

PREOPERATIVE INFORMATION ON LAPAROSCOPIC HYSTERECTOMY

Desert Women's Care is a strong proponent of Minimally Invasive Hysterectomy and believes in the clear benefits achieved when the uterus is removed without opening the abdomen. Vaginal Hysterectomy was the first Minimally Invasive route. Over the last twenty years techniques have evolved to include Total Laparoscopic Hysterectomy (TLH), Laparoscopic Supracervical Hysterectomy (LSH) and Robotic Assisted variants of each procedure. Desert Women's Care has extensive experience in all of these techniques.

Studies have confirmed that vaginal hysterectomy is usually the preferred route for hysterectomy with superior results compared with abdominal hysterectomy.¹⁻⁴ Laparoscopic variants (TLH and LSH) are shown to have faster recovery, less post-operative pain and similar complication rates when compared with total abdominal hysterectomy.^{1, 5-7}

At Desert Women's Care we have carefully monitored our outcomes over many years. Dr. Demir recently completed evaluation of data for 1125 consecutive hysterectomies performed for benign disease. Of those, 1120 have been successfully completed using minimally invasive techniques. We also present a subset of this series including 800 consecutive Minimally Invasive hysterectomies. The total number of complications and the percent of cases with that complication are noted in the following Table.

Non-Robotic Minimally Invasive Hysterectomy

Total Patients in study period	1125 ^a		800 ^b	
Total patients successfully completing ^c	1120	99.56%	800	100.00%
--vaginal hysterectomy	140	12.59%	78	9.75%
--laparoscopic hysterectomy	980	87.50%	722	90.25%
--Laparoscopic Supracervical (LSH)	502	44.82%	325	40.63%
--Total Laparoscopic (TLH)	478	42.68%	397	49.62%
--Post-Operative Stay				
--out-patient only	94	8.39%	91	11.38%
--one hospital day	896	80.00%	628	78.50%
--two hospital days	100	8.93%	60	7.50%
--three or more hospital days	30	2.68%	21	2.63%
--Average hospital days	1.09		1.08	

--Complications: Non-Reoperated Cases

--injury to bowel	1	0.09%	1	0.13%
--injury to bladder	12	1.07%	6	0.75%
--injury to ureter	2	0.18%	2	0.25%
--injury to major vessels	0	0.00%	0	0.00%
--febrile morbidity	62	5.54%	44	5.56%
--pelvic infection	45	4.02%	32	4.00%
--deep vein thrombosis	2	0.18%	1	0.13%
--pulmonary embolism	1	0.09%	1	0.13%
--port site hernia	0	0.00%	0	0.00%
--cuff cellulitis	10	0.89%	5	0.63%
--death	0	0.00%	0	0.00%

--Complications: Re-operated Cases

--post-operative hemorrhage	5	0.45%	3	0.38%
--vaginal cuff bleeding	0	0.00%	0	0.00%
--injury to bowel	1	0.09%	1	0.12%
--injury to bladder	0	0.00%	0	0.00%
--injury to ureter	1	0.09%	1	0.12%
--urinary tract fistula	0	0.00%	0	0.00%
--vaginal cuff dehiscence	0	0.00%	0	0.00%

--Surgical Indications

--menometrorrhagia	390	34.82%	288	36.00%
--premenopausal menorrhagia	210	18.75%	109	13.63%
--endometrial hyperplasia	38	3.39%	27	3.38%
--uterine fibroids	190	16.96%	160	20.00%
--pelvic pain	91	8.13%	69	8.63%
--cervical dysplasia, carcinoma in situ or microinvasive carcinoma	9	0.80%	7	0.88%
--uterine / pelvic prolapse	153	13.57%	122	15.25%
--stress urinary incontinence	11	1.41%	8	1.00%
--with benign adnexal pathology	12	0.98%	8	1.00%
--other	2	0.18%	2	0.25%

- a. Consecutive surgeries from January 1, 2003, through April 30, 2012. Surgeries performed at: 1.) Arizona Regional Medical Center, Mesa and Apache Junction, AZ; 2.) Gilbert Hospital, Gilbert, AZ; 3.) Tempe St. Luke's Hospital, Tempe, AZ; 4.) Phoenix St. Luke's Hospital, Phoenix, AZ; 5.) Poplar Creek Surgical Center, Hoffman Estates, IL; and 6.) Provena St. Joseph Hospital, Elgin, IL.
- b. Subset of Series 1, 800 consecutively completed MIS hysterectomies.
- c. Minimally Invasive Surgical procedures include Total Vaginal Hysterectomy, Laparoscopic Supra-cervical hysterectomy or Total Laparoscopic Hysterectomy.

