

Outcomes of adhesion barriers in gynecologic surgeries

A retrospective study at a medical center

Ci Huang, MD^a, Dah-Ching Ding, MD, PhD^{a,b,*}

Abstract

During second-look surgery or hospitalization, intra-abdominal surgeries may cause severe postoperative complications, such as pelvic adhesion, postoperative ileus, and severe pain. However, only few studies have analyzed the outcomes of antiadhesive barriers in second-look surgery. This retrospective study aims to identify the outcomes of different antiadhesive barriers by analyzing surgical images. The study included patients who received an adhesion barrier during second-look surgery between January 2011 and November 2017. Four brands of adhesive barriers were used: Interceed, Seprafilm, Adept, and SurgiWrap. Adhesion scores were calculated for four quadrants of the uterus and surrounding structures before and after the use of antiadhesive barriers. The differences between the data of 2 observers and surgery times were also determined. A total of 18 patients were enrolled in the study. The adhesion scores were not significantly different before and after the placement of antiadhesive barriers. The difference in the adhesion scores between the two observers was also not significant, except in the Seprafilm group ($P = .029$). Furthermore, no significant change in the adhesion scores was observed between the first and second surgeries. Therefore, using adhesion barriers may not decrease the adhesion scores in the current setting.

Keywords: Adept, adhesion barrier, Interceed, Seprafilm, SurgiWrap

1. Introduction

Intra-abdominal surgery may lead to severe postoperative complications, such as pelvic adhesion, postoperative ileus, and severe pain, due to surgical trauma-induced ischemia and inflammation. Consequently, fibrin persistence may develop in the form of bands, thus affecting the peritoneal surfaces on the opposite side.^[1] A second-look laparoscopic survey has revealed that 50% to 100% of pelvic adhesions develop in the first few weeks after surgery.^[2] Adhesions may be caused by subfertility, chronic abdominal pain, and dyspareunia.^[3] Therefore, their formation must be reduced to prevent subsequent events.

Compared with open surgery, laparoscopy reduces peritoneal trauma and de novo adhesion formation; however, it may cause peritoneal inflammation due to pneumoperitoneum pressure duration and thermal injuries.^[4] Therefore, the use of an antiadhesive barrier has become common.

Pelvic adhesion after gynecologic surgeries may cause pelvic pain, gastrointestinal upset, or infertility, influencing the patients' quality of life.^[5] Therefore, its prevention is mandatory. Despite the use of rigorous surgical techniques, several antiadhesive barriers can be used after gynecologic surgeries.^[6] Theoretically, inert physical barriers can be used to separate the serosal surface from the trauma area for more than 3 days, preventing adhesion formation. Most previous studies have demonstrated the outcomes of different antiadhesive barriers using second-look laparoscopy 3–16 weeks after a primary surgery.^[7–9] A subsequent surgery can effectively evaluate the effects of antiadhesive barriers used in previous surgeries. However, only few reports have investigated the effects of antiadhesive barriers in subsequent gynecologic surgeries.

Several antiadhesive barriers are currently used in gynecologic surgeries. Adept (Baxter, Deerfield, IL), which comprises 4% icodextrin, can prevent postoperative adhesions.^[7] Interceed (Ethicon, New Brunswick, NJ),^[8] which comprises oxidized regenerated cellulose, and Seprafilm (Genzyme, Cambridge, MA),^[10] which comprises 4% icodextrin, oxidized regenerated cellulose, and hyaluronic acid–carboxymethylcellulose membrane, are also effective in adhesion prevention.

This retrospective study aims to identify the outcomes of different antiadhesive barriers via the analysis of surgical images obtained during subsequent surgeries.

Editor: N/A.

The authors declare no conflict of interest.

^aDepartment of Obstetrics and Gynecology, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, ^bInstitute of Medical Sciences, Tzu Chi University, Hualien, Taiwan.

*Correspondence: Dah-Ching Ding, Department of Obstetrics and Gynecology, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Tzu Chi University, 707, Chung-Yang Road, Sec. 3, Hualien 970, Taiwan (e-mail: dah1003@yahoo.com.tw).

