original article

Single-port laparoscopic surgery for benign salpingo-ovarian pathology: a single-center experience from Saudi Arabia

Ismail A. Al-Badawi,[a,b] Osama AlOmar,[a] Naryman Albadawi,[a,b] Ahmed Abu-Zaid[a,b]

From the [a]Department of Obstetrics and Gynecology, King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia; [b]College of Medicine, Alfaisal University, Riyadh, Saudi Arabia

Correspondence: Dr. Ismail A. Al-Badawi · Department of Obstetrics and Gynecology, King Faisal Specialist Hospital and Research Centre, PO Box 3354 Riyadh 11211, Saudi Arabia · T: +966-011-442-7392 F: +966-011-442-7393 · i_albadawi@yahoo.com

BACKGROUND: There are limited data and few solid conclusions on the use of single-port laparoscopic surgery (SPLS) in gynecologic procedures.

OBJECTIVE: The objective of our descriptive study was to review our single-center experience with benign salpingo-ovarian conditions (feasibility, safety and surgical outcomes).

DESIGN: A retrospective cross-sectional study from January-2012 to October-2014.

SETTING: King Faisal Specialist Hospital & Research Center—a referral tertiary healthcare center.

PATIENTS AND METHODS: All gynecologic patients who underwent SPLS procedures for benign adnexal pathologies were analyzed for pre-, intra- and postoperative details. SPLS was done using a single multi-port trocar and standard laparoscopic instruments.

MAIN OUTCOME MEASURES: Perioperative complications and conversion rate.

RESULTS: Eighty (n=80) patients underwent SPLS interventions. The median age and BMI were 37 years and 24.6 kg/m^2, respectively. Thirty-one patients (38.8%) had ≥1 previous abdominopelvic surgeries. Of 104 SPLS procedures conducted, the three most common procedures were unilateral ovarian cystectomy (n=21/104; 20.2%), bilateral ovarian transposition (n=20/104; 19.2%), and unilateral salpingo-oophorectomy (n=16/104; 15.4%). No patient required addition of extra ports or conversion to conventional multi-port laparoscopy or laparotomy. The median operative time, estimated blood loss and hospital stay were 66 min, 10 mL and 1 day, respectively. No patient experienced major intraoperative or postoperative complications. The median postoperative pain grade using the visual analogue scale was 2 (examined in 74 of 80 patients). At six-weeks postoperatively, the median wound scar length (measured at outpatient clinic) was 1.2 cm.

CONCLUSION: SPLS in the management of benign salpingo-ovarian conditions is generally feasible, potentially safe, and associated with satisfactory operative and postoperative outcomes.

LIMITATIONS: Retrospective and non-comparative design. Single-center experience. Subjective scores of the patients' self-reported satisfaction about post-operative pain, subject to recall bias.

Laparoscopic surgery, also known as minimally invasive surgery (MIS), is evolving as the standard of care for the management of various benign and malignant adnexal gynecologic conditions.[1,2] The advantages of laparoscopic surgery over laparotomy have been well-documented through various retrospective studies and prospective randomized controlled trials. Such advantages include: reduced post-operative morbidity, pain, hospitalization, as well as rapid post-operative recovery, better quality-of-life, superior cosmesis, and improved surgical outcomes.[1,3-8]

As opposed to the conventional laparoscopy that is often performed using three to five small incisions (5-20 mm each), single-port laparoscopic surgery (SPLS) uses only one small skin incision of the umbilicus to completely perform the laparoscopic surgical procedures.[9]

In a recent systematic review of all SPLS-related articles, only around 9% of all reviewed articles were related to gynecologic procedures.[10] Although there are still limited data and few solid conclusions on the use of

SPLS in gynecologic procedures,[11] the currently available published data have shown the feasibility, safety and reproducibility of SPLS for managing numerous gynecologic conditions.[12]

The aim of this study was to retrospectively report our single-center experience of SPLS (feasibility, safety, and surgical outcomes) in the management of various benign gynecologic salpingo-ovarian conditions.

PATIENTS AND METHODS

This study took place at King Faisal Specialist Hospital and Research Centre (KFSH&RC), Riyadh, Saudi Arabia, a tertiary healthcare institution, from January-2012 to October-2014. All gynecologic patients who underwent SPLS procedures for benign salpingo-ovarian (adnexal) pathologies were retrospectively reviewed and the abstracted data were analyzed. This study was approved by the Research Advisory Council (RAC) for publishing outcomes.

