The Impact of Body Mass Index on Perioperative Outcomes After Laparoscopic Colorectal Surgery

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Summary: Laparoscopic colorectal surgery has gained increasing attention during the past 20 years. Surgeons today are more often confronted with obese patients. Therefore, it is timely to investigate the feasibility and safety of laparoscopic surgery for colorectal disease in obese patients. This study included 65 patients with colorectal disease who underwent laparoscopic surgery, between January 2009 and January 2014, at Kurume University Hospital. We divided the patients in this study into two groups based on their body mass index (BMI): <25 kg/m² (non-obese group) and ≥25 kg/m² (obese group). We assessed baseline characteristics and surgical outcomes, and these were compared between the non-obese group and the obese group. There were 53 patients in the non-obese group, and 12 patients in the obese group. There was no significant difference between the two groups of patients with regard to age, sex, co-morbidity, tumor location, tumor node metastasis (TNM) stage, tumor size and serum carcinoembryonic antigen (CEA) level. The duration of the operation was longer (by about 49 mins) for obese patients than non-obese patients. The conversion rate, amount of blood loss, number of lymph nodes resected, and duration of postoperative hospital insertion were each similar between the two groups. There was no significant difference between the two groups with regard to the overall incidence of postoperative complications; however, the incidence of incisional hernia tended to be more frequent in obese patients. There was no mortality in the two groups. Laparoscopic colorectal surgery is technically feasible and safe for obese patients. However, obesity is associated with longer duration and with higher risk of incisional hernia. Our findings suggest that BMI may not be an accurate estimate of visceral fat, and further studies may be useful for understanding the impact of obesity.

Key words laparoscopic surgery, impact of body mass index

INTRODUCTION

Colorectal cancer is the third most common cancer and leading cause of cancer death in Japan, with more than 100,000 new cases and 36,000 deaths per year [1]. Laparoscopic colorectal surgery has gained increasing attention during the past 20 years. The potential benefits of rapid recovery, decreased postoperative pain, and reduction in pulmonary dysfunction make it an attractive alternative for many patients [2].

Obesity is a growing problem in the industrialized world with an increased risk of hypertension, cardiovascular disease, diabetes, colorectal cancer, etc. In Japan, 16% of the population above 18 years of age has a body mass index (BMI) ≥ 25 [3], and surgeons today experience obese patients with increasing frequency. When laparoscopic resection for colorectal cancer was first introduced, obesity was associated with an increased risk for conversion and post-operative morbidity due to technical issues [4-6]. Although
there are still some reports of increased conversion rate, operative duration, and postoperative morbidity with longer hospital stay in obese patients [7-9], recent studies have shown that with sufficient experience, laparoscopic colorectal surgery in obese patients is feasible and safe [10-12].

In our department, laparoscopic surgery in the obese has not been associated with any kind of increased peri- or postoperative risk. Therefore in this study we evaluate laparoscopic surgery for colorectal cancers in the obese and measure the impact on short-term results. The aim of this study was to investigate the impact of obesity on perioperative outcomes after laparoscopic colorectal resections in obese patients based on the short-term outcomes in our department, since the BMI may be a useful index as an accurate estimate of visceral fat.

PATIENTS AND METHODS

Patient and tissue samples

This study included 65 patients with colorectal disease who underwent laparoscopic surgery, between January 2009 and January 2014, at Kurume University Hospital. Informed consent was obtained from each of the patients before performing surgical resection, and the treatments were also approved by the Institutional Review Committee for Research on Human Subjects at the Kurume University Hospital.

The Japan Society for the Study of Obesity (JASSO) defined obesity as a BMI of ≥ 25 kg/m² for Japanese subjects. Accordingly, we divided the patients in this study into two groups based on their BMI: <25 kg/m² (non-obese group) and ≥ 25 kg/m² (obese group).

We assessed the baseline characteristics (age, gender, BMI, co-morbidity, tumor location, tumor size, TNM status, and preoperative carcinoembryonic antigen (CEA) level) and surgical outcomes (duration of operation, measured blood loss, duration of hospitalization, postoperative complications, and mortality). The baseline characteristics and surgical outcomes were compared between the non-obese group and the obese group. Tumor differentiation and the degree of invasion were examined by pathologists, and histopathological classification was performed according to the General Rules for Colorectal Cancer Study. Clinicopathological factors were assessed according to the tumor node metastasis (TNM) classification of the International Union Against Cancer (UICC) [13].

