

Laparoscopic surgery in pregnant patients with acute abdomen



Ann. Ital. Chir., 2015 86: 137-142
pii: S0003469X15023246

Pinar Cigdem Kocael, Osman Simsek, Kaya Saribeyoglu, Salih Pekmezci, Ertugrul Goksoy

Department of General Surgery, Cerrahpasa Medical Faculty, Istanbul University, Istanbul, Turkey

Laparoscopic surgery in pregnant patients with acute abdomen

AIM: Notwithstanding the significant advantages compared to open surgery, laparoscopic surgery was considered to be contraindicated in pregnant patients. Currently, there are opposing views on the safety of laparoscopic surgery during pregnancy, especially in last trimester. The aim of this study was to examine feasibility of laparoscopic surgery in pregnant women with acute abdomen.

PATIENTS AND METHODS: We retrospectively reviewed records of all patients who were admitted to the Emergency Department of Cerrahpasa Medical Faculty between January 1995 and January 2013. All clinical data of pregnant patient who underwent laparoscopic surgery were analyzed including inpatient records, operative reports, pathology records, and delivery information.

RESULTS: Fourteen pregnant patients (mean gestational age 19.2 weeks, ranged from 9 to 33 weeks) who underwent laparoscopy for appendectomy (n=11), cholecystectomy (n=2), and diagnostic reasons (n=1) were included. Average time of delivery was 37.4 gestational weeks (range 35-40 weeks). Two patients had preterm labor. No complications such as uterine injury, fetal death, or maternal mortality were encountered during laparoscopic procedures.

CONCLUSION: Laparoscopic surgery can be safely performed at all trimesters of pregnancy. Laparoscopy may be useful in differentiation of acute abdominal pain in pregnancy and may decrease fetal loss due to delay in diagnosis. shorter operative time reduces negative effects of surgery on mother and fetus.

KEY WORDS: Acute abdomen, Laparoscopy, Pregnancy

Introduction

Acute appendicitis and symptomatic cholelithiasis are the most common causes of non-obstetric surgical emergency in pregnancy. The incidence of acute appendicitis is 0.13% in pregnancy, being similar to that in non-preg-

nant women ¹. However, the main problem in pregnant patients is that there is a high risk of serious complications such as perforation of appendicitis, which may result in fetal loss. Compared to a rate of 1.5% in uncomplicated acute appendicitis, the rate of fetal loss is 20% in perforated appendicitis and up to 37.5% in generalized peritonitis ².

It is thought that pregnancy represents a predisposing factor for gallbladder disease particularly in the last two trimesters due to increased secretion of cholesterol and the effect of progesterone associated with impaired gallbladder motility. The incidence of symptomatic biliary tract disease is 0.16% in pregnancy and about 40% of symptomatic patients require cholecystectomy ³⁻⁵. The rate of fetal loss is 5% for cholecystectomy ⁶. In acute biliary pancreatitis, this rate increases to 60%, with 15% of maternal mortality ⁷.

Pervenuto in Redazione Agosto 2014. Accettato per la pubblicazione Novembre 2014

Correspondence to: Dr. Pinar Cigdem Kocael, Department of General Surgery, Cerrahpasa Medical Faculty, Istanbul University, Istanbul Üniversitesi, Cerrahpasa Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, 34098 Istanbul, Turkey (e-mail: pkocael@yahoo.com)

Until quite recently, it was believed that laparoscopy was contraindicated in pregnant women because it would increase the incidence of fetal loss by reducing uterine and fetal blood flow. A controversy still exists about the safety of laparoscopic surgery during pregnancy⁸⁻¹¹. This study aimed to investigate the feasibility of laparoscopy in pregnant women with acute abdomen.

Patients and Methods

After getting approval of the local ethics committee, we retrospectively reviewed medical records of all patients who were admitted to the Emergency Department of Istanbul University Cerrahpasa Medical Faculty between January 1995 and January 2013. The medical records of 55 pregnant women who were examined for acute abdomen and underwent surgical treatment were evaluated. Of those 14 pregnant women who underwent laparoscopic surgical treatment were evaluated further using their hospital files, operative reports, pathology records, and delivery records. Data on patients whose delivery was performed at another institution were obtained by telephone interviews.

Fetal heart rates were evaluated during obstetric examination in all patients immediately before and after laparoscopic procedure. Tocolysis was not a routine treatment. However, tocolysis was performed in two patients (patients no 6, 10) for their treatment and in five patients for prophylaxis on the advice of the obstetrician.

