



Original Article

Comparison of single-port and three-port laparoscopic salpingectomy in the management for tubal pregnancy

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Abstract

Background: To compare the short-term outcome of patients undergoing single-port laparoscopic salpingectomy (SP-LS) and conventional three-port laparoscopic salpingectomy (C-LS).

Methods: A retrospective evaluation of 112 patients with tubal pregnancies treated by one surgeon at a single teaching hospital. Among these, 47 patients were treated with SP-LS and the remaining 65 were treated with C-LS.

Results: The characteristics of patients were similar in both groups. There were no statistically significant differences in operative time, estimated blood loss, intraoperative and immediate postoperative complications, and length of hospital stay between both groups. Time to bowel recanalization (6.2 ± 1.0 vs. 7.2 ± 1.4 h, $p < 0.05$) and postoperative visual analog scale for pain scores (3.0 ± 0.5 vs. 3.6 ± 0.6 , $p < 0.005$) were significantly lower in the SP-LS group compared with those in the C-LS group.

Conclusion: Our study demonstrated the feasibility to use the single-port laparoscopic salpingectomy in the management of women with tubal pregnancy, which showed the similar or better outcome compared with the use of conventional three-port laparoscopic salpingectomy.

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Keywords: Laparoscopy; Salpingectomy; Single-port; Tubal pregnancy

1. Introduction

Compared with laparotomy, laparoscopy — a minimally invasive surgery, is associated with less subjectively reported

postoperative pain, rapid postoperative recovery, shorter hospital stay, and better cosmetic results.^{1–5} Nearly all benign gynecological diseases can be performed by laparoscopic surgery.^{2–4}

Ectopic pregnancy is one of the most common emergencies occurred in women during the reproductive age.^{6,7} Women with ectopic pregnancies can be managed by medical, surgical or combination of both therapies successfully.^{8–10} Besides systemic medical treatment with methotrexate, laparoscopic surgery is a treatment of choice in the management of tubal ectopic pregnancies.¹¹ Laparoscopic surgery included

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laparoscopic salpingotomy and laparoscopic salpingectomy.¹¹ Results from the European Surgery in Ectopic Pregnancy (ESEP) study suggested that salpingectomy could be considered in the management of women with tubal ectopic pregnancy who have a healthy contralateral tube, based on the findings of no cost-effectiveness and no significant improvement of future fertility in women with tubal pregnancy who received salpingotomy.^{12,13}

Conventional laparoscopic surgery can be finished either by one, two or three ancillary trocars.^{1–4} Recently, innovations in technology have allowed laparoscopic surgeons to perform the surgery through single-incision approach.^{14–16} One of the most important advances is a development of the multi-channel single-port devices.^{14–16} For tubal pregnancy, Ghezzi is a pioneer who used one trocar laparoscopy in the management of tubal pregnancies.¹⁷ However, it is not really a single wound, because Dr. Ghezzi had an additional wound, located approximately 3 cm above the symphysis in the midline.¹⁷ This accessory wound is for the purpose to insert a straight hand needle for surgery.¹⁷ So far, only a few reports discussed the feasibility of single-port laparoscopy in the management of tubal pregnancies.^{18–22} No reports have been found in Taiwan. The following study was attempted to compare the outcome of women with tubal pregnancies treated either with single-port laparoscopic salpingectomy (SP-LS) or with conventional three-port laparoscopic salpingectomy (C-LS).

2. Methods

2.1. Study population

This retrospective cohort study was designed to evaluate short-term outcome of women with tubal pregnancy performed by one operator (Dr. Sun) between March 2011 and December 2015. Approval for the study was obtained from the hospital's ethics committee. A total of 131 patients diagnosed for tubal pregnancy during the study period were reviewed. Exclusion criteria included the followings: (1) initial treatment by medical treatment; (2) initial treatment by exploratory laparotomy; (3) initial treatment by organ-sparing surgery, such as salpingotomy, local injection of medicine (methotrexate, or etoposide); and (4) absence of pathological diagnosis. Finally, 112 women were analyzed, including 47 women treated with SP-LS and the remaining 65 with C-LS (Fig. 1).

