

Clinical Science

The use of laparoscopic surgery in pregnancy: evaluation of safety and efficacy

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KEYWORDS:

Laparoscopy;
Pregnancy;
Surgery;
Appendicitis;
Cholecystitis;
Pregnancy outcome

Abstract

BACKGROUND: Laparoscopic surgery in pregnant women has become increasingly more common since the 1990s; however, the safety of laparoscopy in this population has been widely debated, particularly in emergent and urgent situations.

METHODS: A retrospective chart review of all pregnant women following a nonobstetric abdominal operation at a University hospital between 1993 and 2007. Perioperative morbidity and mortality for the mother and fetus were evaluated.

RESULTS: Ninety-four subjects were identified; 53 underwent laparoscopic procedures and 41 underwent open procedures. Cholecystectomy and appendectomy were performed in both groups with salpingectomy/ovarian cystectomy only in the laparoscopic group. No maternal deaths occurred, while fetal loss occurred in 3 cases within 7 days of the operation and in 1 case 7 weeks postoperatively. This and other perinatal complications occurred in 36.7% of the laparoscopic group and 41.7% of the open group.

CONCLUSION: Laparoscopic appendectomy and cholecystectomy appear to be as safe as the respective open procedures in pregnant patients; however, this population in particular remains at risk for perinatal complications regardless of the method of abdominal access.

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Nonobstetric general surgery procedures are required in approximately 1 in 635 pregnancies, acute appendicitis and symptomatic biliary disease being the most common indication for these procedures.^{1–4} The rate of appendicitis during pregnancy is similar to that of nonpregnant women; however, the rate of appendiceal perforation is much higher in the pregnant population.⁵ Perforated appendicitis is the

most common general surgical cause of fetal loss during pregnancy. When perforation does occur, the rate of fetal loss is up to 20%, and as high as 37.5% with generalized peritonitis compared with 1.5% for uncomplicated appendicitis.⁶

Cholecystectomy is required in approximately 45% of pregnant patients who present with symptomatic cholelithiasis with a 5% rate of fetal loss associated with open cholecystectomy.⁷ This is complicated by a 15% incidence of maternal mortality and up to a 60% incidence of fetal loss if the disease progresses to acute biliary pancreatitis.⁸

Pregnancy remains a relative contraindication for laparoscopic procedures. Despite this, the use of laparoscopy for

This study was presented at the 2008 meeting of the Southwest Surgical Society.

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Manuscript received May 2, 2009; revised manuscript August 17, 2009

Table 1 Demographics

	Subjects (n)	Age (y)	Hospital length of stay	Postoperative length of stay
Open procedures	41	25 ± 6	4 ± 3	3 ± 2
Appendectomy	40	26 ± 6	4 ± 3	3 ± 2
Cholecystectomy	1	22	7	2
Laparoscopic procedures	53	26 ± 6	6 ± 5	4 ± 3
Appendectomy	9	24 ± 8	5 ± 4	3 ± 3
Cholecystectomy	39	26 ± 6	6 ± 6	4 ± 3
Salpingectomy/cystectomy	5	30 ± 2	4 ± 1	4 ± 1
All procedures	94	26 ± 6	5 ± 4	4 ± 3

the treatment of appendicitis and biliary disease in pregnant women has increased and the question of its safety to the mother and fetus when compared with open procedures still remains.^{4,6,9} We hypothesize that laparoscopic management of nonobstetrical abdominal disease in the pregnant patient is safe to both the mother and fetus. A review of our institutional experience was undertaken to address this question.

Methods

This study was conducted as a single-center retrospective review of all pregnant women who underwent a nonobstetric abdominal procedure between January 1, 1993 and June 30, 2007. This study was approved by the Institutional Review Board of the University of Texas Health Science Center at San Antonio (UTHSCSA).

Subjects were identified through a query of the University Hospital Medical Records for all ICD-9 and CPT codes with modifiers for pregnancy coinciding with a nonobstetric abdominal procedure. For each subject, charts and electronic medical records were used to collect data regarding demographic information, past medical and surgical history, known obstetric history, presenting clinical history, operative reports, and clinical course/discharge disposition. Fetal heart tones, using Doppler or ultrasound, were documented

in each patient pre- and postoperatively per obstetric guidelines.

The birth records for each study subject who returned to University Hospital to give birth were reviewed. The perinatal complications rate was defined as a composite of fetal losses (abortion and fetal demise/stillbirth), preterm deliveries, pre-eclampsia/eclampsia, placenta previa, placental abruption, oligohydramnios, and intrauterine growth restriction. Abortion was defined as the loss of a fetus or embryo before 20 weeks of gestation or weighing less than 500 g.^{10,11} Fetal demise/stillbirth was defined as a fetus born dead at 20 or more weeks of gestation or weighing greater than 500 g.^{10,11} Statistical analysis between groups was by Student *t* test or χ^2 where appropriate.