Laparoscopic colorectal surgery was carried out by a single colorectal surgical team with extensive experience in laparoscopic procedure. In general, five trocars were inserted, and an umbilical trocar was used for a camera port using a scope. Initially, we ligated the vascular pedicles and then mobilized the colon or rectum. The lesion was extracted through an extended incision in the umbilicus. Standard techniques were then used to resect and anastomose the bowel. In case of anterior resection or low anterior resection, the anastomosis was performed intracorporeally using a circular stapler. We routinely placed a drain near the anastomosis intraperitoneally. The skin edges of all wounds were closed with subcuticular sutures. Surgery for obese and non-obese patients was performed using the same procedure.

Statistical analysis

Statistical analysis was performed using JMP version 10.0 (SAS institute Inc, USA). Statistical comparisons were made using Fisher’s exact test, the x² test, or the Wilcoxon rank-sum test, depending on the type of data. Values of p<0.05 were considered to indicate statistical significance.

RESULTS

Clinicopathologic Characteristics

The clinical characteristics of the patients are summarized in Table 1. A total of 65 patients with colon and rectal disease underwent surgery. Of these, 53 were classified as non-obese, and 12 as obese.

There were no significant differences between the two groups of patients with regard to age, sex, co-morbidity, tumor location, TNM stage, tumor size and serum CEA level.

The surgical outcomes are shown in Table 2. Operative duration was about 49 mins longer for obese patients than non-obese patients. The amount of blood loss, number of lymph nodes resected, duration of postoperative hospitalization, and resection margin distance were similar between the two groups.

There were no significant differences between the two groups with respect to the overall incidence of postoperative complications; however, incisional hernia was more common in obese patients (16.7% vs. 0%). There was no mortality in the two groups.

DISCUSSION

This study demonstrated that laparoscopic colorectal surgery in obese patients was not correlated with increased perioperative mortality, higher reoperation rate or delayed postoperative recovery of gastrointestinal function. Longer operative duration and wound
TABLE 1.
The clinical characteristics of the patients (n=65)

<table>
<thead>
<tr>
<th></th>
<th>Obese (n=12)</th>
<th>Non-obese (n=53)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>66.3</td>
<td>61.2</td>
<td>0.236</td>
</tr>
<tr>
<td>gender</td>
<td></td>
<td></td>
<td>0.642</td>
</tr>
<tr>
<td>male</td>
<td>5</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>female</td>
<td>7</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>BMI kg/m²</td>
<td>26.5</td>
<td>21.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>tumor location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>right</td>
<td>1</td>
<td>14</td>
<td>0.104</td>
</tr>
<tr>
<td>left</td>
<td>10</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>rectum</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>comorbidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>7</td>
<td>15</td>
<td>0.233</td>
</tr>
<tr>
<td>cardiovascular</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>TNM stage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0/I/II</td>
<td>9</td>
<td>38</td>
<td>0.138</td>
</tr>
<tr>
<td>III</td>
<td>2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tumor size (mm)</td>
<td>42.8</td>
<td>31.4</td>
<td>0.673</td>
</tr>
<tr>
<td>CEA level (ng/dl)</td>
<td>8.49</td>
<td>4.4</td>
<td>0.295</td>
</tr>
</tbody>
</table>

BMI: body mass index, CEA: carcinoembryonic antigen

TABLE 2.
The surgical outcomes (n=65)

<table>
<thead>
<tr>
<th></th>
<th>Obese (n=12)</th>
<th>Non-obese (n=53)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>diverting stoma</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>Length of operation (min)</td>
<td>345</td>
<td>296.6</td>
<td>0.135</td>
</tr>
<tr>
<td>Blood loss (mL)</td>
<td>47.2</td>
<td>28.9</td>
<td>0.282</td>
</tr>
<tr>
<td>Number of lymph nodes resected</td>
<td>14.4</td>
<td>15.1</td>
<td>0.547</td>
</tr>
<tr>
<td>Margin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>negative</td>
<td>12</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Length of hospital day (day)</td>
<td>26.9</td>
<td>23.4</td>
<td>0.331</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>2</td>
<td>3</td>
<td>0.177</td>
</tr>
<tr>
<td>Bleeding</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Leakage</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Surgical wound infection</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>incisional hernia</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
</tbody>
</table>
hernia rates in obese patients were found, but we con-
cluded that laparoscopic colorectal resection appeared to be safe and feasible in the obese with no compro-
mise in the treatment of disease. For the reasons men-
tioned above, the BMI may not be an accurate estimate of visceral fat.

There are several methods of evaluating obesity. The BMI is a simple index of the weight-for-height that provides an objective measure of body fat in adults, with the lower limit for obesity (BMI > 30.0 kg/m²) set by the World Health Organization (WHO) [14]. Using this definition of obesity, no more than 2-3% of the Japanese population is obese; this number is in con-
trast to the 10-20% observed in Europe and the USA [15]. Indeed, only 1.2% of our patients were defined as obese using this definition. Japanese patients some-
times have small abdominal cavities and much visceral fat, especially males. In these cases, surgery can be very dif-
cult to perform laparoscopically, despite the non-
obese classification.

