

Original article

A new concept of minimally invasive laparoscopic surgery utilizing the vaginal route to prevent iatrogenic spillage of dermoid cysts: The bathtub method



Katsuya Mine, Masao Ichikawa*, Masaki Sekine, Hanako Kaseki, Shuichi Ono, Takashi Abe, Shigeo Akira, Toshiyuki Takeshita

Division of Obstetrics and Gynecology, Nippon Medical School, Tokyo, Japan

ARTICLE INFO

Article history:

Received 13 July 2015

Received in revised form

10 August 2015

Accepted 27 August 2015

Available online 25 September 2015

Keywords:

cystectomy
dermoid cyst
endoscopic bag
laparoscopy
vaginal trocar

ABSTRACT

Objective: Surgical management of dermoid cysts remains controversial, and some surgeons prefer to approach these cysts via laparotomy due to the high risk of intraperitoneal cyst rupture in laparoscopic surgery and the related risks of chemical peritonitis. In our hospital, laparoscopic-assisted cystectomy (LAC) has been performed as a gasless laparoscopic surgery using an abdominal wall lifting method with a 3–5-cm transverse suprapubic incision that enables the dermoid cyst to be approached directly, as in laparotomy. Although LAC is safe and effective, it is performed in only specific areas and limited institutes. Therefore, we developed the “bathtub method,” a modified laparoscopic method that uses an endoscopic bag inserted through the vagina. The cyst is enucleated within the bag to catch cyst spillage. We compared results of the bathtub method with those of LAC.

Methods: We evaluated 37 patients scheduled for laparoscopic cystectomy with the bathtub method and 37 patients scheduled for LAC.

Results: Intraoperative cyst rupture occurred in 22 patients treated with the bathtub method; the majority of the cyst contents spilled into the endoscopic bag. White blood cell count and C-reactive protein level on postoperative Day 1 were $7708.3 \pm 1920.0/\mu\text{L}$ and $0.91 \pm 1.0 \text{ mg/dL}$, respectively, for the bathtub method versus $9913.9 \pm 2644.9/\mu\text{L}$ and $2.7 \pm 1.9 \text{ mg/dL}$ for LAC ($p < 0.01$ for both). There was no secondary chemical peritonitis in either group.

Conclusion: The bathtub method is less invasive than is LAC, with unremarkable scarring and minimum spillage. It is considered safe and useful.

Copyright © 2015, The Asia-Pacific Association for Gynecologic Endoscopy and Minimally Invasive Therapy. Published by Elsevier Taiwan LLC. All rights reserved.

Introduction

Dermoid cysts represent 21% of all ovarian tumors and are some of the most common benign ovarian lesions.¹ The laparoscopic approach has become increasingly accepted for surgical treatment of dermoid cysts. Because most patients with dermoid cysts are of reproductive age, a conservative approach is ideal; laparoscopy may minimize adhesion formation and thus decrease the chance of

compromising fertility. However, the surgical management of dermoid cysts remains controversial, and some surgeons prefer to approach these cysts via laparotomy due to the high risk of intraperitoneal cyst rupture in laparoscopic surgery² and the related risks of chemical peritonitis³ or spread of any neoplastic cells. The laparoscopic approach is associated with a greater risk of spillage of cyst contents into the peritoneal cavity. In a review of the literature that combined reports of 470 laparoscopic dermoid cystectomies, spillage occurred in 310 cases (66%).⁴ The rate of clinical chemical peritonitis following spillage from laparoscopic dermoid cystectomy is 0.2%.⁵ To reduce the risk of spillage during laparoscopy, several methods have been reported. Some authors have proposed removing dermoid cysts via the vaginal route.⁶ Morelli et al⁷ noted that a mesial side ovarian incision was effective in avoiding dermoid cyst rupture, because the spillage rate was only 3%. However,

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

* Corresponding author. 1-1-5, Sendagi, Bunkyo-ku, Tokyo, 113-8602, Japan.

E-mail address: masai@nms.ac.jp (M. Ichikawa).