2.2. Surgical technique

All patients were under general anesthesia with endotracheal tube intubation, and placed in the dorsal lithotomy position with a Foley and a uterine manipulator. The operator stood on the left side of the patient. In the SP-LS group, a 2.0-cm transverse umbilical skin incision, and 3.0-cm fasciotomy was done to open the peritoneal cavity and Alexis small wound retractor (Applied Medical, Rancho Santa Margarita, CA, USA) was inserted (Fig. 2). The wrist portion of a sized 6.5 surgical glove was fixed to the outer ring of the wound

retractor and three-channel single port instruments were set up (Fig. 3). The pneumoperitoneum was inflated to 16 mmHg and 5 mm 30-degree scope was used. In the C-LS, three port wounds were established, including one port wound on the umbilicus area, and the second on left upper quadrant area, and the third on the suprapubic area.

The estimated blood loss was calculated after cleaning the hemoperitoneum resulted from tubal pregnancies. Salpingectomy was performed with a bipolar electrosurgical instrument. The specimen was extracted from the umbilical wound. The umbilical fascia and subcutaneous tissue were closed.

2.3. Outcome measurements

The collection of the patient data included age, obstetrics history, operative time, amount of intra-abdominal bleeding, time to flatus, final pathology, estimated blood loss, postoperative pain score, and postoperative analgesic use. Time to flatus, which indicates resumption of normal bowel function as expressed by the presence of bowel sounds and the passage of flatus was recorded by on-duty nurse and verified by the one of the authors (Dr. Sun). Postoperative pain control was provided with meperidine hydrochloride intramuscularly every 4 h as needed within 48 h after operation if the subjects were still during the hospitalization. Nonsteroidal anti-inflammatory drugs were not used within 48 h every 6 h after operation.^{23–27} The accumulated dose was calculated as the summation of all used meperidine per patient during the hospitalization. The pain score determined by visual analog pain scale (VAS) applicable to the patients was used to evaluate postoperative pain after the surgery.^{23–25} All pain assessments were made at rest and finished by on-duty nurse and verified by the operator (Dr. Sun).

2.4. Statistical analysis

Statistical analysis was performed using SPSS 18.0.0 software (SPSS, Chicago, IL, USA). Descriptive statistics are presented as the means and standard deviation or percentages. A two-tailed $p < 0.05$ was considered significant.

3. Results

Forty-seven women in the SP-LS group (27 and 20 at the right and left side, respectively) and 65 patients in the C-LS group (35 and 30 at the right and left side, respectively) were analyzed.

There were no significant differences of the mean age (35.3 ± 5.9 years for the SP-LS group compared with 36.9 ± 6.0 years for the C-LS group, $p = 0.36$), the mean operating time (30.5 ± 4.6 min for the SP-LS group compared with 31.0 ± 5.8 min for the C-LS group, $p = 0.71$), the amount of hemoperitoneum (125.0 ± 56.9 mL for the SP-LS group compared with 335.0 ± 504.0 mL for the C-LS group, $p = 0.11$), and the analgesic use (0.1 ± 0.3 vial for the SP-LS group compared with 0.2 ± 0.4 vial for the C-LS group, $p = 0.38$). Patients in the SP-LS group had statistically

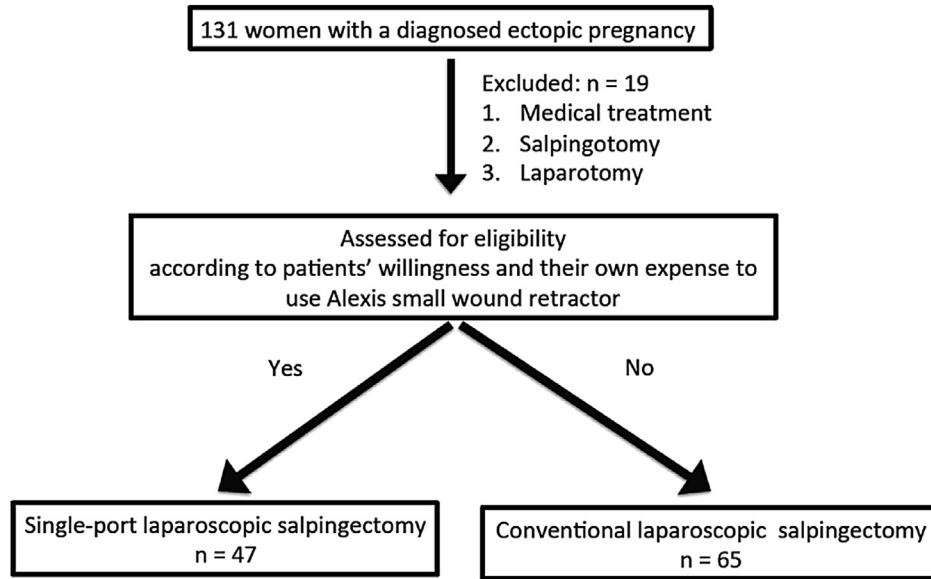


Fig. 1. Cohort flow chart illustrating the inclusion and exclusion criteria of patients in the study.