At our institute, SPLS is an optional treatment. Patients were informed in detail about the current literature, benefits and potential risks of undergoing the standard surgery (i.e., multi-port laparoscopy or laparotomy) or optional surgery (i.e., SPLS). Afterwards, patients were requested to sign a written informed consent on the desired surgical treatment.

Inclusion criteria for patients undergoing SPLS procedures included: (1) age below 75 years, (2) body mass index (BMI) below 50.0 kg/m², (3) Karnofsky performance status more than 50%, (4) satisfactory hematological, hepatic, coagulation, renal and electrolyte profiles, (5) proven diagnosis of feasibly resectable, early-stage and benign-to-borderline gynecologic adnexal pathology (ovarian or fallopian tube masses SPLS than 30 cm in the maximum dimension), (6) patients eligible for adhesiolysis, omental biopsy, diagnostic laparoscopy or transposition of ovaries due to anticipated pelvic irradiation, and (7) signed written informed consent by patients for the SPLS intervention and its possible conversion to conventional laparoscopy or laparotomy if deemed necessary by the operating surgeons.

All SPLS procedures were performed by the corresponding author as the primary laparoscopic surgeon, and the second author as the assisting laparoscopic surgeon.

Prior to surgery, all patients were requested to void, or a Foley catheter was inserted intraoperatively. All SPLS procedures were performed under the general anesthesia. Patients were prepped and draped according to the hospital protocol. Patients were placed in supine position. A 15-20 mm umbilical or para-umbilical incision was made and then each skin edge was grasped

with an Allis clamp and a fascial incision was performed. Next, stay sutures (number 0 Maxon) were placed at each fascial incision edge this would be used at the end of surgery to close the fascia. Afterwards, the Covidien SILS™ Port multiple access port device (Covidien plc, Dublin, Ireland) was used. The device has 3-port sites and accommodates 3-mm and 5-mm ports, or 2-mm, 5-mm and one 5-12 mm ports. Afterwards, the device was introduced into the peritoneal cavity using packing forceps. Then, pneumoperitoneum was achieved using carbon dioxide (CO_2) through the attached valve. Then we started the procedure by using 5-mm 0-degree scope, and inserted the other laparoscopic instruments in the remaining 2 ports. At the end of SPLS procedure, the specimen was removed using the 5-12 mm port. In some cases with large adnexal cysts, the exteriorization method was used.[13] In this method, the SPLS device was removed, and subsequently the ovary plus adnexal cysts were brought to the outside of the peritoneal cavity through the umbilical incision. Afterwards, cystectomy was performed outside the peritoneal cavity and then the ovary was returned to the inside of peritoneal cavity.

Patient data were retrospectively abstracted and analyzed for pre-, intra- and postoperative details. Preoperative details included age, body mass index (BMI), previous abdominal and/or pelvic surgeries, type of surgery, and number of coexisting morbidities. Intraoperative details included procedures performed, addition of extra ports, conversion to 3 multi-port conventional laparoscopy or laparotomy, operative time (OT) [time from the umbilical skin incision to the complete closure of the umbilicus], estimated blood loss (EBL), size of resected lesion, and intraoperative morbidity (complications) and mortality. Postoperative details included hospital length-of-stay, 6-month postoperative morbidity and mortality, 6-week post-SPLS wound length (measured at outpatient clinic), and patient self-reported satisfactory scores for post-operative pain (range from 0 [lowest level of satisfaction] to 10 [highest level of satisfaction]) after their SPLS procedures. The self-reported satisfactory scores for postoperative pain were documented immediately postoperatively based on a validated visual analogue scale.[2,14-16] All patients were followed up at the gynecologic oncology clinic 1 week, 6 weeks, and 6 months postoperatively. Whenever appropriate, all data were presented as percentages and median (standard deviation) and range values.

RESULTS

Characteristics of the 80 patients who underwent SPLS

are shown in **Table 1**. The median age was 37 (14.4 years, range: 11-67). The median BMI was 24.6 (8.1 kg/m^2)(range: 15.0-49.8). Thirty-one patients (38.8%) had ≥ 1 previous abdominal and/or pelvic surgeries, as follows: 1 surgery (n=19/80; 23.8%), 2 surgeries (n=6/80; 7.5%) and 3 surgeries (n=6/80; 7.5%). The rates of laparoscopic and laparotomy surgeries were 12.5% (n=10/31) and 26.3% (n=21/31), respectively. Twenty-three patients (28.8%) had ≥ 1 co-existing morbidities, as follows: 1 morbidity (n=15/80; 18.8%), 2 morbidities (n=6/80; 7.5%) and ≥ 3 morbidities (n=2/80; 2.5%). Twenty-four (30%), 2 (2.5%) and 54 (67.5%) patients were nulliparous (para 0), primiparous (para 1) and multiparous (para 2+), respectively.