<http://dx.doi.org/10.1016/j.gmit.2015.08.007>

2213-3070/Copyright © 2015, The Asia-Pacific Association for Gynecologic Endoscopy and Minimally Invasive Therapy. Published by Elsevier Taiwan LLC. All rights reserved.

intraperitoneal spillage of cyst contents could not be prevented completely.

An alternative approach to avoid those complications is a gasless laparoscopic surgery using an abdominal lifting method with a 3–5-cm transverse suprapubic incision that enables the dermoid cyst to be approached directly, as in laparotomy. This method is called “laparoscopic-assisted cystectomy (LAC).” In our hospital, LAC has been performed as a gasless laparoscopic surgery using the abdominal wall lifting method since 1999.⁸ Although LAC is safe and effective, it is performed in only specific areas and limited institutes, including our hospital.

For global applicability, a laparoscopic approach might be preferable if those problems could be improved. Endoscopic bags to retrieve ovarian cysts are widely used to prevent intraperitoneal spillage.^{9,10} Although spillage rates vary based on the removal method (62% for port removal without an endoscopic bag and 13.6% for removal within an endoscopic bag⁵), an abdominal port with a diameter of ≥ 2 cm is sometimes required for the insertion of an endoscopic bag to retrieve hard teeth or cartilage tissues of dermoid cysts. If an endoscopic bag is placed at the beginning of surgery, the forceps and endoscopic bag occupy the abdominal port and often disturb the view of the operation.

To solve these problems, we developed the “bathtub method,” which is a modified laparoscopic method to enucleate ovarian dermoid cysts by inserting an endoscopic bag through a 12-mm vaginal port, thereby ensuring minimum spillage. The purpose of this study was to compare the feasibility and safety of the bathtub method with those of LAC in the surgical management of ovarian dermoid cysts.

Materials and methods

Between January 2010 and April 2015, 101 patients were scheduled for laparoscopic cystectomy of ovarian dermoid cysts with the bathtub method or LAC. Thirty-seven of those have undergone laparoscopic cystectomy with the bathtub method since September 2011, and 64 of them have undergone LAC. Among the 64 patients who received LAC, we evaluated data from only 37 patients in whom the cyst diameters were limited to <7.5 cm, because the study included only those cases in which the diameter of the endoscopic bag used in the bathtub method was 10 cm (study inclusion criterion). These 37 enrolled patients mainly underwent cystectomy (LAC) from January 2010 to September 2011. In each case, informed consent was obtained. The protocol was approved by our local ethics committee, and it conforms to the provisions of the Declaration of Helsinki (as revised in Tokyo 2004). All surgical procedures were standardized and performed under the supervision of the lead author.

The efficacy of the bathtub method was retrospectively verified by comparing data from the patients who were scheduled for surgery with the bathtub method with those from 37 matched control patients scheduled for LAC.

The preoperative diagnosis of ovarian dermoid cyst was established by transvaginal ultrasonography.¹¹ Magnetic resonance imaging was used to distinguish between benign dermoid cysts and malignant ovarian cysts in most cases. The indications for the bathtub method were that the dermoid cysts showed no malignancy based on the preoperative work-up, and that the diameters of the cysts were <7.5 cm because of the 10-cm diameter of the endoscopic bag. Age, body mass index, nullipara or multipara, cyst diameter, and the unilateral or bilateral nature of the cysts were recorded for all patients as preoperative characteristics. Operative time and blood loss were compared between groups as parameters related to procedural difficulty. Furthermore, white blood cell (WBC) count, C-reactive protein (CRP) level, and the Numeric

Rating Scale (NRS) results for pain intensity¹² on postoperative Day 1 were compared between groups as parameters related to procedural invasiveness.

Measurement of serum anti-Müllerian hormone (AMH) was performed in 10 patients prior to surgery and at 1 month after cystectomy to assess ovarian reserve.¹³

Normally distributed data are reported as mean $\pm$ standard deviation. Statistical comparisons were made using the Chi-squared test, Mann–Whitney *U* test, or paired Student *t* test. Values of $p < 0.05$ were considered statistically significant.