It is important to realize in evaluating any set of data that the enumerated complications can always occur; so that even though a particular problem was not encountered in the last 1125 cases it does not mean that it cannot happen in any given case.

Common infection and febrile morbidity following surgery can always result. Injuries to other structures within the abdominopelvic cavity are known complications of even minimally invasive hysterectomy. Structures within the abdominopelvic cavity include but are not limited to urinary tract, bowel, and major vessels. Even though the intention is not to injure other structures, injury to other structures is a recognized complication of major surgery. Every effort will be made to avoid these injuries and to diagnosis injuries expediently should they occur. It is not always possible to notice all injuries intraoperatively and that a reoperation or series of operations may be required to fix such things as injury to the urinary tract or injury to bowel.

Vaginal cuff dehiscence (opening of the top of the vagina) is increasingly reported in other large series of minimally invasive laparoscopic or robotic hysterectomies. This complication was very uncommon in traditional hysterectomy (abdominal or vaginal).⁸⁻⁹ Comparing Total Laparoscopic Hysterectomy (with laparoscopic cuff closure) to vaginal or abdominal routes, a study showed a 21 to 53 times increased risk of cuff dehiscence.¹⁰ Cuff dehiscence occurs 3% of the time in Robotic hysterectomy compared with 0.29% for vaginal hysterectomy.¹¹ At DWC we believe our low cuff dehiscence rate (0.0% for 1125 cases) relates to our practice of closing the cuff vaginally with traditional instruments and suture.

Risks with Elevated Weight (Body Mass Index)

Careful examination of our data showed no statistical association between increasing BMI and failure to successfully complete any listed hysterectomy type:

	Total Vaginal	Laparoscopic Supracervical	Total Laparoscopic	Grand Total
Patient Wt (BMI)—				
< 18.5	0 / 6	0 / 18	0 / 10	0 / 34
18.5 – 24.9	0 / 44	1 / 160	1 / 93	2 / 297
25.0 – 29.9	0 / 78	0 / 159	1 / 211	1 / 448
30.0 – 34.9	0 / 8	0 / 130	1 / 80	1 / 218
> 35.0	0 / 4	1 / 37	0 / 87	1 / 128
Grand Total	0 / 140	2 / 504	3 / 481	5 / 1125

Although elevated BMI is recognized as a de-selector for candidacy for Minimally Invasive Hysterectomy by many other GYN Surgeons, it has not compromised our ability to achieve a Minimally Invasive outcome for our patients. Our initial data was presented at the American College of Surgeons Meeting, 2011.

Risks with Previous Cesarean Section

The same statistical evaluation of our data showed no relationship between increasing number of prior Cesarean Sections and MIH failure with any listed hysterectomy type or overall.

	Total Vaginal	Laparoscopic Supracervical	Total Laparoscopic	Grand Total
Prior C-Sections—				
0	0 / 102	1 / 345	1 / 289	2 / 736
1	0 / 24	0 / 110	2 / 86	2 / 220
2	0 / 6	1 / 22	0 / 65	1 / 93
3	0 / 5	0 / 15	0 / 11	0 / 31
≥4	0 / 3	0 / 12	0 / 30	0 / 45
Grand Total	0 / 140	2 / 504	3 / 481	5 / 1125

Many GYN Surgeons also view prior Cesarean Section and multiple prior Cesarean Sections as important de-selectors for patients considering Minimally Invasive hysterectomy. Our data does not validate such a conclusion. Based on this we offer Minimally Invasive hysterectomy to virtually all women requiring hysterectomy.

Risks with Increasing Uterine Size (Specimen Weight)

Gynecologists also commonly believe the larger a uterus the more necessary abdominal hysterectomy becomes. Our data does not bear this conclusion out:

Specimen Weight (grams)—	Total Vaginal	Laparoscopic Supracervical	Total Laparoscopic	Grand Total
0 - 227	0 / 86	0 / 342	0 / 121	0 / 549
228 - 454	0 / 38	1 / 85	1 / 77	2 / 200
455 - 681	0 / 10	1 / 47	1 / 141	1 / 198
682 - 908	0 / 3	0 / 19	0 / 81	0 / 103
> 908	0 / 3	0 / 11	1 / 61	1 / 75
Grand Total	0 / 140	2 / 504	3 / 481	5 / 1125

DWC is capable of doing the largest uteri without resorting to laparotomy. In 2008 we received a Guinness World Record for avoiding laparotomy in a 3200 gram (7 pound) fibroid uterus. We do not believe elevated BMI, increasing number of prior C-Sections or bigger uteri require abdominal hysterectomy. We believe all women having hysterectomy for benign indications should be offered Minimally Invasive Hysterectomy.