Copyright © 2019 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Huang C, Ding DC. Outcomes of adhesion barriers in gynecologic surgeries: a retrospective study at a medical center. *Medicine* 2019;98:50(e18391).

Received: 24 April 2019 / Received in final form: 15 October 2019 / Accepted: 15 November 2019

<http://dx.doi.org/10.1097/MD.00000000000018391>

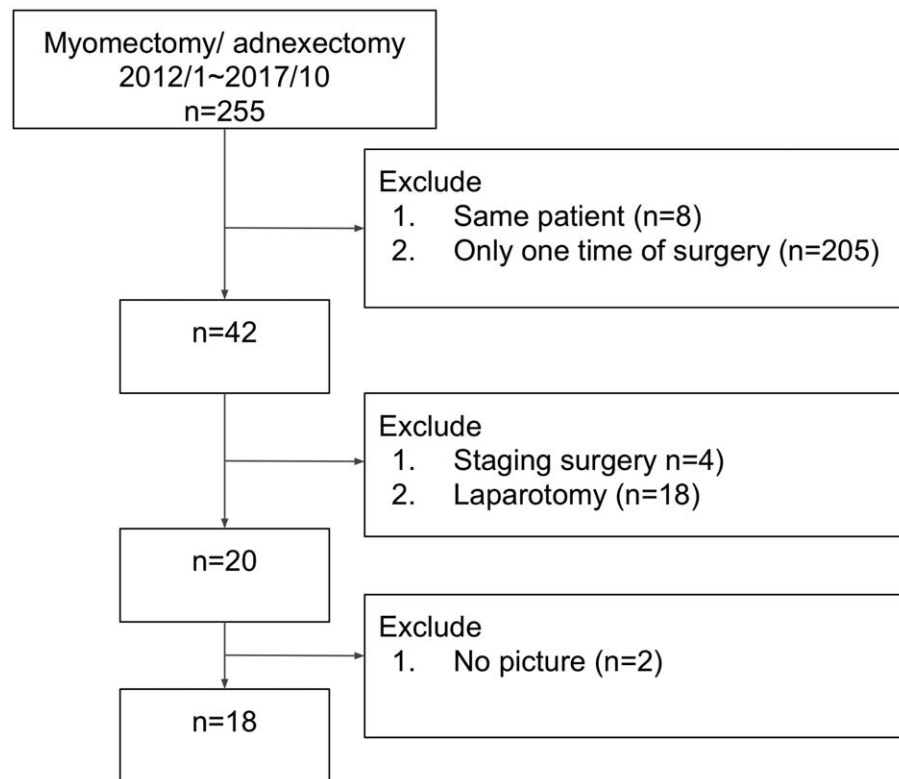


Figure 1. Study flowchart.

2. Materials and methods

The Research Ethics Committee of the Hualien Tzu Chi Hospital approved this study (REC No: IRB 108-33-B).

2.1. Patient enrollment

In this retrospective study, the medical records of our hospital as well as procedure codes were reviewed to identify patients who received an adhesion barrier with second-look surgery between January 2011 and November 2017. Furthermore, the procedure codes for laparoscopic adnexectomy (80420C), laparoscopic bilateral adnexectomy (80425C), and laparoscopic myomectomy (80402B) were explored.

In total, 255 procedural events were recorded, of which 8 were excluded because they included the same patient. Furthermore, 205 more events were excluded because they involved only one procedure that was not followed by second-look surgery. Finally, 42 patients were enrolled. The patients who underwent staging surgery (4 patients) and laparotomy (18 patients) were also excluded. In total, 20 patients who underwent second-look surgery during the study period were identified; however, the surgical images of only 18 patients were available for review. The patient selection process is illustrated in Figure 1.

2.2. Brands of antiadhesive barriers

Four brands of antiadhesive barriers were found in operation notes: Interceed (Johnson & Johnson, New Brunswick, NJ), Seprafilm (Genzyme Corp., Cambridge, MA), Adept (icodextrin

w/v 4% solution; Baxter Healthcare, Deerfield, IL), and Surgi-Wrap (MAST BIOSURGERY Inc., San Diego, CA).

