Non-Gynecologic and Gynecologic Laparoscopic Surgery During Pregnancy

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With the popularity of minimally invasive procedures in the last two decades, laparoscopy has been performed for gynecologic and non-gynecologic conditions during pregnancy. In spite of the fact that laparoscopic approach provides some advantages such as less post operative discomfort; many potential risks including uterine and fetal injury, decreased uterine blood flow due to increased intraabdominal pressure and carbon dioxide absorption can take place during laparoscopy. This review evaluates the literature for laparoscopic surgery during pregnancy.

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Key Words: Laparoscopy, Pregnancy

In the last two decades with the advances and new developments in laparoscopy, which includes many advantages of minimally invasive surgery, it has became more populer in some surgical procedures during pregnancy.[1-15]

Although some surgeons thought that laparoscopy may decrease uterine blood flow, maternal venous return and cardiac output resulting in fetal hypotension and hypoxia; these considerations have not been proved yet with prospective controlled studies.[1,3,4,9] The risk of uterine/fetal damage has not also been elucidated.[2,5,14,15]

In this review we summarize the general knowledge about laparoscopy during pregnancy. We searched MEDLINE with keywords "laparoscopy" and "pregnancy".

Non-Gynecologic Laparoscopic Surgery

Pregnant women can expose to underwent any non-obstetric and gynecologic surgery. Acute appendicitis and symptomatic cholecystolithiasis occurs in 1 to 500 pregnancies,[16] and the most common non-obstetric operations performed in pregnancy are cholecystectomy and appendectomy.[2,3,4]

Experiences in laparoscopic surgery performed during pregnancy have increased gradually each year. Rollins et al reported 31 laparoscopic cholecystectomies in pregnant women (3 in first trimester, 19 in second trimester and 9 in third trimester). They reported that obstetric complications were not seen more frequently compared with pregnant women who did not have any surgery. And they reported that laparoscopy become the first choice for cholecystectomies in pregnant women.[2] Buser KB reported 11 laparoscopic surgery (10 cholecystectomy, 1 appendectomy and reduction of ovarian torsion) during pregnancy. In one of 11 laparoscopies, an uterine perforation occurred during operation with 10 mm port canula. But in this case no fetal injury was observed and the patient successfully delivered the baby later in the pregnancy. He thought that laparoscopic operations can be performed safely in pregnant women but surgeons must be skilled well in laparoscopic techniques.[5] Halkic et al reported 11 laparoscopic appendectomies that they performed successfully. They reported no maternal or fetal morbidity and they thought that pregnancy is not a contraindication for laparoscopic appendectomy.[9] Likewise, Palanivelu et al reported 7 laparoscopic appendectomies during pregnancy and they reported that there was no fetal or maternal morbidity and mortality in patients.[10] In addition to appendectomy and cholecystectomy, Anglin et al reported the first successful laparoscopic splenectomy during pregnancy. Operation was performed because of immune thrombocytopenic purpura during the second trimester of pregnancy and after a short hospital stay the patient was discharged home.[11]

Some authors compared laparoscopy and open surgery with respect to surgical complications and pregnancy outcomes. Affleck et al compared 13 open cholecystectomies, 18 open appendectomies and 45 laparoscopic cholecystectomies, 22 laparoscopic appendectomies. They reported that preterm delivery rates were similar in laparoscopy and laparotomy groups (15.8% laparoscopic appendectomy, 11.8% open appendectomy, 11.9% laparoscopic cholecystectomy, 10% open cholecystectomy). But these ratios were slightly higher than normal population and they attributed this to the main illness. In their series they reported no fetal losses, uterine injuries or spontaneous abortions and they suggested both operation may be performed safely and effectively during pregnancy.[3] Curet et al compared 16 laparoscopic surgery (4 appendectomy and 12 cholecystectomy) and 18 laparotomy in first or second trimester of pregnancy. They found that there was no difference in obstetric complications between two

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group. And they suggest that laparoscopic surgery is a safe method for cholecystectomy in pregnant patients.[4] Bell RH compared 20 patients with laparoscopic cholecystectomy in pregnancy with open cholecystectomy. He reported that laparoscopic group had fewer premature contractions and fetal distress. And laparoscopy has lower risk of wound infection and post operative pain.[6]

Table 1 shows a conclusion of 28 small series of a total of 361 patients who underwent nongynecologic laparoscopic surgery during pregnancy.[3,4,5,9,10,11,17-38]