significantly shorter time to flatus (6.2 ± 1.0 h for the SP-LS group compared with 7.2 ± 1.4 h for the C-LS group, $p = 0.02$) and less pain score (3.0 ± 0.46 for the SP-LS group compared with 3.6 ± 0.6 for the C-LS group, $p = 0.0015$). Nearly all patients were discharged on the next day after operation. In all women treated either by SP-LS or by C-LS, postoperative hospital stay was 2 days. There was no surgery-related morbidity in both groups (Table 1).

4. Discussion

The evolution of laparoscopic surgery has allowed a significant improvement of immediate postoperative condition (less pain and fewer needs of analgesic agents) and possible better cosmetics (a reduction of size and number of visible postsurgical scars).^{1–5,25–27} Single-incision laparoscopy, because of the decreasing number of the port wounds, might further increased the benefits of the laparoscopic surgery.^{14–22,27–35} As expected, our present study showed a statistically significantly lower VAS

in the SP-LS group compared with that in the C-LS group (3.0 vs. 3.6, $p < 0.002$). However, the frequency of injection of analgesic agents was similar in both groups (0.1 vs. 0.2, $p = 0.38$). Taken together, postoperative pain in both groups was not severe, contributing to no need of additional analgesic injection. Results in the current are similar to previously published studies.^{19,30}



Fig. 2. External view of a wound retractor.

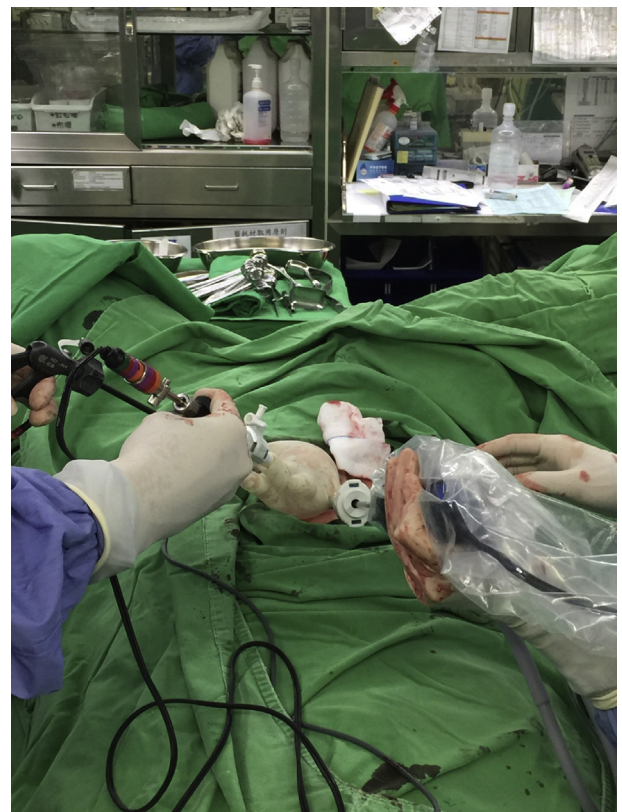


Fig. 3. External view of the single-port laparoscopy using a wound retractor and a surgical glove.

Table 1
Clinical characteristic of patients with tubal pregnancy treated with either single-port or multiple-port laparoscopic salpingectomy.

Variables	SP-LS (n = 47)	C-LC (n = 65)	†p
Age (years of age)	35.3 ± 5.9	36.9 ± 6.0	0.36
Operation time (minutes)	30.5 ± 4.6	31.0 ± 5.8	0.71
Amount of blood (hemoperitoneum; mL)	125.0 ± 156.9	335.0 ± 504.0	0.11
Time to bowel recanalization (hours)	6.2 ± 1.0	7.2 ± 1.4	0.02
Visual analog scale	3.0 ± 0.5	3.6 ± 0.6	0.0015
Analgasic use (times)	0.1 ± 0.3	0.2 ± 0.4	0.38
Hospital stay (days)*	2	2	—
Complication	0	0	0.71

Data are presented as mean ± standard deviation (SD) or number (percentage); †Wilcoxon rank sum test; *: all subjects in both groups were discharged on the next day postoperatively. SP-LS = single-port laparoscopic salpingectomy; C-LC = conventional three-port laparoscopic salpingectomy.