2.3. Adhesion scores

Adhesion scores were calculated for 4 quadrants of the uterus and surrounding structures before and after using antiadhesive barriers during surgery (Fig. 2A). The modified American Fertility Society score was used to evaluate adhesion scores.^[11] In brief, the surgical field was divided into four parts: uterus and surrounding structures, right adnexa, left adnexa, and omentum and peritoneum. Adhesion scores were divided into 5 categories based on previous studies:^[7,12] no adhesion (score=0), mild adhesion and localized (score=1) and mild adhesion and no extent evaluation (score=2), moderate adhesion [mild and extensive extent (score=4) and severe and localized extent (score=4)], moderate to severe adhesion [(severe but no extent evaluation (score=8)), and severe adhesion [severe and extensive extent (score=16)]. The localized and extensive extents were classified as <50% and ≥50% of the site covered by adhesions, respectively, whereas severity was categorized as mild (filmy, avascular) and severe (dense, cohesive, vascular, or organized). The basic adhesion score was based on the surgical image during the whole procedure. Grading was conducted by two reviewers. The basic scoring system is shown in Figure 2B.

2.4. Statistical analysis

SPSS software version 25 (IBM, New York, NY) was used for statistical analyses. All continuous variables were presented as

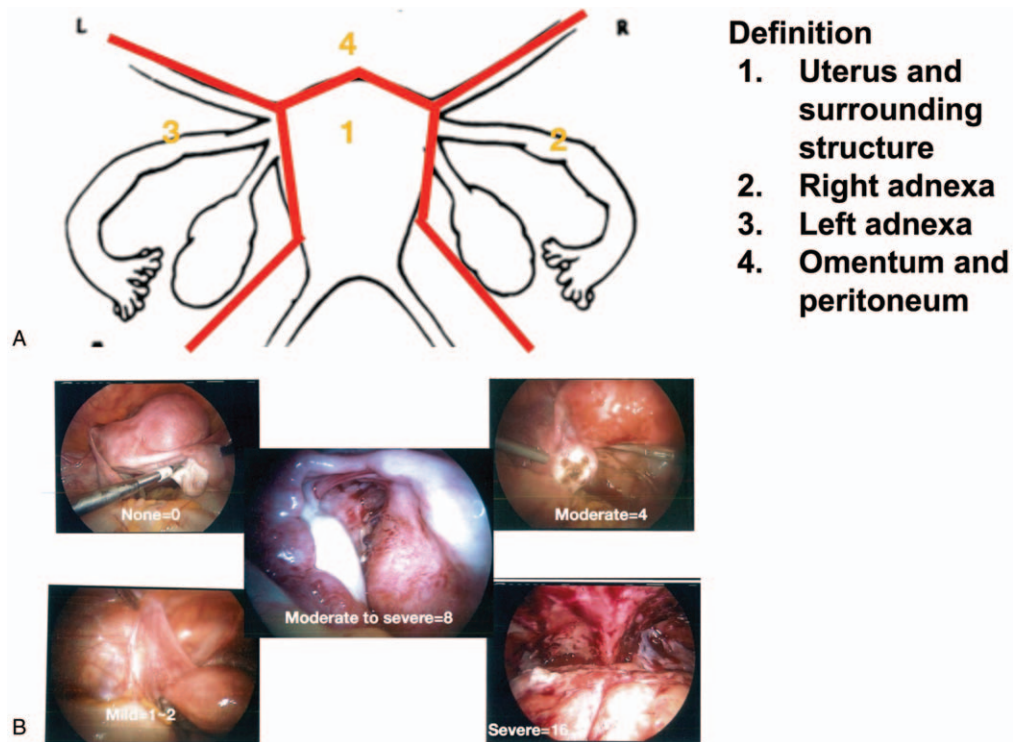


Figure 2. Adhesion score pattern. (A) Adhesion location. (B) Adhesion severity was classified as none (score=0), mild (score=1–2), moderate (score=4), moderate to severe (score=8), and severe (score=16).

median or mean ± standard deviation. The Mann–Whitney *U* test was used to compare the average of variables between 2 groups (before and after surgery, 2 observers, the first and second surgery) to determine the association between 2 continuous variables. *P* values <.05 were considered statistically significant.

