Original Article

A Safe Laparoscopic Approach for Ovarian Tumors during Pregnancy

Junki Imaizumi, Kanako Yoshida*, Hiroki Noguchi, Takaaki Maeda, Takeshi Kato, Takeshi Iwasa

Department of Obstetrics and Gynecology, Graduate School of Biomedical Sciences, Tokushima University, Tokushima, Japan

Abstract

Objectives: Surgery for pregnant women with ovarian tumors poses the risk of uterine irritation. We aimed to demonstrate the superiority of our laparoscopic technique over conventional methods and to compare the outcomes of laparoscopy with those of laparotomy for ovarian tumors during pregnancy.

Materials and Methods: This retrospective study included 50 patients undergoing procedures for ovarian tumors during pregnancy at the Tokushima University Hospital between January 2005 and December 2021. We compared surgical outcomes between laparoscopic procedures and laparotomy, along with complications. In addition, we compared the frequency of uterine stimulation with the conventional trocar position to that with the currently used trocar position in laparoscopic surgery.

Results: Forty patients in the laparoscopy group and 10 in the laparotomy group underwent procedures. The laparoscopy group had less bleeding (16.4 ± 28.8 vs. 58 ± 72.2 mL, $P < 0.05$) and shorter hospital stays (7.6 ± 1.7 vs. 12.8 ± 13.1 days, $P < 0.05$) compared with those of the laparotomy group. The outcomes showed no significant differences between groups. All laparoscopies and laparotomies were successful and without complications. Furthermore, the current trocar position tended to stimulate the uterus less frequently.

Conclusion: The results suggested that, compared to laparotomy, laparoscopy for ovarian tumors during pregnancy had better outcomes. The trocar position in our technique allows for easy operation of ovarian tumors without interference by forceps or cameras, resulting in minimal irritation of the uterus. Our original laparoscopic method may be safer with superior outcomes over the conventional method.

Keywords: Laparoscopy, laparotomy, pregnancy, trocar position

Introduction

Approximately 1% of pregnant women are diagnosed with ovarian tumors via ultrasonography.[1] If masses are large or suspected of malignancy, intervention using laparoscopy or laparotomy is necessary to prevent rupture or torsion.[2]

Recently, laparoscopy has been recognized as the most efficient treatment for benign ovarian tumors because of better outcomes;[3-5] however, concerns regarding pelvic cavity manipulation, miscarriage due to uterine irritation, and hypercarbia exist.[6] Therefore, the most optimal treatment has yet to be concluded.[7] Thus, this study aimed to develop an original technique for the laparoscopic treatment of ovarian cysts during pregnancy and compare its outcomes with those of laparotomy.

Materials and Methods

Ultrasonography was used to diagnose ovarian tumors early in pregnancy and magnetic resonance imaging (MRI) after 12 weeks of gestation. Laparotomy was selected for cases in which malignancy was suspected, severe adhesion was presumed, or laparoscopic surgery was expected to be difficult due to the large tumor size.

Article History:
Submitted: 23-Oct-2022
Revised: 06-May-2023
Accepted: 01-Jun-2023
Published: 23-Feb-2024

Access this article online

Quick Response Code:

Website: https://journals.lww.com/gmit

DOI: 10.4103/gmit.gmit_119_22

Address for correspondence: Dr. Kanako Yoshida, 3-18-15, Kuramoto-cho, Tokushima 770-8503, Japan.
E-mail: yoshida.kanako@tokushima-u.ac.jp

How to cite this article: Imaizumi J, Yoshida K, Noguchi H, Maeda T, Kato T, Iwasa T. A safe laparoscopic approach for ovarian tumors during pregnancy. Gynecol Minim Invasive Ther 2024;13:19-24.

Endotracheal general anesthesia was performed for both laparoscopy and laparotomy procedures, and propofol (Propofol Intravenous Injection 1% "Maruishi,"® Maruishi Pharmaceutical Corporation) was used for induction of anesthesia. For maintenance, inhalation anesthesia drugs such as Sevoflurane (Sevoflurane inhalation anesthetic liquid "NIKKO,"® NIKKO Pharmaceutical Corporation), fentanyl (Fentanyl Injection "Terumo,"® TERUMO Corporation), and rocuronium (Rocuronium Bromide Intravenous Solution "Maruishi"® Maruishi Pharmaceutical Corporation) were used. Patients undergoing laparoscopy were placed in the supine position with a head-down tilt. The tilt angle θ was an angle in the range of 12–14, and intra-abdominal pressure was set at 8 mmHg. For procedures involving pregnant women, it is our protocol to change the trocar position as shown in Figure 1b and c; this trocar placement is our original method for operating easily and safely.