Results

A total of 94 subjects were identified (Table 1). Of these, 53 underwent laparoscopic procedures and 41 underwent open procedures. Laparoscopic procedures included appendectomy, cholecystectomy, and salpingectomy/ovarian cystectomy; open procedures included appendectomy and cholecystectomy. Postoperative lengths of stay were not significantly different between groups. Most both the laparoscopic and open procedures were performed in either the first or second trimester of pregnancy. There was a significant difference in

Table 2 Distribution of procedures during the course of pregnancy

	First trimester (n)	Second trimester (n)	Third trimester (n)	Estimated gestational age at surgery (wk)
Open procedures	19 (20%)	12 (13%)	10 (11%)	17 ± 9
Appendectomy	19 (20%)	12 (13%)	9 (10%)	17 ± 9
Cholecystectomy	0	0	1 (1%)	36
Laparoscopic procedures	21 (22%)	28 (30%)	4 (4%)	16 ± 7
Appendectomy	6 (6%)	3 (3%)	0	11 ± 6
Cholecystectomy	9 (10%)	25 (27%)	4 (4%)	18 ± 7
Salpingectomy/cyst	5 (5%)	0	0	7 ± 2
All procedures	40 (43%)	40 (43%)	14 (15%)	16 ± 8

Percentages are ratios of the total procedures (n = 94). A significant difference was seen in distribution between open and laparoscopic groups for all procedures for an increase in open procedures in the third trimester (*P* = .022).

Table 3 Patients with severe disease and respective operations performed

Pathology	Procedure performed
Gangrenous cholecystitis, perforated	Laparoscopic Cholecystectomy
Acute appendicitis, severe	Laparoscopic Appendectomy
Gangrenous gallbladder with focal areas of necrosis	Open cholecystectomy
Acute appendicitis, perforated	Open appendectomy
Acute appendicitis, perforated	Open appendectomy
Acute appendicitis, perforated	Open appendectomy
Acute appendicitis, perforated, with fecalith	Open appendectomy
Acute gangrenous appendicitis, perforated	Open appendectomy
Acute gangrenous appendicitis, perforated	Open appendectomy
Acute gangrenous appendicitis	Open appendectomy
Acute appendicitis, serositis	Open appendectomy
Acute appendicitis, serositis	Open appendectomy
Acute appendicitis, serositis with abscess formation	Open appendectomy
Acute appendicitis, transmural inflammation extending to serosa and adjacent adipose tissue	Open appendectomy
Acute necrotizing appendicitis, acute peritonitis, fecalith	Open appendectomy
Acute necrotizing appendicitis, reactive lymph node	Open appendectomy
Acute appendicitis, pinworms in lumen	Open appendectomy
Acute appendicitis, suppurative appendix	Open appendectomy
Acute appendicitis, perforation, suppurative appendix	Open appendectomy

distribution between groups, favoring open procedures in the third trimester (Table 2).

Immediate operative complications included 2 conversions from laparoscopic to open, 1 each for appendectomy and cholecystectomy. One patient with biliary pancreatitis required an emergent cesarean section for severe pre-eclampsia and fetal bradycardia. A Pfannenstiel approach was opened and closed, following which a laparoscopic cholecystectomy was performed.

The rate of perforation identified intraoperatively differed significantly between the open and laparoscopic groups. The rate of perforation in the open group was 27% (11/41) and 2% (1/53) in the laparoscopic group ($P < .05$). Nineteen patients were identified by postoperative pathology reports as having a more advanced stage of disease. Seventeen of these women underwent open procedures and 2 underwent laparoscopic procedures (Table 3).

Of the 94 patients identified, 54 had delivery records in the University Hospital system. Of these 54 patients, 30 underwent laparoscopic procedures and 24 underwent open procedures. There were 50 live births and 4 pregnancy losses. The pregnancy losses included 3 instances of spontaneous abortion and 1 instance of stillbirth/fetal demise. Of the 50 patients who had a live birth, 21 underwent an open surgical procedure during pregnancy, and 29 underwent a laparoscopic procedure (Table 4). The average age of patients in both groups was 26 ± 6 years. The average gestational age of patients who underwent open procedures was 19 ± 9 weeks and the average gestational age of patients who underwent laparoscopic procedures was 18 ± 7 weeks ($P =$ not significant). Estimated gestational age at delivery was not different between groups. We found no relationship between trimester of pregnancy at which a surgical procedure was performed and estimated gestational age at delivery. The average Apgar scores at 1 minutes and 5 minutes for each group were the same at 8 ± 2 and 9 ± 2 , respectively.

