

Study of Complications during Laparoscopic Surgery and Identify Associated Risk Factors

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Abstract:

Objective: To analyze the frequency of complications during laparoscopic surgery and identify associated risk factors

Methods: A descriptive observational study was performed between January 2024 and December 2024 and included all laparoscopies performed at our center. Variables were recorded for patient characteristics, indication for surgery, length of hospital stay (in days), major and minor complications, and conversions to laparotomy.

Results: Of all 188 laparoscopies included, most were procedures of moderate difficulty (adnexal surgery) (54.2%). The overall frequency of major complications was 1.93%, and that of minor complications was 4.29%. The level of technical difficulty and existence of prior abdominal surgery were associated with a higher risk of major complications and conversions to laparotomy.

Conclusion: Laparoscopic surgery is associated with a low frequency of complications but is a procedure that is not without risk. Greater technical difficulty, inexperienced surgeon and prior surgery were factors associated with a higher frequency of complications.

Keywords: Laparoscopy, Complications, Risk factors, Outcomes.

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Introduction

Laparoscopic surgery has become widely accepted by surgeons and patients as an effective technique to treat abdominal pathologies. Better recovery, a shorter hospital stay, less postoperative pain, and lower blood loss are the main arguments in favor of this approach. As the technology has improved and surgical skills have increased, the nature and characteristics of laparoscopic procedures have also become more complex. At centers equipped for advanced laparoscopic surgery, procedures such as surgery for complex adnexal lesions, hysterectomies, appendicectomy, cholecystectomy, hernia repair, pelvic floor repair, cancer surgery and resection for severe endometriosis are now performed by this approach

Although the incidence of complications decreases as surgeons gain experience with laparoscopy, the growing difficulty of some procedures in gynecologic surgery may increase the frequency of severe complications (visceral and great vessel injuries). According to published studies, the overall rate of complications ranges from 0.4% to 3%. Complications can be classified as major or

minor: the former involve the viscera (intestine, bladder, or ureter) or great vessels (including severe hemorrhage), whereas minor complications generally have a relatively low impact on the patient's postoperative course.

Materials and Methods

This descriptive study was designed to include all laparoscopic abdominal surgeries performed at Hospital January 2024 to December 2024. A total of 188 cases were included. The complex procedures were performed by 2 experienced surgeons, and the rest of the surgical procedures was performed by 6 surgeons. Information about patient characteristics, surgical procedure, laparoscopy-related complications, and length of hospital stay was entered into a database for later analysis. This is a descriptive, retrospective study.

At our center, pneumoperitoneum is generally established with a Veress needle located sub umbilically, supraumbilically or at the palmer point, to an intra-abdominal pressure of approximately 14 to 16 mm Hg. In some cases, the Hasson technique

is used. After adequate pressure is achieved, the trocar is inserted, and after video images are obtained, the remaining trocars (between 2 and 4, depending on the technical complexity of the procedure) are inserted under direct visualization.

The following variables for patients' characteristics were recorded: age, morbid obesity (body mass index >35 kg/m²), prior abdominal surgery, year of surgery, and length of hospital stay (in days). Age was classified into 3 categories: <30 years, 30 to 64 years, and >64 years. To facilitate data analysis, the surgical indications for laparoscopy were classified into 3 groups according to the level of technical difficulty. Groups 1 and 2 together were considered technically simple procedures, group 3 was considered moderate difficulty, and group 4 was considered complex surgery. The simple surgery group included tubal electrocoagulation, coagulation of bleeding areas without other procedures, and diagnostic laparoscopy with or without biopsy. The moderate difficulty group comprised ovarian surgery (management of ectopic pregnancy, adnexectomy, cystectomy, salpingectomy, tubalplasty, and ovarian drilling), appendisectomy, cholecystectomy and removal of an intrauterine device that had migrated to abdominal cavity. The complex surgery group included total hysterectomy with or without pelvic lymphadenectomy, hernia repair surgery, endometriosis surgery, radical hysterectomy and myomectomy.

Complications from laparotomy were classified as major and minor. The former group of intraoperative complications included injury to the hollow organs of the viscera (intestine, bladder, or ureter) and bleeding or infection during laparoscopy or the postoperative period requiring additional intervention by laparoscopy or laparotomy. Deaths and severe medical pathologies that occurred during the postoperative period were also considered major complications. Minor complications were recorded when any of the following occurred: anemia, mild bleeding or infection, fever, abdominal wall hematoma, urinary tract infection, postoperative urinary retention, and ileal paralysis. Major and minor complications or >1 minor complication could coexist in a single patient; women with 1 major and 1 minor complication were considered to have a major complication. The reasons for conversion to laparotomy were classified into 2 groups (conversion because of complications and conversion for technical reasons). Conversion to laparotomy occurred when any complication arose during laparoscopy that required laparotomy. Failed laparoscopy was recorded when the laparoscopic procedure could not be completed successfully because of inadequate pneumoperitoneum or the presence of any pathology that prevented the surgeon from performing the technique by laparotomy.

