Is there any role of visceral fat area for predicting the difficulty of laparoscopic gastrectomy for gastric cancer?

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Major in Medicine

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December 21st. 2016

Abstract

Purpose: Obesity is known to be associated with postoperative morbidity in gastric cancer surgery, but its impact on laparoscopic gastrectomy (LG) remains controversial. In present study, we evaluate the obesity parameters including body mass index (BMI) and abdominal fat area as a predictive factors for postoperative complications.

Materials and methods: A total of 217 patients who underwent consecutive LG for gastric cancer between May 2003 and December 2005 were reviewed for the present study. We divided the patients into two groups by 50^{th} case based on the learning curve effect, and then each group was subclassified by $25kg/m^2$ of BMI and $100cm^2$ of VFA. The surgical outcomes including operative time, blood loss and postoperative complications were compared according to BMI and VFA.

Results: The mean operative time, the length of hospital stays, and complication rate were significantly higher in before 50^{th} case group. In subgroup analysis, complication rate and the length of hospital stays did not differ in high BMI or VFA subgroups compared with lower BMI or VFA subgroups. However, in before 50^{th} case group, the mean operative time and blood loss were significantly higher in high VFA subgroup ($p=0.047$ and $p=0.028$, respectively).

Conclusion: To minimize the surgical complication in inexperienced surgeon, VFA can be a better predictive marker than BMI for selecting candidates of laparoscopic gastrectomy.

Key words: Gastric cancer, Laparoscopic gastrectomy, Obesity, Body mass index, Intra-abdominal fat

Introduction

Laparoscopic gastrectomy (LG) is being accepted as the main treatment for early gastric cancer in Eastern Asia. Many studies have reported its clinical advantages over open gastrectomy such as less blood loss, less postoperative pain, faster bowel recovery and better short-term quality of life.[1-5] Recently the large scale multicenter retrospective study showed that long-term results of LG were comparable with those of open gastrectomy, thus it seems that the application of LG is going to be extended to far advanced cancer or a specific situation such as remnant gastric cancer, extremely elderly patients, and obese patients.[6-9]

Obesity has been the one of the challenging issues in the performance of LG for gastric cancer. Because obesity is a well-known risk factor for postoperative complications and it makes appropriate radical lymphadenectomy difficult, some surgeons considered laparoscopic procedure as a relative contraindication for gastric cancer.[10] Recently, several studies reported promising results that LG could be safely performed and it showed clinical advantages over open gastrectomy.[7 11-13] However, the impact of obesity on LG still remains controversial.

Body mass index (BMI) is a simple and commonly used tool for measuring obesity. However, BMI may not reflect the accurate amount of intra-abdominal fat which makes laparoscopic procedure more difficult. Several studies reported that visceral fat was associated with a longer operation time and a high volume of intraoperative blood loss, and it was a predictive factor for postoperative complications.[14-17] However, there are a few reports of the impact of visceral fat on LG, and no study on the impact of visceral fat correlated with surgeon's experience of LG have been undertaken.

Therefore, this study aimed to evaluate the role of visceral fat area (VFA) for predicting postoperative complications and the surgical outcomes according to the surgeon's level of experiences of LG for gastric cancer.

Materials and Method

Patients

Between May 2003 and December 2005, a total of 217 patients underwent LG consecutively at Ajou University Hospital by a single surgeon. Of them, 25 patients were excluded from the present study because the measurement of abdominal fat area was technically impossible due to the poor quality of computed tomography (CT) images scanned from the imported films which had been examined in other hospital. Therefore, remaining 192 patients were finally included and analyzed for the present study.

We previously reported that about 50^{th} case was the cut off value for operative time by the moving average method.[18] Thus, we divided the patients into two groups as the before and after 50^{th} case. And then, each group was classified into two subgroups by obesity parameters; BMI-L or -H was defined as BMI < 25 kg/m^2 or ≥ 25 kg/m^2, and VFA-L or -H was defined as VFA < 100 cm^2 or VFA ≥ 100 cm^2. The surgical outcomes including operative time, blood loss and postoperative complications were compared between subgroups according to BMI and VFA.

The estimation of body fat compartments

Abdominal fat distribution was analyzed on preoperatively scanned CT images at the level of L4/5. The Fatscan software (Philips EBW, version 3.5, Netherlands) was used to measure abdominal fat compartments. The adipose tissue was determined electronically by setting the attenuation values for a region of interest within the range of -190 to -30 hounsfield units. The cross-sectional surface area (cm^2) including total fat area, subcutaneous fat area (SFA), and VFA were quantified automatically by the software.

