should be informed of the favorable and advantageous aspects of endoscopic operations in greater detail.

Previous studies have shown that the largest indication group for LH consists of women with abnormal uterine bleeding^{14,15}. In our study, the most frequent LH indications were treatment-resistant menometrorrhagia and myoma uteri, with a percentage of 57.14%. Longer operation durations were initially reported with regard to LH than for other hysterectomy routes¹⁶⁻¹⁸. However, these durations have been reduced as surgical and endoscopic techniques have developed, in addition to the training received and the experience gained^{12,13}. In our study, the operation duration decreased after the first 3 years assessed. Some previous studies have stated that the highest blood losses occur in VH,^{8,19} while others have reported

that they occur in AH^{17,20}. In an LH series of 96 cases, the mean change in blood loss was identified as between 50 and 600 ml^{8,21}. In the present study, we observed a mean blood loss change of between 144.52+56.17 ml and 168.46+69.40 ml over the years assessed. It has previously been shown that the hospital stay is shorter and the analgesic requirements are lower in patients that undergo LH and VH in comparison to AH, with no statistically significant difference between the LH and VH groups being observed^{7,22}. In our study, we could not compare length of hospital stay with that associated with other hysterectomy types, but the duration of hospitalization was reduced after the first 3 years assessed.

High BMI, large uterus, intra-abdominal adhesions caused by earlier surgical procedures, technical challenges, and lack of clinician experience increase the risk of conversion from laparoscopy to laparotomy²³. In the present study, extensive adhesions caused by prior abdominal operations meant that we had to convert six patients to laparotomy, and it was necessary to convert a further three patients to laparotomy as a result of morbid obesity and because the size of the uterus blocked the view.

Previous studies have reported conflicting information with regard to the major and minor complications of LH. Although it was first reported that LH could result in higher complication rates than other hysterectomy techniques because of its longer operation duration,^{7,24} recent reports have stated that there is no such difference^{4,20}. In our study, the major and minor complication rates were 2.16% and 0.99%, respectively, and the total complication rate was 3.15%.

It has been reported that there is no significant difference between LH (0.25%) and VH (0.33%) with respect to ureteral damage⁴, although it has also been stated that this ranges between 0.5 and 1% for LH^{7,19}. In particular, it has been claimed that ureteral injury could occur, due to excessive electrocoagulation of the uterine vessels and the cardinal ligament, and it has been proposed that ureter dissection during LH could reduce this injury²⁵. In our clinical practice, we do not perform routine ureter dissection if there are no pathologies that disrupt pelvic anatomy, and ureteral damage did not occur in any of the cases in our study. It has been stated that the main concerns in laparoscopic surgeries are injuries that occur when entering the

abdomen, and complications due to the need for adhesiolysis in patients with prior abdominal history^{7,18,26}. In our study, bowel injury occurred in three patients, while bladder injury occurred in a further two patients, and laparoscopic repair was performed.

Vaginal cuff dehiscence may be spontaneous or post-coital. Post-operative coitus, smoking, obesity, constipation, the menopause, vaginal cuff infections, and hematomas are among the risk factors, and the result may be vaginal bleeding, intestinal herniation, or pain. It has been proposed that this is caused by suboptimal healing, tissue necrosis, and devascularization due to electrosurgery^{14,27}. In our study, cuff dehiscence due to early post-operative coitus developed in only one patient. In minor complications, cure was achieved with conservative management.

Although our study was a retrospective investigation, we believe that our large sample size was sufficient to demonstrate that length of operation time and hospital stay have significantly reduced on a year-by-year basis.

In conclusion, we observed that the less invasive LH method is safe and effective for patients, that postoperative recovery has improved, and that the length of hospital stay has been reduced by emphasizing endoscopy training for gynecological surgeons, as well as technological advances and the use of surgical techniques.

REFERENCES

1. Garry R. The future of hysterectomy. *BJOG*. 2005;112:133–9.
2. Reich H, DeCaprio J, McGlynn F. Laparoscopic hysterectomy. *J Gynaecol Surg*. 1989;5:213–6.
3. Donnez O, Jadoul P, Squifflet J, Donnez J. A series of 3190 laparoscopic hysterectomies for benign disease from 1990 to 2006: evaluation of complications compared with vaginal and abdominal procedures. *BJOG*. 2009;116:492–500.
4. Donnez O, Donnez J. A series of 400 laparoscopic hysterectomies for benign disease: a single centre, single surgeon prospective study of complications confirming previous retrospective study. *BJOG*. 2010;117:752–5.
5. Dolanbay M, Kutuk MS, Ozgun MT, Uludag S, Sahin Y. Laparoscopically-assisted vaginal hysterectomy for enlarged uterus: operative outcomes and the learning curve. *Ginekol Pol*. 2016;87:333–7.

