

Laparoscopic Appendectomy and Cholecystectomy During Pregnancy: Six Case Reports

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ABSTRACT

Background: Pregnancy was once considered a contraindication to laparoscopic cholecystectomy and appendectomy. The progression of laparoscopic techniques has resulted in a continued reassessment of laparoscopic procedures during pregnancy. There still exists some controversy as to the safety of laparoscopic procedures during pregnancy. This paper reviews our series of six pregnant patients treated laparoscopically for appendicitis and cholecystitis.

Methods: Charts were reviewed of all pregnant patients who underwent laparoscopic cholecystectomy or appendectomy at St Clare's Hospital Schenectady, New York between 1992 and 1996. Six patients were identified. Patients and obstetricians were contacted to investigate the results of the pregnancy.

Results: All patients and fetuses survived the procedure. Two patients delivered prematurely but remote from the operative procedure. All infants were healthy postpartum. One patient underwent an elective abortion as she had planned. The abortion was remote from the surgical procedure.

Conclusion: Our series adds to the growing evidence that laparoscopic cholecystectomy and laparoscopic appendectomy can be performed safely during pregnancy.

Key Words: Laparoscopy, Pregnancy.

INTRODUCTION

Acute cholecystitis and appendicitis are the most common intra-abdominal emergencies that complicate pregnancy.¹⁻⁴ They are associated with significant rates of spontaneous abortion, premature labor, and fetal mortality.^{1,5} Historically, appendicitis and cholecystitis were managed medically until postpartum when surgery could be performed with minimal maternal risk and no fetal risk.² Acute worsening, or severe illness required prompt surgical intervention with laparotomy.

Over the past seven years, laparoscopic surgery has evolved as a potential treatment option for pregnant patients. Until recently, it had been avoided during pregnancy.^{2,5-10} This paper reports on six pregnant patients successfully treated with laparoscopic appendectomy or cholecystectomy and describes the risks and benefits of this new management technique.

METHODS

Charts were reviewed at our institution of all pregnant patients who underwent laparoscopic cholecystectomy or appendectomy. Six patients were identified. Our first case occurred in 1992 and the most recent in 1996. The six procedures were performed by two surgeons. Patients and obstetricians were contacted by phone to investigate the results of the pregnancy.

RESULTS

An open laparoscopic approach with the Hasson trocar rather than the Veress needle was utilized in each case. There were no uterine injuries. All six patients and fetuses survived the procedure. A summary of the operative procedures are contained in **Table 1**. Two patients delivered prematurely but remote from the procedure. All infants were healthy postpartum. One patient subsequently underwent an elective abortion as she had planned. The abortion was remote from the operative procedure.

DISCUSSION

Pregnant patients present many unique diagnostic and therapeutic concerns. The physiologic alterations of pregnancy, if not recognized or understood, may delay patient pre-

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Table 1.
Summary of Operative Procedures

Patient	Age (years)	Procedure	Gestation (weeks)	Complications
K.S.	23	Lap. Chole.	14	None
C.M.	37	Lap. Chole.	16	None
M.B.	30	Lap. Appy.	4	PROM* at 33 wks healthy fetus/infant
V.S.	32	Lap. Appy.	8	None
P.O.	22	Lap. Chole.	10	None peri-operatively ETOP**
J.A.	24	Lap. Chole.	30	Premature (4 weeks) healthy fetus/infant

*PROM - premature rupture of membranes
**ETOP - elective termination of pregnancy

sentations, diagnosis, and the initiation of treatment. This delay translates into increased fetal mortality, ranging from rates of 5% in cases of acute appendicitis to 20% in cases of advanced disease or perforation.^{11,12} Similarly, increased maternal and fetal risk has been observed in cases when symptoms have been present for more than 24 hours prior to surgery.¹¹ Once a diagnosis has been made, there are additional concerns associated with performing surgery. The increased incidence of preterm labor and miscarriage observed with standard cholecystectomy and appendectomy in pregnancy has been a valid basis for concern.⁶ In approximately two of every thousand pregnancies, however, some form of nongynecological surgery is required and successfully performed.¹³ Preventing unnecessary fetal injury during surgery is a key consideration. In our series of six cases of laparoscopic appendectomy and cholecystectomy, all patients and fetuses survived the procedure. Two patients delivered prematurely but remote from the operative procedure. In the following discussion we briefly discuss the diagnosis and medical management of appendicitis and cholecystitis in the pregnant patient, and focus on a review of the advantages and risks of laparoscopic appendectomy and cholecystectomy during pregnancy.

