# Predicting Risk of Complications With Gynecologic Laparoscopic Surgery

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*Objective:* To determine the incidence and predictors of risk for operative complications, conversions to laparotomy, and postoperative admissions after laparoscopic procedures.

*Methods:* We obtained demographic information on and medical histories of a consecutive series of 843 women who underwent laparoscopic surgery for all procedures other than tubal ligation at Brigham and Women's Hospital during 1994. All major complications after surgery were recorded. Major operative complications were defined as bowel, bladder, ureter, or vascular injuries or significant abdominal wall or other internal bleeding. Categorical analysis was used to compare differences in the rates of operative complications, conversions to laparotomy, and postoperative admissions after laparoscopy. We also estimated the influence of medical history and specific laparoscopic procedures on the risk of adverse complications after surgery.

*Results:* Operative complications and conversion to laparotomy occurred in 1.9% and 4.7% of laparoscopic procedures, respectively. Complications included four bowel, two bladder, one ureteral, two vascular, and five abdominal wall injuries. There were 165 patients (19.6%) admitted postoperatively. Aside from the type of operative procedure, increasing age was the most important predictor of complications. Relative to all other operative procedures, women treated for endometriosis or ovarian cystectomy had generally low rates of operative complications, conversions to laparotomy, and postoperative admissions. In contrast, 12.5% of women undergoing laparoscopically assisted vaginal hysterectomy experienced operative injuries or abdominal bleeding and 90% were hospitalized postoperatively.

*Conclusion:* Serious operative complications after gynecologic laparoscopy were rare in this patient population. The more complex laparoscopic procedures resulted in proportionately greater rates of operative complications, conversions to laparotomy, and postoperative admissions to the hospital. (Obstet Gynecol 1998;92:327–31. © 1998 by The American College of Obstetricians and Gynecologists.)

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Over the past decade, operative laparoscopy has provided minimally invasive options for patients undergoing gynecologic surgery. It has been well documented that the risk associated with these procedures is low for diagnostic laparoscopy, tubal ligation, and most operative laparoscopy.[1-7] Contrary to expectations, other studies have suggested that complications associated with laparoscopically assisted vaginal hysterectomy might be greater or equal to those of abdominal hysterectomy or simple vaginal hysterectomy.[8-10] Theoretically, advances in techniques and increased training in the use of endoscopic surgery by gynecologists will allow for a broadening of the application of this minimally invasive surgery. To determine the appropriateness and safety of these broader applications, it is important to have a full understanding of the factors that predict complications or the need for more aggressive surgery after major gynecologic laparoscopic procedures. It would be helpful to determine how to draw the line between truly minimally invasive procedures and those procedures that have a greater risk of complications or hospital admission.

At the request of our Tissue and Practice Committee, we sought to determine, over a 1-year period, whether occurrences of operative complications, conversions to laparotomy, and hospital admissions were predicted by the existence of specific patient characteristics or operative laparoscopic procedures.

## Materials and Methods

We evaluated a consecutive series of operative laparoscopies for all procedures other than tubal ligation (*n* = 843). Laparoscopic tubal sterilizations were excluded because of inconsistencies in coding this procedure, because it lacks a preceding pathologic condition. The laparoscopic operations were performed by a diverse

group of gynecologists at Brigham and Women's Hospital, an academic tertiary care center, between January 1, 1994, and December 31, 1994. Information was abstracted from patient medical records onto optically scannable data collection forms. The information abstracted from the charts included medical record number, age, insurance carrier, preoperative and postoperative diagnoses, procedure performed, open versus closed trocar placement, pathology report, type of operative complication, number of previous abdominal surgeries, height, weight, number of units of nonautologous transfused blood, use of perioperative antibiotics, history of endometriosis or pelvic inflammatory disease (as documented in the chart), previous pelvic radiation, conversion to laparotomy, reoperation, readmission, postoperative overnight admission (whether admission was planned or unplanned was not available), gravidity, parity, and patient medical history.

We defined serious complications as bowel, bladder, ureter, or vascular injuries or significant abdominal wall or other internal bleeding occurring at the time of the procedure. These complications were ascertained by medical record documentation of the visualization of the injury during surgery or by physical examination or diagnostic tests in the postoperative period.