3. Results

3.1. Patient characteristics

This study included a total of 18 patients. The surgical types included laparoscopic myomectomy (n=23), laparoscopic-assisted ovarian cystectomy (n=6), adhesiolysis (n=21), laparoscopic subtotal hysterectomy (n=9), and others (n=5). The mean number of surgical events in one person was 1.7. The surgical time

ranged between 80 and 205 min based on surgical complexity. In addition, the mean age and bodyweight of the patients were 37.8 ± 7.9 years old and 60.2 ± 12.3 kg, respectively.

3.2. Surgical time for different barriers

The mean surgical time for the whole procedure and adhesion barrier placement ranged between 123 (no adhesion barrier) and 205 min (SurgiWrap barriers) (Fig. 3).

3.3. Time interval between surgeries in our study patients

Table 1 shows the time interval between the 2 surgeries (primary and secondary). The median time intervals of the first, second, and third surgeries were 3.56, 1.87, and 1.89 years, respectively.

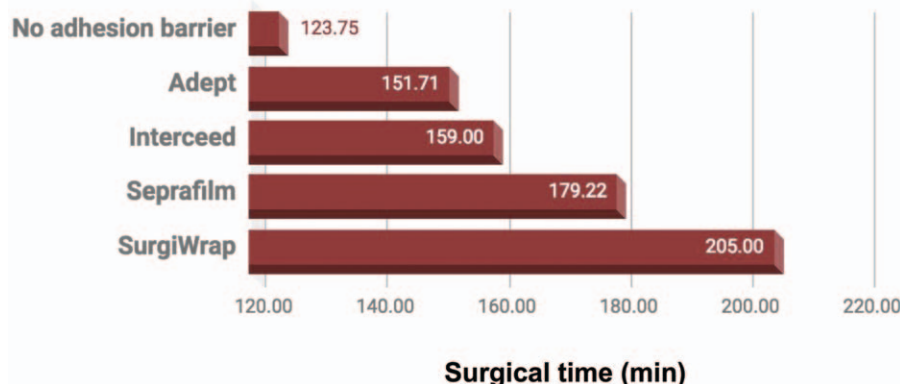


Figure 3. Surgical time of different antiadhesive barrier brands.

Table 1
The time interval of re-operation.

	First re-operation Interval (operation 2- operation 1)	Second re-operation Interval (operation 3- operation 2)	Third re-operation Interval (operation 4- operation 3)
N (times)	20	4	2
Mean ±SD (year)	3.87 ±3.07	2.28 ±1.86	1.89 ±2.24
Median (year)	3.56	1.87	1.89

SD = standard deviation.

3.4. Adhesion scores of different barriers

Two reviewers who were blinded to the patient profile assessed the adhesion scores. Table 2 presents the average adhesion scores before and after the use of adhesion barriers. No significant differences were observed before and after the use of Seprafilm ($P=.057$), Adept ($P=.057$) and Interceed ($P=1.0$) as well as without the use of a barrier ($P=1.0$).

3.5. Interobserver differences

Two reviewers assessed the adhesion scores. Table 3 shows the outcomes of different adhesion brands. The *t* test revealed a significant difference in the Seprafilm group between 2 observers ($P=.029$).

3.6. Differences in the adhesion scores for various pelvic parts between the 2 surgeries

Table 4 presents the differences in the adhesion scores between the 2 surgeries at various anatomic sites. During second surgery, the adhesion scores tended to increase; however the difference was nonsignificant.

4. Discussion

The present study revealed that different antiadhesive barrier brands were associated with varying degrees of adhesion formation. However, their effects may be comparable. Among the brands used, Adept was associated with the highest adhesion formation score. Moreover, we found that the adhesion scores of all antiadhesive barrier brands tended to slightly increase by 1–2 points. Adhesion scores were the highest at the uterus after second-look surgery. Primary surgeries with high adhesion scores showed less decrease in the antiadhesion effect in the following surgery. Nevertheless, the group that did not have an antiadhesive barrier showed increased adhesion scores.