All laparoscopic procedures were performed under general anesthesia. Trocar placement was made according to the height of the uterus. The first trocar entry was pre-

ferred under and above the umbilicus in pregnancies up to 18 weeks and over, respectively. In one patient with 13 weeks of pregnancy (patient No. 2), trocar entry was made above the umbilicus at the discretion of the surgeon. In patients with acute appendicitis and after the latter half of the second trimester, the upper right quadrant was used to ensure adequate visualization. A Veress needle was used for the first access to the abdomen in six patients. Pneumoperitoneum was created at an intra-abdominal pressure of 10-12 mmHg. Other trocars were placed in the abdomen according to the height of the uterus. Appendectomy and cholecystectomy were performed with standard procedures.

For antibiotic prophylaxis, cefazolin sodium or ampicillin-sulbactam was used in all patients but one who received piperacillin-tazobactam due to perforation of appendicitis. Ceftriaxone-metronidazole was post-operatively started in a patient with pelvic inflammatory disease.

Results

A total of 14 pregnant women who had laparoscopy during their pregnancy for acute abdomen were included. The mean age of patients was 27 years. The duration of pregnancy ranged from 9 to 33 weeks (mean 19.21 weeks). Four patients were in the first trimester, eight patients were in the second trimester, and two were in the third trimester. Laparoscopic procedures included appendectomy in 11 patients, cholecystectomy in two patients, and diagnostic laparoscopy in one patient (Table I).

Laparoscopic appendectomy was performed upon the diagnosis of acute appendicitis with abdominal pain

TABLE I - Clinical and operative features of the pregnant women who had laparoscopy for acute abdomen

Patient no	Age (years)	Gestational age at surgery (weeks)	Initial abdominal access	Operative time (min)	Histo-pathology	Tocolysis	Gestational age at delivery (weeks)
1	26	24	Hasson	55	Phlegmonous appendicitis	prophylactic	39
2	19	13	Veress ⁺	35	Lymphoid hyperplasia	no	40
3	30	33	Hasson	40	Phlegmonous appendicitis	prophylactic	38
4	27	18	Veress	80	Appendicitis	prophylactic	40
5	22	24	Hasson	35	Lymphoid hyperplasia	no	37
6	33	22	Veress	35	Appendicitis	therapeutic	38
7	21	18	Veress	55	Perforated appendicitis	no	36
8	29	20	Veress	20	Phlegmonous appendicitis	prophylactic	39
9	38	9	Veress ⁺	95*	Gangrenous appendicitis	no	
10	27	30	Hasson	100*	Perforated appendicitis	therapeutic	37
11	25	12	Hasson ⁺	50	Appendicitis	no	38
12	28	18	Hasson	75	Chronic Cholecystitis	prophylactic	35
13	25	15	Hasson ⁺	20	Chronic Cholecystitis	no	37
14	28	13	Hasson ⁺	60	—	no	38

Legend: ⁺the site of first trocar placement was preferred under the umbilicus; * conversion to open surgery

localized in the right lower quadrant in nine patients, in the right upper quadrant in one patient, and widespread abdominal pain in one patient. All patients but one had nausea and vomiting. The mean body temperature was 37.2 °C (range 36.2-38.7 °C) and the mean leukocyte count was 13,763 (range 9,550-17,500). All patients underwent ultrasonographic evaluation. It revealed findings suggesting acute appendicitis in nine patients, while in two patients there were no pathological ultrasound findings (patients no 5 and 6).

Laparoscopic appendectomy was successfully completed in nine patients. Two patients required conversion to open surgery due to the breakdown of the device during operation and to auto-amputation of the appendix, respectively (patients no 7 and 8). The mean operative time for successfully completed laparoscopic appendectomies was 43.9 minutes (range 20-70 min). Pathological examination of appendectomy specimens revealed acute appendicitis in nine cases and lymphoid hyperplasia in two cases.

Laparoscopic cholecystectomy was performed in two patients with the diagnosis of cholecystitis. Both patients were admitted with abdominal pain localized in the right upper quadrant, nausea and vomiting, and with body temperatures of 37.2 °C and 37.5 °C and white blood cell counts of 13,600 and 14,800, respectively. Ultrasonographic findings were consistent with cholecystitis. No problems were encountered during laparoscopic cholecystectomy. The mean operation time was 47.5 minutes (20 and 75 min, respectively). Pathological examination showed cholecystitis in both patients.