We reviewed all patients who underwent surgery for ovarian tumors during pregnancy at the Tokushima University Hospital between January 2005 and December 2021. This retrospective study followed the guidelines of the Declaration of Helsinki, and was approved by the Ethics Committee of Tokushima-University Hospital (Approval number 4238). Informed written consent was taken from all the patients. Data collection included surgical approach (laparoscopy and laparotomy), maternal age, site of lesions, gestational age at surgery, operative time, tumor diameter, bleeding volume, hospitalization period, adnexal mass pathology, administration period of uterine contraction inhibitors (ritodrine hydrochloride [ritodrine hydrochloride for i.v. infusion "ASKA,"® ASKA Pharmaceutical Corporation] or isoxsuprine hydrochloride [Duvadilan intramuscular injectio®, Alfresa Pharma Corporation] by intravenous infusion), and pregnancy outcome.

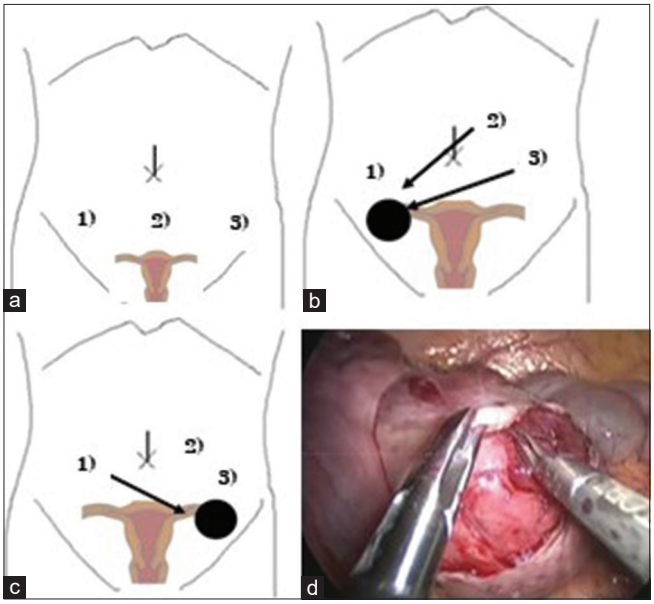

Figure 1: Trocar placement, 1) operated by the assistant, 2) and 3) operated by the surgeon. Black arrows indicate the direction of forceps insertion. (a) trocar position during nonpregnancy, (b) right ovarian cyst during pregnancy, (c) left ovarian cyst during pregnancy, (d) sixteen weeks of gestation with a right ovarian cyst, we placed the trocar as shown in (b)

In addition to collecting data on the outcomes of both procedures, complications were examined. The uterine stimulation frequency was measured when using the conventional trocar position (n = 5) and compared with that measured when using the current trocar position (n = 5) during cystectomy.

Statistical analyses were performed using Excel statistical software (Microsoft, Redmond, WA, USA), and the Mann–Whitney test was used. Data are shown as mean ± standard error.

Results

There were 40 cases of laparoscopy and 10 of laparotomy for ovarian tumors during pregnancy. All patients assigned to laparoscopy underwent procedures without conversion to laparotomy, and only one underwent a small laparotomy owing to a large ovarian cyst. All surgeries were performed without complications such as massive bleeding requiring blood transfusion, peripheral organ damage, thrombosis, conversion from laparoscopic to open surgery, reoperation, miscarriage, or fetal death.

The two groups' patient characteristics and perioperative data are shown in Table 1a. There were no significant differences in patient age, gestational age at surgery, or tumor diameter. The laparoscopy group had less estimated blood loss and shorter postoperative hospital stays than the laparotomy group. However, the two groups found no significant differences between operating time and period of uterine contraction inhibitor administration.

