Gynecology and Minimally Invasive Therapy 6 (2017) 12–16

Contents lists available at ScienceDirect

Gynecology and Minimally Invasive Therapy

journal homepage: www.e-gmit.com

Original article

Feasibility of reduced port surgery applying Higuchi's transverse incision

Kazu Ueda [a], Yoko Nagayoshi [a], Ayako Kawabata [a], Takafumi Kuroda [a], Yasushi Iida [a], Motoaki Saitou [a], Nozomu Yanaihara [a], Kouhei Sugimoto [a], Masaru Sakamoto [b], Aikou Okamoto [a,*]

[a] Department of Obstetrics and Gynecology, The Jikei University School of Medicine, Tokyo, Japan
[b] Department of Gynecology, Sasaki Foundation Kyoundo Hospital, Tokyo, Japan

ARTICLE INFO

Article history:
Received 15 January 2016
Received in revised form
4 May 2016
Accepted 9 May 2016
Available online 15 June 2016

Keywords:
laparoscopically assisted myomectomy
power morcellator
reduced port surgery

ABSTRACT

Objective: Higuchi's transverse incision is made at a lower position than the Pfannenstiel transverse incision and is superior in terms of cosmetic outcomes. The purpose of this study was to examine the safety and efficacy of novel forms of reduced port surgery for ovarian cysts and uterine fibroids applying Higuchi's transverse incision.

Methods: In 33 patients with ovarian cysts who underwent low-position single-incision laparoscopic surgery (L-SILS)-modified single-port laparoscopy placed in the 2–3-cm Higuchi's incision above the pubis, patient's characteristics and perioperative outcomes were compared with those of patients who underwent multiport laparoscopy ($n = 53$). In addition, 18 patients with uterine fibroids who underwent dual-port laparoscopically assisted myomectomy without using power morcellators and conventional four-port laparoscopically assisted myomectomy were investigated.

Results: There were no significant differences between L-SILS and multiport laparoscopy in tumor diameter, bleeding, hospital stay, or postoperative pain. However, the L-SILS group demonstrated significantly shorter operative and pneumoperitoneum times ($p < 0.01$ and $p < 0.01$). In comparison with cases of uterine fibroids, no significant differences were found in maximum fibroid diameter, operative time, pneumoperitoneum time, or bleeding. However, the dual-port laparoscopically assisted myomectomy group demonstrated a significantly shorter length of hospital stay than the conventional laparoscopically assisted myomectomy group ($p < 0.05$).

Conclusion: We reported novel forms of reduced port surgery applying Higuchi's transverse incision. It was suggested that these procedures are relatively simple, but ensure the same safety and efficacy as conventional methods. We intend to increase the number of cases and examine safety, efficacy, and patient satisfaction for these procedures.

Introduction

Compared with laparotomy, laparoscopic surgery results in fewer perioperative complications, less postoperative pain, shorter hospitalization, and faster recovery.[1] Furthermore, as the evolution of energy devices and other medical equipment has led to improved safety and shorter operative times, reduced port surgery (RPS) such as single-port laparoscopy and microlaparoscopy have been developed; these RPS techniques are less invasive and yield superior cosmetic outcomes compared with conventional surgery, and multiple studies have reported their utility.[2,3]

In gynecology, single-port laparoscopy is typically performed with an umbilical approach, the utility of which has been reported by several studies.[4–7] However, the surgery is difficult to perform,[8,9] and a number of studies have reported postoperative complications such as umbilical hernias and refractory infections.[10–12]

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

* Corresponding author. Department of Obstetrics and Gynecology, The Jikei University School of Medicine, 3-25-8 Nishi-Shimbashi, Minato-ku, Tokyo 105-8461, Japan.
E-mail address: aikou7000@gmail.com (A. Okamoto).

http://dx.doi.org/10.1016/j.gmit.2016.05.003

In addition, in April 2014, the United States Food and Drug Administration issued a warning regarding the safety of power morcellators typically used in laparoscopy for uterine fibroids, thus posing problems for the surgical procedure and fibroid removal.[13,14]

Higuchi's transverse incision is made at a lower position than the conventional Pfannenstiel transverse incision and is superior in terms of cosmetic outcomes. We perform Higuchi's transverse incision as a standard approach in laparotomy for benign tumors (except for giant tumors) and for cesarean sections.