One patient (patient no 14) was hospitalized with the diagnosis of acute abdomen at 13 weeks of pregnancy. She underwent diagnostic laparoscopy. During exploration, widespread purulent fluid was noted in the pelvic region. After consultation with an obstetrics and gynecology specialist during laparoscopy, the patient was considered to have pelvic inflammatory disease. Laparoscopy was terminated at 60 minutes the fluid was sent for culture.

Overall, no complications such as uterine injury, fetal death, or maternal mortality occurred during laparoscopic procedures. Two patients required postoperative tocolysis due to the increased risk of preterm labor (patients No 6 and 10). These patients were discharged uneventfully after 4 and 7 days of laparoscopic treatment and both had term delivery.

The mean duration to labor was 37.9 weeks (range 35-40 weeks). Two patients had premature labors without any problems with the newborns (Patients no 7 and 12). The follow-ups of all the infants were uneventful.

Discussion

The results of our retrospective study showed that laparoscopic surgery was associated with no maternal or fetal

losses in pregnant patients presenting with acute abdomen, suggesting that laparoscopy can be safely performed at all trimesters of pregnancy.

Acute appendicitis and symptomatic biliary disorders are the leading causes of non-obstetric acute abdomen during pregnancy. Although appendicitis may develop at any time during pregnancy, it has been reported that it most commonly occurs (42%) at the second trimester¹². The incidence of acute appendicitis at the second trimester was also higher (57%) in our cases.

In uneventful pregnancies, loss of appetite and vomiting are usual signs often accompanied by leukocytosis. During the course of pregnancy, the appendix anatomically moves to the right upper quadrant. These natural changes occurring in pregnancy make it difficult to diagnose acute appendicitis or cholecystitis. Delays in diagnosis may result in more complicated forms of the disease, increasing maternal and fetal morbidity and mortality¹³. While the incidence of biliary disease is higher in pregnant women compared to general population, that of appendicitis is similar. However, compared to general population, perforation of appendicitis occurs at a much higher rate during pregnancy (43% vs. 19%)¹⁴, the incidence being even higher in the last two trimesters¹². In our series, perforation was identified in only one patient whose pregnancy was in the second trimester (patient No. 7). Although the rate of fetal loss may be as low as 0 to 1.5% in uncomplicated cases, it rises up to 36% in patients with perforation². This rate may exceed 60% in acute biliary pancreatitis, with a corresponding increase in maternal mortality to about 15%⁷.

Fetal results in pregnant patients seem to be associated with the type of disease (simple / complicated) rather than with the type of surgery (laparoscopic / open)¹⁵. In other words, the main prognostic factor is the time elapsed from the appearance of initial symptoms to surgical interventional procedures¹⁶. Surgical treatment performed within 24 hours after the onset of symptoms is effective in decreasing the risk of maternal / fetal mortality and morbidity¹⁷. Delayed surgical interventions beyond the first 24 hours are associated with a significant increase in the incidence of perforations, which may be up to 66%¹³. In the light of these data, it should be taken into account that surgical exploration is indicated in the presence of clinical suspicion of acute appendicitis in pregnancy¹⁸. Of the pregnant patients with appendicitis, only one patient was found to have perforation and she was operated on within the first 24 hours (patient no 10). No maternal or fetal complications developed in this patient. In our opinion two premature labors (patients No 7 and 12) in our series were associated with specific factors other than surgical procedures. Both patients underwent surgery in the second trimester, long before the normal delivery time (about 18 weeks), and also in the former patient acute abdomen was complicated by perforation.

Currently, laparoscopic procedures are widely accepted in the surgical treatment of patients with acute appendicitis. Laparoscopy offers significant advantages such as smaller incisional site, less postoperative pain, and early return to normal activity^{9,19,20}. With increased experience, its use is becoming growingly popular in pregnant patients. The uterus is exposed to less manipulation during laparoscopic exploration, thus causing less uterine irritability and contractions, reducing the risk for spontaneous abortion, preterm labor, and premature birth. Moreover, fetal distress decreases as a result of reduced need for narcotic analgesics. Laparoscopic exploration of the abdomen allows the diagnosis. Thus, the diagnostic difficulty in pregnant women can be overcome^{19,21}.