Table 1b shows the pathologies of the ovarian cysts in two groups. Teratoma was the most frequent histological type among both groups. In the laparoscopy group, one case was diagnosed with a borderline malignancy after surgery; the patient received a follow-up examination without additional surgery. In the laparotomy group, one case was diagnosed with a carcinoma; the patient underwent emergency surgery for tumor rupture, and only an adnexectomy was performed. She then interrupted her pregnancy and underwent radical surgery for ovarian cancer as its histological type was found to be clear cell carcinoma after the initial surgery.

Table 1c shows pregnancy outcomes. There were no significant differences between rates of preterm delivery and miscarriage. All procedures were completed without injury to the gravid

Table 1: Patient characteristics and pregnancy outcomes

a. Patient characteristics and perioperative dates			
	Mean±SE		*P*
	Laparoscopy (*n*=40)	Laparotomy (*n*=10)	
Age (years old)	29.0±0.7	30.3±1.6	NS
Site lesion	Unilateral 31 cases Bilateral 9 cases	Unilateral 8 cases Bilateral 2 cases	
Gestational age (week)	13.7±0.3	15.1±0.8	NS
Tumor diameter (cm)	6.84±0.35	8.3±0.84	NS
Operating time (min)	95.9±4.15	101.3±17.8	NS
Bleeding amount (mL)	16.4±4.68	58.0±22.9	<0.05
Hospitalization period (days)	7.6±0.3	12.8±4.1	<0.05
Administration period of uterine contraction inhibitors (days)	1.70±0.33	2.60±0.79	NS
	Laparoscopy (*n*=40)	**Laparotomy (*n*=10)**	
b. Pathologies of ovarian tumors			
Teratoma	36	6	
Serous cystadenoma	6	0	
Mucinous cystadenoma	3	1	
Lutein cyst	3	0	
Endometrial cyst	2	2	
Borderline malignant tumor	1	0	
Carcinoma	0	1	
Others	0	2 (fibroma, paraovarian cyst)	
c. Pregnancy outcomes			
Delivery (>37 weeks)			
Spontaneous vaginal	18	6	
Cesarean section	4	0	
Premature delivery	2	0	
Abortion	1*	2†	
Threatened abortion/premature delivery	0	0	
Unknown	15	3	

*One case experienced intrauterine fetal death because of cystic hygroma at 15 week's gestation, †One case experienced spontaneous miscarriage, and one case opted for artificial abortion to prioritize ovarian cancer therapy. NS: Nonsignificant, SE: Standard error

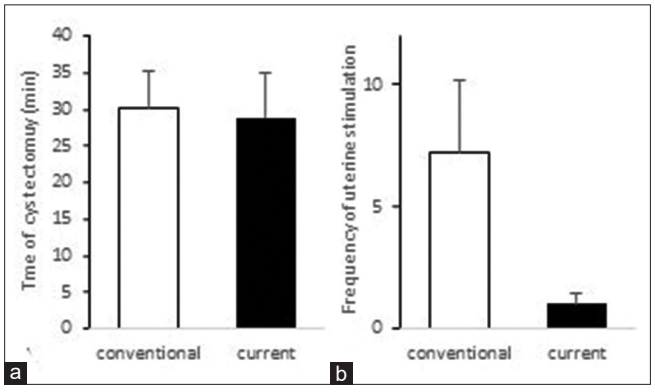

Figure 2: Cystectomy time and frequency of uterine stimulation in the conventional and current trocar positions, Although there was no difference in cystectomy time (a), the frequency of uterine stimulation tended to be less in the current trocar position (b)

uterus or loss of pregnancy. In the laparoscopic group, one case had an abortion owing to cystic hygroma. In the laparotomy group, one patient experienced a spontaneous miscarriage, and one chose an artificial abortion to prioritize ovarian cancer therapy. Figure 2a indicates cystectomy time, and Figure 2b shows a tendency to stimulate the uterus less frequently during cystectomy in the current trocar position compared to the conventional trocar position.

Discussion

This study showed that laparoscopic surgery during pregnancy might be safely performed using an original trocar position, with outcomes superior to those of laparotomy.

