Benefit of Laparoscopic Radical Nephrectomy in Patients with a High BMI

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Objective: The aim of the present study was to analyze all relevant data collected thus far at our hospital in order to compare the laparoscopic vs. open techniques in terms of the intraoperative results and to analyze whether patients with a higher BMI may derive greater benefit from laparoscopy.

Methods: We reviewed the medical records of 93 patients treated with laparoscopic nephrectomy and 91 patients treated with the open method at our institution. We analyzed the data with the aim of determining what kind of factor would be associated with an increase in estimated blood loss and prolongation of operative time, and we compared the results for laparoscopic and open nephrectomy.

Results: A statistically significant correlation was observed between body mass index and operating time ($P = 0.018$) or estimated blood loss ($P = 0.017$) in laparoscopic nephrectomy. Multivariate analysis demonstrated that body mass index was an independent risk factor for prolonged operating time ($P = 0.030$, odds ratio = 1.174). In the open nephrectomy patients, body mass index also had a significant correlation with operating time ($P < 0.001$) and estimated blood loss ($P < 0.001$). Multivariate analysis also revealed that operating time depended on body mass index ($P < 0.001$, odds ratio = 1.348) and tumor size ($P = 0.030$, odds ratio = 1.320), and the odds ratio of body mass index was higher than that in laparoscopic nephrectomy.

Conclusions: As body mass index increases, both laparoscopic nephrectomy and open nephrectomy become technically more difficult. However, our data showed that for patients with a high body mass index, the laparoscopic approach is comparatively safer and of greater benefit.

Key words: nephrectomy – laparoscopy – body mass index – obesity

INTRODUCTION

Obesity is a common problem in most industrialized countries and even in some newly industrializing countries. Previously, obesity was thought to be a relative contraindication to laparoscopy (1,2). However, since the prevalence of obesity is increasing (3), more overweight patients are now being considered for laparoscopic surgery. Laparoscopic nephrectomy was first introduced in 1991 by Clayman et al. (4) for benign renal disease. Following this, laparoscopic nephrectomy became accepted as the preferred mode of management for clinically localized renal cell carcinoma (5–8). However, it is still controversial as to whether this procedure is suitable for obese patients.

Several studies in the literature have reported on the safety of laparoscopic radical nephrectomy in obese patients and suggested that obesity need not necessarily be regarded as a contraindication for laparoscopy (9–13). These studies used different cut-off points for body mass index (BMI) and demonstrated the safety of laparoscopic nephrectomy in obese patients by comparing them with counterparts who had normal BMI or low BMI. Meanwhile, in the present study, we integrated BMI into a statistical analysis as one of the clinical factors involved in the operation and evaluated the effect of BMI on operating time and the estimated loss of blood in both laparoscopic nephrectomy and open nephrectomy.

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The aim of the present study was to analyze all relevant collected data in order to compare laparoscopic vs. open techniques in terms of intraoperative results and to analyze whether patients with a higher BMI may derive greater benefit from laparoscopy.

**PATIENTS AND METHODS**

We performed a retrospective analysis of data obtained from patients who had undergone laparoscopic or open nephrectomy at our institution. From January 2002 to December 2007, 93 laparoscopic radical nephrectomies were performed for T1 and selected T2 or T3a renal cell carcinomas. Laparoscopic radical nephrectomy was not considered in patients with a tumor size exceeding 10 cm. From January 2000 to December 2007, 91 open radical nephrectomies were performed for T1, T2 and T3a renal cell carcinomas. Patients with a tumor size exceeding 10 cm were excluded from analysis in order to harmonize the terms with those of the patients who underwent laparoscopic radical nephrectomy. All laparoscopic nephrectomies were performed via the transperitoneal approaches, whereas some of the open nephrectomies were performed using a retroperitoneal approach. Five surgeons performed the laparoscopic radical nephrectomy, whereas 10 surgeons performed the open procedures. All are highly trained surgeons who have more than 10 years of experience in urological surgery. The decision concerning whether to perform a laparoscopic nephrectomy or open nephrectomy was left to the discretion of the attending physicians and the patients.