Time to bowel recanalization (time to postoperative flatus passage) seemed to be shorter in the SP-LS group compared with that in the C-LS group (6.2 vs. 7.2 h, $p = 0.02$). However, this clinical finding may not be clinically significant. In fact, Takeda's study and Kim's study did not show any statistically significant difference between SP-laparoscopy and C-laparoscopy (19 h vs. 25 h,¹⁹ and 28 h vs. 24 h,²⁰ respectively).

To evaluate the feasibility of the use of single-port laparoscopy for ectopic pregnancy, we used the term “single-port laparoscopy, and ectopic pregnancy” (from 1990 to December 6, 2016) to search PubMed for relevant English-language articles (<https://www.ncbi.nlm.nih.gov/pubmed/?term=single+port+laparoscopy%2C+ectopic+pregnancy>), and we found that only 15 articles fulfilled the screening criteria. The

detailed information was summarized as Table 2. All studies confirmed the feasibility and safety of using single-port laparoscopic surgery in the management of ectopic pregnancies.^{16–22,28–35}

Similar to the need of longer learning curve for laparoscopic surgery in surgeons, single-port laparoscopic surgery also required a longer intraoperative time than traditional laparoscopic surgery, when surgeons began to perform SP-LS.¹⁴ As operators have gained experience, the operative time seems to be similar to that of conventional laparoscopy.¹⁴ Using the wound retractor (Fig. 2) in the umbilical incision wound and the use of a surgical glove can make the simultaneous transit of conventional laparoscopic instruments possible (Fig. 3). Our experience for treatment of tubal pregnancies was positive, suggesting that SP-LS is a feasible and safe procedure.

Operative time was similar between both groups in our current study. Many studies showed longer operative time in the single-port laparoscopic surgery than that in the multiple-port laparoscopic surgery.^{36,37} The possible explanations included; (1) we did not use the knot-tying process, which has been reported as a major limiting step and a key determinant of the popularity of single-port laparoscopic surgery¹⁸; (2) salpingectomy was a relatively simple procedure; and (3) we used a surgical glove and a wound retractor and a traditional straight instrument to perform SP-LS, and did not use other commercial single-port devices and/or curved laparoscopic equipment. With much more friendly instruments and familiar procedures, we minimized the effect of the learning curve, contributing to the similar operative time.

This study has limitations, including the retrospective study in nature, short follow-up period (1–12 months), lack of

Table 2
Summary of the studies focusing on the use of single-incision (or single-port) laparoscopic surgery in the management of women with tubal pregnancies.

Authors (year) [R]	Patients (n)	Parameters during OP	Parameters after OP	Comments
Ghezzi F (2005) [17]	SP: 10	OP time: 27 min		
Yoon BS (2010) [28]	SP: 20	OP time: 55 min	Drop of Hgb: 1.8; HS: 2	Feasibility
Kumakiri J (2010) [29]	SP: 3	OP time: 54 min		Feasibility (salpingotomy)
Yoon BS (2011) [22]	SP vs. C: 30 vs. 30	OP time: 53 min vs. 47 min	Drop of Hgb: 1.7 vs. 1.8; HS: 2.4 vs. 2.4	Feasibility and no difference
Takeda A (2011) [30]	SP vs. C: 10 vs. 12	OP time: 49 min vs. 44 min EBS: 10 mL vs. 10 mL	Analgasic use: 0.5 times vs. 0.9 times Flatus: 19 vs. 25; CRP: 1 vs. 0.7; HS: 3.5 vs. 4	Gasless SP, and no difference
Bedaiwy MA (2011) [31]	SP: 11	OP time: 35 min; EBS: 30 mL	HS: 0.3	Feasibility
Lazard A (2011) [32]	SP: 2	OP time: 35 min and 25 min	EBS: 150 mL and 100 mL	Interstitial pregnancy
Lee ES (2011) [33]	SP: 1	OP time: 90 min		Cornual pregnancy
Marcelli M (2012) [21]	SP vs. C: 37 vs. 40	OP time: 50 min vs. 35 min	HS: 1.5 vs. 2.3	Longer OP time and less HS
Calcagno M (2012) [34]	SP: 12	OP time: 37 min; EBS: 40 mL	HS: 0.6; VAS: 1.2	Feasibility
Kim YW (2013) [20]	SP vs. C: 63 vs. 71	OP time: 49 min vs. 46 min	Drop of Hgb: 1.9 vs. 1.7; HS: 3.5 vs. 3.8 Needing blood transfusion: 25% vs. 21% Blood transfusion units: 1.8 units vs. 1.9 units.	Feasible alternative No difference
Bedaiwy MA (2014) [35]	SP: 1			Heterotopic pregnancy
Chang YW (2015) [16]	SP: 1			Cornual pregnancy
Kim MK (2015) [19]	SP vs. C: 26 vs. 80	OP time: 55 min vs. 50 min EBS: 100 mL vs. 100 mL	Drop of Hgb: 1.6 vs. 1.5 Needing blood transfusion: 19% vs. 26% VAS: 3 vs. 4; Flatus: 28 vs. 24; HS: 4.2 vs. 4.3	Feasibility and safety No difference
Zhao M (2015) [18]	SP: 3	OP time: 36 min	HS: 4	Safety and efficiency
The current study [2017]	SP vs. C: 47 vs. 65	OP time: 31 min vs. 31 min	Flatus: 6.2 vs. 7.2; VAS: 3.0 vs. 3.6	Feasibility and no difference