The most commonly encountered tumors in pregnancy are ovarian tumors,[8] and the most frequent type of ovarian masses are corpus luteum cysts. Serous cystadenomas and dermoid cysts follow in frequency as histological types.[2,8-10] The overall incidence of ovarian tumors during pregnancy is approximately 41 in 1500 pregnancies.[11] However, approximately 80%–95% of ovarian masses with a diameter <6 cm will resolve without intervention during pregnancy; therefore, surgical treatment

is unnecessary for small ovarian masses.[12] Further, these masses are typically benign, and ovarian cancers are observed in only approximately 1 of 25,000 pregnancies.[13] However, some reports list the rate to be as high as 5.9%.[2] If ovarian masses are small and suspected to be benign, operation during pregnancy is not indicated. Nonetheless, if the tumors are larger than 6 cm in diameter, large cysts pose the risks of twisting, rupturing, or leaking. As these events can cause abdominal pain and provoke preterm labor, surgery for benign cysts is occasionally required, even during pregnancy.[2,14]

Accurate assessment of surgical indications is indispensable, and ultrasound imaging is frequently used to diagnose ovarian masses. Several ultrasonographic features are suspicious for malignancy, including the presence of solid components, large multicentric tumors, maximum diameter >6 cm, and a grossly visible internal septum.[15] In this study, MRI scans were used for diagnosis when such findings were present, as they helped us to understand the morphology of the suspected lesion better.[16-19]

Corpus luteum cysts are the most common masses during pregnancy and supply progesterone during the luteal phase of the first two-thirds of pregnancy.[20] These cysts enlarge in early pregnancy and then regress by the 12th week,[21] thus, surgical treatment for corpus luteum cysts is typically unnecessary. However, we performed MRI after 12 weeks based on the possibility of disappearance.

If an ovarian mass was shown to be large or suspected to be malignant according to MRI, we recommended surgical removal,[2] with treatment including tumor enucleation and tubal oophorectomy by laparotomy or laparoscopy.[22] Laparoscopic surgery is currently becoming the standard procedure for benign ovarian cysts. In contrast, laparoscopy during pregnancy was uncommon in the past owing to the limited surgical field and the risk of damaging the enlarged pregnant uterus, which could cause bleeding or miscarriage.[23,24]

Thus far, laparoscopy during pregnancy has been performed successfully. In 2019, Ye *et al*. reported that laparoscopy for pregnant women could reduce the risk of preterm labor, hospital stay, and blood loss compared with laparotomy.[6] In another study, laparoscopy during pregnancy was shown to have a good advantage regarding outcomes such as earlier postoperative ambulation than with open surgery.[25] Thus, many studies have shown that laparoscopy during pregnancy can be performed safely, although it requires more advanced techniques than performance during nongestation periods, as the enlarged uterus limits the operating space. Keeping these in mind, we have introduced some techniques to avoid complications.

In this study, we conducted laparotomy for suspected borderline malignancies or malignancies, and if the tumor was suspected to be benign, laparoscopic surgery was selected. The period of 14–16 weeks' gestation seemed to be most adequate for surgery, as general anesthesia in the first trimester may lead to an increased risk of microcephaly and other nonneural tube defects.[26] In the second trimester, the enlarged uterus makes it more difficult to perform laparoscopic surgery.[27,28] Previous reports on laparoscopy during pregnancy have shown that laparoscopy can be performed safely.[29,30]

When laparoscopy is performed in the pelvic cavity, it is our protocol to place the trocar, as shown in Figure 1a. However, it is difficult to maneuver the forceps during pregnancy as the surgical space is limited by an enlarged uterus. For example, the fundus uteri of patients at 16 gestational weeks extend approximately 4 cm below the umbilicus.[31] At that point, it is difficult to manipulate the forceps because of the large uterus, and the forceps touch the uterus more often, inducing uterine contractions, which can lead to complications.

The method for performing the first puncture for the trocar is an open-entry technique. As for ancillary trocars, the positions are varied depending on the number of weeks of pregnancy, tumor size, and the complexity of the surgery. As the uterus becomes larger during pregnancy, the trocar should be inserted in a more cephalic position than usual. We also place the trocar to allow easy access to the ovarian tumor, as shown in Figure 1b and 1c) of Figure1 operated by the assistant, 2) and 3) of Figure1 operated by the surgeon. In the case of the right ovarian cyst, the insertion position of the surgeon's right-hand forceps is moved to the upper left of the camera port as shown in Figure 1b. We can then manipulate the right-hand forceps on the camera's right side. In the case of the left ovarian cyst, the insertion position of the sub-surgeon's right-hand forceps is moved to the upper position, as shown in Figure 1c. This way, we can reduce stimulation of the uterus and operate the forceps with minimal contact to the uterus and with the same field of view as is afforded during nonpregnancy.