The major drawbacks of laparoscopy include possible adverse effects of pneumoperitoneum on the fetus and uterine injuries during performance of surgery. In the first trimester, teratogenicity presents as the major disadvantage, while injury to the uterine is the main disadvantage in the second and third trimesters²². Teratogenicity caused by medications given in the first trimester increases fetal risk²³. The uterus is less vulnerable to traumatic injury in the second trimester due to its relatively smaller volume. Therefore, there is a consensus that laparoscopy is safer in the second trimester²³. Apart from studies maintaining that open surgical techniques are superior in the third trimester¹⁰, there are studies showing that laparoscopic techniques can be applied safely in all the trimesters. However, enhanced experience with laparoscopy is essential to avoid complications^{24,25}. In our series, presentation included each of the three trimesters and no complications occurred during the follow-up and delivery of the patients, especially in those in the third trimester. Therefore our results, with the limitation of patient size, support the application of laparoscopic surgery in the third trimester of pregnancy.

Although a recent study found a significantly higher rate of fetal loss (5.6%) with laparoscopy compared to open appendectomy ($p=0.001$)²⁶, there are studies which show laparoscopy has no effect on fetal loss⁸. Two studies investigating the effect of laparoscopy on increased intra-abdominal pressure and fetal acidosis found no discernable adverse effects on the fetus with a maximal pneumoperitoneum pressure of 10-12 mmHg and laparoscopic time of less than 60 minutes^{27, 28}. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) recommends the pneumoperitoneum pressure to be 10-15 mmHg in pregnant women undergoing laparoscopy⁹. We performed laparoscopic procedures at an intra-abdominal pressure of 10-12 mmHg.

Controversy exists as to the best approach for abdominal access and creating pneumoperitoneum. Although open access is often described in the literature, the routine use of the Veress needle was reported in three studies²⁹⁻³¹. Walsh et al. examined 116 patients undergo-

ing laparoscopic surgery using the Hasson technique in 79 cases and the Veress needle in 37 cases and found no statistically significant difference between these two techniques ($p=0.32$). The authors reported only one complication (2.8%) with the Veress needle²⁶. The SAGES recommends that both methods can be used safely if the height of the uterus is properly considered⁹. Although there are several recent studies using the Veress needle for the first laparoscopic entry^{24,32}, our current clinical approach involves the use of both techniques with consideration of the height of the uterus (the Veress needle in the early stages of pregnancy, and the Hasson technique in the late period). No injury to the uterus was observed associated with the use of the Veress needle.

Trocar placement is usually left to the discretion of the team performing surgery. However, in order to avoid iatrogenic injury to the uterus, trocars must be placed cephalically. After the second trimester, it is recommended that pregnant patients be laid on their left side to avoid uterine compression by the vena cava and to have easier access to the appendix⁹.

Kirshtein et al²³ reported the mean operative time to be 29.9 ± 6.3 minutes for pregnant patients undergoing laparoscopic appendectomy. Of note, operative time for pregnant patients is shorter than that spent for laparoscopic appendectomy in non-pregnant women. The mean duration of laparoscopic surgery in nonpregnant women has been reported to be 60 minutes. Moreover, conversion to laparotomy is reported to be 1%²⁶. This suggests that laparoscopic surgery in pregnant women is mainly performed by experienced surgeons. In our series, the mean operation time for successfully completed laparoscopic appendectomies was 43.9 minutes and the rate of conversion to open surgery was 16.6%. We believe, higher number of patients and increased experience will further reduce the operation duration and conversion rate to open surgery.

Tocolytic agents are often used for prophylactic purposes or to prevent postoperative uterine contractions. No statistically significant difference was reported for preterm delivery rates between the cases with or without prophylactic tocolysis²⁶. Therefore, it has been concluded that routine use of prophylactic tocolytic agents is not necessary unless there are signs of uterine contractions and the risk of premature labor^{9, 26}. We do not use tocolytic agents routinely in our clinic. However seven patients, for whom we used tocolysis due to recommendation of the obstetricians, were the exceptions to our routine practice.

Though the need for continuous perioperative fetal heart monitoring had been emphasized in early studies, this practice was later abandoned due to the difficulty of the procedure and its limited benefits^{33, 34}. Today, monitoring is recommended before and after surgery⁹. Fetal heart monitoring was routinely performed before and after surgery in our study.

Conclusion

Laparoscopic surgery is safe in all trimesters of pregnancy. The advantages of laparoscopy over open surgery have also been justified in pregnant patients. Laparoscopy has unquestionable benefits for the diagnosis of complicated acute abdomen, which is otherwise difficult in pregnant patients. Moreover, in the hands of experienced surgeons, laparoscopy shortens operative time and reduces the negative effects of surgery both on mother and fetus.