R = reference; n = number of the patients; OP = operation or operative; SP = single port laparoscopic surgery for ectopic pregnancy; min = minutes; C = conventional laparoscopic surgery for ectopic pregnancy; min = minutes; vs. = versus; Hgb = hemoglobin (g/dL); HS = hospital stay (days); EBS = amount of estimated blood loss (mL); Flatus = time of bowel recanalization (hours); CRP = C-reactive protein value on postoperative day 3 (mg/dL); VAS pain = visual analog scale evaluation form 0 (no pain) to 10 (worst pain).

further fertility outcome, and the fixed hospitalization day for ectopic pregnancy guided by the policy of the National Health Insurance. Furthermore, we only focused on women who were treated with salpingectomy for tubal pregnancy. Other strategies (e.g., salpingotomy or salpingostomy, and of most importance, medical treatment by methotrexate) need further validation. Medical treatment can be always considered as one of the best choices in the management of women with ectopic pregnancy before rupture. In the current study, the percentage of medical treatment was extremely low. Although it is hard to explain, we believed at least two possibilities contributing to this result. One was the patient source, since the majority of patients (93%, $n = 122$) were enrolled from the Emergency Department and these patients were symptomatic; therefore, surgical intervention is frequently suggested. The other was the physician's preference (the surgery in the current study was performed by one operator) when these patients visited the Emergency Department. In addition, the potential confounders, such as learning curve were excluded in the current study, since the possible longer learning curve might be present in the use of single-port laparoscopic surgery than that in the use of traditional laparoscopic surgery. The inclusive subjects in the current study were limited after March 2011, and the operator had a good experience in performing single-port laparoscopic surgery. Moreover, the fertility outcome after surgery in both groups was not evaluated; in terms of this concern, a further study might be needed. Finally, the use of analgesics was dependent on patient's request, which might be a bias to evaluate pain score and the frequency or the need of analgesics in our current study.

In conclusion, our study demonstrated the feasibility of single-port laparoscopic salpingectomy in the management of women with tubal pregnancy and the therapeutic outcome was similar to conventional three-port laparoscopic salpingectomy if the patients need surgical intervention for their tubal pregnancy. However, the current study does not recommend that this surgical intervention is a better choice in the management of patients with tubal pregnancy.