Diagnosis and Medical Management of Appendicitis and Cholecystitis in the Pregnant Patient:

The diagnosis of intra-abdominal inflammatory processes during pregnancy is frequently complex.^{5,19} Appendicitis during pregnancy is falsely diagnosed and has negative explorations in 35 to 50 percent of cases.^{7,20,22,24} The significance of abdominal pain, nausea, vomiting, and a leukocytosis are difficult to assess because of their expected occurrence in normal pregnancy.^{5,7,21,23} The finding of right lower quadrant pain at McBurney's point is also less helpful because uterine growth displaces the appendix and cecum superiorly in the abdomen.

The clinician also experiences limitations in his or her choice of radiologic diagnostic tools. Radiologic studies such as abdominal films, urograms, and upper gastrointestinal series all expose the fetus to radiation and the potential for fetal malformation, oncogenesis, and death.²² Ultrasonography may be used safely, although diagnostic limitations exist.

The medical management of cholecystitis and appendicitis during pregnancy typically includes fetal monitoring, intravenous hydration, analgesia, and antibiotics.^{3,4,14} Medical management during pregnancy carries a significant risk of treatment failure⁷ (approximately 35% of cholecystitis cases), prolonged hospital admissions, and pregnancy loss.^{9,14,16,25} Treatment complications or failures, as evidenced by recurrent bouts of cholecystitis or biliary colic, necessitate surgery.^{2,4,5,18,23}

Surgical Management of Appendicitis and Cholecystitis During Pregnancy:

Despite the emergence, increased use, and success of laparoscopy, an open surgical approach has remained the procedure of choice for managing appendicitis and cholecystitis during pregnancy. Similar to medical management, surgical treatment and its associated therapies may result in unwanted adverse effects.⁷ Surgical procedures in pregnant patients have been associated with a 10 to 15 percent increased risk of premature labor.²² Open cholecystectomies and appendectomies have been known to increase the incidence of preterm labor as well as miscarriage.¹⁵ Several general anesthesia inhalation agents are teratogenic and cross the placenta. This is of special concern for those patients in the first trimester of pregnancy.²⁴ The risk of iatrogenic injury during surgery must also be considered. After surgery has been completed, potential problems exist with the use of certain antibiotics, opioids, and non-steroidal anti-inflammatory medications.^{18,23}

Laparoscopic Management of Appendicitis and Cholecystitis During Pregnancy:

The lack of prospective trials and understudied risks of laparoscopy have prevented the extrapolation of laparoscopy's success in the general patient population to the pregnant population. Interestingly, obstetricians have been safely performing laparoscopic procedures on pregnant patients for decades.⁷ Women suspected of having ectopic pregnancies have been found at laparoscopy to have normal first-trimester pregnancies, and have progressed with normal gestations and births.^{15,16} Reedy et al. recently published an analysis of a Swedish Health Registry dataset comparing laparoscopy to laparotomy during pregnancy. The authors compared 2181 laparoscopies to 1522 laparotomies stratifying for five fetal outcomes: birth weight, gestational duration, intrauterine growth restriction, congenital malformations, stillbirths, and neonatal deaths. There was no difference in the five fetal outcome variables between the laparoscopy and laparotomy groups.²⁷ A survey of the Society of Laparoendoscopic Surgeons addressing complications of laparoscopy in pregnancy was performed by Reedy et al. Responses to the survey suggested

that laparoscopy may be performed safely in the gravid patient.²⁶ It is recognized that selection bias limits the interpretation of this data. In light of these clinical experiences and advancements in laparoscopic technology, general surgeons are increasingly performing laparoscopic surgery on pregnant patients.