Riassunto

Nonostante i significativi vantaggi della chirurgia laparoscopica rispetto a quella laparotomica, essa era considerata controindicata per le donne gestanti. Attualmente si confrontano opinioni contrastanti riguardo alla sicurezza durante la gestazione della chirurgia laparoscopica, specie se nell'ultimo trimestre. Lo scopo di questo studio è quello di valutare la fattibilità della chirurgia laparoscopica in donne gestanti in caso di addome acuto analizzando retrospettivamente la casistica della pazienti ricoverate tra il gennaio 1995 ed il gennaio 2013 presso l'Emergency Department della Cerrahpasa Medical Faculty. Sono stati pertanto analizzati tutti i dati clinici riguardanti le gestanti sottoposte a chirurgia laparoscopica, comprese le cartelle cliniche, gli interventi eseguiti, i reperti anatomopatologici, e le informazioni riguardanti il parto.

Nella casistica sono rientrate 14 donne gravide (in media alla 19,2° settimana di gestazione, distribuite tra 9 e 33 settimane), di cui 11 sottoposte ad appendicectomia laparoscopica, 2 a colecistectomia laparoscopica ed 1 per scopi diagnostici. In media il parto si è espletato alla 37,4° settimana di gestazione (tra la 35° e la 40° settimana). Due pazienti hanno avuto un parto prematuro, ma in nessuna dei casi si sono verificate complicazioni durante le manovre laparoscopiche, e cioè danni all'utero, morti fetali o mortalità materna.

Si conclude che la chirurgia laparoscopica può essere effettuata nel corso di tutti i trimestri della gravidanza, con il possibile vantaggio di una utile diagnosi differenziale in caso di dolori addominali acuti durante la gravidanza, e diminuzioni delle morti fetali dovute a ritardi diagnostici, e che tempi chirurgici più brevi riducono gli effetti negativi sulla madre e sul feto.

References

1. Eryilmaz R, Şahin M, BaşG, Alimoglu O, Kaya B: *Acute appendicitis during pregnancy*. Dig Surg, 2002; 19(1):40-4.
2. Fallon WF Jr, Newman JS, Fallon GL, Malangoni MA: *The surgical management of intra-abdominal inflammatory conditions during pregnancy*. Surgical Clin North Am, 1995; 75(1):15-31.
3. Machado NO, Machado LS: *Laparoscopic cholecystectomy in the third trimester of pregnancy: Report of 3 cases*. Surg Laparosc Endosc Percutan Tech, 2009; 19(6):439-41.
4. Ghumman E, Barry M, Grace P: *Management of gallstones in pregnancy*. Br J Surg, 1997; 84(12):1646-650.
5. Swisher SG, Schmit PJ, Hunt KK, Hiyama DT, Bennion RS, Swisher EM, Thompson JE: *Biliary disease during pregnancy*. Am J Surg, 1994; 168(6):576-81.
6. Lachman E, Schienfeld A, Voss E, Gino G, Boldes R, Levine S, Borstien M, Stark M: *Pregnancy and laparoscopic surgery*. J Am Assoc Gynecol Laparosc, 1999; 6(3):347-51.
7. Kammerer WS: *Nonobstetric surgery in pregnancy*. Med Clin North Am, 1987; 71(3):551-60.
8. Wilasrusmee C, Sukrat B, McEvoy M, Attia J, Thakkestian A: *Systematic review and meta analysis of safety of laparoscopic versus open appendectomy for suspected appendicitis in pregnancy*. B J Surg, 2012; 99(11):1470-478.
9. Pearl J, Price R, Richardson W, Fanelli R: *Society of American Gastrointestinal Endoscopic Surgeons: Guidelines for diagnosis, treatment, and use of laparoscopy for surgical problems during pregnancy*. Surg Endosc, 2011; 25(11):3479-492.
10. Corneille MG, Gallup TM, Bening T, Wolf SE, Brougier C, Myers JG, Dent DL, Medrano G, Xenakis E, Stewart RM: *The use of laparoscopic surgery in pregnancy: Evaluation of safety and efficacy*. Am J Surg, 2010; 200(3):363-67.
11. McGory ML, Zingmond DS, Tillou A, Hiatt JR, Ko CY, Cryer HM: *Negative appendectomy in pregnant women is associated with a substantial risk of fetal loss*. J Am Coll Surg, 2007; 205(4):534-40.
12. Gilo NB, Amini D, Landy HJ: *Appendicitis and cholecystitis in pregnancy*. Clin Obstet Gynecol, 2009; 52(4):586-96.
13. Tamir IL, Bongard FS, Klein SR: *Acute appendicitis in the pregnant patient*. Am J Surg, 1990; 160(6):571-76.
14. Borst A: *Acute appendicitis: Pregnancy complicates this diagnosis*. JAAPA, 2007; 20(12):36-8, 41.
15. de Bakker JK, Dijkstra LM, Donkervoort SC: *Safety and outcome of general surgical open and laparoscopic procedures during pregnancy*. Surg Endosc, 2011; 25(5):1574-578.
16. Miloudi N, Brahem M, Ben Abid S, Mzoughi Z, Arfa N, Tahar Khalfallah M: *Acute appendicitis in pregnancy: Specific features of diagnosis and treatment*. J Visc Surg, 2012; 149(4):e275-e9.
17. Pastore PA, Loomis DM, Sauret J: *Appendicitis in pregnancy*. J Am Board Fam Med, 2006; 19(6):621-26.
18. Kapan S, Bozkurt MA, Turhan AN, Gönenç M, Alış H: *Management of acute appendicitis in pregnancy*. Ulus Travma Acil Cerrahi Derg, 2013; 19(1):20-4.
19. Çarkman S: *Laparoscopy in acute abdomen*. Türkiye Klinikleri J Surg Med Sci, 2005; 1(4):67-72.
20. Machado NO, Grant CS: *Laparoscopic appendectomy in all trimesters of pregnancy*. JSLS, 2009; 13(3):384-90.
21. Holzer T, Pellegrinelli G, Morel P, Toso C: *Appendectomy during the third trimester of pregnancy in a 27-year old patient: Case report of a "near miss" complication*. Patient Saf Surg, 2011; 5(1):11.
22. Halkic N, Tempia-Caliera AA, Ksontini R, Suter M, Delaloye