Forty women included in the study did not have birth records in the University Hospital system. Of these 40 patients, 17 underwent an open surgical procedure and 23 underwent a laparoscopic procedure. The average ages of patients who underwent open and laparoscopic procedures were 25 ± 7 years and 26 ± 6 years, respectively. The estimated gestation ages at the time of the procedure for patients who underwent open and laparoscopic procedures were 14 ± 9 years and 13 ± 6 years, respectively. A comparison of patients who did and did not have available birth records at University Hospital is detailed in Table 5.

No maternal deaths occurred in this series; however, there were 4 recorded instances of fetal loss (4%, 4/94). Two subjects who underwent an open appendectomy suffered spontaneous abortion within the first 7 days following their respective surgical procedure (2%; 2/94). One of these was found to have a perforated and gangrenous appendix

Table 4 Distribution of procedures in patients with live births and available delivery records

	No. of subjects (n)	Average age at time of procedure (y)	Average EGA at time of procedure (wk)	EGA at time of delivery (live birth) (wk)
Open procedures	21	26 ± 6	19 ± 9	38 ± 3
Laparoscopic procedures	29	26 ± 6	18 ± 7	38 ± 5
All procedures	50	26 ± 6	18 ± 8	38 ± 4

EGA = Estimated gestational age.

Table 5 Summary of patients with and without available birth records

	Delivery at UH	Delivery records unavailable
No. of patients (n)	54	40
Average age (y) ($P = NS$)	26 ± 6	25 ± 7
Open procedures	21	17
Laparoscopic procedures	29	23
EGA at time of procedure (wk)	18 ± 8	13 ± 8
Specific diagnoses ($P = NS$)		
Acute appendicitis, uncomplicated	10	10
Acute appendicitis, severe	10	7
Acute cholecystitis, uncomplicated	7	2
Acute cholecystitis, severe	2	0
Chronic cholecystitis	15	11
Normal pathology	10	10

UH = University Hospital; NS = not significant; EGA = Estimated gestational age.

intraoperatively and suffered a spontaneous abortion on postoperative day 7 in the 10th week of gestation. The second underwent an exploratory laparotomy for appendicitis and experienced a septic abortion on postoperative day 1 in the 12th week of gestation. One woman underwent a laparoscopic salpingectomy at the 8th week of gestation had a spontaneous abortion at the 15th week of gestation; however, the fetus was only at a 9 week size. The last woman, who was also found to have a perforated and gangrenous appendix, suffered fetal loss/stillbirth on postoperative day 2 in the 23rd week of gestation (Table 6). Other perinatal complications included premature delivery, pre-eclampsia/eclampsia, placenta previa, placental abruption, oligohydramnios, and intrauterine growth restriction. The overall perinatal complication rate, including the 4 instances of fetal loss, was 38.8% (21/54); 36.7% (11/30) for laparoscopic procedures and 41.7% (10/24) for open procedures.

Comments

The advantages of laparoscopic procedures over open procedures in the general population are well described. These include reduced postoperative pain, shorter length of hospital stay, a decreased incidence of thromboembolic events, faster recovery, improved cosmesis, and decreased rates of postoperative ileus.¹² For these reasons, laparoscopy has become the preferred method for many surgical procedures, including cholecystectomy and appendectomy. Despite this, some surgeons are reluctant to employ this technique when treating a pregnant patient with appendicitis or biliary disease, as there are few data showing the safety of laparoscopy for general surgical procedures during pregnancy.

Our retrospective review of both laparoscopic and open procedures performed on pregnant women showed that laparoscopic cholecystectomy and appendectomy were as

safe and effective as their respective open procedures; this correlates well with previous findings reported in the literature. Affleck et al reported 67 laparoscopic operations safely performed on pregnant women with no incidence of fetal loss, uterine injury, or birth defects.¹³ They concluded that the use of laparoscopy during pregnancy was safe for both the mother and fetus. Halkic et al also reported on 16 laparoscopic procedures in pregnant patients without any maternal or fetal morbidity.¹⁴ Neither of these groups compared laparoscopic procedures to open. An additional group reported 1 case of fetal demise in both the laparoscopic and open appendectomy groups in pregnant women, within 1 months to 2 months after surgery.¹⁵ This is consistent with our data for those operations.