We compared differences in crude and age-adjusted rates of operative complications, conversions to laparotomy, and postoperative hospital admissions by type of operative procedure. Estimates of the relative risk for operative complications, conversions to laparotomy, and postoperative admissions with respect to patient characteristics and medical histories were determined through logistic regression analyses. These estimates were adjusted for potential confounders and are presented as odds ratios (ORs) with 95% confidence intervals (CIs).

## Results

Table 1 includes the characteristics of the study population. The women ranged in age from 14 to 80 years and the median age was 31 years. Approximately 64% had private medical insurance, and the remainder were covered either through state or federal programs or through health maintenance organizations (HMOs). Approximately 60% were nulliparous. About a third of our sample had undergone prior abdominal surgery, and the same proportion had had previous laparoscopy. History of pelvic infection was uncommon, but about 20% of our sample reported histories of endometriosis. Two thirds of the women studied received preoperative antibiotics.

Major operative complications occurred during or after laparoscopy in 16 (1.9%) of 843 women (Table 2).

Table 1. Characteristics of 843 Women Undergoing Laparoscopy

| Characteristic | n | % |
|---|---|---|
| Age (y) | | |
| <30 | 217 | 25.7 |
| 30–34 | 207 | 24.6 |
| 35–39 | 195 | 23.1 |
| ≥40 | 224 | 26.6 |
| Insurance status | | |
| Private | 541 | 64.2 |
| State | 108 | 12.8 |
| HMO | 194 | 23.0 |
| Parity | | |
| Nulliparous | 492 | 58.4 |
| 1 | 153 | 18.1 |
| ≥2 | 193 | 22.9 |
| Unknown | 5 | 0.6 |
| Body mass index (kg/m$^2$) | | |
| <23 | 426 | 50.5 |
| ≥23 | 417 | 49.5 |
| History of abdominal surgery | | |
| No | 562 | 66.7 |
| Yes | 281 | 33.3 |
| Number of prior laparoscopies | | |
| 0 | 526 | 62.4 |
| 1 | 216 | 25.6 |
| ≥2 | 101 | 12.0 |
| History of PID | | |
| No | 791 | 93.8 |
| Yes | 52 | 6.2 |
| History of endometriosis | | |
| No | 676 | 80.2 |
| Yes | 160 | 19.0 |
| Unknown | 7 | 0.8 |
| Preoperative antibiotic therapy | | |
| No | 291 | 34.5 |
| Yes | 552 | 65.5 |

HMO = health maintenance organization; PID = pelvic inflammatory disease.

There were four bowel, two bladder, one ureteral, and two vascular injuries, and eight women had bleeding severe enough to be reported in the operative notes (one woman sustained two injuries). Forty patients (4.7%) had conversions of their laparoscopic procedures to laparotomies, and 165 (19.6%) were admitted to the hospital postoperatively. Rates of injuries and bleeding were about nine times higher, and rates of postoperative admissions were more than five times higher among women undergoing laparoscopically assisted vaginal hysterectomy, compared with women undergoing other laparoscopic procedures. However, there were no differences in rates of conversion to laparotomy whether or not a laparoscopically assisted vaginal hysterectomy was done.

Estimated risk of operative complications and conversions to laparotomy as a consequence of patient characteristics and medical history is shown in Table 3.

Table 2. Crude Risk of Operative Injuries, Conversion to Laparotomy, and Postoperative Admission After Gynecologic Laparoscopy

| Complication | No LAVH (n = 803) | | | LAVH (n = 40) | | | All women (n = 843) | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | 95% CI* | n | % | 95% CI* | n | % | 95% CI* |
| Operative injuries or abdominal bleeding | 11 | 1.4 | 0.6, 2.2 | 5 | 12.5 | 2.3, 22.7 | 16 | 1.9 | 1.0, 2.8 |
| Bowel | 2 | 0.2 | 0.0, 0.6 | 2 | 5.0 | 0.0, 11.8 | 4 | 0.5 | 0.0, 11.8 |
| Bladder | 0 | | | 2 | 5.0 | 0.0, 11.8 | 2 | 0.2 | 0.0, 0.6 |
| Ureteral | 1 | 0.1 | 0.0, 0.4 | 0 | | | 1 | 0.1 | 0.0, 0.4 |
| Vascular | 1 | 0.1 | 0.0, 0.4 | 1 | 2.5 | 0.0, 7.3 | 2 | 0.2 | 0.0, 0.6 |
| Abdominal bleeding | 5 | 0.6 | 0.1, 1.1 | 0 | | | 5 | 0.6 | 0.1, 1.1 |
| Other bleeding | 3 | 0.4 | 0.0, 0.8 | 0 | | | 3 | 0.4 | 0.0, 0.8 |
| Conversion to laparotomy | 38 | 4.7 | 3.3, 6.2 | 2 | 5.0 | 0.0, 11.8 | 40 | 4.7 | 3.3, 6.2 |
| Postoperative admissions | 129 | 16.1 | 13.5, 18.6 | 36 | 90.0 | 80.7, 99.3 | 165 | 19.6 | 16.9, 22.3 |