In this study, the American Fertility Society^[16] adnexal adhesion score was used to evaluate adhesion severity, which

was determined by the observer. Weijenborg et al^[17] have reported that the evaluations of videotaped laparoscopies for endometriosis were reliable and justified the use of recorded findings. To assess the adhesion scores, laparoscopic surgical images, and not videos, were used in the present study. These were reliable and justified the results; furthermore, the 2 observers were not the primary operators.

Recently, a randomized controlled trial was conducted to evaluate Interceed as an antiadhesive barrier in colorectal surgery. It was found that Interceed was safe and technically feasible for laparoscopic colorectal surgeries.^[8] Another study using Interceed in gynecologic surgeries for adolescent and pediatric patients found no major adverse outcome or adhesion during the second surgery in the Interceed group.^[18] However, a retrospective study comparing the use and nonuse of antiadhesive barriers in myomectomy and hysterectomy reported the presence of ileus and fever in the antiadhesive barrier group.^[19] In our study, a slight decrease in the adhesion scores was noted.

The antiadhesion effect of Seprafilm has been well documented.^[9,20] A randomized study has explored the antiadhesive capability of Seprafilm in myomectomy cases and has shown that 48% of patients were free of adnexal adhesions.^[21] They checked adhesion after a short period of time following the first surgery. However, according to our data, the antiadhesive ability of Seprafilm, which is the most popular brand, did not have a significant effect on second-look surgeries. In addition, the median time between the first and second surgery was 3.56 years, which was different from that observed in previous studies.

In a randomized controlled trial, Adept was demonstrated to be an effective antiadhesive barrier.^[7] However, we found that it was ineffective. This may be because high adhesion scores were noted in the Adept group during the first surgery. This high score may have been due to the presence of many adhesions that could not be covered by only one sheet of Interceed or Seprafilm. Therefore, Adept was the reasonable choice of antiadhesive barrier for this situation.

Owing to cost and infective conditions, 30% of the surgeries did not use antiadhesive barriers in our study. Moreover, among

Table 2
The outcome of anti-adhesive barriers.

Antiadhesive barriers	Adhesion score		P value*
	The 1st time of surgery	The 2nd time of surgery	
Seprafilm (n = 17)	4.1 ±0.7	5.7 ±1.6	.057
Interceed (n=6)	6.0 ±1.7	4.7 ±2.8	1.0
Adept (n=7)	6.9 ±1.2	8.7 ±0.5	.057
No use (n = 14)	4.1 ±1.5	5.0 ±1.5	1.0

* Mann–Whitney U test

n = event numbers

SurgiWrap (n = 1), no adhesion score available in the 1st time of surgery.

Table 3
Difference in adhesion scores observed by the 2 doctors.

Antiadhesive barriers	Adhesion score		P value
	Doctor 1	Doctor 2	
SurgiWrap (n = 1)	0.25 ±0.5	0.5 ±1.0	1.0
Seprafilm (n=17)	5.7 ±1.6	2.5 ±1.1	.029*
Interceed (n=6)	4.7 ±2.8	3.2 ±5.0	.343
Adept (n=7)	8.7 ±0.5	8.0 ±4.0	.343
No use (n = 14)	5.0 ±1.5	5.0 ±1.3	1.0

* Mann–Whitney U test

n = event numbers.

Table 4
The change between adhesion scores and surgical times.

Anatomic sites	Adhesion score		P value*
	The first time of surgery (n=11)	The second time of surgery (n=16)	
Uterus	2.0±2.6	4.6±5.0	.19
Rt-adnexa	2.4±2.4	3.5±4.1	.64
Lt-adnexa	2.4±2.4	3.6±4.2	.57
Omentum	1.0±2.5	1.6±2.8	.48

* Mann-Whitney U test
n=patient numbers.

the barrier groups, no significant difference in the adhesion scores was noted after the second surgery. Therefore, this finding deserves further study.