Surgical technique

LG was performed with the patients in the supine position under general anesthesia. The operator and endoscopist stood on the right side of the patients, and the first assistant stood on the left side. Two 12 mm ports and three 5 mm ports were placed and the pneumoperitoenum was maintained between 10-13 mmHg. A harmonic scalpel (LCS; Ethicon Endo-Surgery, Cincinnati, OH, USA) was used for lymph node dissection. After radical lymphadenectomy, a mini-laparotomy was made on the epigastric area, and then specimen delivery and anastomosis were conducted via the mini-laparotomy.

Regarding reconstruction after LG, gastroduodenostomy was made using a circular stapler (Proximate CDH; Ethicon Endo-Surgery) and gastrojejunostomy was performed by hand sewing. After total gastrectomy, esophagojejunostomy was made using a circular stapler and jejunojejunostomy was made at the point of 50cm apart from the esophagojejunostomy by hand sewing.

Statistical analysis

All statistical analyses were performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). The χ^2 test, Fisher's exact test, Student's *t* test and Mann-Whitney *U* test were used for between-group comparisons. Linear regression with a coefficient of determination was used for correlations between BMI and abdominal fat area. The overall survival rates were estimated using Kaplan-Meier curves and compared using the log-rank test. A P-value < 0.05 was considered statistically significant.

Results

Patient characteristics

Patient characteristics and surgical outcomes are listed in Table 1. There was no difference in age, sex, comorbidity, BMI, abdominal fat area, extent of surgery, reconstruction methods, and lymph node dissection between two groups. However, more previous abdominal surgical history was observed in 'after 50th case' group.

Regarding short-term surgical outcomes, 'before 50th case' group showed longer mean operation time (235.7 *vs*. 185.0 min, p<0.001), higher mean blood loss (383.5 *vs*. 278.2 ml, p=0.017), and longer hospital stays (13.1 *vs*. 10.4 days, p=0.003) compared with 'after 50th case' group. The complication rate was significantly different between two groups, especially wound problem was most commonly occurred in 'before 50th case' group.

Correlation between BMI and body fat compartment

Fig 1 showed the correlations between BMI and body fat compartments. There were significant correlations between BMI and total fat area (R^2= 0.805, p < 0.0001). However, the correlation efficiency between BMI and VFA was lower than those of between BMI and total fat area (R^2 = 0.686, p < 0.0001).

Subgroup analysis according to BMI and VFA

To evaluate the impact of BMI and VFA on surgical outcomes, we performed a subgroup analysis in each groups (Table 2).

In 'before 50th case' group, BMI-H subgroup showed tendencies of higher blood loss, longer operative time, and higher complication rate, however those were not significant statistically. In contrast, there was significant difference between VFA-L and VFA-H subgroups. The operative time was significantly longer and blood loss was higher in VFA-H subgroup

(p=0.028 and p=0.047, respectively). However, complication was not different between BMI-L and -H subgroups, nor VFA-L and -H subgroups.

In 'after 50th case' group, there was no difference between subgroups according BMI and VFA.

Overall survivals according to the obesity and surgeons' experience

Overall survivals were shown in Fig 2. The difference was not significant between subgroups statistically. In 'before 50th case' group, overall survival was 86.7% and 84.6% in BMI-L and -H subgroups (p=0.967), and 90.0% and 82.6% in VFA-L and -H subgroups, respectively (p=0.280). In 'after 50th case' group, overall survival was 94.3% and 93.0% in BMI-L and -H subgroups (p=0.685), and 92.8% and 95.0% in VFA-L and -H subgroups, respectively (p=0.422)

Discussion

Obese population is increasing not only in Western countries but also in Easter Asia.[19,20] According to the Korean Society for the Study of Obesity, the prevalence of obesity (BMI ≥ 25 kg/m^2) was recently over 30%, and the severe obesity is steadily increasing as years go by.[21] This means that more obese patients with gastric cancer can be encountered and treated by surgeons in the near future.

Laparoscopic technique is emerging as an alternative option to treat gastric cancer. It is getting accepted as a standard treatment for early gastric cancer. However, the impact of obesity on LG remains still controversial. A few studies reported that the obesity may not increase surgical morbidities in LG, but other study demonstrated that a high BMI was found to predict technical difficulties during LG, as well as postoperative complication.[11,12,22,23]

Recently, high VFA was recognized to be more accurate to predict perioperative risk than high BMI in obese patients with gastric cancer.[10,11,16] Excessive visceral fat tissues may make it difficult to identify organs, vessels and lymph nodes accurately. However, because BMI is a simple calculation of body volume based on height and weight, not reflect the accurate status of intra-abdominal fat which makes laparoscopic procedure more difficult. In the present study, figure 1 showed that the correlation efficiency between BMI and total fat area was quite high as 0.805, but those between BMI and VFA was relatively low as 0.686. Moreover, our result showed blood loss and operation time were significantly higher in VFA-H subgroup in 'before 50th case' group, nevertheless there was no significant difference between BMI-L and BMI-H subgroups in 'before 50th case' group as well as in 'after 50th case' group. These imply that VFA is more accurate for predicting the difficulty of laparoscopic procedure in obese patient than BMI.