BMI, as defined by the ratio of the weight of the patient in kilograms divided by the square of the patient height in meters, was calculated for all patients. All variables are expressed as mean ± standard deviation. The backgrounds of the two groups and operative data were compared using the two-sided Student’s t-test and one-way ANOVA. The Shapiro–Wilk W test was performed to evaluate the distribution of the variables. The two-sided Mann–Whitney U test was used to determine the statistical difference between two groups and one-way ANOVA was used if there were more than three groups. The correlation between continuous variables was investigated by simple regression analysis. Multivariate analyses using logistic regression were performed to identify risk factors associated with the prolonged operation time in both types of nephrectomy. In these analyses, the mean of each operating time for laparoscopic and open nephrectomy was used as a cut-off value, regardless of whether the operation time was long or not. We could not perform multivariate analysis on estimated blood loss because in many laparoscopic surgery cases, the volumes of blood were too small to measure. A P value of <0.05 was considered to be statistically significant. The analyses were performed with SPSS, version 11.0.

**RESULTS**

A total of 184 patients were identified, 93 of whom had undergone laparoscopic radical nephrectomy and 91 open radical nephrectomy. In the laparoscopic group, 69.9% of the patients were classified as having a healthy weight (BMI < 25.0), 23.6% as overweight (BMI = 25.0–29.9) and 6.5% as obese (BMI > 30.0) according to the WHO classification. In the open group, the corresponding values were 63.0%, 28.2% and 8.8%, respectively.

The patient characteristics and demographics are presented in Table 1. No significant differences in the backgrounds between the two groups were found. However, in the intraoperative outcomes, the mean volumes of estimated blood loss in the laparoscopic and open nephrectomy groups were 85.8 ± 153.6 and 569.4 ± 966.8 ml, respectively, and the difference was significant (P < 0.001). With respect to operating time, laparoscopic nephrectomy required a longer operating time (209.1 ± 64.3 min) than open nephrectomy (187.2 ± 47.2 min) (P = 0.009).

Simple regression analysis demonstrated a correlation between BMI and estimated blood loss (P = 0.017) (Fig. 1a) as well as operating time (P = 0.018) (Fig. 1b) for laparoscopic radical nephrectomy. Multivariable analysis using logistic regression also demonstrated that BMI was a significant risk factor for prolonged operating time (P = 0.031, odds ratio = 1.174) (Table 2).

In the open radical nephrectomy group, simple regression analysis also demonstrated a significant correlation between

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<tr>
<th>Table 1. Patient characteristics and demographics</th>
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<td>No. of patients</td>
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<tr>
<td>Sex</td>
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<td>Male</td>
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<tr>
<td>Female</td>
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<td>Age</td>
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<td>BMI</td>
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<td>Tumor size</td>
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<td>T1a</td>
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<td>T3a</td>
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<td>EBL</td>
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<td>Operating time</td>
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<td>Transfusion</td>
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BMI, body mass index; EBL, estimated blood loss.
BMI and estimated blood loss ($P < 0.001$) (Fig. 1c) as well as operating time ($P < 0.001$) (Fig. 1d). Multivariate analysis showed that BMI ($P < 0.001$, odds ratio $= 1.348$) and tumor size ($P = 0.030$, odds ratio $= 1.320$) were independent risk factors for prolonged operating time (Table 2).

Next, we recalculated the estimated blood loss and operating time in both the normal and high BMI groups (Table 3). Laparoscopic radical nephrectomy required longer operating time than the open method in the normal BMI group ($P = 0.002$) (Table 3), whereas in the high BMI group, there was no significant difference in operating time ($P = 0.288$) (Table 3). Furthermore, as shown in Table 3, in the high BMI group, estimated blood loss was much higher in patients who underwent open nephrectomy, although the operating times were almost the same as those for laparoscopic surgery.

None of the patients who had undergone laparoscopic radical nephrectomy required transfusion, whereas transfusion was needed in 11 patients in the open radical nephrectomy group. In these 11 cases, bleeding was observed from the renal vein in 2 cases, the lumber vein in 1 case, the inferior vena cava in 1 case and the spleen in 2 cases. In the other five cases, the cause of the bleeding was unknown because the data were old. The patients with a high BMI had higher transfusion rates (9 of 34, 26.4%) compared with the patients with a normal BMI (2 of 57, 3.5%), and the difference was statistically significant ($P = 0.001$).