Conservation of the Uterine Cervix

The decision to conserve the cervix is based on multiple variables. In general we feel a woman with history of recent cervical dysplasia, prior Carcinoma In Situ of the cervix treated with conization only, endometrial hyperplasia or a strong family history of cervical or uterine malignancy should be encouraged to remove the cervix at time of hysterectomy.

The apex of the vagina is attached to the cervix which in turn is supported by the utero-sacral and cardinal ligaments. Although it has never been demonstrated in a randomized, controlled trial, it seems logical to believe conservation of the cervix, without interrupting the cervix's support ligaments, ought to decrease the long-term incidence of vaginal vault prolapse¹².

Some studies have demonstrated shorter operating times, decreased infection rate, less blood loss, lower chance of injuring other intra-abdominal structures and shorter hospital stays when the cervix is preserved.

A recent study by Harmanli demonstrated a small but statistically significant increase in urinary tract injury in Total Laparoscopic Hysterectomy compared to Laparoscopic Supra-Cervical Hysterectomy.¹³ Additionally, the increased risk of vaginal cuff dehiscence related to TLH and Robotic-Assisted TLH is completely eliminated when the cervix is conserved in LSH. These facts should be considered within the overall risk vs. benefit ratio of retaining the cervix at the time of hysterectomy.

Whenever the cervix is conserved the chance of re-operation at a later date to remove it must be discussed. The likelihood of developing benign or malignant disease requiring trachelectomy (removal of the cervix) varies based on the pre-operative history of patients involved in the study but is well less than a 1 % lifetime risk. The chance of bowel injury with trachelectomy is described at 2 % and chance of infection or significant bleeding is 9% in one series from 2005.¹⁴

The American College of Obstetrician Gynecologists states, "The supracervical approach should not be recommended by the surgeon as a superior technique for hysterectomy for benign disease," in their 2007 Committee Opinion.¹²

Complications related to each type of Hysterectomy

There are potential complications including death related to the use of general anesthesia.

The vast majority of young women do not have major complications from anesthesia in the contemporary period, however, and most complications arise in individuals who are considered poor medical risks for surgery pre-operatively. Aspiration pneumonia can occur so that it is very important that patients remain N.P.O. (nothing by mouth) after midnight the night prior to surgery. Eliminating food for several hours preoperatively reduces but does not eliminate the possibility of aspiration pneumonia.

A vast array of potential complications are presented and their relationship to the principal routes of hysterectomy is outlined in the table below:

GRID OF POTENTIAL COMPLICATIONS RELATED TO HYSTERECTOMY TYPE

	-----type of procedure ^b -----			
	TAH	TVH	TLH	LSH
Intra-Operative Complications^a				
-injury to bowel	X	X	X	X
-possible colostomy	X	X	X	X
-injury to bladder	X	X	X	X
-injury to ureters	X	X	X	X
-possible nephrostomy	X	X	X	X
-injury to major vessels	X	X	X	X
-require transfusion	X	X	X	X
-thermal injury	X	X	X	X
-CO2 embolism			X	X
-failed intubation	X	X	X	X
-sore throat	X	X	X	X
-nerve compression from retractor	X			
-may require laparotomy		X	X	X
--hypovolemia or hypoperfusion	X	X	X	X

GRID OF POTENTIAL COMPLICATIONS RELATED TO HYSTERECTOMY TYPE

	-----type of procedure ^b -----			
	TAH	TVH	TLH	LSH
Immediate Post-Operative Complications^a				
-febrile morbidity				
a. UTI	X	X	X	X
b. Pneumonia	X	X	X	X
c. Peritonitis	X	X	X	X
-cuff abscess	X	X	X	
-tubo-ovarian abscess	X	X	X	X
-ileus / bowel obstruction	X	X	X	X
-wound infection	X		X	X
-late hemorrhage	X	X	X	X
-deep vein thrombosis	X	X	X	X
-pulmonary embolism	X	X	X	X
-septicemia	X	X	X	X
-death	X	X	X	X
-hip / leg pain from surgical positioning		X	X	X

	-----type of procedure ^b -----			
	TAH	TVH	TLH	LSH
Late Post-Operative Complications^a				
-Ventral hernia	x		x	x
-Port Site hernia			x	x
-possible re-operation	x	x	x	x
-other unspecified complications	x	x	x	x