Table 1. Non-gynecologic laparoscopic operations during pregnancy

Author	**Trimester**	Type of Operation	Number of Cases	**Follow-up**
Affleck et al.[3]	1st, 2nd, and 3rd	45 Chol., and 22 Appen.	67	1 conversion to open surgery. No important differences in birth data.
Andreoli et al.[19]	2nd	5 Appen., 5 Chol.	10	1 premature contraction resolved with tocolysis.
Anglin et al.[11]	2nd	Splenectomy	1	Uneventful
Auabara and Sirinek [20]	1st, 2nd, and 3rd	Chol.	20	1 spontaneous abortion
Buser[5]	1st, 2nd, and 3rd	10 Chol., 1 Appen.	11	1 uterin perforation with no fetal injury
Carver et al.[21]	1st and 2nd	Appen.	17	2 spontaneous abortion
Conron et al.[22]	1st and 2nd	Chol.,Appen.,and Diagnostic	12	2 spontaneous abortions
Cosenza et al.[23]	1st, 2nd, and 3rd	Chol.	12	2 conversion to open surgery
Curet et al.[4]	1st and 2nd	4 Appen., 12 Chol.	16	Uneventful
Daradkeh et al.[24]	1st, 2nd, and 3rd	Chol.	20	Uneventful
Geisler et al.[25]	2nd and 3rd	6 Chol., 2 Appen., and 1 Diagnostic	9	Tocolysis started in 5 patients. No preterm labor
Gouldman et al.[26]	1st and 2nd	Chol.	8	Uneventful
Gurbuz and Peetz[27]	1st, 2nd, and 3rd	10 Chol., 5 Appen.	15	Uneventful
Halkic et al.[9]	2nd and 3rd	11 Appen., 5 Chol.	16	Uneventful
Lanzfame[28]	2nd and 3rd	Chol.	5	Uneventful
Lyass et al.[29]	1st, 2nd, and 3rd	Appen.	11	Uneventful
Moreno-Sanz et al.[30]	1st and 2nd	Appen.	6	Uneventful
Morrell et al.[31]	2nd and 3rd	Chol.	5	Uneventful
Muench et al.[32]	2nd and 3rd	Chol.	16	3 premature contraction resolved with tocolysis, 2 conversion to open surgery
O'Connor et al.[33]	1st and 2nd	Chol.	10	Uneventful, except for 1 conversion to an open surgery at 26 weeks of gestation due to size of the gravid uterus.
Palanivelu et al.[10]		Appen.	7	Uneventful
Patel et al.[34]	1st and 2nd	Chol.	8	Uneventful
Rizzo [35]	2nd and 3rd	5 Chol., 3 Appen.	8	Uneventful
Soper et al.[17]	2nd	Chol.	5	Uneventful
Steinbrook et al.[36]	1st, 2nd, and 3rd	Chol.	10	Uneventful
Sungler et al.[37]	2nd and 3rd	Chol.	9	Uneventful
Wischner et al.[18]	2nd	Chol.	6	Uneventful
Wu JM et al.[38]	1st, 2nd, and 3rd	Appen.	11	Uneventful

PROM=Premature rupture of membranes; IUFD=Intrauterine fetal death.

Gynecologic Laparoscopic Surgery

During pregnacy adnexal mass could be established in 1 of 600 live births.[1] Most of the masses are corpus luteum cysts or benign cystic teratomas and malignancy may be in 2%-5% of the patients.[1,12] These masses have been generally disappeared spontaneously by the time. If they persist into the second trimester, they should removed to prevent rupture or torsion during pregnancy and to rule out malignancy. Laparoscopy can be performed instead of laparotomy to achieve this aim. Also in emergency conditions such as adnexal torsion and ovarian cyst ruptur, laparoscopy may be preferred to laparatomy for early diagnosis and primary treatment of pathology.

Mashiach et al reported 12 torsion of hyperstimulated ovary which were treated with laparoscopic surgery. They reported that there were no complications and ovaries in all cases were saved succesfully.[13] Lenglet et al reported 26 pregnant women who underwent laparoscopy because of persistent adnexal mass, ovarian cysts having suspicion of malignancy or cysts with complications. Twelve patients were in the first trimester, 13 in second and 1 in third trimester. They performed 11 cystectomy, 7 adnexectomy and 1 oophorectomy, 6 aspiration and cyst wall biopsi and 1 ovarian torsion removal with laparoscopy. And they reported that in all patients obstetrical outcomes were good, and laparoscopic management of adnexal masses is safe for both mother and fetus.[14] Yuen et al reported 67 laparoscopic adnexal mass removal in second trimester. They reported no intraoperative or postoperative complications. Except one patient (spontaneous abortion after 6 weeks), all women had their baby without any pregnancy complication and they reported that laparoscopic surgery is safe when performed by experienced surgeons.[15]

In Table 2, we analyze 15 small series of 285 women who underwent laparoscopic surgery due to adnexial masses during pregnancy.[1,13,14,15,32,39-48]