Bathtub method

For the bathtub method, the patient was placed in the dorsal lithotomy position on the operating table under general anesthesia. The laparoscope was inserted using a 5-mm umbilical port, and three 3-mm ancillary ports were introduced suprapubically (Figure 1A). Pneumoperitoneum of 10 mmHg was established using carbon dioxide insufflation and maintained constantly throughout the surgery. An intrauterine manipulator was positioned to mobilize the uterus during surgery. A 12-mm port was introduced into the posterior vaginal fornix after the absence of adhesions around the pouch of Douglas was confirmed. An endoscopic bag (diameter 10 cm; ENDOPOUCH; Ethicon, Somerville, NJ, USA) was inserted into the abdominal cavity through the vaginal port, and the dermoid cyst was then placed into the bag, within which the cyst was enucleated (Figures 1B–1D). We selected the name “bathtub method,” because the swollen ovary appears to be soaking in the bathtub of an endoscopic bag.

If the cyst wall was ruptured during enucleation, the majority of the cyst contents spilled into the endoscopic bag (Figure 1E). The cyst was then removed from the abdominal cavity in the same bag. The vaginal wound was transvaginally closed by interrupted suture. In all patients, the abdominal cavity was washed using saline solution at the end of the surgery, and clear fluid was confirmed macroscopically.

Laparoscopic-assisted cystectomy

LAC was performed as a gasless laparoscopic surgery using the abdominal lifting method with a 3–5-cm transverse suprapubic incision as previously described.⁸

In all patients undergoing LAC, a 1-cm umbilical incision was made using an open technique. The laparoscope was introduced into the abdominal cavity through this incision, and three intra-abdominal fan retractors were introduced separately through the same incision. The abdominal wall was pulled upward using a small winching device, and a small transverse incision (2–3 cm in length) was made along the suprapubic line using conventional surgical techniques (Figure 2). In addition, one or two 5-mm ancillary ports were introduced suprapubically, if necessary. The cyst was punctured from the small transverse incision, and the cyst contents were aspirated for downsizing. The downsized cyst was extracted from the abdomen through the small transverse incision, and the cyst was enucleated extracorporeally (Figure 2).

Results

We scheduled cystectomy for patients with ovarian dermoid cysts using the bathtub method ($n = 37$) or with LAC ($n = 37$). Table 1 shows the baseline patient characteristics of the two patient groups. There were no significant differences in any of the variables. Two patients were excluded from the study: one patient scheduled for the bathtub method converted to LAC because of adhesions in the pouch of Douglas, and another patient scheduled for LAC