In our series, of the patients undergoing appendectomy, 2 perioperative spontaneous abortions (2%) and 1 perioperative instance of fetal demise/stillbirth were reported. These instances of abortion and fetal demise/stillbirth occurred in women who carried a diagnosis of perforated appendicitis. All 3 underwent open appendectomies; however, it more likely that the subsequent spontaneous abortions and fetal demise were associated with maternal disease severity rather than with operative technique. This is consistent with authors who report the rate of fetal loss as high as 35% associated with perforated appendicitis, compared with 2% for nonperforated appendicitis.¹⁶ In our series, the rate of fetal loss was 25% for those with perforated appendicitis (3/12), and 0% for nonperforated appendicitis (0/37). No maternal deaths occurred in our series.

The risk of developing appendicitis does not appear to be increased by pregnancy, but the incidence of perforated appendicitis in pregnant patients is significantly higher than in the general population.¹⁶ In our series the overall rate of perforated appendicitis was 14% (7/49), the second trimester having the highest rate (20%, 3/15). The rate of perforation was lowest in the first and third trimesters, at 12% (3/25) and 11% (1/9), respectively. Dietrich et al described the incidence of perforated appendicitis in pregnancy to be as high as 43% of those with appendicitis, compared with 4% to 19% in the general population.¹⁷ The increased inci-

Table 6 Pregnancy/delivery complications

	Laparoscopic procedures			Open procedures	
	Appy	Chole	Sal	Appy	Chole
Premature birth	1	3	0	5	0
Fetal loss	0	0	1	3	0
Pre-eclampsia/eclampsia	1	0	0	3	0
Placental abruption	0	1	0	0	0
Placenta previa	0	1	0	0	0
Intrauterine growth delay	0	1	0	0	0
Oligohydramnios	0	2	0	0	0

This group of 54 patients underwent 30 laparoscopic procedures and 24 open procedures. Appy = appendectomy; Chole = cholecystectomy; Sal = salpingectomy.

dence of appendiceal perforation in the pregnant patient is often attributed to a delay in diagnosis and operative management.^{16,18} The physiological changes that occur during pregnancy can make the diagnosis of acute appendicitis more difficult. Though right lower quadrant pain is still the most common location for appendicitis pain in pregnant women, the appendix may be displaced as the uterus enlarges. Thus, the expected right lower quadrant pain seen in nonpregnant patients with acute appendicitis may not be present in pregnant patients.¹⁸

Complications other than the instances of fetal loss included the premature birth of a viable neonate (15%, 8/54), pre-eclampsia/eclampsia (7%, 4/54), placenta previa or abruption (4%, 2/54), intrauterine growth restriction (2%, 1/54), and oligohydramnios (4%, 2/54). All of the placental and amniotic complications occurred in patients undergoing cholecystectomy, and were all in the laparoscopic group. Additionally, the incidence of placental/amniotic complications was statistically higher in those undergoing cholecystectomy compared with appendectomy ($P < .05$). The etiology of this association is not clear.

Of the pregnancy and birth complications that occurred, none were technical or operative complications. Three of the 4 cases of fetal loss occurred within 7 days of the surgical procedure. As discussed previously, these cases of fetal loss were most likely due to maternal disease severity rather than the actual operation itself. The patient who had the laparoscopic salpingectomy at the 8th week of gestation had a spontaneous abortion at the 15th week of gestation. Because the fetus was at a 9-week size, it is possible that fetal loss occurred within 7 days following the operation. We were unable to find any further documentation of this instance, so we cannot definitively conclude when fetal loss occurred. All of the other pregnancy and birth complications that occurred in women who had undergone laparoscopic procedures occurred at least 4 weeks postoperatively. Due to this temporal span, we conclude that the complications were most likely not influenced by the surgical approach that was performed.

A total of 50 of the women with available birth records had live births. Of these women, 16% (8/50) delivered before 37 weeks of gestation and were therefore classified as having a premature delivery. In the laparoscopic and open groups, 14% (4/29) and 19% (4/21) gave birth before 37 weeks, respectively. Although the incidence of delivery before 37 weeks in our study population is slightly higher than the published norms,¹⁹ we are unable to determine if the difference is statistically significant. Overall, the estimated gestational age at time of delivery was the same in both the open and laparoscopic groups. This suggests that laparoscopic procedures during pregnancy do not impart a higher risk of premature delivery than open procedures.

In conclusion, we have shown in a series of pregnant patients undergoing general surgery procedures that out-

comes following laparoscopic approach appear to be similar to those following open procedures. The open approach; however, was somewhat favored in the last trimester. Maternal mortality is absent, but the instances of fetal loss that occurred in our study population are believed to be secondary to maternal disease rather than operative technical complications. These findings underscore the importance of a timely diagnosis and expedient intervention of surgical diseases that occur during pregnancy.

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