In the present study, we applied Higuchi's transverse incision in RPS; here, we discuss new surgical procedures with the objective of further improving cosmetic outcomes. We report our introduction of two new operative procedures: low-position single-incision laparoscopic surgery (L-SILS), which does not involve the umbilicus, for ovarian cysts, and dual-port laparoscopically assisted myomectomy (2P-LAM), which does not use a power morcellator, for uterine fibroids.

Methods

Higuchi's transverse incision

First, we will describe Higuchi's transverse incision.

(1) Skin incision: The incision is made at a low position, 1.5 cm above the pubis. The wound is covered by the pubic hair and thus has a superior cosmetic outcome. This incision also enables easier surgeries on the bladder, cervix, and elsewhere in the pelvis.
(2) Blunt dissection of subcutaneous adipose tissue: The extensive use of blunt dissection of subcutaneous adipose tissue makes it possible to avoid abdominal wall blood vessel injury.
(3) T incision of the rectus abdominis fascia: After bluntly extending the rectus abdominis fascia incision from 2–3 cm cranial to the skin incision line in a transverse direction to the lateral margin of the rectus abdominis, a longitudinal incision is made toward the area directly above the pubic symphysis. The opening of a T incision in the rectus abdominis fascia ensures a sufficient visual field.
(4) Longitudinal incision of the peritoneum: Treatment of the peritoneum while confirming the bladder makes it possible to avoid bladder injury. The skin, fascia, and peritoneum incision sites do not coincide, thus making it possible to prevent an abdominal incisional hernia.

L-SILS for ovarian cysts

(1) A platform is placed in the 2–3 cm Higuchi's transverse incision superior margin on the pubis (Figure 1A).
(2) A Lap Protector and an EZ access (Hakko Medical, Nagano, Japan) are used with the platform. Three Versaport trocars (Medtronic, Minneapolis, MN, USA) are attached to the EZ access (Figure 1B).
(3) A 5-mm flexible videoscope (Olympus, Tokyo, Japan) is used to observe the tumor site, tumor size, and possible presence of adhesions following pneumoperitoneum.
(4) Following fine-needle aspiration of ovarian cyst fluid, the cyst is resected extracorporeally.

The 2P-LAM procedure for uterine fibroids

(1) A camera port is inserted through the umbilicus using the optical method. A 5-mm flexible videoscope (Olympus, Tokyo, Japan) is used to observe the possible presence of intra-abdominal adhesions.
(2) A platform is placed in the 3-cm Higuchi's transverse incision above the pubis.
(3) A Lap Protector and an EZ access (Hakko Medical, Nagano, Japan) are used with the platform. Two Versaport trocars (Medtronic, Minneapolis, MN, USA) are attached to the EZ access (Figure 2A).
(4) The fibroid is enucleated intra-abdominally, and the wound in the uterus is sutured under direct observation. The absence of remaining fibroids is confirmed by palpation.
(5) The enucleated fibroid is collected into an isolation bag, morcellated with a scalpel in the bag under direct observation, and removed from the abdominal cavity via the Higuchi's transverse incision without using power morcellators (Figure 2B).

Results

We began performing cystectomy by L-SILS for ovarian cysts in March 2014. A breakdown of cases is shown in Table 1. Initially, the

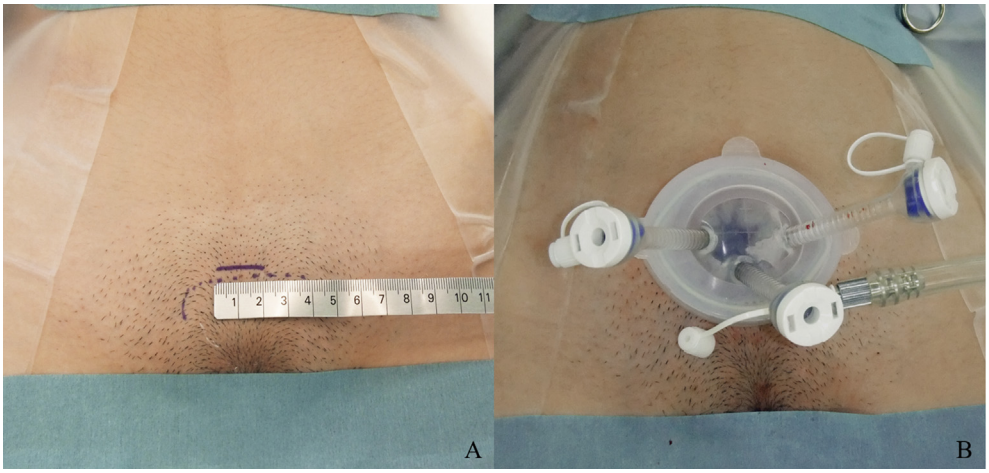

Figure 1. L-SILS applying Higuchi's transverse incision. (A) The skin incision made at the superior margin on the pubis. (B) The platform is placed in the 2–3-cm Higuchi's transverse incision. Three trocars are attached to the EZ access. L-SILS = low-position single-incision laparoscopic surgery.