In our results, obesity itself did not increase the postoperative morbidity after LG.

Nevertheless the complication rate seemed to be higher in BMI-H and VFA-H subgroups

compared with those of BMI-L and VFA-L subgroups, the differences did not reach statistical significance. However, it was note that the complication in VFA-H subgroup was 47.8%, which was 1.5 times of that of VFA-L subgroups in 'before 50th case' group. This result might stemmed from a small sample size of 'before 50th case' group, thus it seems that large sample size from a multicenter study is needed to confirm this result.

To our best knowledge, the present study was the first try to evaluate the role of VFA for predicting postoperative outcomes correlated with the surgeon's level of experiences of LG. At the beginning of this study, we hypothesized that high VFA may affect the surgical outcomes especially in inexperienced laparoscopic surgeon rather than experienced surgeon. Our data showed that blood loss and operation time did not differ between VFA subgroups in 'after 50th case' group but significantly differ in VFA-H subgroup in 'before 50th case' group. This implies that inexperienced surgeon can be more influenced by visceral fat in the aspect of technique during LG than experienced surgeon. Thus, we recommend that inexperienced surgeons with less than 50 cases of LG would check VFA rather than BMI, to select appropriate candidate for laparoscopic gastrectomy for gastric cancer to avoid an unsatisfactory surgical outcome.

Our study has several limitations. It was retrospectively designed and confined to a single center and single surgeon's experience. In addition, we excluded 25 patients from the present study due to the quality of scanned CT images, so there might be a selection bias which might cause distorted results. Therefore, further retrospective studies are needed to confirm the impact of VFA on surgical outcomes of LG in inexperienced surgeons.

In conclusion, the present study demonstrated that excessive visceral fat accumulation was associated with technical difficulties in inexperienced surgeons with less than 50 cases of LG for gastric cancer. Therefore, to minimize the surgical complication in inexperienced surgeon, VFA can be a better predictive marker than BMI for selecting candidates of LG.

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Table 1. Clinical and surgical outcomes according to surgeon's experience

Variable	< 50th case (n=43)	≥ 50th case (n=149)	P-value
Age	58.2 ± 12.9	59.1 ± 12.5	0.700
Sex			0.350
Male	31 (72.1%)	96 (64.4%)	
Female	12 (27.9%)	53 (35.6%)	
Comorbidity	13 (30.2%)	62 (41.6%)	0.178
Previous abdominal surgery	2 (4.7%)	28 (18.8%)	0.030
BMI (kg/m^2)	23.3 ± 2.8	23.6 ± 3.0	0.481
Total body fat area (cm^2)	223.7 ± 102.3	240.1 ± 110.9	0.384
SFA	123.7 ± 70.3	135.5 ± 74.2	0.354
VFA	99.8 ± 50.9	104.6 ± 56.8	0.623
Extent of surgery			0.531
Total gastrectomy	2 (4.7%)	14 (9.4%)	
Distal gastrectomy	41 (95.3%)	135 (90.6%)	
Reconstruction			0.178
Billroth I	16 (37.2%)	43 (28.9%)	
Billroth II	25 (58.1%)	86 (57.7%)	
Roux en Y	2 (4.7%)	20 (13.4%)	
Lymph node dissection			0.223
< D2	23 (53.5%)	95 (63.8%)	
≥ D2	20 (46.5%)	54 (36.2%)	
Estimated blood loss (ml)	383.5 ± 243.8	278.2 ± 206.8	0.017
Operation time (min)	235.7 ± 44.8	184.3 ± 42.9	<0.001
Length of hospital stays (days)	13.1 ± 5.2	10.4 ± 5.0	0.003
Postoperative complication	17 (39.5%)	18 (12.1%)	<0.001
Wound	10 (23.3%)	5 (3.4%)	
Bleeding	1 (2.3%)	4 (2.6%)	
Intestinal obstruction	2 (4.7%)	3 (2.0%)	
Pulmonary	1 (1.3%)	2 (1.3%)	
Fluid collection	2 (4.7%)	1 (0.7%)	
Anastomotic leakage	1 (2.3%)	1 (0.7%)	
Other		2 (1.3%)	

BMI = body mass index, SFA = subcutaneous fat area, VFA = visceral fat area

Table 2. Comparison of surgical outcomes after LADG between subgroups which were classified according to BMI and VFA