(a) listed complications may not be unique to any specific time period

(b) TVH: Total vaginal hysterectomy; TAH: Total abdominal hysterectomy; CLH: Complete laparoscopic hysterectomy; LSH: Laparoscopic surpa-cervical hysterectomy; and EH: Extended hysterectomy

Cystoscopy is performed at the time of laparoscopic and vaginal hysterectomy because injury to the lower urinary tract is a somewhat common sequellae. The AAGL, in a 2012 statement, supports the advisability of evaluating the lower urinary tract after hysterectomy is completed with cystoscopy.¹⁵

Hysterectomy can be done in either an outpatient or inpatient setting. Although no guarantee can be given regarding the duration of postoperative stay for any one patient, the duration of stay for the last 1125 cases completed with minimally invasive surgery is enumerated.

There can always be discrepancies between diagnoses made preoperatively and those returned on final pathology. Final pathology is able to evaluate a greater number of samples of tissue from the entire organ and therefore occasionally findings not noted previously come to the fore. It takes approximately four to five days for the final pathology report and that every effort will be made to have your final pathology report prior to the first postoperative visit.

The duration of recuperation is always variable. With conventional abdominal hysterectomy the likely hospital stay is four to six days with approximately five to six weeks off of work or away from normal activities for recuperation. With the minimally invasive approach it is more likely than not that a patient will have one or fewer days in the hospital and be able to return to normal functioning within 10 to 14 days postoperatively. This is, however, an average of many women and that individual patient experiences may vary.

Of Dr. Demir's last 1125 hysterectomies, 1120 of them have been completed successfully using techniques of minimally invasive surgery. This means that 5 of them or 0.45% required laparotomy. Although every effort will be made to accomplish hysterectomy using minimally invasive techniques, the likelihood of requiring laparotomy always exists and has been quantified from the above listed data. For any single individual the likelihood of requiring laparotomy will either be 0% or 100%. It is impossible prospectively to determine whether any individual patient's surgery will successfully be completed using minimally invasive techniques; however, it is highly likely that it can be.

Cost Information

It is well recognized that the laparoscopic approach to hysterectomy is more cost effective than the abdominal route¹⁶. More rapid return to work further tips the balance in favor of minimally invasive surgery when viewed from a cost perspective. Although costs vary markedly from institution to institution, a 2009 study reported the following: abdominal hysterectomy \$12,086, laparoscopic hysterectomy \$10,868 and vaginal hysterectomy \$9,544 per case. Out patient minimally invasive hysterectomy costs are markedly lower than those for in patient abdominal hysterectomy. A more recent study evaluated cost data at Brigham and Women's Hospital including robotic hysterectomy.¹⁷ The authors concluded that although the actual cost of performing robotic hysterectomy was the highest of the various hysterectomy types.

In 2012 the Cochrane review of almost three hundred publications failed to demonstrate any advantage to robotics over conventional laparoscopy in benign gynecology.¹⁸ In January, 2013, AAGL published a Position Statement on Robotic-Assisted Laparoscopic Surgery in Benign Gynecology. They concluded "Robotic-assisted laparoscopic surgery should not replace conventional laparoscopic or vaginal procedures for women who could otherwise undergo conventional laparoscopic or vaginal surgery for benign gynecologic diseases."¹⁹ Based on these considerations DWC surgeons continue to offer traditional laparoscopic or vaginal hysterectomy for benign indications.

Disposition of Ovaries at Time of Hysterectomy

Conservation of ovaries is a controversial issue. Our recommendation regarding removal or retention of ovaries at the time of hysterectomy requires knowledge of a patient's risk factor status for development of ovarian cancer.

Historically, ovaries were electively removed at the time of hysterectomy for benign indication. This was done based on various factors: 1.) 15,000 deaths from ovarian cancer annually in the USA; 2.) relative difficulty in diagnosing ovarian cancer; 3.) late stage of usual diagnosis of ovarian cancer; and, 4.) high mortality associated with ovarian cancer owing in large part to items 2 and 3. It must be noted that this old practice was rampant in days when effects of menopause and surgical castration were not as well understood and women were not empowered as participants in health-care decision making.

In evaluating whether prophylactic, bilateral oophorectomy is beneficial, additional information is required. The most significant factor is a woman's family history related to breast and ovarian cancer. Recommendation for women at High-Risk of ovarian cancer and at Average Risk for ovarian cancer are different.