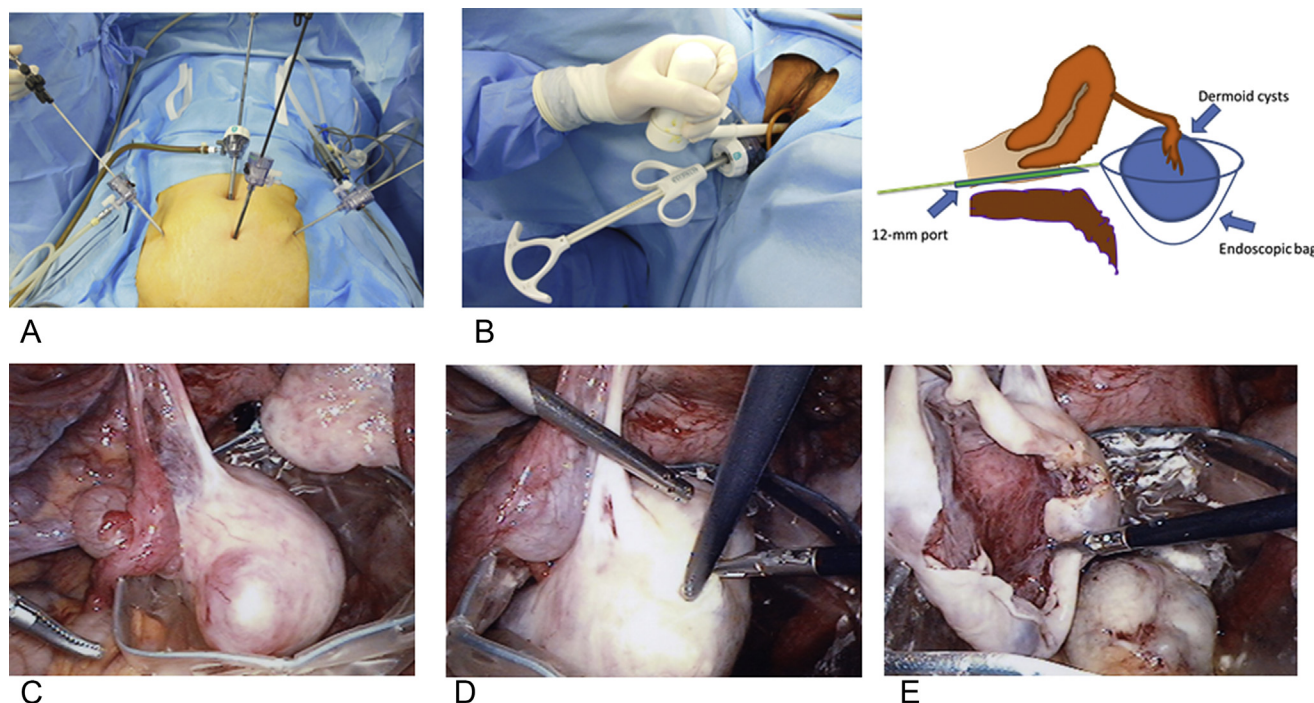


Figure 1. Cystectomy with the bathtub method. (A) The laparoscope was inserted using a 5-mm umbilical port, and three 3-mm ancillary ports were introduced suprapubically. (B) An intrauterine manipulator was positioned to mobilize the uterus during the surgery. A 12-mm port was introduced into the posterior vaginal fornix after the absence of adhesions around the pouch of Douglas was confirmed. (C) An endoscopic bag was inserted into the abdominal cavity through the vaginal port, and the dermoid cyst was then placed into the bag. (D) Enucleation of the dermoid cyst was performed in the bag. (E) If the cyst wall was ruptured during enucleation, the majority of the cyst contents spilled into the endoscopic bag. The cyst was then removed from the abdominal cavity in the same bag. We selected the name “bathtub method,” because the swollen ovary appears to be soaking in the bathtub of an endoscopic bag.

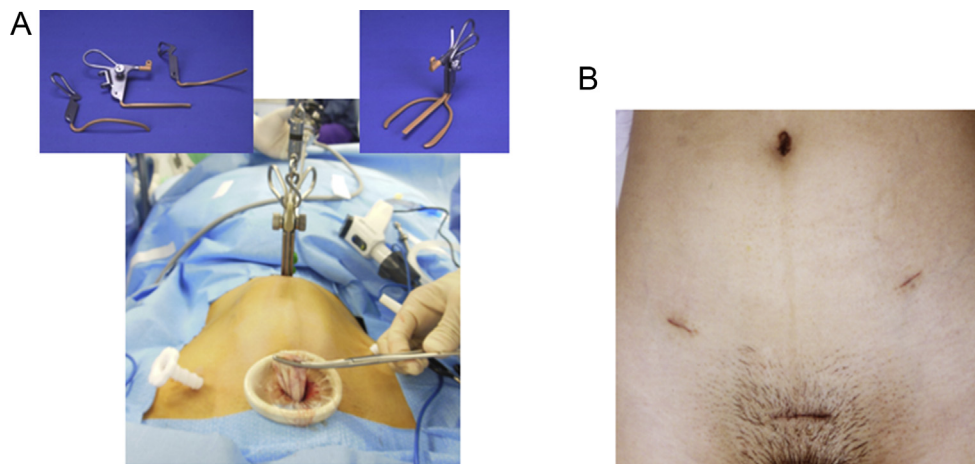


Figure 2. Laparoscopic-assisted cystectomy. (A) A 1-cm umbilical incision was made using an open technique. The laparoscope was introduced into the abdominal cavity through this incision, and the three intra-abdominal fan retractors were introduced separately through the same incision. The abdominal wall was pulled upward using a small winching device, and a small transverse incision was made along the suprapubic line using conventional surgical techniques. The cyst was punctured through the small transverse incision, and the cyst contents were aspirated for downsizing. The downsized cyst was extracted from the abdomen through the small transverse incision, and then the cyst was enucleated extracorporeally. (B) Location of small transverse incision.

converted to laparotomy because of adhesions in the omentum and abdominal wall.