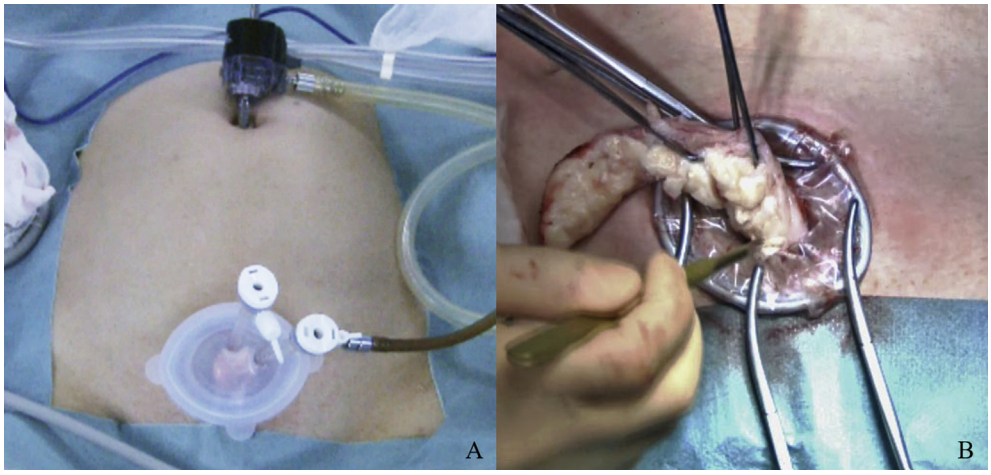

Figure 2. Dual-port LAM applying Higuchi's transverse incision. (A) The 5-mm trocar for the videoscope is inserted through the umbilicus by the optical method. The platform is placed in the 3-cm Higuchi's transverse incision above the pubis. Two trocars are attached to the EZ access. (B) The enucleated fibroid from the uterus is collected into an isolation bag, manually morcellated with a scalpel in the bag, and removed from the abdominal cavity via the Higuchi's transverse incision. LAM = laparoscopically assisted myomectomy.

Table 1
Characteristics and perioperative outcomes of ovarian cysts.

	L-SILS ($n = 33$)	TLC ($n = 53$)	p[a]
Age (y)	31 (19–42)	33 (24–44)	0.077
Body mass index	19.8 (15.8–24.1)	19.6 (18.4–24.4)	0.77
Histologic type			<0.01
Teratoma	28 (84.8)	17 (32.1)	
Endometriotic	3 (9.1)	31 (58.5)	
Others	2 (6.1)	5 (9.4)	
Tumor site			0.725
Unilateral	23 (69.7)	35 (66.0)	
Bilateral	10 (30.3)	18 (34.0)	
Anesthesia			0.983
GA	13 (39.4)	21 (39.6)	
GA + TAP/EP	20 (60.6)	32 (60.4)	
Tumor size (cm)	9.3 (4.0–21.0)	8.4 (3.4–17.8)	0.264
Surgical time (min)	110.8 (72–167)	140.5 (76–243)	<0.01
Aeroperitoneum time (min)	30.1 (7–92)	109.8 (55–219)	<0.01
Estimated blood loss (g)	20.6 (0–340)	42.3 (0–450)	0.234
CRP (mg/dL)	1.29 (0.13–3.57)	1.43 (0.14–6.43)	0.604
VAS			
Rest	20.7 (0–52)	22.1 (0–88)	0.710
Motion	43.4 (7–83)	48.7 (0–100)	0.245
Postoperative hospital stay (d)	4.1 (3–6)	4.0 (3–6)	0.446