Women at High-Risk of ovarian Cancer based on family history and BRCA1 or BRCA2 mutations should undergo bilateral salpingo-oophorectomy at the time of hysterectomy.²⁰ There are also a large number of low-penetrance genetic variants that account for women

who have a strong family history for ovarian cancer but do not have the BRCA1 or 2 genes.²¹

The data is quite different for women at Average Risk of Ovarian Cancer. Safety of ovarian conservation was recently addressed in by Parker and colleagues.²²⁻²³ The Nurses' Health Study (NHS) demonstrated various downsides to elective bilateral oophorectomy in association with benign hysterectomy: 1.) 12% increase in all-cause mortality; 2.) 27% increase in death from coronary artery disease; 3.) 31% increase in death from lung cancer, and, 4.) 17% increase in total cancer-related mortality. These findings were arrived at after twenty-four years of follow up.

The likelihood of developing ovarian cancer after hysterectomy is surprisingly low-- 0.75% of women with hysterectomy and conservation of ovaries ultimately develop ovarian carcinoma.²⁴ In contradistinction, risks of castration are many and significant.

In premenopausal women, cognitive impairment or dementia was increased 50%.²⁵ A Danish study showed a seven times increased risk of ischemic heart disease in women having oophorectomy prior to 40 years of age compared with those having it after 45 years of age.²⁶ Bilateral oophorectomy prior to menopause also increases women's risk for depression and Parkinson's disease.^{25,27-28} Premenopausal bilateral oophorectomy also increases the risk of osteoporosis.²⁹

The Nurse's Health Study showed changes related to use of post bilateral oophorectomy hormone replacement therapy (HRT). Women not using HRT had twice the risk of MI compared with age-matched premenopausal women. There was an 85% increased incidence of stroke in women not using HRT.

In postmenopausal women undergoing bilateral oophorectomy at time of hysterectomy for benign indication, there were: 1.) 54% more osteoporotic hip fractures than in postmenopausal women retaining their ovaries; 2.) 80% increased risk of Parkinson's disease; 3.) 200% increased risk of depression; 4.) 70% increased risk of cognitive impairment and dementia.

Data demonstrates that even after menopause ovaries continue to make significant amounts of testosterone and androstenedione which are converted to estrogen by fat, muscle and skin cells. These hormones are protective of muscle strength, loss of which is related to increased predisposition to falls and fractures.³⁰

Further analysis of the data in the Nurse's Health Study concluded bilateral oophorectomy is associated with increased mortality in women younger than fifty years of age who never used estrogen therapy and at no age as oophorectomy associated with increased survival.³¹

Women with conservation of the ovaries at the time of hysterectomy have been shown to have a 9.2% lifetime risk of requiring another surgery to remove the ovaries.³² Because the need for future oophorectomy is so low and the consequences of oophorectomy are so

high in low-risk women, DWC advocates retention of ovaries, when no ovarian pathology is observed intra-operatively, at the time of hysterectomy for benign indication.

Special Circumstances

Oophorectomy for prevention of ovarian cancer in elderly women at average risk—

Thought has been given to an age at which the benefits of oophorectomy to prevent development of ovarian cancer outweighs the increased risk of Coronary Heart Disease, neurologic conditions and overall mortality in average risk women associated with surgical castration. The risk of ovarian cancer increases with advancing age but peaks at 75 years. Parker published a computer modeling study in which conservation of ovaries was recommended up to age 65 years.³³

No clear consensus on this recommendation exists today amongst other authorities.

Oophorectomy at time of hysterectomy for endometriosis—

In women with severe pelvic pain from endometriosis unresponsive to conservative measures, bilateral oophorectomy at the time of hysterectomy decreases persistence of symptoms and lessens the chance of re-operation.³⁴ Namnoum addressed outcome of women with symptomatic endometriosis conserving or removing ovaries with hysterectomy.³⁵ Of 29 women conserving ovaries, 18 (62%) had recurrent pain and 9 (31%) required re-operation. Of 10 women having ovarian removal at hysterectomy, 11 (10%) had recurrent pain and only 4 (4%) required re-operation. A clear, statistically significant benefit is noted in this comparison.

Data for women under 40 years of age is not as encouraging. These women had no difference noted in likelihood of persistent pain or frequency of re-operation. Because of the significant risks associated with castration, particularly at an early age, DWC recommends ovaries not be removed at time of hysterectomy in women under 40 years of age.³⁶

Disposition of Tubes at Time of Hysterectomy

Current recommendations favor bilateral salpingectomy at the time of benign hysterectomy to decrease the likelihood for future development of epithelial ovarian cancer (incidence of germ cell and stromal tumors will remain unaffected).