To date, the results of more than 50 laparoscopic cholecystectomies performed in pregnant patients, with 15 concomitant intraoperative cholangiograms, have been reported. In this group of patients, there were no intraoperative or postoperative complications. Twenty-seven patients had delivered at the time these reports were published, and all but two children were born healthy and at full term. One child was born at 37 weeks with hyaline membrane disease, while another patient gave birth to twins at 36 weeks gestation.²³

In 1987, Spirtos reported no fetal loss after 13 pregnant patients received diagnostic laparoscopy for suspected appendicitis.⁷ Schreiber reported the results of six laparoscopic appendectomies in pregnant patients. There were no maternal complications; however, fetal outcomes were not reported.²⁴ In a more recent report, Curet et al. describe four laparoscopic appendectomies in which there were no immediate peri-operative complications.²³ Fetal complications in the laparoscopic group included oligohydramnios, tight nuchal cord, macrosomia, and failure to progress. These complications occurred with no greater incidence than in the same hospital's obstetric population that did not receive surgery. There were no statistically significant differences between the delivery-related complications observed in the laparoscopic and open laparotomy groups.²³ These reports suggest no significant increase in maternal-fetal complications following the performance of laparoscopic cholecystectomy or appendectomy.^{15,22}

The Advantages of Laparoscopy:

As experience with laparoscopy increases, the unique diagnostic and therapeutic advantages of this surgical approach are emerging. In patients who present with confusing clinical pictures, laparoscopy and direct visualization of the appendix is a valuable diagnostic tool.^{22,24} In a study of non-pregnant patients, Laine et al. randomized 50 female patients, ages 16 to 40, with acute right lower abdominal pain to receive either laparoscopy or open appendectomy. Diagnosis in the laparoscopic group was established in 96% of cases versus 72% in the open group. Unnecessary appendectomies were performed in 44% of open group but only 4% in the laparoscopic group.²⁷

Intraoperatively, there is less uterine manipulation with laparoscopy and, therefore, there is less risk of preterm labor and spontaneous abortion.^{13,18}

The majority of laparoscopy's advantages, however, are realized postoperatively. The incisions required for laparoscopic procedures are smaller and patients experience less postoperative pain, thereby requiring decreased volumes of narcotic analgesia.^{9,10,12-14,18,23,28} Less narcotics means less depression of gastrointestinal motility.²³ Patients often resume a regular diet within 24 hours of surgery, reducing fetal nutritional stress. Less narcotics also means less fetal respiratory depression, risk of fetal narcotic addiction, and in utero fetal narcotic withdrawal.²⁹ Decreased postoperative pain encourages earlier ambulation, which assists in preventing the formation of deep venous thromboses.^{17,24} The incidence of wound infection, wound dehiscence, and ventral hernia is less. Lastly, smaller incisions decrease the formation of abdominal adhesions, which may occur in 70% to 80% of patients undergoing laparotomy.²⁴

Complications of Laparoscopy:

The greatest concern of performing laparoscopy during pregnancy is the carbon dioxide (CO₂) insufflation of the abdomen to maintain an operative visual field. Insufflation increases intra-abdominal pressures and may decrease venous return to the heart and subsequent cardiac output. Maternal hypotension and fetal hypoxia potentiate the risks of intraoperative fetal morbidity and mortality. Increased intra-abdominal pressures may also restrict blood flow to the uterus by directly compressing the uterine vasculature.²³

Fetal acidosis is a potential complication of creating a pneumoperitoneum. Carbon dioxide has been reported to diffuse across placental membranes in both animal and human models. Hunter et al. described the effects of a pneumoperitoneum on the acid-base status, heart rate, and blood pressure in pregnant sheep. Creating a CO₂ pneumoperitoneum decreased the pH into acidemic range of both mother and fetus, increased mean fetal heart rate, and increased mean fetal arterial pressure. After desufflation all values returned to normal. These changes were not observed when insufflation was performed with nitrous oxide. Hunter concluded that hypercarbia and not increased intra-abdominal pressure was the cause of the changes seen, and there did not appear to be significant risk to the healthy fetus.¹³ Amos et al. also reported findings in animal models. Those who underwent CO₂ insufflation developed maternal and fetal hypoxemia, acidosis, hypercarbia, and increased variability in heart rate and blood pressure.¹⁵ Curet et al. studied the effects of CO₂ pneumoperitoneum in pregnant ewes. A CO₂ pneumoperitoneum of 15 mmHg for 30 minutes resulted in a decrease in uterine blood flow, increased intra-abdominal pressure, maternal tachycardia, fetal hypertension, and

maternal and fetal acidosis. All ewes delivered healthy lambs at full gestation, and there were no long-term deleterious effects.¹⁰

The placenta is usually adept at the removal of CO₂ from the circulation and protecting the fetus from adverse effects. This protective mechanism makes the observed intraoperative elevations in end-tidal CO₂ and PaCO₂ less concerning, especially in those patients without pre-existing cardiopulmonary disease.^{14,18} Unfortunately, the altered physiologic state of pregnancy increases patients' susceptibility for developing a metabolic acidosis.²⁹ The concern is that the compensatory mechanisms (increases in ventilation) aimed at maintaining an acid-base equilibrium may be insufficient to prevent the formation of an acidosis during the prolonged exposure to CO₂ which occurs with abdominal insufflation.¹³ Maternal hyperventilation during surgery should minimize maternal PaCO₂ and pHa.²⁸ In all of our reported cases, the CO₂ insufflation pressures were maintained below 15 mmHg.