The intraoperative details of SPLS are depicted in **Table 2**. A total of 104 SPLS procedures were performed. In a descending order, the three most commonly performed SPLS procedures were unilateral ovarian cystectomy (n=21/104; 20.2%), bilateral ovarian transposition (n=20/104; 19.2%), and unilateral salpingo-oophorectomy (n=16/104; 15.4%). No patient required addition of extra ports or conversion to conventional multi-port laparoscopy, or laparotomy. The median size of resected lesions was 8 (4.1 cm) (range: 4-33), and all lesions examined were benign. The median OT, EBL and hospital length of stay were 66 (27.1) min (range: 31-139), 10 (55.6) mL (range 5-200), and 1 (1.1) days (range 1-5), respectively. No patient experienced major intraoperative morbidity or mortality.

The postoperative details of SPLS are illustrated in **Table 3**. During 6-month follow-up, no patient experienced major post-operative morbidity or morality. Using the visual analogue scale, the median post-operative pain was 2 (0.8) (range: 1-5), examined in 74 of 80 patients. At six-weeks postoperatively, the median length of the wound scar (measured at Outpatient Clinic) was 1.2 cm (range: 1.0-1.7).

All patients were followed up regularly up to six

Table 1. Characteristics of single-port laparoscopic surgery patients (pre-operative details) (n=80).

Median age (standard deviation) (range), years	37 (14.4) (11-67)
Median body mass index (standard deviation) (range), kg/m^2	24.6 (8.1) (15.0-49.8)
Previous abdominal and/or pelvic surgeries	
None	49 (61.3%)
1 surgery	19 (23.8%)
2 surgeries	6 (7.5%)
3 surgeries	6 (7.5%)
Type of surgery	
Laparoscopy	10 (12.5%)
Laparotomy	21 (26.3%)
Co-morbidities	
None	57 (71.3%)
1	15 (18.8%)
2	6 (7.5%)
3 and more	2 (2.5%)
Parity	
None (para 0)	24 (30%)
1 (para 1)	2 (2.5%)
2 and more (para 2+)	54 (67.5%)

Table 2. Intraoperative details of single-port laparoscopic surgery procedures (n=104).

Procedures (n=104)	
Unilateral salpingo-oophorectomy	16 (15.4%)
Bilateral salpingo-oophorectomy	11 (10.6%)
Unilateral ovarian cystectomy	21 (20.2%)
Bilateral ovarian cystectomy	9 (8.7%)
Adhesiolysis	10 (9.6%)
Resection of non-communicating uterine horn	2 (1.9%)
Bilateral ovarian transposition	20 (19.2%)
Appendectomy	5 (4.8%)
Omental biopsy	1 (1.0%)
Salpingectomy	2 (1.9%)
Diagnostic laparoscopy	7 (6.7%)
Addition of extra ports	0
Conversion to multi-port conventional laparoscopy	0
Conversion to conventional laparotomy	0
Intra-operative complications	0
Intra-operative mortality	0
Median size (greatest dimension) of resected lesions±SD (range)	8±4.8 cm (4-34)
Median operative time±SD, (range)	66±27.1 min (31-139)
Estimated blood loss±SD, (range)	10±55.6 ml (5-200)

months and no patient was lost during the follow-up visits.

DISCUSSION

SPLS represents one of the latest and promising tech-

Table 3. Postoperative details of single-port laparoscopic surgery procedures.

Median hospital stay±SD, (range)	1 (1.1) days (1-5)
6-week post-operative wound length (range)	1.2 cm (1.0-1.7)
6-month major post-operative complications	0
6-month SPLS-related mortality	0
Median patients' post-operative pain grade using the visual analogue scale ± SD, (range)*	2 (0.8) (1-5)

SD: standard deviation

nological advances in gynecologic laparoscopic procedures. However, there are inadequate data regarding the long-term outcomes of SPLS in gynecologic procedures.