Values are presented as mean (range) or n (%).
CRP = C-reactive protein on the next day; GA = general anesthesia; L-SILS = low-position single-incision laparoscopic surgery; TAP/EP = transversus abdominis plane block/epidural anesthesia; TLC = total laparoscopic cystectomy; VAS = visual analog scale on the next day.
[a] Statistical analysis was performed using the Student t test or the chi-square test. A p value < 0.05 was considered statistically significant.

participants were patients with no adhesions; 85% of cases (28/33) were teratomas. In a comparison with 53 patients who underwent conventional multiport laparoscopic cystectomy during that same period, no significant differences were observed in tumor diameter, bleeding, length of hospital stay, or postoperative pain; however, patients who underwent L-SILS demonstrated significantly shorter operative and pneumoperitoneum times ($p < 0.01$ and $p < 0.01$). Additionally, in order to eliminate bias due to adhesions and tumor localization, we compared only cases with unilateral ovarian cysts (Table 2); we thus found that while L-SILS involved significantly larger tumor diameters ($p < 0.05$), operative and pneumoperitoneum times were shorter ($p < 0.01$ and $p < 0.01$).

We began performing 2P-LAM in December 2014 and have used it in seven patients thereafter (Table 3). In comparison with cases of conventional four-port laparoscopically assisted myomectomy (LAM) performed during the same period, no significant differences were found in maximum fibroid diameter, operative time, pneumoperitoneum time, or bleeding; however, the 2P-LAM group demonstrated a significantly shorter length of hospital stay than the conventional LAM group ($p < 0.05$).

In addition, neither of these novel procedures resulted in any perioperative complications.

Discussion

The Higuchi's transverse incision was proposed by Shigetsugu Higuchi, the first professor of obstetrics and gynecology at the Jikei University School of Medicine. The incision is comparable with the conventional Pfannenstiel transverse incision in some characteristic ways, as indicated in the methods. The main characteristic of the Higuchi's transverse incision is a T incision of the rectus abdominis fascia; bluntly extending the incision in a transverse direction prevents injury to the perforating branches of the deep arteries and veins of the abdominal wall. Next, a longitudinal incision is made

Table 2
Comparison of unilateral ovarian cysts.

	L-SILS ($n = 23$)	TLC ($n = 35$)	p[a]
Tumor size (cm)	8.38 (4.0–17.4)	6.65 (3.4–13.4)	0.036
Surgical time (min)	103.5 (72–130)	127.2 (76–193)	<0.01
Aeroperitoneum time (min)	28.2 (7–84)	90.1 (55–159)	<0.01
Estimated blood loss (g)	3.3 (0–30)	26.5 (0–250)	0.086

Values are presented as mean (range).
L-SILS = low-position single-incision laparoscopic surgery; TLC = total laparoscopic cystectomy.
[a] Statistical analysis was performed using the Student t test. A p value < 0.05 was considered statistically significant.

of fibroids through a small incision. In addition, LAM enables confirmation of small, low-position fibroids by palpation and can also be performed for relatively large fibroids. A study that compared LM and LAM found that LAM involved significantly shorter operative times and significantly smaller uterine incisions.[22] In addition, although power morcellators are typically used to remove enucleated fibroids, they have been implicated in potentially disseminating occult uterine malignancy in the abdominal cavity and causing peritoneal metastasis; thus, in 2014, the United States Food and Drug Administration issued a warning against the use of power morcellators in laparoscopic surgery for uterine fibroids.[13,23] Therefore, in order to avoid using a power morcellator, we introduced a method in which the fibroid is

Table 3
Characteristics and perioperative outcomes of uterine fibroids.

	2P-LAM ($n = 7$)	conventional LAM ($n = 11$)	p[a]
Age (y)	34 (33–40)	38 (31–47)	0.148
Body mass index	19.6 (17.9–22.2)	20.7 (17.0–24.9)	0.215
Number of fibroids			0.801
1	4 (57.1)	5 (45.5)	
2	1 (14.3)	3 (27.3)	
≥3	2 (28.6)	3 (27.3)	
Tumor size (cm)	7.04 (6.5–8.7)	7.57 (5.8-10.4)	0.604
Surgical time (min)	204.1 (140–260)	194.3 (147–237)	0.579
Aeroperitoneum time (min)	96.7 (46–141)	86.8 (52–167)	0.532
Estimated blood loss (g)	100 (0–280)	227.7 (0–970)	0.274
Hb (g/dL)	10.6 (9.7–11.5)	10.8 (8.8–13.9)	0.710
CRP (mg/dL)	2.26 (0.84–2.98)	3.45 (0.83–9.05)	0.205
Postoperative hospital stay (d)	4.14 (4–5)	5.09 (4–7)	0.023