A study has reported that adhesions start to form after starting surgeries.^[13] Another study has reported that the longer the surgical time, the more severe is the adhesion.^[14] Surgical time is also affected by surgical complexities and antiadhesive barrier types. Because Adept and Interceed are a solution and fabric film, respectively, they can be easily placed. However, Seprafilm placement requires advanced skills in laparoscopic surgeries.^[15] SurgiWrap also requires a suturing skill to fix the film, necessitating more surgical time. Therefore, surgical time may indicate the complexity of the surgery and the placement of antiadhesive barriers, affecting the choice of antiadhesive barrier that is used. If the surgical time is longer than expected, the surgeons may select barriers that have easy placement, such as Interceed or Adept. In our study, the surgical time of each adhesive barrier brand was different. Furthermore, the personal favorite barrier of a surgeon also affects the choice of barriers. In our study, one doctor only used Seprafilm to prevent adhesion. The longest surgical time was noted in SurgiWrap. We speculate that this may be due to the surgical complexity and unfamiliarity of the placement of SurgiWrap.

Some studies have explored interobserver variance,^[22,23] and some variation has been observed between observers. In our study, interobserver difference in the Seprafilm group was statistically significant. Each doctor had his/her own opinion regarding the surgical picture. Therefore, some variation existed in score counting.

Our study showed a surprising finding that all antiadhesive barriers cannot effectively prevent adhesion. This may be due to the small sample size and surgery complexity. Moreover, selection bias may have existed. The patients who need second surgeries may indicate that their pelvic condition is not well due to the presence of pelvic adhesions. The first surgery may be complex and thus cause several peritoneal injuries that cannot be covered by the antiadhesive barriers. A large number of patients who received antiadhesive barriers did not undergo a second surgery; therefore, the adhesion condition in these patients could not be determined. This study was based on the findings of the second surgery. Therefore, these patients may carry adhesion characteristics due to their diseases or body conditions.

The strength of the present study is that our results were real-world outcomes because we did not schedule a second-look surgery. The patients were enrolled based on our hospital procedure coding system, and the need for second-look adhesion was determined based on laparoscopic images. Furthermore, different adhesion brands were used and selected based on the

surgeon's personal experience or surgical complexity. Finally, the American Fertility Society adnexal adhesion score was used to evaluate adhesion severity.^[16]

However, our study has some limitations. The sample size was small, the data were obtained from a single center, and the study design was retrospective. In addition, second-look surgeries were performed at different time periods. The initial surgeries were of different types and performed under different conditions. Furthermore, the pain scores before and after the placement of different antiadhesive barrier brands were not compared.

In conclusion, we observed that using antiadhesive barriers may not decrease the adhesion scores in the current setting. A prospective large-scale study investigating the long-term efficacy of antiadhesive barriers should be conducted.

Author contributions

Conceptualization: Dah-Ching Ding.

Data curation: Ci Huang, Dah-Ching Ding.

Formal analysis: Ci Huang, Dah-Ching Ding.

Funding acquisition: Dah-Ching Ding.

Investigation: Ci Huang, Dah-Ching Ding.

Methodology: Ci Huang, Dah-Ching Ding.

Project administration: Dah-Ching Ding.

Supervision: Dah-Ching Ding.

Validation: Dah-Ching Ding.

Visualization: Dah-Ching Ding.

Writing – original draft: Ci Huang, Dah-Ching Ding.

Writing – review & editing: Ci Huang, Dah-Ching Ding.