Intraoperative cyst rupture occurred in 22 patients who received cystectomy with the bathtub method (61.1%), and the majority of the cyst contents spilled into the endoscopic bag. The total operative time and total blood loss for the bathtub method were 110.4 ± 27.8 minutes and 8.3 ± 34.3 mL, respectively, compared with 115.7 ± 23.8 minutes and 19.9 ± 35.3 mL, respectively, for LAC, with no significant differences between groups

(Table 2). The WBC count and CRP level on postoperative Day 1 were $7708.3 \pm 1920.0/\mu\text{L}$ and 0.91 ± 1.0 mg/dL versus $9913.9 \pm 2644.9/\mu\text{L}$ and 2.7 ± 1.9 mg/dL for the bathtub method versus LAC, respectively. Both WBC count and CRP level on postoperative Day 1 were significantly different between groups ($p < 0.01$). The NRS scores for pain intensity did not differ between groups.

The levels of serum AMH during the preoperative period and at 1 month postoperatively in the bathtub method group were

Table 1
Baseline patient characteristics.

Characteristic	Bathtub method	LAC	<i>p</i>
<i>n</i>	37	37	NS
Dropout	1	1	NS
Age (y)	30.6 ± 6.9 (20–59)	29.8 ± 5.4 (19–41)	NS
BMI (kg/m ²)	21.2 ± 2.6 (17.1–28.7)	20.2 ± 1.4 (17.4–23.1)	NS
Nulliparous (%)	62.1	81.1	NS
Cyst size (mm)	49.0 ± 13.9 (28.0–72.7)	53.9 ± 11.8 (32.0–73.0)	NS

Data are expressed as the mean ± standard deviation (minimum–maximum values).

BMI = body mass index; LAC = laparoscopic-assisted cystectomy; NS = not statistically significant.

4.1 ± 1.4 ng/mL and 3.3 ± 0.9 ng/mL, respectively. The decline rate of serum AMH was 85.4% of the preoperative AMH level; however, the mean serum AMH level measured at 1 month after the patients underwent cystectomy with the bathtub method was not significantly different from the preoperative AMH level (Figure 3).

No intraoperative complications occurred. No short-term or long-term postoperative complications, such as high fever or infection, were found in either group. There were also no cases of secondary chemical peritonitis in either group. Figure 4 shows the surgical wound immediately after and 1 month following the operation in patients who underwent cystectomy with the bathtub method.

Discussion

In the bathtub method, inserting an endoscopic bag through a 12-mm vaginal port allows for reduced-port surgery with 3-mm forceps for enucleating ovarian dermoid cysts. The scars from the 5-mm umbilical port and 12-mm posterior vaginal fornix were almost invisible at 1 month postoperatively. The visible scars on the abdominal wall were only 3-mm wounds. Therefore, the aesthetic outcomes of the bathtub method were favorable. Intraoperative cyst rupture occurred frequently in this study, however, the majority of the cyst contents spilled into the endoscopic bag. There were no cases of secondary chemical peritonitis. The bathtub method was thus considered to be safe. The cysts were removed transvaginally from the abdominal cavity in the bathtub method, whereas abdominal ports with diameters of ≥2 cm were sometimes required to retrieve hard teeth or cartilage tissues from dermoid cysts in conventional laparoscopic cystectomy. The export pathways in the bathtub method were facile and convenient, because the vaginal wall is more flexible than the abdominal wall. Although 23 of 37 patients who underwent operation with the bathtub method were nulliparous, the vaginal wound was able to be closed transvaginally in all patients regardless of the patient's parity.