- JF, Vuilleumier H: *Laparoscopic management of appendicitis and symptomatic cholelithiasis during pregnancy*. Langenbecks Arch Surg, 2006; 391(5):467-71.
23. Kirshtein B, Perry ZH, Avinoach E, Mizrahi S, Lantsberg L: *Safety of laparoscopic appendectomy during pregnancy*. World J Surg, 2009; 33(3):475-80.
24. Upadhyay A, Stanten S, Kazantsev G, Horoupian R, Stanten A: *Laparoscopic management of a nonobstetric emergency in the third trimester of pregnancy*. Surg Endosc, 2007; 21(8):1344-348.
25. Jeong J-S, Ryu DH, Yun HY, Jeong EH, Choi JW, Jang LC: *Laparoscopic appendectomy is a safe and beneficial procedure in pregnant women*. Surg Laparosc Endosc Percutan Tech, 2011; 21(1):24-7.
26. Walsh CA, Tang T, Walsh SR: *Laparoscopic versus open appendectomy in pregnancy: A systematic review*. Int J Surg, 2008; 6(4):339-44.
27. Jackson H, Granger S, Price R, Rollins M, Earle D, Richardson W, Fanelli R: *Diagnosis and laparoscopic treatment of surgical diseases during pregnancy: An evidence-based review*. Surg Endosc, 2008; 22(9):1917-27.
28. Curet MJ: *Special problems in laparoscopic surgery: previous abdominal surgery, obesity, and pregnancy*. Surg Clin North Am, 2000; 80(4):1093-110.
29. Schreiber JH: *Laparoscopic appendectomy in pregnancy*. Surg Endosc, 1990; 4(2):100-02.
30. Lemaire BM, van Erp WF: *Laparoscopic surgery during pregnancy*. Surg Endosc, 1997; 11(1):15-8.
31. Geisler JP, Rose SL, Mernitz CS, Warner JL, Hiatt AK: *Non-gynecologic laparoscopy in second and third trimester pregnancy: obstetric implications*. JSLS, 1998; 2(3):235-38.
32. Palanivelu C, Rangarajan M, Senthilkumaran S, Parthasarathi R: *Safety and efficacy of laparoscopic surgery in pregnancy: experience of a single institution*. J Laparoendosc Adv Surg Tech A, 2007; 17(2):186-90.
33. Moreno-Sanz C, Pascual-Pedreño A, Picazo-Yeste JS, Seoane-Gonzalez JB: *Laparoscopic appendectomy during pregnancy: Between personal experiences and scientific evidence*. J Am Coll Surg, 2007; 205(1):37-42.
34. Curet MJ, Allen D, Josloff RK, Pitcher DE, Curet LB, Miscall BG, Zucker KA: *Laparoscopy during pregnancy*. Arch Surg, 1996; 131(5):546-50.