LAVH = laparoscopically assisted vaginal hysterectomy; CI = confidence interval.
* Exact 95% CI.

Women 35 years or older had five times the risk of operative injuries or bleeding than did women less than 35 years of age. Women with greater than the median body mass index (BMI; defined as weight in kilograms divided by height in meters squared) were 60% less likely to experience operative injuries or bleeding than women with less than the median BMI. Age and BMI did not substantially influence risk of conversion to laparotomy. We observed no significant effect on the risk of operative complications or conversion to laparotomy by parity, prior abdominal surgery, or history of endometriosis.

Table 4 presents rates of each of the three considered outcomes, stratified by procedure type. Crude rates indicate that laparoscopically assisted vaginal hysterectomy with oophorectomy and salpingectomy carried the highest risk of operative injuries or abdominal bleeding (15.8%), whereas no operative injuries were recorded during diagnostic laparoscopy or during salpingectomy without laparoscopically assisted vaginal hysterectomy or oophorectomy. No conversions to laparotomy were reported during treatment of endometriosis with laser or cautery. In contrast, 14% of laparoscopically assisted oophorectomies without laparoscopically assisted vaginal hysterectomy were converted to laparotomies. The rates of postoperative hospital admissions ranged from 2.7% to 95.2% depending on the laparoscopic procedure. Differences in age distribution of subjects in the 11 procedure groups render direct comparison of crude rates among these groups inaccurate, because we have demonstrated that age is an independent predictor of operative complications. However, when we standardized the crude rates to the age distribution of the entire study population, age did not affect the relative ranking of the procedures with regard to risk of the three outcomes presented. Laparoscopically assisted vaginal hysterectomy with or without oophorectomy still carried the highest probability of operative injuries, rates that were at least twice that observed for oophorectomy without laparoscopically

Table 3. Risk of Complications and Conversion to Laparotomy by Age, Weight, Medical History, and Insurance Status

| | Operative injuries or abdominal bleeding | | Conversions to laparotomy | |
|---|---|---|---|---|
| | OR* | 95% CI* | OR* | 95% CI* |
| Age ≥35 y[†] | 6.3 | 1.4, 28.1 | 1.7 | 0.9, 3.3 |
| Body mass index ≥23.0[‡] | 0.4 | 0.1, 1.2 | 1.5 | 0.8, 2.9 |
| 1 or 2 live births[§] | 0.9 | 0.2, 4.7 | 0.7 | 0.4, 2.4 |
| >2 live births[§] | 2.5 | 0.8, 8.2 | 1.9 | 0.9, 3.9 |
| History of abdominal surgery | 1.2 | 0.4, 3.4 | 1.6 | 0.8, 3.1 |
| History of endometriosis | 0.7 | 0.2, 3.1 | 1.0 | 0.4, 2.2 |

OR = odds ratio; CI = confidence interval.
* Odds ratios adjusted for age (<35, ≥35 y) and laparoscopically assisted vaginal hysterectomy (yes, no).
[†] Odds ratios relative to women <35 y.
[‡] Odds ratios relative to body mass index <23.
[§] Odds ratios relative to nulliparous women.

