The feasibility of gasless single-port access laparoscopy in overweight patients undergoing adnexal surgery

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INTRODUCTION

Laparoscopic surgery is preferred over laparotomy in gynecological surgery because it is minimally invasive and has less postoperative pain and a short recovery period. Carbon dioxide (CO_2) gas is commonly used in laparoscopic surgery to make pneumoperitoneum to secure the field of vision, whitch can lead to cardiopulmonary dysfunction and complications. If laparoscopic surgery can be performed without CO_2 gas injections, complications may be reduced.

To perform laparoscopic surgery without CO_2 gas, it is essential to lift the abdominal wall to secure an operating space. Various methods and devices for retracting the abdominal wall have been devised, but the complexity of the installation process and the difficulty in securing a field of view have limited its application in overweight or obese patients. There are few studies on whether gasless laparoscopic surgery is possible in overweight or obese patients with an adequate visual field.

OBJECTIVES

This study aims to evaluate the feasibility of gasless single-port access (SPA) laparoscopy in overweight patients undergoing adnexal surgery

MATERIALS AND METHODS

The medical records of 118 patients who underwent gasless SPA laparoscopic adnexal surgery using J-shaped or triangular-shaped retractors between May 2017 and June 2022 were reviewed. Patients with a body mass index (BMI) ≥ 23 and < 23 were categorized in the overweight and standard-weight groups, respectively (Figure 1). Surgical characteristics and outcomes were compared between the two groups. Figure 2 shows the method of abdomen wall traction for gasless laparoscopic adnexal surgery.

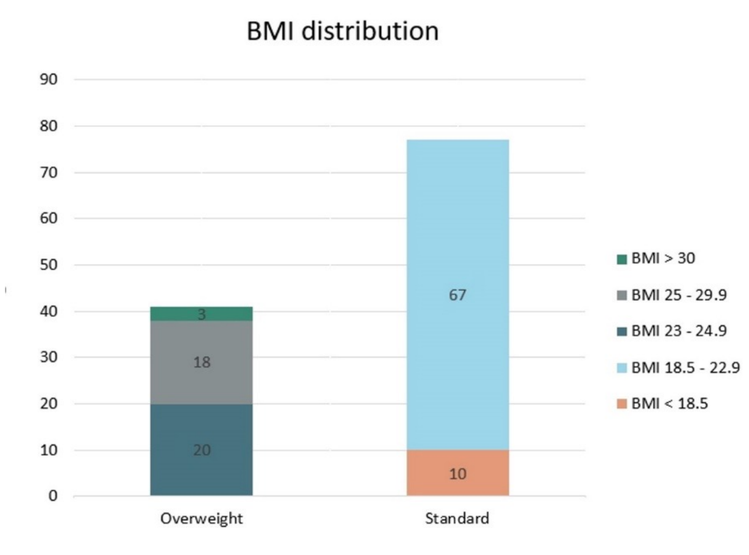

Figure 1. The distribution of body mass index between the overweight and standard groups

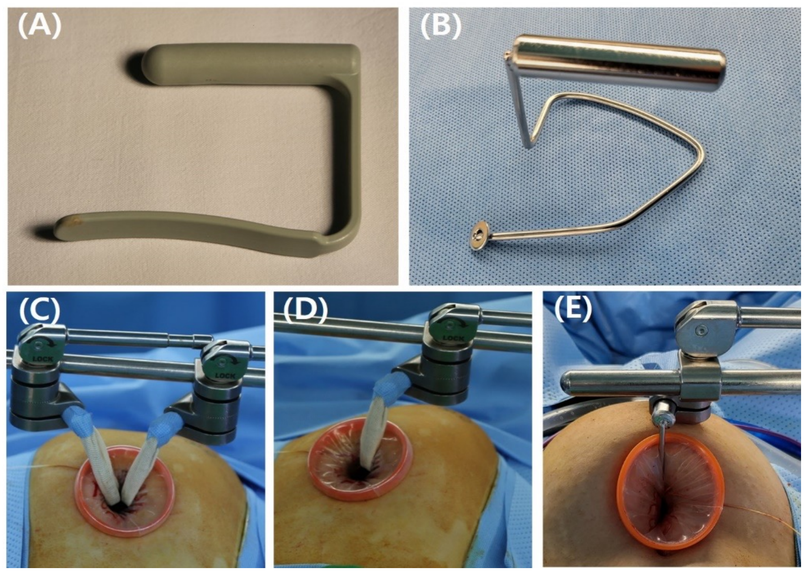

Figure 2. (A) The appearance of the J-shaped retractor, which is made of plastic. (B) The appearance of a triangular-shaped retractor, which is made of stainless steel. Abdominal wall retraction using two J-shaped retractors (C), one J-shaped retractor (D), and a triangular-shaped retractor (E).