Figure 1d shows surgical images during the trocar placement, as shown in Figure 1b. The right forceps were moved to the camera's right side, and we operated with two forceps sandwiching the camera. Under this arrangement, we could manipulate the forceps with minimal uterine stimulation. If we were to place the trocar, as shown in Figure 1a, we would need to lift up the uterus by forceps, raising the risk of irritating the uterus too much.

The strengths of laparoscopy compared to those of laparotomy during pregnancy have been previously discussed in many reports. In many studies, laparoscopy during pregnancy was shown to have less operative blood loss, reduced postoperative hospital stay, decreased preterm labor, and low

maternal and perinatal morbidity and mortality compared with laparotomy.[6,32] In our study, three cases involved abortion; however, the influence of surgery was not considered relevant. Our results suggested laparoscopy to be as safe as laparotomy as far as fetal effects are concerned. Further, we have been able to reduce the length of hospital stay and blood loss volume by opting for laparoscopy. Although laparoscopic surgery is more difficult because of the enlarged uterus, there was no significant difference in operative time between laparoscopy and laparotomy in this study, and the operative time of laparoscopy tended to be shorter than that with laparotomy. Our original trocar position may have contributed to simplifying the surgery and reducing operative time.

If there was too much uterus stimulation during surgery, the uterine contraction becomes stronger postoperatively. For this reason, we have occasionally used uterine contraction inhibitors. No significant differences were found in the length of procedure time with the use of uterine contraction inhibitors. However, there was a trend in improved uterine contraction with the use of laparoscopy compared to laparotomy. One reason may be that trocar placement may be less irritating to the uterus than conventional trocar placement.

Conclusions

Our results showed that laparoscopic surgery during pregnancy could be safely performed with an original trocar position, and the outcomes of laparoscopy were superior to those of laparotomy. Laparoscopy also had the advantage of decreased blood loss and shorter hospitalization. Furthermore, the surgical scars from laparoscopy were smaller than those from laparotomy, providing patients with good cosmetic results. Therefore, laparoscopic surgery may be confidently selected for women with ovarian tumors, including pregnant women.