The ovary is now known to contain no epithelial cells.³⁷ Seventy percent of epithelial ovarian cancers are the serous, high grade and clinically aggressive type. Almost all such lesions are associated with the p53 genetic mutation. Cancer precursor lesions called serous

tubal intraepithelial cancer (STIC) have been found in the fallopian tube but have never been found in the ovary. Many STIC lesions have p53 mutations matching those found in high grade squamous epithelial ovarian cancer. No p53 mutations have been isolated from low grade cancer found inside the ovary (Stage 1 disease). This has caused scientists to believe aggressive squamous epithelial cancer of the ovary actually arises from the fallopian tube.

Some scientists wondered whether bilateral salpingectomy would damage the vascularization of the ovary and compromise ovarian function or lead to early ovarian failure. A 2013 study confirmed no change in antral follicle count, ovarian dimensions, anti-mullerian hormone or follicle stimulating hormone levels three months post bilateral salpingectomy compared with pre-operative levels.³⁸

Because of the relationship between the fallopian tube and high grade epithelial cancer, the Society of Gynecologic Oncology (SGO) in November, 2013, published their recommendation for removal of fallopian tubes during other gynecologic surgery.³⁹

Hysterectomy for Pelvic Pain

Various studies suggest hysterectomy relieves or eliminates chronic pelvic pain in 78 to 96 percent of women.⁴⁰⁻⁴⁴ Hartmann and colleagues reported on a large group of women with chronic pelvic pain and depression.⁴³ At two years post-hysterectomy for pelvic pain, 80.6% of women with both pre-procedure depression and pelvic pain were pain free while 90.7% of non-depressed pelvic pain sufferers were pain free. Most authors agree a thorough, pre-operative multi-organ-system work-up to exclude non-reproductive causes of chronic pelvic pain increases the likelihood that hysterectomy will result in diminution or elimination of pain.

Comparative Data

Recent studies have been published that can be compared with our minimally invasive hysterectomy outcome data. In 2011 O'Hanlan, et al,⁴⁵ published outcomes of 983 hysterectomies by the same surgeon over a 13.9 year period (some cases had been excluded because of confounding effect of concomitant oncologic procedures and missing data). This data is from a single expert pelvic surgeon sub-specialty trained in Gynecologic Oncology and working in a teaching environment.

Complications were divided based on whether additional surgery was required.

Table 6
Non-reoperative and reoperative complications stratified by uterine weight

	Total (n = 983)	Uterine weight		$\Delta\%$ (95% CI)
		<250 g (n = 720)	≥ 250 g (n = 263)	
Non-reoperative complications				
Cystotomy repair	8 (0.8%)	2 (0.3%)	6 (2.3%)	-2.0 (-3.8, -0.2)
Pelvic cellulitis	7 (0.7%)	7 (1.0%)	0 (0.0%)	1.0 (0.3, 1.7)
Retroperitoneal hematoma	4 (0.4%)	3 (0.4%)	1 (0.4%)	0.0 (-0.8, 0.9)
Vaginal cuff bleed	4 (0.4%)	3 (0.4%)	1 (0.4%)	0.0 (-0.8, 0.9)
Subcutaneous hematoma	3 (0.3%)	1 (0.1%)	2 (0.8%)	-0.6 (-1.7, 0.5)
Vaginal nonhealing	2 (0.2%)	2 (0.3%)	0 (0.0%)	0.3 (-0.1, 0.7)
Ureter injury with repair	1 (0.1%)	0 (0.0%)	1 (0.4%)	-0.4 (-1.1, 0.4)
<i>C difficile</i> infection	1 (0.1%)	1 (0.1%)	0 (0.0%)	0.1 (-0.1, 0.4)
Bladder fistula	1 (0.1%)	1 (0.1%)	0 (0.0%)	0.1 (-0.1, 0.4)
Diverticulitis	1 (0.1%)	1 (0.1%)	0 (0.0%)	0.1 (-0.1, 0.4)
Pelvic infection/abscess	1 (0.1%)	1 (0.1%)	0 (0.0%)	0.1 (-0.1, 0.4)
Total	33 (3.4%)	22 (3.4%)	11 (4.2%)	-1.1 (-3.9, 1.6)

Table 6
Non-reoperative and reoperative complications stratified by uterine weight