Table 1. Baseline patient characteristics

Variables	Overweight group (N=41)	Standard group (N=77)	P value
Ages (year: median [range]	47 (14.8-78)	31.8 (10.9-87.7)	0.001
Height (cm, median [range]	159 (44.4-172)	160.0 (148.0-179.0)	0.004
Body weight (kg, median [range]	63.0 (53.0-96)	54.0 (40.3-66.0)	< 0.001
BMI (kg/m2: median [range])	25.2 (23-33.4)	21.0 (15.5-22.9)	< 0.001
Parity, number (%)			
None	10 (24.2)	44 (57.1)	0.001
One	7 (17.1)	10 (13.0)	0.547
Two	19 (46.3)	20 (26.0)	0.025
More than three	5 (12.2)	3 (3.9)	0.124
Previous abdominal surgery, N (%)			
None	20 (48.8)	58 (75.3)	0.004
One time	11 (26.2)	12 (15.6)	0.142
Two times	6 (14.6)	5 (6.5)	0.187
More than three times	7 (17.1)	2 (2.6)	0.008
Previous abdominal surgery type, N (%)			
Ceasrean section	10 (24.4)[c]	12 (15.6[e]	0.138
Laparoscopic gynecologic surgery[a]	8 (19.5)[d]	5 (6.5)	0.060
Appendectomy	4 (9.8)	2 (2.6)	0.184
Bowel surgery	1 (2.4)	1 (1.3)	1.000
Largest diameter (Cm, median [range])[b]	6.0 (3.0-25.2)	6.9 (1.8-30)	0.525

a: Included adenxal surgery, myomectomy and hysterectomy
b : Largest one was included in pateints with bliateral adnexal mass
c : Nine patient had two cesarean sections
e : Six pateint had two cesarean sections and one patient had four cesarean sections
d : One patient had two gynecologic surgeries

Table 2. Surgical characteristics and outcomes

Variables	Overweight group (N=41)	Standard group (N=77)	P value
Operation, Number (%)			
Elective operation	39 (95.1)	67 (87.0)	0.212
Emergency operation	2 (4.9)	10 (13.0)	0.212
Type of surgery, Number (%)			
Unilateral cystectomy	8 (19.5)	42 (54.5)	< 0.001
Bilateral cystectomy	6 (14.6)	6 (7.8)	0.242
Unilateral salpingo-oophorectomy	12 (29.3)	9 (11.7)	0.017
Bilateral salpingo-oophorectomy	11 (26.8)	13 (16.9)	0.201
Bilateral or unilateral salpingectomy	4 (9.8)	7 (9.1)	
Co-operation , Number (%)			
Hysteroscopy	3 (7.3)	4 (5.2)	1.000
Myomectomy	5 (12.2)	6 (7.8)	0.511
Appendectomy	0	3 (3.9)	0.551
Other[a]	0	4 (5.2)	0.297
Type of anesthesia, Number (%)			
General anesthesia	37 (90.2)	64 (83.1)	0.294
Combined spinal and epidural anesthesia	4 (9.8)	13 (16.9)	0.411
Specific surgical finding, Number (%)			
Mild pelvic adhesion	2 (4.9)	9 (11.7)	0.325
Mod to severe pelvic adhesion	10 (24.4)	6 (7.8)	0.012
Rupture	0	3 (3.9)	0.551
Torsion	2 (4.9)	7 (9.1)	0.494
Location of adnexal mass, Number (%)			
Unilateral	33 (80.5)	64 (83.3)	0.772
Bilateral[b]	8 (19.5)	13 (16.9)	0.772
Conversion to laparotomy, Number (%)	1 (2.4)	1 (1.3)	1.000
Use of additional trocar (two port), Number (%)	1 (2.4)	0	0.347
Intraoperative complications, Number (%)	0	0	
Postoperative complications, Number (%)	1 (2.4)[c]	0	0.347
Postoperative hospital stay	2 (2-7)	2 (2-10)	0.329
Operation Time [minute: median (range)]	60 (30-190)	58 (30-155)	0.738
From incision to setup time [minute: median (range)]	7.5 (5-12)	7 (4-12)	0.269
Estimated Blood loss [ml: median (range)]	50 (10-500)	50 (10-500)	0.770

a: Other included endo bx (n= 2), IUD removal (n=1), and conization (n=1)
b: The patients who underwewnt prophylatic bilateral salpingo-oophorectomy due to BRCA mutaiton was regarded as bilateral location
c: The pateint experienced pneumonia after surgery

Table 3. Pathologic outcomes, N (%) .