This study represents one of the first reports from Saudi Arabia on the feasibility of SPLS in gynecology. Additionally, it is one of the very earliest SPLS studies from the developing countries as well as one of the relatively largest studies in the English literature that endeavored to explore the utility of SPLS in the management of various benign gynecologic adnexal conditions. Our study showed that SPLS in gynecologic procedures is largely feasible, potentially safe and satisfying for patients in terms of post-operative pain

Previous reports have validated that obesity, previous abdominopelvic surgeries, comorbidities, and diagnosis of early-stage cancer should not automatically disqualify the attempts of performing SPLS.[1-3,17]

Fader and Eschobar identified no surgical outcome

Table 4. Literature review of the selected previous experiences of single-port laparoscopic surgery in the management of various adnexal pathologies.

Authors	Year	Patients (n)	Median OT min (range)	Median HS day (range)	Median/ Mean EBL ml (range)	Addition of an extra port	Conversion to conventional 3-port laparoscopy	Conversion to conventional laparotomy	Major perioperative complications
Fagotti et al[20]	2009	3	79.7	1	20	No	No	No	No
Kim et al[21]	2009	24	70 (40-128)	1 (1-3)	Minimal (10-100)	Yes (1 dense surgical adhesions)	No	Yes (1 ovarian cancer staging - borderline ovarian malignancy on frozen biopsy)	No
Mereu et al[22]	2010	16	42 (20-72)	1 (1-2)	<10	No	No	No	Yes (1 post-operative umbilical scar infection - treated conservatively)
Escobar et al[4]	2010	9	NR	1	Minimal (10-75)	Yes (1 stage IV endometriosis)	No	No	No
Yoon et al[23]	2010	20	55 (25-85)	2 (2-4)	Minimal	No	No	No	No
Bedaiwy et al[24]	2011	11	35 (25-65)	8 (5-18)	30 (5 to 50)	No	No	No	Yes (1 post-operative umbilical scar infection - treated conservatively)

Pt: patient; OT: operative time; HS: hospital stay; EBL: estimated blood loss; min: minutes; mL: millimeter

differences among various patients for BMI, co-existing morbidities, or prior surgical interventions.[1] However, patients with high BMI scores represent, to a certain extent, a challenging group of candidates for SPLS intervention. This is because of the directly proportional higher possibility of encountering thickened abdominal walls and large intra-peritoneal fat contents, which in turn, complicate port access and distort surgical field exposure.[18] Patients with BMI scores <26-28 kg/m^2 are considered optimal candidates for undergoing SPLS.[19] In our study, 25 patients (31.3%) had BMI scores above 28 kg/m^2 and none experienced eventful surgical adverse events.

Similarly, patients with prior abdominopelvic surgical procedures represent an additional challenging group of patients for SPLS intervention. This is because of the increased probability of encountering dense, surgery-related, extra- and intra-peritoneal adhesions.[18] In our study, despite the relatively higher number of ≥2 previous surgeries in a few patients (n=12/80; 15%), no major SPLS surgical-related technical difficulties (e.g., adhesion dissections) were encountered, and the median OT was largely acceptable 66 (27.1) min (range: 31-139).

In short, appropriate selection of patients for SPLS is important. Our own recommendations for patients who may not be appropriate candidates for SPLS include: BMI >50 kg/m^2, previous four or more abdominopelvic laparoscopies/laparotomies, <50% Karnofsky performance status, absence of native umbilicus, and primary advanced or recurrent late-stage (FIGO stage III/IV) gynecologic cancer conditions.

In our study, no patient required addition of extra port(s) or conversion to conventional multi-access laparoscopy or laparotomy. It must be noted than optimal patient safety and care should never be compromised at any level. Thus, addition of extra ports whenever deemed necessary is more important than cosmetic considerations, and should not be deduced as a failure to perform SPLS. Reasons for adding extra ports or conversions to conventional laparoscopy or laparotomy include: failed trocar insertion, obscured surgical field visualization, non-stopping bleeding, extremely dense surgical adhesions and difficult dissection none of which were encountered in our study.

Previous studies have shown that SPLS can be performed successfully in the management of several benign gynecologic adnexal pathologies such as adhesiolysis, ovarian cystectomy, endometriosis excision, ectopic pregnancy, and unilateral or bilateral salpingo-oophorectomy.[4,20-24] Selected previous experiences of SPLS in the management of various adnexal pathologies are summarized in **Table 4**.