The bathtub method was also considered more minimally invasive compared with LAC based on the WBC counts and CRP

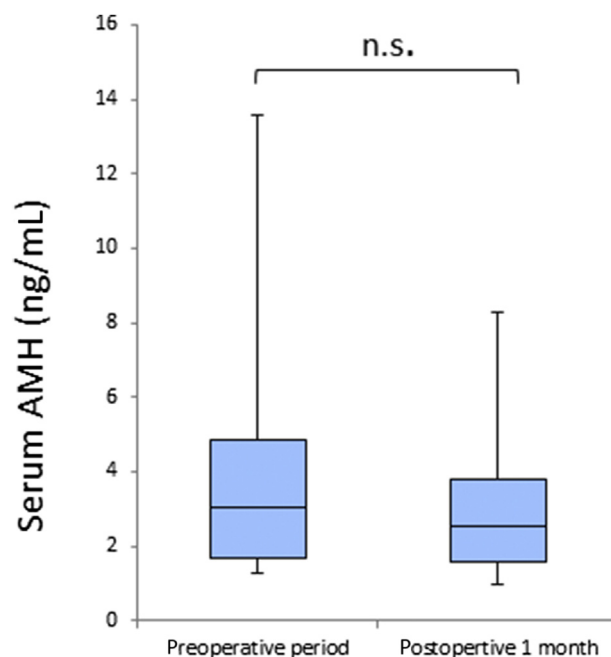


Figure 3. Serial changes in serum anti-Müllerian hormone (AMH) level before and after laparoscopic ovarian cystectomy with the bathtub method. The mean serum level of AMH measured at 1 month postoperatively was not significantly different from the preoperative AMH level.

levels on postoperative Day 1. Furthermore, dermoid cysts are the most common benign ovarian neoplasms occurring in women of fertile age¹⁴; therefore, the influence of ovarian reserve on surgery should be noted. Among newly developed ovarian reserve tests, the serum AMH level has been recognized as an improved and informative marker.¹⁵ AMH is produced by granulosa cells from pre-antral and small antral follicles, and therefore, AMH levels indirectly represent the total number of follicles.¹⁶ The effects of cystectomy for nonendometriotic tumors on AMH levels have been assessed in a few studies. Iwase et al¹⁷ reported that laparoscopic cystectomy for nonendometriomas caused postoperative AMH levels to be 83.9% of the preoperative AMH levels (3.92 ng/mL and 3.29 ng/mL before surgery and 1 month after cystectomy, respectively; *p* = 0.044). Another study reported that serum AMH levels were lower at 1 week after laparoscopic cystectomy for nonendometriotic cysts (69.2% of the preoperative AMH levels; *p* < 0.05).¹¹ Laparoscopic ovarian cystectomy is associated with decreased ovarian reserve, as measured by serum AMH levels. In the cystectomy of dermoid cysts with the bathtub method, the serum AMH levels were also 85.4% of the preoperative AMH levels, however, there were no significant differences between baseline and 1-month postoperative levels. From the point of view of its

Table 2
Surgical outcomes.

Surgical outcomes	Bathtub method	LAC	<i>p</i>
Operative time (min)	110.4 ± 27.8 (62–173)	115.7 ± 23.8 (67–182)	NS
Total blood loss (mL)	8.3 ± 34.3 (0–200)	19.9 ± 35.3 (0–180)	NS
WBC count (/μL) ^a	7708.3 ± 1920.0 (5100–11,500)	9913.9 ± 2644.9 (5900–19,800)	<0.01
CRP level (mg/dL) ^a	0.91 ± 1.0 (0.06–4.31)	2.7 ± 1.9 (0.08–7.31)	<0.01
NRS ^a	2.7 ± 2.4 (1–6)	2.1 ± 0.7 (1–3)	NS

Data are expressed as mean ± standard deviation (minimum–maximum values).

CRP = C-reactive protein; LAC = laparoscopic-assisted cystectomy; NRS = Numeric Rating Scale for pain intensity; NS = not statistically significant; WBC = white blood cell.