6. Kovac SR. Guidelines to determine the route of hysterectomy. *Obstet Gynecol.* 1995;85:18-23.
7. Garry R, Fountain J, Brown J, Manca A, Mason S, Sculpher M, et al. EVALUATE hysterectomy trial: a multicentre randomised trial comparing abdominal, vaginal and laparoscopic methods of hysterectomy. *Health Technol Assess.* 2004;8:1-154.
8. Schindlbeck C, Klauser K, Dian D, Janni W, Friese K. Comparison of total laparoscopic, vaginal hysterectomy. *Arch Gynecol Obstet.* 2008;277:331-7.
9. Mebes I, Diedrich K, Banz-Jansen C. Total laparoscopic hysterectomy without uterine manipulator at big uterus weight (>280 g). *Arch Gynecol Obstet.* 2012;286:131-4.
10. Choosing the route of hysterectomy for benign disease. ACOG Committee Opinion No. 444. American College of Obstetricians and Gynecologists. *Obstet Gynecol.* 2009;114:1156-8.
11. ACOG Committee Opinion. Number 311, April 2005. Appropriate use of laparoscopically assisted vaginal hysterectomy. *Obstet Gynecol.* 2005;105:929-30.
12. Maresh MJ, Metcalfe MA, McPherson K, Overton C, Hall V, Hargreaves J et al. The VALUE national hysterectomy study: description of the patients and their surgery. *BJOG.* 2002;109:302-12.
13. Hoffman CP, Kennedy J, Borschel L, Burchette R, Kidd A. Laparoscopic hysterectomy: the Kaiser Permanente San Diego experience. *J Minim Invasive Gynecol.* 2005;12:16-24.
14. Nezhat F, Nezhat CH, Admon D, Gordon S, Nezhat C. Complications and results of 361 hysterectomies performed at laparoscopy. *J Am Coll Surg.* 1995;180:307-16.
15. Mehra S, Bokaria R, Gujral A, Bhat V, Hotchandani M. Experience in laparoscopic hysterectomy: analysis of three hundred cases. *Ann Acad Med Singapore.* 1996;25:660-4.
16. Hasson HM, Rotman C, Rana N, Asakura H. Experience with laparoscopic hysterectomy. *J Am Assoc Gynecol Laparosc.* 1993;1:1-11.
17. Abdelmonem A, Wilson H, Pasic R. Observational comparison of abdominal, vaginal and laparoscopic hysterectomy as performed at a university teaching hospital. *J Reprod Med.* 2006;51:945-54.
18. Cooper MJW, Cario G, Lam A, Carlton M, Vaughan G, Hammill P. Complications of 174 laparoscopic hysterectomies. *Aust NZ J Obstet Gynaecol.* 1996;36:36-8.
19. Makinen J, Johansson J, Tomas C, Tomas E, Heinonen PK, Laatikainen T et al. Morbidity of 10 110 hysterectomies by type of approach. *Hum Reprod.* 2001;16:1473-8.
20. Doganay M, Yildiz Y, Tonguc E, Var T, Karayalcin R, Eryilmaz OG et al. Abdominal, vaginal and total laparoscopic hysterectomy: perioperative morbidity. *Arch Gynecol Obstet.* 2011;284:385-9.
21. Chapron C, Dubuisson JB, Ansquer Y, Capella-Allouc S. Hysterectomy with adnexectomy. Can operative laparoscopy offer advantages? *J Reprod Med.* 1997;42:201-6.
22. Soriano D, Goldstein A, Lecuru F, Darai E. Recovery from vaginal hysterectomy compared with laparoscopy-assisted vaginal hysterectomy: a prospective, randomized, multicenter study. *Acta Obstet Gynecol Scand.* 2001;80:337-41.
23. Sokol AI, Chuang K, Milad MP. Risk factors for conversion to laparotomy during gynecologic laparoscopy. *J Am Assoc Gynecol Laparosc.* 2003;10:469-73.
24. Johnson N, Barlow D, Lethaby A, Tavender E, Curr E, Garry R. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane Database Syst Rev.* 2006;2:CD003677.
25. Neuman M, Eidelman A, Langer R, Golan A, Bukovsky I, Caspi E. Iatrogenic injuries to the ureter during gynecologic and obstetric operations. *Surg Gynecol Obstet.* 1991;173:268-72.
26. Yada-Hashimoto N, Onoue M, Yoshimi K, Hisa T, Kodama M, Otsuka H et al. Total laparoscopic hysterectomy in patients with previous abdominal surgery. *Arch Gynecol Obstet.* 2011;284:1467-71.
27. Hur HC, Guido RS, Mansuria SM, Hacker MR, Sanfilippo JS, Lee TT. Incidence and patient characteristics of vaginal cuff dehiscence after different modes of hysterectomies. *J Minim Invasive Gynecol.* 2007;14:311-7.