Observation Chart

Table 1: Characteristics Of Abdominal Laparoscopy-

1	Age [Mean (Range)] (Y)	35.81 (11–85) years
2	Morbid obesity (%)	(1.8) %
3	Prior surgery (%)	(15.8) %
4	Level of technical difficulty [n (%)]	
	[A]SIMPLE	(37.20) %
	Tubal ligation	(30.70)
	Diagnostic laparoscopy	(5.40)
	Laparoscopy and biopsy	(0.60)
	[B] MODERATE	(54.20)
	Appendisectomy,	(10.30)
	Adnexectomy	(5.20)
	Salpingectomy & tuboplasty	(10.20)
	Cystectomy	(26.10)
	Cholecystectomy	(0.20)
	Adhesiolysis	(1.40)
	Ovarian drilling	(0.20)
	[C] COMPLEX	(8.60)
	Hernia repair	(1.30)
	Total hysterectomy & radical hysterectomy	(3.60)
	Endometriosis surgery	(2.40)
	Myomectomy	(1.30)
5	Hospital stays [mean (range)] (d)	1.42 (0–33) days
6	Length of hospital stay [n (%)]	
	0–2 d	(84.60)
	3–7 d	(13.50)
	>7 d	(1.30)

Table 2: Complications during Abdominal Laparoscopies, Classified by Level of Difficulty, Conversions to Laparotomy, and Failed Laparoscopies

1	Major Complications [N (%)]	(1.93) (95% CI, 1.41–2.48)
A	Intestinal perforation	(0.35)
B	Bladder perforation	(0.14)
C	Serious bleeding complications	(1.28)
D	Serious complications from infection	(0.10)
E	Acute pulmonary edema	(0.03)
f	Death	(0.03)
2	Minor Complications [N (%)]	(4.29) (95% CI, 3.54–5.05)
A	Mild anemia	(1.04)
B	Severe anemia (transfusion)	(1.01)
C	Minor bleeding complications	(0.52)
D	Minor complications from infection	(0.14)
E	Abdominal wall abscess	(0.03)
F	Urinary tract infection	(0.35)
G	Urinary retention	(0.07)
3	Failed Laparoscopy [N (%)]	(3.57) (95% CI, 2.78–4.35)
4	Conversion to Laparotomy Because of Complications [N (%)]	(1.58) (95% CI, 1.05–2.12)

Table 3: Factors Associated With Complications In Laparoscopies

	Serious Complications (n = 56)	Mild Complications (n = 84)	Conversion (n = 36)	Failed Laparoscopy (n = 81)
Age				
<30 y	(0.8%)	(3.5%)	(0.7%)	(3.7%)
30–64 y	(2.3%)	(2.5%)	(1.8%)	(3.4%)
>64 y	(1.9%)	(5.8%)	(2%)	(7.8%)
P value	0.02	0.12	0.14	0.24
Prior Abdominal Surgery				
Yes	(4.2%)	(1.8%)	(3%)	(6.0%)
No	(1.5%)	(3.1%)	(1.3%)	(3.0%)
P value	< 0.001	0.11	0.013	0.004
Obesity				
Yes	(3.9%)	(0%)	(4.3%)	(21.3%)
No	(1.9%)	(3%)	(1.5%)	(3.2%)
P value	0.26	0.4	0.13	< 0.001
Level Of Difficulty				
Simple	(0.9%)	(1.5%)	(0.3%)	(01.4%)
Moderate	(2%)	(2.9%)	(1.6%)	(3.3%)
Complex	(6%)	(9.2%)	(5.8%)	(12.1%)
P value	< 0.001	< 0.001	< 0.001	< 0.001

Table 4: Variables Associated with Serious and Mild Complications in Laparoscopies: Logistic Regression Analysis