Some reports have demonstrated that obesity is as-
associated with high conversion rates [16-18]. One of the difficulties of performing laparoscopic surgery on obese patients is obtaining good visualization of the surgical field. The identification of the mesenteric vessels is also difficult, as they can be masked by thick fat. Tissue damage and bleeding can easily occur due to the ma-
ipulation of the fatty mesentery and mesocolon. Recently, several studies have suggested that com-
puted tomography (CT) is an optimal technique for the ac-
curate assessment of visceral fat [19,20]. Using CT scan assessments of visceral fat to define obesity, Ishii et al. reported a significant increase in the duration of surgery and morbidity rate in visceral obese patients [21]. Kang et al. [22] reported that the visceral fat area measured by CT could be used as a more accurate pre-
dictor of surgical complexity than BMI. Therefore, the 
BMI may not be an accurate estimate of visceral fat. In future, CT could be used to identify obese patients, who may be at a higher risk for postoperative compli-
cations. Moreover, we have to consider the other eval-
uation methods for obesity.

Obesity is often associated with different kinds of co-
morbidity such as diabetes, hypertension and other cardiovascular disorders, and the percentage of pa-
tients with co-morbidity was higher in the patients with a BMI ≥ 25.

Obesity has been also described as a risk factor for surgical wound infection after conventional colorectal surgery [23,24]. Zou et al. [25] reported that obesity was associated with increased wound infection, ileus, incisional hernia, and with pulmonary events. The in-
cidence of wound infection seen in obese patients in our study, which was similar to that in other studies [26,27], was significantly higher than that in non-obese patients (8.3% vs 1.9%).

Comparison of laparoscopic cholecystectomy in obese vs. non-obese patients showed no significant dif-
ference between the groups [28,29]. However, in a re-
view of laparoscopic urological surgery, complication rates of obese patients were higher than those of the general population [30] and there was no significant difference in the duration of hospital stay between the obese and non-obese groups, as the smaller wounds in-
curred during laparoscopic surgery did not cause se-
vere morbidity.

Whether laparoscopic colorectal surgery is advan-
tageous in obese patients remains a matter of debate. In this study, we found that laparoscopic colorectal sur-
gery was as feasible and safe for obese patients as non-
obese patients. It was associated with longer oper-
a tion and an increase in incisional hernia, however there was no difference between the obese and non-obese groups with respect to the overall rates of compli-
cations. The BMI was not an independent risk factor for postoperative complications. It is now commonly ac-
cepted that despite co-morbidity, the risk of postoperative complications is not or only slightly increased after laparoscopic colorectal cancer [31-33].

In terms of the oncological feasibility at resection, most studies, including our present study, showed that the number of harvested lymph nodes and resection margins were not affected by obesity. However, these results were based on the short-term outcomes of laparoscopic colorectal surgery. Several investigators have studied the long-term prognostic outcomes after laparoscopic colorectal cancer surgery in obese pa-
tients [26] [34]. No statistically significant differences were observed between the obese and non-obese pa-
tients in terms of the disease-free survival and overall survival. Thus, the authors concluded that obesity did not negatively affect the long-term outcomes.

Recent studies that examined the association be-
tween obesity and CEA tumor markers showed that obese populations have lower CEA concentration than do non-obese subjects [35,36]. Park et al. reported that a hemodilution effect from the decreased CEA con-
centrations was observed in patients with a higher BMI. In contrast, our study showed that the serum CEA lev-
els were higher in obese patients than in non-obese patients. The mean tumor stage was slightly more ad-
vanced in our obese patients; this might have resulted in the higher serum level in these patients.

Although there are some limitations to this study,
namely the nonrandomized design and the fact that the patients were treated in a single institution, our findings indicate that laparoscopic colorectal surgery, despite the slightly longer operative duration and slightly higher blood loss, is feasible and safe in obese patients with a BMI above 25, without the patients experiencing an increased risk of postoperative morbidity or mortality. However, we did not perform any analysis of the disease-free survival and overall survival. We need to evaluate the prognosis of colorectal cancer patients after laparoscopic surgery in future.

In conclusion, laparoscopic colorectal surgery is technically feasible and safe for obese patients. However, obesity is associated with longer surgeries and higher frequencies of wound infection. The BMI may not be an accurate estimate of visceral fat, so we have to consider other evaluation methods for obesity.

REFERENCES