	Total (n = 983)	Uterine weight		$\Delta\%$ (95% CI)
		<250 g (n = 720)	≥ 250 g (n = 263)	
Reoperative complications				
Postoperative bleeding	9 (0.9%)	7 (1.0%)	2 (0.8%)	0.2 (-1.1, 1.5)
Vaginal cuff bleeding	7 (0.7%)	6 (0.8%)	1 (0.4)	0.5 (-0.5, 1.5)
Ureter fistula reimplanted	4 (0.4%)	3 (0.4%)	1 (0.4%)	0.0 (-0.8, 0.9)
Ureter fistula stented	3 (0.3%)	2 (0.3%)	1 (0.4%)	-0.1 (-0.9, 0.7)
Vaginal nonhealing	3 (0.3%)	2 (0.3%)	1 (0.4%)	-0.1 (-0.9, 0.7)
Pelvic infection/abscess	2 (0.2%)	2 (0.3%)	0 (0.0%)	0.3 (-0.1, 0.7)
Colon injury	2 (0.2%)	1 (0.1%)	1 (0.4%)	-0.2 (-1.0, 0.6)
SBO adhesions	2 (0.2%)	0 (0.0%)	2 (0.8%)	-0.8 (-1.8, 0.3)
Incisional hernia	1 (0.1%)	0 (0.0%)	1 (0.4%)	-0.4 (-1.1, 0.4)
Cystotomy repair	1 (0.1%)	0 (0.0%)	1 (0.45%)	-0.4 (-1.1, 0.4)
Retained device	1 (0.1%)	1 (0.1%)	0 (0.0%)	0.1 (-0.1, 0.4)
Suture granuloma	1 (0.1%)	1 (0.1%)	0 (0.0%)	0.1 (-0.1, 0.4)
Total	36 (3.7%)	25 (3.5%)	11 (4.2%)	-0.7 (-3.5, 2.1)

In 2012 Twijnstra, et al,⁴⁶ reported on a fifteen hundred minimally invasive hysterectomies in the Netherlands over a twelve month period. The majority, but not all, surgeons and hospitals in the country were included. In contradistinction to the O'Hanlan data (above), this data is from a diffuse group of surgeons with varying abilities and levels of experience. This data is more generalizable to a population of Gynecological surgeons (see table below).

Evaluation of complication data demonstrate that DWC outcomes are in line with published series.

Table 1. Procedure and Patient Characteristics for Each Type of Laparoscopic Hysterectomy

	Total (N=1,534)	Laparoscopically Assisted Vaginal Hysterectomy (n=183, 12%)	Supracervical Laparoscopic Hysterectomy (n=391, 25%)	Total Laparoscopic Hysterectomy (n=960, 63%)	P*
Procedure characteristics					
Operative time (min)	116±42	114±35	112±49	118±40	.021
Blood loss (mL)	185±247	238±302	195±266	170±226	.002
Uterus weight (g)	227±199	165±131	280±221	217±196	<.001
Patient characteristics					
Age (y)	47.8±10.2	47.1±10.4	45.9±6.0	48.8±11.3	<.001
BMI (kg/m ²)	27.2±5.3	27.3±4.8	26.5±4.8	27.5±5.7	.009
No former abdominal surgery	24.6	30.1	26.6	22.8	.066
ASA classification 1	66.9	63.9	73.4	55.9	.007
Main indications					
Dysfunctional uterine bleeding	50	62	55	45	
Myomata	27	14	40	25	
(Pre)malignancy	15	14	0.5	22	
Pelvic pain	2	1.5	1.5	2.5	
Complicated procedures					
Requiring re-intervention	116 (7.6)	19 (10.4)	22 (5.6)	75 (7.8)	.119
Top five complications	23 (1.5)	5 (2.7)	3 (0.8)	15 (1.6)	.189
Lesion					
Bladder	31 (2.0)	5 (2.7)	2 (0.5)	23 (2.4)	.142
Ureter	13 (0.9)	—	—	13 (1.4)	.020
Vessel	7 (0.5)	2 (1.1)	—	4 (0.4)	.366
Intestine	3 (0.2)	2 (1.1)	—	1 (0.1)	.224
Blood loss greater than 1 L	8 (0.5)	1 (0.6)	2 (0.5)	5 (0.5)	.999
Infection	43 (2.8)	10 (5.5)	11 (2.8)	22 (2.3)	.033
Wound dehiscence	12 (0.8)	1 (0.6)	1 (0.3)	10 (1.0)	.480
Technical failure	15 (1.0)	2 (1.1)	3 (0.8)	10 (1.0)	.688
Conversions to laparotomy	6 (0.4)	1 (0.6)	2 (0.5)	3 (0.3)	.815
Proportion attributable to complication	71 (4.0)	12 (6.6)	13 (3.3)	46 (4.8)	.221
	31	42	54	22	.178

BMI, body mass index; ASA, American Society of Anesthesiologists.