There are a few technical challenges associated with the use of SPLS.[25] The capacity to triangulate and grasp tissues to facilitate traction and counter-traction for exposure and dissection is a fundamental pre-requisite of MIS. SPLS is largely associated with limited triangulation and retraction abilities. This is because of the restriction of SPLS instruments to a single axis, and therefore necessitating a higher level of manual laparoscopic proficiency and fine-motor hand dexterity. Further challenges include the conflict between camera and laparoscopic instruments in the surgical field. However, possible measures have been suggested to overcome these drawbacks. For example, the use of instruments of diverse lengths can help in the avoidance of surgical field clashing.[26] Moreover, the use of articulating, flexible or pre-bent instruments can help in the resolution of SPLS-associated limited triangulation abilities.[27] More advances in SPLS instrumentation are in-progress.

The learning curve for SPLS in the management of gynecologic procedures has been reported in literature.[2,28] As opposed to multi-port conventional laparoscopy, attaining expertise with SPLS appears to be more challenging as it demands advanced levels of laparoscopic training and skills.[11] The learning curve is directly proportional to the number of SPLS procedures performed by gynecologic surgeons. Fader and colleagues concluded that 10 procedures are needed to perform SPLS adeptly.[2] A similar notion was reported by Escobar and partners; they concluded that approximately 10-15 procedures are needed to perform SPLS skillfully.[28] In these two studies, as experiences were gained by surgeons over time, there had been a reduction in the overall operating time, reflecting gained proficiency in performing SPLS procedures.

Several mechanisms have been suggested to further ease and expedite the learning curve process of SPLS for beginner surgeons, such as: 1) development of real-time simulated (virtual) SPLS models, 2) implementation of hands-on animal exercise sessions, and 3) observation of live or recorded SPLS procedures.[25,29] In our institute, the above-mentioned mechanisms are already in place to accelerate the learning curve for surgeons performing SPLS procedures. A detailed study on the learning curve for SPLS procedures at our institute is in-progress and will be reported in a future focused brief communication manuscript. Furthermore, additional future research is directed towards comparing SPLS vs. conventional laparoscopy in management of various benign and malignant gynecologic pathologies.

Our study has three main limitations. The first limitation is the retrospective and non-comparative study design. This limitation is similar to other leading studies

original article

reported elsewhere in literature.[4,20-24] The second limitation is the single-center experience of SPLS; hence, a much broader picture of the status of SPLS in Saudi Arabia is yet to be defined and addressed through multi-intuitional studies. The third limitation is the subjective scores of the patients' self-reported satisfaction about post-operative pain; therefore, these scores are liable to recall bias (overestimation and/or underestimation).

CONCLUSION

Laparoscopic single-port incision for salpingo-ovarian pathology is technically feasible and is associated with reduced pain and short hospital stay. The technique demands advanced surgical skills from the operator.