^a WBC count, CRP level, and NRS were evaluated on postoperative Day 1.

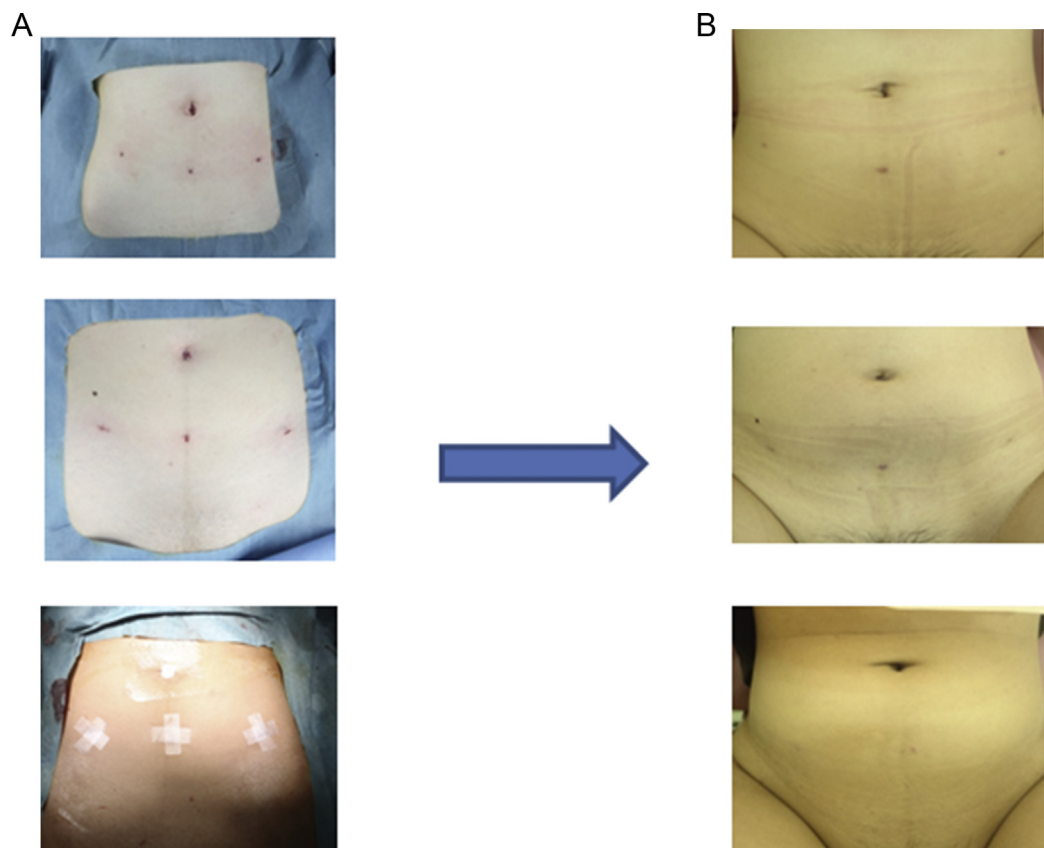


Figure 4. Surgical wounds (A) immediately after and (B) 1 month following the cystectomy with the bathtub method. The scars from the 5-mm umbilical port and the 12-mm posterior vaginal fornix are almost invisible. The visible scars on the abdominal wall are only 3-mm wounds. Therefore, the aesthetic outcomes following the bathtub method are favorable.

influence on ovarian reserve, the bathtub method compared favorably with the other laparoscopic cystectomy method.

Nevertheless, a disadvantage of the bathtub method, which is related to the 10-cm diameter of the endoscopic bag, could be the increased risk of spillage in cases of large tumors occupying the endoscopic bag. Furthermore, pregnant patients and patients with adhesions in the pouch of Douglas are not suitable candidates for the bathtub method. Therefore, the bathtub method is indicated for patients with cysts <7.5 cm in diameter, who are not pregnant, and who do not have adhesions in the pouch of Douglas. LAC is indicated for patients with large tumors, who are pregnant, or who have adhesions in the pouch of Douglas.