Variables	Serious Complications		Mild Complications	
	cORa (95% CI)	aORa (95% CI)	cOR (95% CI)	aOR (95% CI)
Age group				
<30 y	1	1	1	1
30–64 y	(0.99–5.79)	(1.01–5.87)	(0.43–1.08)	(0.34–0.93)
>64 y	(0.14–1.13)	(0.68–3.11)	(0.47–5.41)	(0.26–3.45)
Prior abdominal surgery (yes v/s no)	(1.49–4.77)	(1.54–4.99)	(0.27–1.59)	(0.28–1.25)
Obesity (yes v/s no)	(0.50–8.87)			
Level of difficulty				
Simple	1	1	1	1
Moderate	(1.23–5.95)	(1.26–6.40)	(1.10–3.48)	(1.02–3.43)
Complex	(3.18–8.46)	(3.38–1.81)	(3.50–12.94)	(3.7–15.74)

Results

The mean age was 35.8 years (range, 11–85 years), and 70% of the patients were aged between 30 and 64 years. Prior abdominal surgery was recorded in 15.8% of the patients in this group. Most of the laparoscopies performed at our center during the study period were of moderate technical difficulty (54.2%). The mean length of hospital stay was <2 days, and 84.6% of the patients were discharged during the first 2 days after the procedure. As shown in, the percentage rate of major complications was 1.93% (95% CI, 1.43%–2.48%), with bleeding as the most frequent complication, with only 1 due to a major vessel injury. We found a total of 22 minor complications (4.29%), which were recorded in 18 patients.

Among the 188 laparoscopies, the procedure could not be completed in 10 (5.15%) despite the initial indication for this route of access. Laparoscopy failed (ie, the procedure could not be started) in 3.57% of the cases (95% CI, 2.78%–4.35%), and conversion to laparotomy because of a complication was necessary in 1.58% of the cases (95% CI, 1.05%–2.12%) during the procedure. In the bivariate analysis, the factors associated with major and minor complications, conversion, and failed laparoscopy are shown. Patients with prior abdominal surgery had significantly more ($P < .001$) serious complications (4.2% vs 1.5%) and more failed attempts at laparoscopy. A greater level of difficulty of the procedure was associated with both complications and failed laparoscopy ($P < .001$). Obesity and age were also significantly associated with failed laparoscopy ($P < .001$) and serious complications ($P = .02$), respectively.

Table summarizes the serious complications that occurred during laparoscopy. We found 2 cases of intestinal perforation, 1 of which were diagnosed intraoperatively and 1 postoperatively. In both cases conversion to laparotomy was necessary to manage the perforation. There were 2 cases of injury to the bladder; 1 was managed during laparoscopy. Among the severe bleeding complications, 1 great vessel injury occurred during insertion of the Veress needle into the abdominal cavity, and urgent laparotomy was required. There were 2 cases of serious infection that required further surgery.

Statistical Analysis: A descriptive analysis was produced for each variable. Differences between groups were identified with the χ^2 test for qualitative variables. In all analyses based on bilateral comparisons, $P < .05$ was considered statistically significant. To identify the factors associated with major and minor complications, conversion to laparotomy, or failed laparoscopy, a specific logistic regression model was constructed for each dependent variable, and the crude and

adjusted odds ratios were calculated together with their 95% confidence interval (CI). The final regression model was obtained from step-wise analyses with significance of $P < .1$ in the bivariate analysis as the criterion for entering a given factor into the model. All analyses of the data were performed with SPSS software, version 15.0 (SPSS, Armonk, New York).

Discussion

As the technology has improved and surgical skills have increased, the nature and characteristics of laparoscopic procedures have also become more complex. At centers equipped for advanced laparoscopic surgery, procedures such as surgery for complex adnexal lesions, hysterectomies, appendectomy, cholecystectomy, pelvic floor repair, and resection for severe endometriosis are now performed by this approach. Although the incidence of complications decreases as surgeons gain experience with laparoscopy, the growing difficulty of some procedures in abdominal surgery may increase the frequency of severe complications (visceral and great vessel injuries). According to published studies, the overall rate of complications ranges from 0.4% to 3%. Complications can be classified as major or minor: the former involve the viscera (intestine, bladder, or ureter) or great vessels (including severe hemorrhage), whereas minor complications generally have a relatively low impact on the patient's postoperative course.

Magrina JF et al and Mirhashemi R et al did studies predicting risk of complications with laparoscopic surgery, conversions to laparotomy, and postoperative admissions after laparoscopic procedures. Categorical analysis was used to compare differences in the rates of operative complications, conversions to laparotomy, and postoperative admissions after laparoscopy. Serious operative complications after minor gynecologic laparoscopy were rare. The more complex laparoscopic procedures resulted in proportionately greater rates of operative complications, conversions to laparotomy, and postoperative admissions to the hospital.