	Variable	Body mass index		P-value	Visceral fat area		P-value
		BMI-L	BMI-H		VFA-L	VFA-H	
< 50th case	Number of patients	29	12		20	23	
	Extent of surgery			0.518			1.000
	Total gastrectomy	1 (3.3%)	1 (7.7%)		1 (5.0%)	1 (4.3%)	
	Distal gastrectomy	29 (96.7%)	12 (92.3%)		19 (95.0%)	22 (95.7%)	
	Blood loss (ml)	223.0 ± 277.0	376.9 ± 231.5	0.109	189.5 ± 263.7	352.2 ± 256.9	0.047
	Operation time (min)	227.8 ± 45.6	253.8 ± 38.8	0.080	219.8 ± 44.8	249.6 ± 40.9	0.028
	Length of hospital stays (day)	13.1 ± 5.4	13.1 ± 5.1	0.988	12.1 ± 5.8	13.9 ± 4.7	0.240
	Complication			0.559			0.223
	None	19 (63.3%)	7 (53.8%)		14 (70.0%)	12 (52.2%)	
	Yes	11 (36.7%)	6 (46.2%)		6 (30.0%)	11 (47.8%)	
≥ 50th case	Number of patients	106	43		69	80	
	Extent of surgery			0.352			0.393
	Total gastrectomy	12 (11.3%)	2 (4.7%)		8 (11.6%)	6 (7.5%)	
	Distal gastrectomy	94 (88.7%)	41 (95.3%)		61 (88.4%)	74 (92.5%)	
	Blood loss (ml)	217.4 ± 231.1	217.0 ± 181.4	0.994	210.3 ± 241.2	216.3 ± 194.2	0.867
	Operation time (min)	184.4 ± 42.9	186.1 ± 43.7	0.827	182.4 ± 42.7	187.2 ± 43.7	0.869
	Length of hospital stays (day)	10.2 ± 5.2	10.5 ± 4.8	0.746	10.2 ± 5.3	10.4 ± 4.8	0.786
	Complication			0.317			0.501
	None	95 (89.6%)	36 (83.7%)		62 (89.9%)	69 (86.3%)	
	Yes	11 (10.4%)	7 (16.3%		7 (10.1%)	11 (13.8%)	

BMI-L = body mass index < 25 kg/m^2, BMI-H = body mass index ≥ 25 kg/m^2 VFA-L = visceral fat area < 100 cm^2, VFA-H = visceral fat area ≥ 100 cm^2

Fig 1. Correlation between BMI and abdominal fat area

The correlation efficiency between BMI and VFA was lower compared to it between BMI and total fat area. These results imply that the measurement of VFA probably showed the different ability to predict surgical outcomes after laparoscopic surgery.

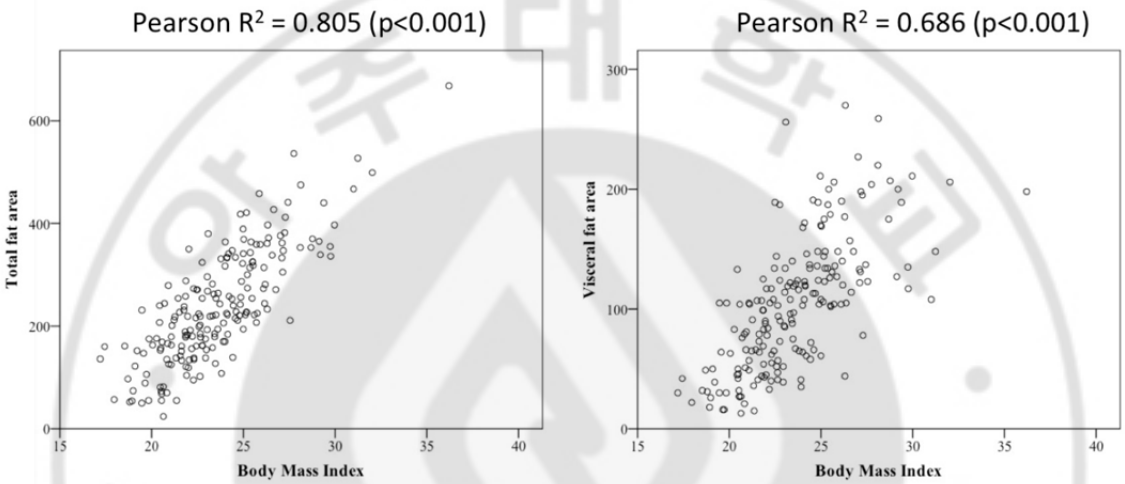

Fig 2. Overall survival rate of patients according to the obesity and surgeons' experience

Although the result did not show statistical significant, the difference of overall survival rate according to the obesity was emphasized when the patients were divided by VFA in early experience period, although the difference did not reach statistical significance.