References

- Arung W, Meurisse M, Detry O. Pathophysiology and prevention of postoperative peritoneal adhesions. *World J Gastroenterol* 2011;17:4545–53.
- diZerega GS. Contemporary adhesion prevention. *Fertil Steril* 1994;61:219–35.
- Tabibian N, Swehli E, Boyd A, et al. Abdominal adhesions: A practical review of an often overlooked entity. *Ann Med Surg (Lond)* 2017;15:9–13.
- Mais V. Peritoneal adhesions after laparoscopic gastrointestinal surgery. *World J Gastroenterol* 2014;20:4917–25.
- Hirschelmann A, Tchartchian G, Wallwiener M, et al. A review of the problematic adhesion prophylaxis in gynaecological surgery. *Arch Gynecol Obstet* 2012;285:1089–97.
- Han ES, Scheib SA, Patzkowsky KE, et al. The sticky business of adhesion prevention in minimally invasive gynecologic surgery. *Curr Opin Obstet Gynecol* 2017;29:266–75.
- Brown CB, Luciano AA, Martin D, et al. Adept (icodextrin 4% solution) reduces adhesions after laparoscopic surgery for adhesiolysis: a double-blind, randomized, controlled study. *Fertil Steril* 2007;88:1413–26.
- Naito M, Ogura N, Yamanashi T, et al. Prospective randomized controlled study on the validity and safety of an absorbable adhesion barrier (Interceed®) made of oxidized regenerated cellulose for laparoscopic colorectal surgery. *Asian J Endosc Surg* 2017;10:7–11.
- Vrijland WW, Tseng LNL, Eijkman HJM, et al. Fewer intraperitoneal adhesions with use of hyaluronic acid-carboxymethylcellulose membrane: a randomized clinical trial. *Ann Surg* 2002;235:193–9.
- Diamond MP, Burns EL, Accomando B, et al. Seprafilm (®) adhesion barrier: (2) a review of the clinical literature on intraabdominal use. *Gynecol Surg* 2012;9:247–57.
- Thornton MH, Johns DB, Campeau JD, et al. Clinical evaluation of 0.5% ferric hyaluronate adhesion prevention gel for the reduction of adhesions following peritoneal cavity surgery: open-label pilot study. *Hum Reprod* 1998;13:1480–5.
- Johns DB, Keyport GM, Hoehler F, et al. Intergel Adhesion Prevention Study Group Reduction of postsurgical adhesions with Intergel adhesion prevention solution: a multicenter study of safety and efficacy after conservative gynecologic surgery. *Fertil Steril* 2001;76:595–604.

- [13] González-Quintero VH, Cruz-Pachano FE. Preventing adhesions in obstetric and gynecologic surgical procedures. *Rev Obstet Gynecol* 2009;2:38–45.
- [14] Ahmad M, Crescenti F. Significant adhesion reduction with 4DryField PH after release of adhesive small bowel obstruction. *Surg J (N Y)* 2019;5:e28–34.
- [15] Hong MK, Ding DC. Seprafilm® application method in laparoscopic surgery. *JLS* 2017;21.
- [16] American Fertility Society. The American Fertility Society classifications of adnexal adhesions, distal tubal occlusion, tubal occlusion secondary to tubal ligation, tubal pregnancies, Müllerian anomalies and intrauterine adhesions. *Fertil Steril* 1988;49:944–55.
- [17] Weijenborg PTM, ter Kuile MM, Jansen FW. Intraobserver and interobserver reliability of videotaped laparoscopy evaluations for endometriosis and adhesions. *Fertil Steril* 2007;87:373–80.
- [18] Moon LM, Kaiserman JB, Dietrich JE. Use of interceed® absorbable adhesion barrier in pediatric and adolescent gynecology surgery. *J Pediatr Adolesc Gynecol* 2017;30:309.
- [19] Tulandi T, Closon F, Czuzoj-Shulman N, et al. Adhesion barrier use after myomectomy and hysterectomy: rates and immediate postoperative complications. *Obstet Gynecol* 2016;127:23–8.
- [20] van der Wal JBC, Iordens GIT, Vrijland WW, et al. Adhesion prevention during laparotomy: long-term follow-up of a randomized clinical trial. *Ann Surg* 2011;253:1118–21.
- [21] Diamond MP. Reduction of adhesions after uterine myomectomy by Seprafilm* membrane (HAL-F): a blinded, prospective, randomized, multicenter clinical study. Seprafilm Adhesion Study Group. *Fertil Steril* 1996;66:904–10.
- [22] Nádas J, Putz Z, Kolev G, et al. Intraobserver and interobserver variability of measuring waist circumference. *Med Sci Monit* 2008;14:CR15–8.
- [23] Singh K, Jacobsen BK, Solberg S, et al. Intra- and interobserver variability in the measurements of abdominal aortic and common iliac artery diameter with computed tomography. The Tromsø study. *Eur J Vasc Endovasc Surg* 2003;25:399–407.