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Table 4. Crude Risk of Operative Injury, Conversion to Laparotomy, and Postoperative Hospital Admission by Type of Operative Procedure

| Procedure | Operative injuries or abdominal bleeding | | Conversion to laparotomy | | Postoperative admissions | |
|---|---|---|---|---|---|---|
| | % | 95% CI* | % | 95% CI* | % | 95% CI* |
| Diagnostic laparoscopy (n = 234) | 0 | 0.0, 1.6† | 9.8 | 6.3, 14.4 | 28.2 | 22.5, 34.4 |
| Endometriosis, laser (n = 75) | 1.3 | 0.0, 7.2 | 0 | 0.0, 4.8† | 2.7 | 0.3, 9.3 |
| Endometriosis, cautery (n = 102) | 2.0 | 0.2, 6.9 | 0 | 0.0, 3.6† | 7.8 | 3.4, 14.9 |
| Salpingostomy (n = 55) | 3.6 | 0.4, 12.5 | 7.3 | 2.0, 17.6 | 43.6 | 30.3, 57.7 |
| Lysis of adhesions (n = 271) | 3.0 | 1.3, 5.7 | 4.1 | 2.0, 7.2 | 15.1 | 11.1, 20.0 |
| Ovarian cystectomy (n = 115) | 0.9 | 0.0, 4.8 | 2.6 | 0.5, 7.4 | 13.9 | 8.2, 21.6 |
| Salpingectomy without LAVH or oophorectomy (n = 29) | 0 | 0.0, 12.0† | 6.9 | 0.8, 22.8 | 6.9 | 0.8, 22.8 |
| Oophorectomy without LAVH but with or without salpingectomy (n = 50) | 4.0 | 0.5, 13.7 | 14.0 | 5.8, 26.7 | 38.0 | 24.6, 52.8 |
| LVAH without oophorectomy and salpingectomy (n = 21) | 9.5 | 1.2, 30.4 | 4.8 | 0.1, 23.8 | 95.2 | 76.2, 99.9 |
| LAVH with oophorectomy and salpingectomy (n = 19) | 15.8 | 3.4, 39.6 | 5.3 | 0.1, 26.0 | 84.2 | 60.4, 96.6 |
| Other procedures (n = 54) | 0 | 0.0, 6.6† | 3.7 | 0.5, 12.7 | 9.3 | 3.1, 20.3 |

CI = confidence interval; LAVH = laparoscopically assisted vaginal hysterectomy.
* Exact 95% CI.
† One-sided CI.

assisted vaginal hysterectomy, lysis of adhesions, salpingostomy, or cautery of endometrial implants. Age-standardized rates of operative complications remained the lowest for diagnostic procedures, laser treatments of endometrial implants, and salpingectomies.

## Discussion

Minimally invasive surgery has become a topic of great discussion among surgeons. As more managed care groups and HMOs emerge, the incentive to keep costs to a minimum by performing less invasive surgeries becomes great. Laparoscopic surgery in gynecology has been a valuable technique for evaluating patients with various problems. Whereas laparoscopy initially was used in the 1970s as a diagnostic tool, it has become an operative alternative to such open procedures as adnexectomy, hysterectomy, appendectomy, and lysis of adhesions.

There has been scant information on risk factors and complication rates for operative laparoscopy from large surgical series. In this study, the overall major complication rate was 1.9% (16 cases). In a 1993 survey,[7] the American Association of Gynecologic Laparoscopists assessed rates of specific complications of operative laparoscopy in 45,042 procedures. The specific complication rates were as follows: hemorrhage 1%, unintended laparotomy 1%, blood transfusion for hemorrhage 0.45%, and bowel or urinary injury 0.41%. The results of this 1993 survey are similar to our findings. We observed a 5% unintended laparotomy rate and a

rate of less than 1% for bowel and urinary injuries combined. In 1996, Saidi et al[2] reviewed urinary complications after 953 consecutive operative laparoscopies and reported an incidence of 1.6%. They concluded that the incidence compared favorably with that of serious urinary complications after standard gynecologic surgery. Also in 1996, Bateman et al[4] assessed the characteristics and rates of complications for operative laparoscopy and diagnostic laparoscopy. They reviewed 2324 cases of laparoscopy and reported an overall complication rate of 0.9%. They concluded that the majority of complications resulted from the insertion of the Verres needle and the trocar rather than from the actual procedure. Most recently, Harkki-Siren and Kurki[3] evaluated 96 major complications after 70,607 laparoscopic procedures during a 4-year nationwide study in Finland from 1990 to 1994. They defined major complications as intestinal, urinary tract, and vascular injuries. Their rate for major complications was 1.4 per 1000. Because this figure represents one of the lowest rates of complications reported in the literature, the authors concluded that diagnostic and sterilization procedures were safe, but the more complex laparoscopies were associated with higher numbers of serious complications.