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References

- Li HK, Chung HJ, Huang EY, Lin AT, Chen KK. Impact of warm ischemia time on the change of split renal function after minimally invasive partial nephrectomy in Taiwanese patients. *J Chin Med Assoc* 2015;**78**:62–6.
- Chu LH, Chang WC, Sheu BC. Comparison of the laparoscopic versus conventional open method for surgical staging of endometrial carcinoma. *Taiwan J Obstet Gynecol* 2016;**55**:188–92.
- Wang PH, Horng HC, Chen CP. Is it safe to use minimally invasive surgery in the management of endometrial cancer? *Taiwan J Obstet Gynecol* 2016;**55**:1–2.
- Teng SW, Tseng JY, Chang CK, Li CT, Chen YJ, Wang PH. Comparison of laparoscopy and laparotomy in managing hemodynamically stable patients with ruptured corpus luteum with hemoperitoneum. *J Am Assoc Gynecol Laparosc* 2003;**10**:474–7.
- Bhave Chittawar P, Franik S, Pouwer AW, Farquhar C. Minimally invasive surgical techniques versus open myomectomy for uterine fibroids. *Cochrane Database Syst Rev* 2014;(10). CD004638.
- Chen CH, Lee WL, Chiu LH, Sun HD, Liu WM, Wang PH. A cohort study to evaluate the effectiveness of laparoscopic-guided local injection of etoposide in the management of women with unruptured tubal pregnancy. *Fertil Steril* 2011;**96**:654–8.
- Jiang LY, Wang PH, Lee HY, Chen CY. Diagnosis of interstitial ectopic pregnancy using a three-dimensional high-definition live rendering image. *Taiwan J Obstet Gynecol* 2015;**54**:465–6.
- Chen CL, Wang PH, Chiu LM, Yang ML, Hung JH. Successful conservative treatment for advanced interstitial pregnancy. A case report. *J Reprod Med* 2002;**47**:424–6.
- Juan YC, Wang PH, Chen CH, Ma PC, Liu WM. Successful treatment of ovarian pregnancy with laparoscopy-assisted local injection of etoposide. *Fertil Steril* 2008;**90**:1200. e1–2.
- Li YT, Pan CC, Chang WH, Wang PH. Laparoscopy-aided medical or surgical treatment for tubal pregnancy. *J Obstet Gynaecol Res* 2009;**35**:832.
- D'Hooghe T, Tomassetti C. Surgery for ectopic pregnancy: making the right choice. *Lancet* 2014;**383**:1444–5.
- Mol F, van Mello NM, Strandell A, Strandell K, Jurkovic D, Ross J, et al. Salpingotomy versus salpingectomy in women with tubal pregnancy (ESEP study): an open-label, multicentre, randomised controlled trial. *Lancet* 2014;**383**:1483–9.
- Mol F, van Mello NM, Strandell A, Jurkovic D, Ross JA, Yalcinkaya TM, et al. Cost-effectiveness of salpingotomy and salpingectomy in women with tubal pregnancy (a randomized controlled trial). *Hum Reprod* 2015;**30**:2038–47.
- Chen YJ, Wang PH, Ocampo EJ, Twu NF, Yen MS, Chao KC. Single-port compared with conventional laparoscopic-assisted vaginal hysterectomy. *Obstet Gynecol* 2011;**117**:906–12.
- Yang YS, Kim SH, Jin CH, Oh KY, Hur MH, Kim SY, et al. Solo surgeon single-port laparoscopic surgery with a homemade laparoscope-anchored instrument system in benign gynecologic diseases. *J Minim Invasive Gynecol* 2014;**21**:695–701.
- Chang YW, Tsai HW, Wang PH, Wu H, Twu NF, Yen MS, et al. Single-port laparoscopic surgery for cornual pregnancy after failure of methotrexate treatment. *Taiwan J Obstet Gynecol* 2015;**54**:322.
- Ghezzi F, Cromi A, Fasola M, Bolis P. One-trocar salpingectomy for the treatment of tubal pregnancy: a 'marionette-like' technique. *BJOG* 2005;**112**:1417–9.
- Zhao M, Zhao J, Hua K, Zhu Z, Hu C. Single-incision multiport laparoscopy versus multichannel-tipped single port laparoscopy in gynecologic surgery: outcomes and benefits. *Int J Clin Exp Med* 2015;**8**:14992–8.
- Kim MK, Kim JJ, Choi JS, Eom JM, Lee JH. Prospective comparison of single port versus conventional laparoscopic surgery for ectopic pregnancy. *J Obstet Gynaecol Res* 2015;**41**:590–5.
- Kim YW, Park BJ, Kim TE, Ro DY. Single-port laparoscopic salpingectomy for surgical treatment of tubal pregnancy: comparison with multiport laparoscopic salpingectomy. *Int J Med Sci* 2013;**10**:1073–8.
- Marcelli M, Lamourdedieu C, Lazard A, Cravello L, Gamberre M, Agostini A. Salpingectomy for ectopic pregnancy by transumbilical single-site laparoscopy with the SILS system. *Eur J Obstet Gynecol Reprod Biol* 2012;**162**:67–70.
- Yoon BS, Park H, Seong SJ, Park CT, Jun HS, Kim IH. Single-port versus conventional laparoscopic salpingectomy in tubal pregnancy: a comparison of surgical outcomes. *Eur J Obstet Gynecol Reprod Biol* 2011;**159**:190–3.
- Tsai HW, Wang PH, Yen MS, Chao KC, Hsu TF, Cheng YJ. Prevention of post-laparoscopic shoulder and upper abdominal pain: a randomized controlled study. *Obstet Gynecol* 2013;**121**:526–31.
- Tsai HW, Chen YJ, Ho CM, Hseu SS, Chao KC, Tsai SK, et al. Maneuvers to decrease laparoscopy-induced shoulder and upper abdominal pain: a randomized controlled study. *Arch Surg* 2011;**146**:1360–6.