Data are mean±standard deviation, %, or n (%) unless otherwise specified.

* Analysis of variance test was used for continuous variables; χ^2 test was used for proportions.

Both of these studies also considered the number of surgeries intended to be laparoscopic that were converted to abdominal hysterectomy intra-operatively. The DWC data showed only 5 of 1125 cases converted to laparotomy (0.43%). The O'Hanlan series reported of cases in which laparotomy was required (1.0%). Twijnstra⁴⁶ published a literature review with 71 of 1534 cases converted to laparotomy (4.6%). The same investigators⁴⁷ published a literature review (see Table below) including 33 studies from 2000 to 2012. This time 264 of 7827 intended laparoscopic hysterectomies were changed to abdominal (3.5%). All of these publications have conversion rates far higher than ours.

Table from Twijnstra, et al.⁴⁷

Reported conversion rates in laparoscopic hysterectomy

Source, year	Type of LH	Study design	No. of procedures	No. of conversions	Conversion rate (%)	Strategic conversion (%)
Brunner et al [20], 2009	Mixed	Prospective cohort	1686	87	5.2	76
Candiani et al [21], 2009	TLH	Prospective cohort	30	0	0	NA
Chang et al [22], 2005	LAVH	Prospective cohort	225	2	0.9	0
Chen et al [23], 2008	LAVH	Prospective cohort	147	1	0.7	0
Daraï et al [24], 2001	LAVH	RCT	40	3	7.5	67
David-Montifiore et al [25], 2007	Mixed	Prospective cohort	121	23	19.0	65
Donnez and Donnez [26], 2010	Mixed	Prospective cohort	400	0	0	NA
Drahonovsky et al [27], 2010	Mixed	RCT	125	3	2.4	Unknown
Erian et al [28], 2005	SLH	Prospective cohort	100	0	0	NA
Garry et al [29], 2004	Mixed	RCT	920	32	3.5	72
Ghezzi et al [30], 2010	TLH	RCT	41	0	0	NA
Ghomi et al [31], 2007	SLH	Prospective cohort	60	1	1.7	0
Holub et al [32], 2001	LAVH	Prospective cohort	271	3	1.1	33
Johnston et al [33], 2007	Mixed	Prospective cohort	364	4	1.1	75
Karaman et al [34], 2007	Mixed	Prospective cohort	1120	26	2.3	92
Kluiters et al [35], 2007	Mixed	RCT	27	2	7.4	100
Kreiker et al [36], 2004	LAVH	Prospective cohort	160	5	3.1	100
Leung et al [37], 2007	Mixed	Prospective cohort	143	1	0.7	100
Lieng et al [38], 2005	SLH	Prospective cohort	43	1	2.3	0
Long et al [39], 2002	Mixed	Prospective cohort	104	3	2.9	Unknown
Mourits et al [40], 2010	TLH	RCT	185	20	10.8	60
Mueller et al [41], 2011	TLH	Prospective cohort	567	1	0.2	100
Muzii et al [42], 2007	LAVH	RCT	40	2	5.0	0
Obermair et al [43], 2012	TLH	RCT	404	24	5.9	Unknown
Ottosen et al [44], 2000	LAVH	Prospective cohort	40	4	10.0	75
Pan et al [45], 2008	TLH	Prospective cohort	132	9	6.8	100
Persson et al [46], 2006	LAVH	RCT	63	3	4.8	33
Schütz et al [47], 2002	LAVH	Prospective cohort	28	0	0	NA
Seracchioli et al [48], 2002	TLH	RCT	60	1	1.7	0
Sesti et al [49], 2008	LAVH	RCT	50	0	0	NA
Shahid et al [50], 2011	SLH	Prospective cohort	29	0	0	NA
Soriano et al [51], 2001	LAVH	RCT	40	3	7.5	100
Wang et al [52], 2005	LAVH	Prospective cohort	62	0	0	NA
Total			7827	264	3.5	73 ^a

LAVH = laparoscopic-assisted vaginal hysterectomy; LH = laparoscopic hysterectomy; NA = not applicable; RCT = randomized controlled trial; SLH = supracervical laparoscopic hysterectomy; TLH = total laparoscopic hysterectomy.

^a Weighted average.

Additional information can be found at WebMD, UpToDate or similar websites. Be certain to bring new questions or issues to our attention either by scheduling an additional pre-operative appointment or directly with your physician prior to signing your consent in the hospital.

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