Values are presented as mean (range) or n (%).
CRP = C-reactive protein on the next day; Hb = hemoglobin level on the next day; LAM = laparoscopically assisted myomectomy; 2P-LAM = dual-port laparoscopically assisted myomectomy.
[a] Statistical analysis was performed using the Student t test or the chi-square test. A p value of <0.05 was considered statistically significant.

directly above the pubic symphysis; treatment of the peritoneum while confirming the bladder makes it possible to prevent bladder injury and ensures an adequate visual field. We usually perform Higuchi's transverse abdominal wall incision as a standard approach for laparotomy for benign tumors and cesarean sections.

Recently, in response to the demand for reducing invasiveness further, the application of RPS has become widespread. Single-port laparoscopic surgery through the umbilicus, a form of RPS, was reported in 2005 as a new approach to tubal pregnancy[15]; thereafter, its use has grown beyond laparoscopic surgery for benign tumors, and it has also been introduced for malignant tumors and in robotic surgeries.[16,17] Although many studies have reported on the utility of RPS,[18–20] there are also reports that RPS did not improve the health-related quality of life,[21] and reports of the high degree of difficulty of RPS and problems with umbilical wounds.[8–12] L-SILS, which we introduced in the present study, is an extremely simple method that permits extracorporeal tumor resection and removal of the tumor content in a short time. Despite the small number of cases, an investigation of unilateral teratomas with no adhesions statistically demonstrated that while tumor diameter is significantly larger than in conventional multiport laparoscopic surgery, operative and pneumoperitoneum times are significantly shorter. In addition, applying the Higuchi's transverse incision enables a skin incision above the pubis, which causes the wound to be hidden completely by pubic hair and underwear, thereby providing excellent cosmetic outcomes.

Examples of laparoscopic uterine fibroid enucleation include laparoscopic myomectomy (LM) and LAM. Although LAM is inferior to LM in terms of cosmetic outcomes, it is a technically simple procedure that enables suturing of the uterine wound and removal collected into a bag, morcellated in the bag with a scalpel through the LAM incision, and removed. Furthermore, in order to improve cosmetic outcomes, we have applied 2P-LAM, in which a small Higuchi's transverse incision is completely hidden by pubic hair and underwear, and in which a 5-mm camera port is inserted through the umbilicus. Moreover, by making a small incision above the pubis rather than in the umbilicus, a cesarean section can later be performed through a Higuchi's transverse incision at the same site, thus avoiding the need for a new abdominal wound. Despite the small number of cases, our results indicate that compared with conventional four-port LAM, regardless of the lack of a significant difference in maximum fibroid diameter, 2P-LAM shows no significant difference in operative time, bleeding, or perioperative complications; results in significantly shorter length of hospitalization; is equally safe; and is less invasive.

Conclusion

In the present study, we reported on L-SILS and 2P-LAM, novel forms of RPS for ovarian cysts and uterine fibroids that apply Higuchi's transverse incision. In the current environment, in which improved cosmetic outcomes and further reduction in invasiveness are sought in laparoscopic surgery, both these procedures are relatively simple, but ensure the same safety and efficacy as conventional methods; therefore, they have potential as novel forms of RPS. Going forward, we intend to increase the number of cases, and examine the safety and efficacy of, and patient satisfaction with these procedures.