25. Wang PH, Liu WM, Fuh JL, Chao HT, Yuan CC, Chao KC. Symptomatic myoma treated with laparoscopic uterine vessel occlusion and subsequent immediate myomectomy: which is the optimal surgical approach? *Fertil Steril* 2009;**92**:762–9.
26. Wang PH, Liu WM, Fuh JL, Chao HT, Yuan CC, Chao KC. Comparison of ultramini-laparotomy for myomectomy through midline vertical incision or modified Pfannenstiel incision- A prospective short-term follow-up. *Fertil Steril* 2009;**91**:1945–50.
27. Wen KC, Chen YJ, Sung BL, Wang PH. Comparing uterine fibroids treated by myomectomy through traditional laparotomy (LT) and two modified approaches: ultraminilaparotomy (UMLT) and laparoscopically-assisted ultraminilaparotomy (LA-UMLT). *Am J Obstet Gynecol* 2010;**202**:144. e1–8.
28. Yoon BS, Park H, Seong SJ, Park CT, Park SW, Lee KJ. Single-port laparoscopic salpingectomy for the surgical treatment of ectopic pregnancy. *J Minim Invasive Gynecol* 2010;**17**:26–9.
29. Kumakiri J, Kikuchi I, Kitade M, Matsuoka S, Tokita S, Takeda S. Linear salpingotomy with suturing by single incision laparoscopic surgery for tubal ectopic pregnancy. *Acta Obstet Gynecol Scand* 2010;**89**:1604–7.
30. Takeda A, Imoto S, Mori M, Nakano T, Nakamura H. Early experience with isobaric laparoscopic single-site surgery using a wound retractor for the management of ectopic pregnancy. *Eur J Obstet Gynecol Reprod Biol* 2011;**154**:209–14.
31. Bedaiwy MA, Escobar PF, Pinkerton J, Hurd W. Laparoendoscopic single-site salpingectomy in isthmic and ampullary ectopic pregnancy: preliminary report and technique. *J Minim Invasive Gynecol* 2011;**18**:230–3.
32. Lazard A, Poizac S, Courbiere B, Cravello L, Gamorre M, Agostini A. Cornual resection for interstitial pregnancy by laparoendoscopic single-site surgery. *Fertil Steril* 2011;**95**:2432. e5–8.
33. Lee ES, Hahn HS, Park BJ, Ro DY, Kim JH, Kim YW. Single-port laparoscopic cornual resection for a spontaneous cornual ectopic pregnancy following ipsilateral salpingectomy. *Fertil Steril* 2011;**96**:e106–10.
34. Calcagno M, Pastore M, Montanino M, di Palumbo VS. Laparoendoscopic single-site salpingectomy for treatment of ectopic pregnancy. *Int J Gynecol Obstet* 2012;**116**:81.
35. Bedaiwy MA, Volsky J, Lazebnik N, Liu J. Laparoscopic single-site linear salpingostomy for the management of heterotopic pregnancy: a case report. *J Reprod Med* 2014;**59**:522–4.
36. Hoyer-Sorensen C, Vistad I, Ballard K. Is single-port laparoscopy for benign adnexal disease less painful than conventional laparoscopy? A single-center randomized controlled trial. *Fertil Steril* 2012;**98**:973–9.
37. Bedaiwy MA, Starks D, Hurd W, Escobar PF. Laparoendoscopic single-site surgery in patients with benign adnexal disease: a comparative study. *Gynecol Obstet Investig.* 2012;**73**:294–8.