One final complication of laparoscopy in pregnancy is uterine injury due to inadvertent puncture by the Veress needle or during trocar insertion.^{5,7,11,30} This may result in uterine insufflation and CO₂ embolization.⁵ In all of our cases, only the Hasson trocar was utilized.

Laparoscopic Surgery in Pregnancy:

Recommendations have been published outlining how to avoid the potential complications of laparoscopy during pregnancy. The second trimester appears to be the optimal window for surgical intervention because organogenesis is complete, and there is minimal teratogenic risk.^{5,7,13,18,25,29} In addition, a second trimester uterus will not obstruct the operative visual field or disrupt surgical technique.⁵ Less uterine manipulation decreases the risk of preterm labor and spontaneous abortion.

During surgical management there are technical maneuvers which may minimize operative morbidity. Preoperatively, the patient should be positioned towards a left lateral decubitus position to displace the intra-abdominal pressures of the pneumoperitoneum and the gravid uterus away from the inferior vena cava and increase venous return.^{13,25,29} Some authors recommend an oral antacid (e.g., sodium citrate, 30 ml) and metoclopramide, 10 mg, IV prior to surgery to reduce the risk of pulmonary acid aspiration.²⁸ The patient should wear lower extremity pneumatic compression devices throughout surgery and postoperatively until the patient begins to ambulate. Regional anesthesia is preferred in pregnant patients even though general anesthesia

presents minimal risk to the fetus from the second trimester onwards. Access to the peritoneal cavity is best achieved through the use of a Hasson trocar.^{14,16} This method avoids the use of the Veress needle, decreasing the risk of uterine or intra-abdominal injury due to blind needle placement. Carbon dioxide pressures should be maintained between 10 mmHg and 15 mmHg.^{14,25} Intraoperative monitoring of maternal end-tidal CO₂ and PaCO₂ is advised to assess acid-base balance.^{15,28} Lastly, a consensus has not been reached on the necessity of intraoperative fetal heart monitoring. The decision to monitor with transvaginal or abdominal ultrasound during the surgical procedure appears to be patient-specific based on severity of illness, age of the fetus, and the level of involvement of consulting obstetricians.^{13,14,28,29}

CONCLUSIONS

This report adds to the growing evidence that laparoscopic cholecystectomy and laparoscopic appendectomy can be performed safely in pregnancy. The procedure should be performed by an experienced laparoscopist. The technique with the Hasson trocar should be utilized. A slight left lateral decubitus position may be advantageous. Insufflation pressures should be kept below 15 mmHg. Any manipulation of the uterus should be avoided. There is some concern that two patients in our series did deliver pre-term, but the ultimate outcomes were favorable for both mother and child.

References:

- Halvorsen AC, Brandt B, Andreasen JJ. Acute appendicitis in pregnancy: complications and subsequent management. *Eur J Surg*. 1992;158:603-606.
- Morrell DG, Mullins JR, Harrison PB. Laparoscopic cholecystectomy during pregnancy in symptomatic patients. *Surgery*. 1992;112(5):856-859.
- Scott LD. Gallstone disease and pancreatitis in pregnancy. *Gastroenterol Clin North Am*. 1992;21(4):803-815.
- Weber AM, Bloom GP, Allan TR, Curry SL. Laparoscopic cholecystectomy during pregnancy. *Obstet Gynecol*. 1991;78(5):958-959.
- Gurbuz AT, Peetz. The acute abdomen in the pregnant patient: is there a role for laparoscopy? *Surg Endosc*. 1997;11:98-102.
- Lanzafame RJ. Laparoscopic cholecystectomy during pregnancy. *Surgery*. 1995;118:627-633.
- Lemaire BMD, van Erp WFM. Laparoscopic surgery during pregnancy. *Surg Endosc*. 1997;11:15-18.
- Wishner JD, Zolfaghari D, Wohlgemuth SD, Baker JW, Hoffman GC, Hubbard GW, Gould RJ, et al. Laparoscopic cholecystectomy in pregnancy: a report of 6 cases and review of the literature. *Surg Endosc*. 1996;10:314-318.
- O'Connor LA, Kavena CF, Horton S. The Phoenix Indian Medical Center experience with laparoscopic cholecystectomy during pregnancy. *Surg Lap Endosc*. 1996;6(6):441-444.
- Curet MJ, Vogt DA, Schob O, Qualls C, Izquierdo LA, Zucker KA. Effects of CO₂ pneumoperitoneum in pregnant ewes. *J Surg Res*. 1996;63:339-344.
- Friedman RL, Friedman IH. Acute cholecystitis with calculous biliary duct obstruction in the gravid patient. *Surg Endosc*. 1995;9:910-913.
- Edelman DS. Alternative laparoscopic technique for cholecystectomy during pregnancy. *Surg Endosc*. 1994;8:794-796.
- Steinbrook RA, Brooks DC, Datta S. Laparoscopic cholecystectomy during pregnancy: review of anesthetic management, surgical considerations. *Surg Endosc*. 1996;10:511-515.
- Camitalo JB, Lynch D. Laparoscopic cholecystectomy in the pregnant patient. *Surg Laparosc Endosc*. 1994;4(4):268-271.
- Amos JD, Schorr SJ, Norman PF, et al. Laparoscopic surgery during pregnancy. *Am J Surg*. 1996;171:435-437.
- Eldering SC. Laparoscopic cholecystectomy in pregnancy. *Am J Surg*. 1993;165:625-627.
- Pucci RO, Seed RW. Case report of laparoscopic cholecystectomy in the third trimester of pregnancy. *Am J Obstet Gynecol*. 1991;165:401-402.
- Bennett TL, Estes N. Laparoscopic cholecystectomy in the second trimester of pregnancy, a case report. *J Reprod Med*. 1993;38:833-834.
- Nezhat FR, Tazuke S, Nezhat CH, Seidman DS, Phillips DR, Nezhat CR. Laparoscopy during pregnancy: a literature review. *JSLS*. 1997;1:17-27.
- Laine S, Rantala A, Gullichsen R, Ovaska J. Laparoscopic appendectomy—is it worthwhile? A prospective, randomized study in young women. *Surg Endosc*. 1997;11:95-97.
- Mazze RI, Bengt K. Appendectomy during pregnancy: a Swedish Registry study of 778 cases. *Obstet Gynecol*. 1991;77(6):835-840.
- Fallon WF, Newman JS, Fallon GL, Malangoni MA. The surgical management of intra-abdominal inflammatory conditions during pregnancy. *Surg Clin North Am*. 1995;75(1):15-31.
- Curet MJ, Allen D, Josloff RK, et al. Laparoscopy during pregnancy. *Arch Surg*. 1996;131:546-551.

24. Schreiber JH. Laparoscopic appendectomy in pregnancy. *Surg Endosc.* 1990;4:100-102.
25. Wilson RB, McKenzie RJ, Fisher JW. Laparoscopic cholecystectomy in pregnancy: two case reports. *Aust NZ J Surg.* 1994;64:647-649.
26. Reedy MB, Galan HL, Richards WE, Preece CK, Wetter PA, Thomas JK. Laparoscopy during pregnancy: a survey of laparoendoscopic surgeons. *J Reprod Med.* 1997;42:33-38.
27. Reedy MB, Kallen B, Kuehl TJ. Laparoscopy during pregnancy: a study of five fetal outcome parameters with the use of the Swedish Health Registry. *Am J Obstet Gynecol.* 1997;177:673-679.
28. Martin IG, Dexter SPL, McMahon MJ. Laparoscopic cholecystectomy in pregnancy: a safe option during the second trimester? *Surg Endosc.* 1996;10:508-510.
29. Gianopoulos JG. Establishing the criteria for anesthesia and other precautions for surgery during pregnancy. *Surg Clin North Am.* 1995;75:1:33-45.
30. Reddy M, Galan H, Richards W, Keuhl T. Laparoscopy during pregnancy: a survey of the society of the Society of Laparoendoscopic Surgeons. *Am J Obstet Gynecol.* 1995;172:289.

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