	Overweight group (N=41)	Standard group (N=77)	P value
Mature cystic teratoma	6 (14.6)	21 (27.3)	0.120
Paraovarian/paratubal cyst	4 (9.8)	4 (5.2)	0.446
Serous tumor	6 (14.6)	4 (5.2)	0.084
Mucinous tumor	7 (17.1)	12 (15.6)	0.834
Functional cyst[a]	5 (12.2)	5 (6.5)	0.494
Endometriotic cyst	6 (14.6)	22 (28.6)	0.113
Hydrosalpinx	1 (2.4)	3 (3.9)	1.000
Granulosa cell tumor	2 (4.9)	0	0.119
Ectopic pregnancy	1 (2.4)	2 (2.6)	1.000
Tubo-ovarian abscess	2 (4.9)	2 (2.6)	0.609
BRCA mutation	1 (2.4)	2 (2.6)	1.000

a: Included follicular cyst and hemorrhagic corpus luteal cyst

Table 4. Simple and multiple linear regression analysis of operation time

Predictor variables	Coefficient	Standard error	P value	Coefficient	Standard error	P value	VIF[a]
Age	-0.40	0.17	0.02	-0.26	0.14	0.061	1.30
Body mass index	0.31	0.85	0.715	-1.08	0.57	0.064	1.18
Bilaterality	3.32	6.00	0.581	13.77	3.67	< 0.001	1.11
Tumor diameter	2.89	0.47	< 0.001	3.9	0.43	< 0.001	1.09
Presence of adhesion	14.23	6.09	0.021	9.48	4.18	0.026	1.07
Setup time of retractor	5.18	1.47	0.001	3.98	1.04	0.001	1.24
Constant				31.15	13.97	0.029	

a: VIF, Variance inflation factor
Adjust R = 0.645

RESULTS

Among the patients that underwent gasless adnexal laparoscopic surgery during the study period, 41 and 77 patients were classified in the overweight and standard groups, respectively (Figure 1). Table 1 shows the demographics and clinical characteristics of the patients who underwent gasless laparoscopic adnexal surgery in the overweight and standard weight groups. Age ($p = 0.001$), the number of patients who had previous abdominal surgeries ($p = 0.001$), and the number of subjects who had given birth ($p = 0.004$) were significantly higher in the overweight group.

The surgical outcomes are shown in Table 2. 12 (10.2%) of 118 patients underwent emergent SPA laparoscopic surgery. The most common type of adnexal surgery was unilateral cystectomy (50 cases, 42.4% ; 8 cases [19.5%] in the overweight group and 42 cases [54.5%] in the standard group) There was no significant difference in setup time from umbilical skin incision to abdominal wall retraction, use of additional trocar, operation time, estimated blood loss, and length of the postoperative hospital stay between the overweight and standard groups. No serious intraoperative complications such as urologic, bowel, and vessel injuries were noted in either group. Table 3 shows the pathologic outcomes. There were no significant differences in pathologic outcomes between the two groups. An endometrial cyst (28 cases, 23.7%) was the most common reason for adnexal surgery in both groups

Table 4 shows the correlation between operation time and predictor variables. The operation time was significantly correlated with age ($p = 0.020$). Tumor diameter ($p < 0,001$), bilaterality ($p < 0,001$), presence of adhesion ($p = 0.026$), and set up diameter of the retractor ($p = 0.001$) showed a significant correlation with operation time in the multivariate analysis (Adjust R = 0.645). BMI did not correlate with operation time in either the univariate or multivariate analyses ($p = 0.715$ and $p = 0.064$, respectively).

CONCLUSIONS

Our study has several limitations. First, this study was performed at a single center and only included adnexal surgery. Second, this study is retrospective in nature, and there is potential selection bias in a case-control study. Third, other gynecologic surgeries, such as total hysterectomy and myomectomy requiring endoscopic procedures of more advanced complexity, were not included. Fourth, the results cannot be applied to patients with a BMD 30 kg/m^2 or higher as they were not included in the study. In the future, well-designed prospective, controlled studies investigating the potential advantages of gasless laparoscopy and including other gynecologic surgeries are required to verify our findings in overweight or obese patients. As far as we know, this is the first study to evaluate the safety and efficacy of gasless laparoscopic surgery in overweight patients. Gasless SPA laparoscopy using a J-shaped retractor or triangular retractor is a feasible alternative to conventional SPA laparoscopy in individuals who are overweight to avoid the potential negative effects of CO_2 gas.