Table 2. Gynecologic laparoscopic operations during pregnancy

Author	Trimester	Type of operation	Number of Cases	Follow-up
Akira et al.[40]	1st and 2nd	Gasless laparoscopic ovarian cystectomy	17	No abortions or preterm deliveries
Andreoli et al.[19]	1st, 2nd, and 3rd	Ovarian cystectomy	7	Uneventful. Except one irregular uterine contractions resolved with tocolytics. One patient delivered at 35 weeks
Bider et al.[41]	1st and 2nd	Torsion of hyperstimulated adnexa	6	Uneventful
Lenglet et al.[14]	1st, 2nd, and 3rd	11 Cystectomy, 7 Adnexectomy, 1 Oophorectomy, 6 Cyst aspiration and biopsy, 1 Ovarian torsion removal	26	3 conversion to laparotomy
Mashiach et al.[13]	1st and 2nd	Torsion of hyperstimulated adnexa	12	2 missed abortions, one PROM (with IUFD) at 25 weeks, 2 ongoing cases
Mathevet et al.[39]	1st, 2nd, and 3rd	Cystectomy	48	1 fetal loss 4 days after
Moore et al.[42]	2nd	Removal of adnexal masses	14	Uneventful
Morice et al.[43]	1st and 2nd	4 Untwisting followed by puncture, 1 Cystectomy, 1 Untwisting	6	Uneventful
Parker et al.[44]	1st and 2nd	Cystectomy	12	Uneventful
Shalev and Peleg [45]		Aspiration and detorsion	10	Pregnancy unaffected
Shalev [46]	1st and 2nd	Ovarian cyst unwinding	4	Positive outcomes
Soriano et al.[47]	1st	Management of adnexal masses	39	5 1st trimester miscarriages, 2 congenital malformations
Step et al.[48]	2nd	8 Cystectomy, 2 Oophorectomy, 1 Exploratory lap.	11	Uneventful
Yuen et al.[1]	2nd	Cystectomy	6	Uneventful
Yuen et al.[15]	2nd	55 Cystectomy, 9 Oophorectomy, 3 Fenestration	67	2 conversion to laparotomy

PROM=*Premature Rupture Of Membranes;* ***IUFD=****Intrauterine Fetal Death*

Discussion

Pregnancies could be complicated by any non-obstetric surgical problems particularly appendicitis, symptomatic cholelithiasis, and adnexal masses. In some cases immediate surgical intervention must be performed to prevent advers outcomes for mother and fetus. Because of the enlarged uterus and displacement of the appendix and, leukocytosis is commonly a normal finding during pregnancy, diagnosis of appendicitis is very difficult.[7,8] If perforation occurs fetal mortality increases dramatically, so that, the diagnosis should be made promptly and surgery should performed before perforation. But during pregnancy surgical intervention could delay because of the fear of negative laparotomy. With laparoscopic approach it could be easier to perform diagnostic laparoscopy rather than laparotomy and when indicated appendectomy could performed before perforation. In contrast to acute appendicitis, biliary colic or acute cholecystitis should be firstly treated medically during pregnancy.[17,49,50] But if conservative management is not successful, than cholecystectomy is indicated.[18]

In the last 10 years, a substantial advances of laparoscopic surgery has been came into existence for pregnant women. In 1997 Amos et al reported 7 pregnant patients underwent laparoscopic surgery and there were 4 fetal deaths (3 in first postoperative week, one 4 weeks postoperatively). And 5 women underwent laparotomy, 4 progressed to term and 1 was lost to follow up.[51] But with the development of improved anesthesiologic techniques and of new devices designed for laparoscopic use, the results were changed. Today laparoscopy is being performed with increasing frequency during pregnancy. This increased frequency resulted from previous studies and case reports revealing the safety and efficacy of laparoscopy during pregnancy.[2,5,9,15] The advantages of laparoscopic approach includes early return of bowel function, early ambulation, short hospital stay, rapid return to normal activity, low rate of wound infection and hernia, less pain and reduced narcotic use, minimal manipulation of the uterus that causes less uterine irritability, spontaneous abortion, preterm labor and premature delivery.[52]

Direct uterine trauma, decreased uterine blood flow due to the pneumoperitoneum, CO_2 absorption and anesthesic drugs that could be toxic for fetus are the possible complications for laparoscopy. To avoid direct uterine trauma, the abdominal wall should be elevated while the Veress needle or trocar inserted or the trocar could be inserted by an open technique. Intraabdominal pressure level should be lower than 15 mm Hg to minimize the decrease in venous return and cardiac output which will results with reduction of uteroplacental blood flow.[53,54] There is no evidence to support any effect of CO_2 on the human fetus. In animal studies, fetal response to CO_2 was found minimal, and there was no important adverse effects on the placental perfusion and blood gases.[55] Most of anesthetic drugs, muscle relaxants and morphine related drugs are not teratogenic or toxic for the fetus and they can be used during pregnancy.[56]

The safest time for laparoscopy is the second trimester of pregnancy and a gestational age of 26 to 28 weeks has been considered the upper limit by some authors.[51,57] But in some studies it was demonstrated that also in the third trimester laparoscopy can be performed safely[58] and there are a lots of studies that reports successful operations and outcomes during first trimester. So laparoscopic procedures have been performed safely during all trimesters of pregnancy. Prophylactic tocolysis is not generally recommended for the prevention of preterm labor[59,60] but in some institutes post operative prophylactic ketoprofen is used as a tocolytic.[39]

Conclusion

As a result of the studies in the literature it can be suggested that pregnancy is not a contraindication for laparoscopy and laparoscopic surgery during pregnancy is generally associated with good fetal and maternal outcome with a trained surgical team.

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