The goal of our study was to document the incidence of complications attributed to gynecologic laparoscopies over a 1-year period and to determine potential predictors of risk for these complications. It appeared that difficulty of the procedure was the strongest predictor of complications. Laparoscopically assisted vag-

inal hysterectomy with adnexectomy carried the highest risk of adverse outcomes. During a similar period in our hospital, the rates of complications from abdominal hysterectomy (for benign indications) was 1%, which was considerably lower than that observed in this series for women undergoing laparoscopically assisted vaginal hysterectomy. Although both complication rates are low, it is nonetheless reasonable to question whether laparoscopic surgery is in fact more minimally invasive. Furthermore, 90% of the patients undergoing laparoscopically assisted vaginal hysterectomy were admitted postoperatively, which directly contributes to higher costs, a consideration to take into account when determining the overall advantages of a procedure.

We found a trend of increasing rates of operative complications among women with lower BMI. This is an important finding, because many practitioners believe that the heavier patient is at higher risk for complications. One explanation for our finding is that in women with low BMI, pelvic and abdominal viscera are closer to the anterior abdominal wall, which creates a higher likelihood of injuring an organ during the insertion of the instruments.

Patients who had salpingostomies or salpingectomies had high rates of postoperative admissions compared with other procedures. Because ectopic pregnancy is the most common indication for this procedure, many of these patients may have undergone surgery late in the day. Thus, the timing of the operation rather than the operation itself may be the driving force behind this association. We also cannot rule out the possibility that comorbid clinical conditions (ie, hemoperitoneums) may have been present, resulting in more complicated procedures. We observed a 14% conversion rate for oophorectomy. Given that all diagnoses (including malignancy) were included in this analysis, this rate of conversion to laparotomy was not unexpected.

With more sophisticated laparoscopic instruments and evolving experience among surgeons, major operative laparoscopy has replaced traditional abdominal surgery in management of certain gynecologic conditions. This study shows there are risk factors associated with certain adverse outcomes (eg, operative complications, conversions to laparotomy, postoperative admissions) after major operative gynecologic laparoscopy. However, the size of our study limited our ability to detect risk factors for specific types of operative complications. Nevertheless, the future of gynecologic laparoscopy is promising, with rates of adverse complications at acceptably low levels. Our experience has shown that the number and complexity of these procedures are increasing. Therefore, it is important to be able to counsel patients about the potential complications of procedures based on patient characteristics and types of laparoscopic procedures planned.

## References

1. Maudsley RF, Qizilbash AH. Thermal injury to the bowel as a complication of laparoscopic sterilisation. Can J Surg 1979;22: 232–4.
2. Saidi MH, Sadler RK, Vancaillie TG, Akright BD, Farhart SA, White AJ. Diagnosis and management of serious urinary complications after major operative laparoscopy. Obstet Gynecol 1996;87: 272–6.
3. Harkki-Siren P, Kurki T. A nationwide analysis of laparoscopic complications. Obstet Gynecol 1997;89:108–12.
4. Bateman BG, Kolp LA, Hoeger K. Complications of laparoscopy—Operative and diagnostic. Fertil Steril 1996;66:30–5.
5. Thompson BH, Wheeless CR Jr. Gastrointestinal complications of laparoscopy sterilization. Obstet Gynecol 1973;41:669–76.
6. 1977 AAGL Complications Committee report: The prevention and management of laparoscopic complications. Third International Congress of Gynecologic Endoscopy, American Association of Gynecologic Laparoscopists; 1977 Dec 7–11; San Francisco (CA).
7. Hulka JF, Phillips JM, Peterson HB, Surrey MW. Operative laparoscopy: American Association of Gynecologic Laparoscopists' 1993 membership survey. Am Assoc Gynecol Laparosc 1995;2: 133–6.
8. Summitt RC Jr, Stovall TG, Lipscomb GH, Ling FW. Randomized comparison of laparoscopic-assisted vaginal hysterectomy with standard vaginal hysterectomy in an outpatient setting. Obstet Gynecol 1992;80:895–901.
9. Nezhat C, Nezhat F, Gordon S, Wilkins E. Laparoscopic versus abdominal hysterectomy. J Reprod Med 1992;37:247–50.
10. Meikle SF, Nugent EW, Orleans M. Complications and recovery from laparoscopy-assisted vaginal hysterectomy compared with abdominal and vaginal hysterectomy. Obstet Gynecol 1997;89: 304–11.

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