References

1. Medeiros LR, Rosa DD, Bozzetti MC, et al. Laparoscopy versus laparotomy for benign ovarian tumour. *Cochrane Database Syst Rev*. 2009;2:CD004751. http://dx.doi.org/10.1002/14651858.CD004751.
2. 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;52:366–370.
3. Park HS, Kim TJ, Song T, et al. Single-port access (SPA) laparoscopic surgery in gynecology: a surgeon's experience with an initial 200 cases. *Eur J Obstet Gynecol Reprod Biol*. 2011;154:81–84.
4. Fagotti A, Bottoni C, Vizzielli G, et al. Laparoendoscopic single-site surgery (LESS) for treatment of benign adnexal disease: single-center experience over 3-years. *J Minim Invasive Gynecol*. 2012;19:695–700.
5. Ramirez PT. Single-port laparoscopic surgery: is a single incision the next frontier in minimally invasive gynecologic surgery? *Gynecol Oncol*. 2009;114:143–144.
6. Escobar PF, Kebria M, Falcone T. Evaluation of a novel single-port robotic platform in the cadaver model for the performance of various procedures in gynecologic oncology. *Gynecol Oncol*. 2011;120:380–384.
7. Park JY, Kim TJ, Kang HJ, et al. Laparoendoscopic single site (LESS) surgery in benign gynecology: perioperative and late complications of 515 cases. *Eur J Obstet Gynecol Reprod Biol*. 2013;167:215–218.
8. Hoyer-Sørensen 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;98:973–979.
9. 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;18:12–23.
10. Smirnoff A, de Poncheville L, Allix-Béguec C, Lefant PY, Drapier E. Retrospective single-surgeon study of outcomes after laparoendoscopic single-site cholecystectomy and sigmoidectomy. *Hernia*; 2015 Oct 27. Epub ahead of print. Available from: http://link.springer.com/article/10.1007%2Fs10029-015-1434-x. Accessed 9.6.16.
11. Gunderson CC, Knight J, Ybanez-Morano J, et al. The risk of umbilical hernia and other complications with laparoendoscopic single-site surgery. *J Minim Invasive Gynecol*. 2012;19:40–45.
12. Munisamy R, Uppalu H, Raghavendra R, Venkata NP, Harshita S, Janarthanam SV. Type-I complex regional pain syndrome of umbilical port site: an unforeseen complication of laparoscopic surgery. *J Minim Access Surg*. 2012;8:50–53.
13. U.S. Food and Drug Administration: FDA. 2015. Available at: http://www.fda.gov/safety/medwatch/safetyinformation/safetyalertsforhumanmedicalproducts/ucm393809.htm. Accessed 21.11.15.
14. Kikuchi I, Kumakiri J, Aoki Y, et al. Reduced-port surgery in gynecologic fields. *Gynecol Minim Invasive Ther*. 2015;4:110–115.
15. Ghezzi F, Cromi A, Fasola M, Bolis P. One-trocar salpingectomy for the treatment of tubal pregnancy: a 'marionette-like' technique. *BJOG*. 2005;112:1417–1419.
16. Fader AN, Escobar PF. Laparoendoscopic single-site surgery (LESS) in gynecologic oncology: technique and initial report. *Gynecol Oncol*. 2009;114:157–161.
17. Scheib SA, Fader AN. Gynecologic robotic laparoendoscopic single-site surgery: prospective analysis of feasibility, safety, and technique. *Am J Obstet Gynecol*. 2015;212:179.e1–179.e8. Available from: http://www.ajog.org/article/S0002-9378(14)00806-0/. Accessed 21.11.15.
18. Chong GO, Hong DG, Lee YS. Single-port (OctoPort) assisted extracorporeal ovarian cystectomy for the treatment of large ovarian cysts: compare to conventional laparoscopy and laparotomy. *J Minim Invasive Gynecol*. 2015;22:45–49.
19. Park JY, Kim DY, Kim SH, Suh DS, Kim JH, Nam JH. Laparoendoscopic single-site compared with conventional laparoscopic ovarian cystectomy for ovarian endometrioma. *J Minim Invasive Gynecol*. 2015;22:813–819.
20. Park JY, Kim DY, Suh DS, Kim JH, Nam JH. Laparoendoscopic single-site versus conventional laparoscopic surgical staging for early-stage endometrial cancer. *Int J Gynecol Cancer*. 2014;24:358–363.
21. Eom JM, Kim KH, Yuk JS, Roh SI, Lee JH. Quality of life after single-port laparoscopic surgery versus conventional laparoscopic surgery for benign gynecologic disease. *Surg Endosc*. 2015;29:1850–1855.
22. Prapas Y, Kalogiannidis I, Prapas N. Laparoscopy vs laparoscopically assisted myomectomy in the management of uterine myomas: a prospective study. *Am J Obstet Gynecol*. 2009;200:144.e1–144.e6. Available from: http://www.ajog.org/article/S0002-9378(08)01032-6/. Accessed 21.11.15.
23. Siedhoff MT, Wheeler SB, Rutstein SE, et al. Laparoscopic hysterectomy with morcellation vs abdominal hysterectomy for presumed fibroid tumors in premenopausal women: a decision analysis. *Am J Obstet Gynecol*. 2015;212:591.e1–591.e8. Available from: http://www.ajog.org/article/S0002-9378(15)00200-8/. Accessed 21.11.15.