However, this study has some limitations. First, it was a retrospective study, not a prospective one. Second, we did not compare the position of trocars. Third, our study was limited by its relatively small sample. Fourth, the patients were expected to be difficult to operate on when laparotomy was chosen, which may have resulted in longer operative time and hospital stay. Therefore, the present study seems to have a selection bias in selecting the surgery method. Fifth, the length of hospitalization may also have been biased because the patients were given uterine contraction inhibitors temporarily after surgery because of the region's characteristics. Maximum consideration is essential to avoid irritating the uterus during laparoscopic surgery for pregnant women, and thus further accumulation of cases is required to evaluate the safety of our operation method fully.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Hong JY. Adnexal mass surgery and anesthesia during pregnancy: A 10-year retrospective review. Int J Obstet Anesth 2006;15:212-6.
2. Hess LW, Peaceman A, O'Brien WF, Winkel CA, Cruikshank DP, Morrison JC. Adnexal mass occurring with intrauterine pregnancy: Report of fifty-four patients requiring laparotomy for definitive management. Am J Obstet Gynecol 1988;158:1029-34.
3. Chen L, Ding J, Hua K. Comparative analysis of laparoscopy versus laparotomy in the management of ovarian cyst during pregnancy. J Obstet Gynaecol Res 2014;40:763-9.
4. Thepsuwan J, Huang KG, Wilamarta M, Adlan AS, Manvelyan V, Lee CL. Principles of safe abdominal entry in laparoscopic gynecologic surgery. Gynecol Minim Invasive Ther 2013;2:105-9.
5. Huang KG, Lee CL. Lee-Huang point 20 years on. Gynecol Minim Invasive Ther 2013;2:103-4.
6. Ye P, Zhao N, Shu J, Shen H, Wang Y, Chen L, *et al.* Laparoscopy versus open surgery for adnexal masses in pregnancy: A meta-analytic review. Arch Gynecol Obstet 2019;299:625-34.
7. Bunyavejchevin S, Phupong V. Laparoscopic surgery for presumed benign ovarian tumor during pregnancy. Cochrane Database Syst Rev 2013;2013:CD005459.
8. Webb KE, Sakhel K, Chauhan SP, Abuhamad AZ. Adnexal mass during pregnancy: A review. Am J Perinatol 2015;32:1010-6.
9. Jacob JH, Stringer CA. Diagnosis and management of cancer during pregnancy. Semin Perinatol 1990;14:79-87.
10. Kim M. Laparoscopic management of a twisted ovarian leiomyoma in a woman with 10 weeks' gestation: Case report and literature review. Medicine (Baltimore) 2016;95:e5319.
11. Palmer J, Vatish M, Tidy J. Epithelial ovarian cancer in pregnancy: A review of the literature. BJOG 2009;116:480-91.
12. Canis M, Rabischong B, Houlle C, Botchorishvili R, Jardon K, Safi A, *et al.* Laparoscopic management of adnexal masses: A gold standard? Curr Opin Obstet Gynecol 2002;14:423-8.
13. Chung A, Birnbaum SJ. Ovarian cancer associated with pregnancy. Obstet Gynecol 1973;41:211-4.
14. Struyk AP, Treffers PE. Ovarian tumors in pregnancy. Acta Obstet Gynecol Scand 1984;63:421-4.
15. Hakoun AM, AbouAl-Shaar I, Zaza KJ, Abou-Al-Shaar H, A Salloum MN. Adnexal masses in pregnancy: An updated review. Avicenna J Med 2017;7:153-7.
16. Hoover K, Jenkins TR. Evaluation and management of adnexal mass in pregnancy. Am J Obstet Gynecol 2011;205:97-102.
17. Aggarwal P, Kehoe S. Ovarian tumours in pregnancy: A literature review. Eur J Obstet Gynecol Reprod Biol 2011;155:119-24.
18. Graham L. ACOG releases guidelines on management of adnexal masses. Am Fam Physician 2008;77:1320-3.
19. Grigoriadis C, Eleftheriades M, Panoskaltsis T, Bacanu AM, Vitoratos N, Kondi-Pafiti A, *et al.* Ovarian cancer diagnosed during pregnancy: Clinicopathological characteristics and management. G Chir 2014;35:69-72.
20. Duncan WC. The inadequate corpus luteum. Reprod Fertil 2021;2:C1-7.
21. Fleischer AC, Boehm FH, James AE Jr. Sonography and radiology of pelvic masses and other maternal disorders. Semin Roentgenol 1982;17:172-81.
22. Pittaway DE, Takacs P, Bauguess P. Laparoscopic adnexectomy: A comparison with laparotomy. Am J Obstet Gynecol 1994;171:385-9.
23. Yuen PM, Yu KM, Yip SK, Lau WC, Rogers MS, Chang A. A randomized prospective study of laparoscopy and laparotomy in the management of benign ovarian masses. Am J Obstet Gynecol 1997;177:109-14.
24. Barnett MB, Liu DT. Letter: Complication of laparoscopy during early pregnancy. Br Med J 1974;1:328.
25. Al-Fozan H, Tulandi T. Safety and risks of laparoscopy in pregnancy. Curr Opin Obstet Gynecol 2002;14:375-9.

26. Auger N, Ayoub A, Piché N. First trimester general anaesthesia and risk of central nervous system defects in offspring. Br J Anaesth 2020;124:e92-4.
27. Friedman JD, Ramsey PS, Ramin KD, Berry C. Pneumoamnion and pregnancy loss after second-trimester laparoscopic surgery. Obstet Gynecol 2002;99:512-3.
28. 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;205:37-42.
29. Kitai T, Yamabe E, Isobe A, Masuhara K, Fukunaga M, Nobunaga T. Successful laparoscopic treatment of small-bowel obstruction in early pregnancy. Gynecol Minim Invasive Ther 2020;9:248-50.
30. Affleck DG, Handrahan DL, Egger MJ, Price RR. The laparoscopic management of appendicitis and cholelithiasis during pregnancy. Am J Surg 1999;178:523-9.
31. Lee CL, Huang KG, Jain S, Wang CJ, Yen CF, Soong YK. A new portal for gynecologic laparoscopy. J Am Assoc Gynecol Laparosc 2001;8:147-50.
32. Yuen PM, Ng PS, Leung PL, Rogers MS. Outcome in laparoscopic management of persistent adnexal mass during the second trimester of pregnancy. Surg Endosc 2004;18:1354-7.