Chapron C et al in a series of 29,966 cases, studied surgical complications of diagnostic and operative abdominal laparoscopy. The risk of complications has been assessed according to the complexity of the laparoscopic procedure. The overall complication rate was 4.64 per 1000 laparoscopies ($n = 139$). The rate of complications requiring laparotomy was 3.20 per 1000 ($n = 96$). The complication rate was significantly correlated with the complexity of the laparoscopic procedure ($P = 0.0001$). Increased experience by the surgeons has had three consequences: a statistically significant drop in the number of bowel injuries ($P = 0.0003$), a drop in the

rate of complications requiring laparotomy for those laparoscopic surgical procedures that are well defined ($P = 0.01$), and a change in the way complications are treated, with a significant increase in the proportion of incidents treated by laparoscopy ($P = 0.0001$).

Fuentes MN et al did analysis of complications during laparoscopic gynecologic surgery and identified associated risk factors. Variables were recorded for patient characteristics, indication for surgery, length of hospital stay (in days), major and minor complications, and conversions to laparotomy. The overall frequency of major complications was 1.93%, and that of minor complications was 4.29%. The level of technical difficulty and existence of prior abdominal surgery were associated with a higher risk of major complications and conversions to laparotomy. Laparoscopic gynecologic surgery is associated with a low frequency of complications but is a procedure that is not without risk. Greater technical difficulty and prior surgery were factors associated with a higher frequency of complications.

Tarik A et al did a retrospective analysis of 3572 cases from a single institute Fehmi C. Complications during insertion of the Verres needle, principal and accessory trocars were noted in 25 cases (38.2%) and were comparable among the four groups. Intraoperative complications occurred in 32 patients (47.8%) encountered mainly in the major and advanced groups. Overall, acute postoperative complications occurred in 10 (14.9%) patients. Despite advanced technology and experience, complications during the installation phase of laparoscopy remain a major cause of significant morbidity and most operative complications occurred in advanced operative procedures.

Makai G et al in their study on complications of gynecologic laparoscopy stated that complications related to access represent one-third to one-half of these injuries. Major operative complications are more likely to occur in complex procedures. Through the comprehensive understanding of the relevant anatomy, surgical instruments, complex maneuvers, and optimal surgical technique, laparoscopists can avoid most of the complications described. Even in the best of hands, however, complications will occur. Most importantly, surgeons should be diligent in recognizing and managing these events. Similar study was done by Erkson EA et al in which they estimated the association of age, medical comorbidities, functional status, and unintentional weight loss (as a marker of frailty) with postoperative complications undergoing major surgeries. Age 80 years or older, medical comorbidities, dependent functional status, and unintentional weight loss are associated with increased major postoperative complications after procedures.

Krishnakumar S et al studied entry complications in laparoscopic surgery. Over the past 50 years, many techniques, technologies and guidelines have been introduced to eliminate the risks associated with laparoscopic entry. No single technique or instrument has been proved to eliminate laparoscopic entry associated injury. Proper evaluation of the patient, supported by surgical skills and good knowledge of the technology and instrumentation is the keystone to safe access and prevention of complications during laparoscopic surgery.

Obtaining pneumoperitoneum and inserting the trocars form part of laparoscopy and should not be considered "less important" techniques, given that a non-negligible percentage of complications can occur during these procedures. Occasionally, these complications can be dramatic, as when a great vessel is damaged. It is important for major complications to be diagnosed promptly during laparoscopy so that corrective measures can be taken intraoperatively. The risk of conversion to laparotomy increases with the level of difficulty of surgery and can be up to 45-fold higher for complex procedures than for simple procedures. A likely explanation is that the higher frequency of complications during complex operations obliges surgeons to reconvert to laparotomy more often to manage these events.

Complications can occur even in the best of hands and it is vital that these are recognized promptly and immediately addressed. Importance of proper training and the value of experience is clear. It must be our goal to train our future laparoscopic surgeons in the necessary skills and encourage the development of specially designed fellowships for those performing the most advanced procedures. When complications do occur, excellent training and experience will allow these to be managed by laparoscopy. Complications are closely related to the level of difficulty of the operation: complex procedures had an 8-fold higher risk of serious complications and a 7-fold higher risk of minor complications compared with technically simple procedures. This finding is consistent with results published by Magrina, Chapron et al, and Leonard et al. The likelihood of conversion and failed laparoscopy was also related to the level of technical difficulty.

Conclusion

Laparoscopic surgery was a safe procedure in the cases we analyzed at our center, but it is not without risks of serious complications, of which the surgeon should be aware. Technical difficulty and prior abdominal surgery were associated with the appearance of complications; considering this finding, each patient should be evaluated individually, and surgeons should adapt the

procedure and their technical skills to the circumstances particular to each patient

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