In conclusion, laparoscopic cystectomy of dermoid cysts with the bathtub method is an easy, safe, and minimally invasive technique. Therefore, women affected by dermoid cysts meeting the aforementioned criteria should be offered the option of treatment with the bathtub method.

References

- Huntington MK, Kruger R, Ohrt DW. Large, complex, benign cystic teratoma in an adolescent. *J Am Board Fam Pract.* 2002;5:164–167.
- Zanetta G, Ferrari L, Mignini-Renzini M, Vignali M, Fadini R. Laparoscopic excision of ovarian dermoid cysts with controlled intraoperative spillage. Safety and effectiveness. *J Reprod Med.* 1999;44:815–820.
- Shamshirsaz AA, Shamshirsaz AA, Vibhakkar JL, Broadwell C, Van Voorhis BJ. Laparoscopic management of chemical peritonitis caused by dermoid cyst spillage. *JSL.* 2011;15:403–405.
- Cristoforoni P, Palmeri A, Walker D, Gerbaldo D, Lay R, Montz FJ. Ovarian cystic teratoma: to scope or not to scope? *J Gynecol Tech.* 1995;1:153–156.
- Nezhat CR, Kalyoncu S, Nezhat CH, Johnson E, Berlanda N, Nezhat F. Laparoscopic management of ovarian dermoid cysts: ten years' experience. *JSL.* 1999;3:179–184.
- Bae J, Lee SJ, Kim SN. Transvaginal laparoscopic surgery for ovarian cysts. *Int J Gynaecol Obstet.* 2012;117:33–36.
- Morelli M, Mocciano R, Venturella R, Imperatore A, Lico D, Zullo F. Mesial side ovarian incision for laparoscopic dermoid cystectomy: a safe and ovarian tissue-preserving technique. *Fertil Steril.* 2012;98:1336–1340.
- Akira S, Abe T, Igarashi K, et al. Gasless laparoscopic surgery using a new intra-abdominal fan retractor system: an experience of 500 cases. *J Nippon Med Sch.* 2005;72:213–216.
- Kondo W, Bourdel N, Cotte B, et al. Does prevention of intraperitoneal spillage when removing a dermoid cyst prevent granulomatous peritonitis? *BJOG.* 2010;117:1027–1030.
- Campo S, Campo V. A modified technique to reduce spillage and operative time: laparoscopic ovarian dermoid cyst enucleation 'in a bag'. *Gynecol Obstet Invest.* 2011;71:53–58.
- Testa AC. Malignant ovarian neoplasms: the sonographic voyage of discovery. *Ultrasound Obstet Gynecol.* 2008;31:611–614.
- Phan NQ, Blome C, Fritz F, et al. Assessment of pruritus intensity: prospective study on validity and reliability of the visual analogue scale, numerical rating scale and verbal rating scale in 471 patients with chronic pruritus. *Acta Derm Venereol.* 2012;92:502–507.
- Chang HJ, Han SH, Lee JR, et al. Impact of laparoscopic cystectomy on ovarian reserve: serial changes of serum anti-Müllerian hormone levels. *Fertil Steril.* 2010;94:343–349.
- Shawki O, Ramadan A, Askalany A, Bahnassy A. Laparoscopic management of ovarian dermoid cysts: potential fear of dermoid spill, myths and facts. *Gynecol Surg.* 2007;4:255–260.
- Loh JS, Maheshwari A. Anti-Müllerian hormone—is it a crystal ball for predicting ovarian ageing? *Hum Reprod.* 2011;26:2925–2932.
- Durlinger AL, Gruijters MJ, Kramer P, et al. Anti-Müllerian hormone inhibits initiation of primordial follicle growth in the mouse ovary. *Endocrinology.* 2002;143:1076–1084.
- Iwase A, Hirokawa W, Goto M, et al. Serum anti-Müllerian hormone level is a useful marker for evaluating the impact of laparoscopic cystectomy on ovarian reserve. *Fertil Steril.* 2010;94:2846–2849.