REFERENCES

1. Fader AN, Escobar PF. Laparoendoscopic single-site surgery (LESS) in gynecologic oncology: technique and initial report. Gynecol Oncol. 2009;114(2):157-61.
2. Fader AN, Rojas-Espaillat L, Ibeanu O, Grumbine FC, Escobar PF. Laparoendoscopic single-site surgery (LESS) in gynecology: a multi-institutional evaluation. Am J Obstet Gynecol. 2010;203(5):501.e1-6.
3. Escobar PF, Fader AN, Paraiso MF, Kaouk JH, Falcone T. Robotic-assisted laparoendoscopic single-site surgery in gynecology: initial report and technique. J Minim Invasive Gynecol. 2009;16(5):589-91.
4. Escobar PF, Bedaiwy MA, Fader AN, Falcone T. Laparoendoscopic single-site (LESS) surgery in patients with benign adnexal disease. Fertil Steril. 2010;93(6):2074.e7-10.
5. Lee YY, Kim TJ, Kim CJ, Kang H, Choi CH, Lee JW, et al. Single-port access laparoscopic-assisted vaginal hysterectomy: a novel method with a wound retractor and a glove. J Minim Invasive Gynecol. 2009;16(4):450-3.
6. Cho YH, Kim DY, Kim JH, Kim YM, Kim YT, Nam JH. Laparoscopic management of early uterine cancer: 10-year experience in Asan Medical Center. Gynecol Oncol. 2007;106(3):585-90.
7. Kalogiannidis I, Lambrechts S, Amant F, Neven P, Van Gorp T, Vergote I. Laparoscopy-assisted vaginal hysterectomy compared with abdominal hysterectomy in clinical stage I endometrial cancer: safety, recurrence, and long-term outcome. Am J Obstet Gynecol. 2007;196(3):248.e1-8.
8. Walker JL, Piedmonte MR, Spirtos NM, Eisenkop SM, Schlaerth JB, Mannel RS, et al. Laparoscopy compared with laparotomy for comprehensive surgical staging of uterine cancer: Gynecologic Oncology Group Study LAP2. J Clin Oncol. 2009;27(32):5331-6.
9. Bradford LS, Boruta DM. Laparoendoscopic single-site surgery in gynecology: a review of the literature, tools, and techniques. Obstet Gynecol Surv. 2013;68(4):295-304.
10. Pfluke JM, Parker M, Stauffer JA, Paetau AA, Bowers SP, Asbun HJ, et al. Laparoscopic surgery performed through a single incision: a systematic review of the current literature. J Am Coll Surg. 2011;212(1):113-8.
11. Uppal S, Frumovitz M, Escobar P, Ramirez PT. Laparoendoscopic single-site surgery in gynecology: review of literature and available technology. J Minim Invasive Gynecol. 2011;18(1):12-23.
12. Fader AN, Cohen S, Escobar PF, Gunderson C. Laparoendoscopic single-site surgery in gynecology. Curr Opin Obstet Gynecol. 2010;22(4):331-8.
13. Al-Badawi IA, Alshankiti H, Ahmad S. Single incision laparoscopic surgery in pregnancy CRSLS (Case Report - Society of Laparoendoscopic Surgery): 2014; e2014.00404. DOI: 10.4293/CRSLS.2014.00404.
14. Fagotti A, Bottoni C, Vizzielli G, Gueli Alletti S, Scambia G, Marana E, et al. Postoperative pain after conventional laparoscopy and laparoendoscopic single site surgery (LESS) for benign adnexal disease: a randomized trial. Fertil Steril. 2011;96(1):255-8.e2.
15. Cho YJ, Kim ML, Lee SY, Lee HS, Kim JM, Joo KY. Laparoendoscopic single-site surgery (LESS) versus conventional laparoscopic surgery for adnexal preservation: a randomized controlled study. Int J Womens Health. 2012;4:85-91.
16. 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(4):973-9.
17. Yim GW, Jung YW, Paek J, Lee SH, Kwon HY, Nam EJ, et al. Transumbilical single-port access versus conventional total laparoscopic hysterectomy: surgical outcomes. Am J Obstet Gynecol. 2010;203(1):26.e1-6.
18. Chern BSM, Lakhotia S, Khoo CK, Siow AYM. Single incision laparoscopic surgery in gynecology: Evolution, current trends, and future perspectives. Gynecol Minim Invasive Ther 2012;1(1):9–18.
19. Ross SB, Clark CW, Morton CA, Rosemurgy AS. Access for laparoendoscopic single site surgery. Diagn Ther Endosc. 2010;2010:943091.
20. Fagotti A, Fanfani F, Marocco F, Rossitto C, Gallotta V, Scambia G. Laparoendoscopic single-site surgery (LESS) for ovarian cyst enucleation: report of first 3 cases. Fertil Steril. 2009;92(3):1168.e13-6.
21. Kim TJ, Lee YY, Kim MJ, Kim CJ, Kang H, Choi CH, et al. Single port access laparoscopic adnexal surgery. J Minim Invasive Gynecol. 2009;16(5):612-5.
22. Mereu L, Angioni S, Melis GB, Mencaglia L. Single access laparoscopy for adnexal pathologies using a novel reusable port and curved instruments. Int J Gynaecol Obstet. 2010;109(1):78-80.
23. 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(1):26-9.
24. 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(2):230-3.
25. Ahmed I, Paraskeva P. A clinical review of single-incision laparoscopic surgery. Surgeon. 2011;9(6):341-51.
26. Canes D, Desai MM, Aron M, Haber GP, Goel RK, Stein RJ, et al. Transumbilical single-port surgery: evolution and current status. Eur Urol. 2008;54(5):1020-9.
27. Hirano Y, Watanabe T, Uchida T, Yoshida S, Tawaraya K, Kato H, et al. Single-incision laparoscopic cholecystectomy: single institution experience and literature review. World J Gastroenterol. 2010;16(2):270-4.
28. Escobar PF, Starks DC, Fader AN, Barber M, Rojas-Espalliat L. Single-port risk-reducing salpingo-oophorectomy with and without hysterectomy: surgical outcomes and learning curve analysis. Gynecol Oncol. 2010;119(1):43-7.
29. Behnia-Willison F, Foroughinia L, Sina M, McChesney P. Single incision laparoscopic surgery (SILS) in gynaecology: feasibility and operative outcomes. Aust N Z J Obstet Gynaecol. 2012;52(4):366-70.