**COMMENT**

Laparoscopic radical nephrectomy is established as the preferred management technique for T1 and select T2 renal cell carcinomas (5–18). Laparoscopic radical nephrectomy is associated with lower analgesia requirements, a shorter hospital stay and quicker return to work than open procedures (14). Chan et al. (15) reported that there was no significant
High BMI group
Clayman (16) reported that the criteria for laparoscopic nephrectomy for clinical localized tumors. Deane and normal BMI group (BMI < 25) and in the high BMI group (BMI > 25)

Table 3. Comparison of estimated blood loss and operating time in the normal BMI group (BMI < 25) and in the high BMI group (BMI > 25)

<table>
<thead>
<tr>
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<th>Laparoscopic</th>
<th>Open</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>Normal BMI group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of patients</td>
<td>65</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>EBL</td>
<td>62.7 ± 83.4</td>
<td>367.2 ± 395.8</td>
<td>&lt;0.001</td>
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<tr>
<td>Operating time</td>
<td>200.5 ± 55.6</td>
<td>171.8 ± 46.0</td>
<td>0.002</td>
</tr>
<tr>
<td>High BMI group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of patients</td>
<td>28</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>EBL</td>
<td>139.6 ± 244.2</td>
<td>897.6 ± 1441.4</td>
<td>0.007</td>
</tr>
<tr>
<td>Operating time</td>
<td>229.3 ± 78.6</td>
<td>212.8 ± 36.5</td>
<td>0.288</td>
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difference in survival between open and laparoscopic radical nephrectomy for clinical localized tumors. Deane and Clayman (16) reported that the criteria for laparoscopic radical nephrectomy have been expanded to T3a with greater surgeon experience.

Obesity is a common and growing problem in industrialized countries (3) and is a risk factor of renal cell carcinoma (17,18). Therefore, patients with renal cell carcinoma often have a high BMI. Obese patients can be afflicted with many medical conditions, such as cardiovascular disease, diabetes mellitus and high blood pressure (19,20). Obesity and these conditions may become important factors affecting the surgical outcomes (21–23). Mendoza et al. (1) reported that the complication rates for urologic laparoscopic surgery in obese patients were higher than in normal weighted patients undergoing laparoscopic surgery. Bhayani et al. (2) concluded that obese patients should not be selected as candidates for laparoscopic prostatectomy. Therefore, in the past, it was believed that obesity was a relative contraindication to laparoscopy.

However, several recent reports in the literature have described the safety of laparoscopic radical nephrectomy for obese patients and suggested that obesity need not be regarded as a contraindication for laparoscopy (9–13). Klinger et al. (9) reported that patients with a higher BMI (cut-off > 28 kg/m²) benefited more from laparoscopy than slim patients with respect to postoperative pain and morbidity but did not experience more complications. Anast et al. compared obese patients (BMI 30 or greater) and non-obese patients with regard to intraoperative and postoperative complications and found no difference in complication rate between the two groups (10). These studies used various cut-off points for BMI and assessed the safety of laparoscopic nephrectomy in obese patients by comparing them with patients of normal weight. In the present study, we compared the impact of BMI as one of the clinical factors by analyzing intraoperative outcomes in laparoscopic and open nephrectomy performed at our institution during similar periods of time.

Fugita et al. (11) compared 32 obese patients (BMI 30 or greater) undergoing laparoscopic radical nephrectomy with 69 normal weight patients and did not find any statistically significant differences in estimated blood loss, operating time or the incidence of major complications. Meanwhile, in our study, linear regression analysis revealed that BMI was significantly correlated with estimated blood loss and operating time, even for laparoscopic nephrectomy. Multivariate analysis also showed that BMI was selected as a significant risk factor for a prolonged operating time (P = 0.031, odds ratio = 1.174). In contrast, in open nephrectomy, BMI was also a significant risk factor for a prolonged operating time (P < 0.001, odds ratio = 1.348). The odds ratio of BMI in open nephrectomy was higher than that in laparoscopic nephrectomy. We believe that this result indicates that a high BMI could cause the prolongation of operating time in both procedures, although it may have less of an impact in laparoscopic radical nephrectomy than in the open method. As shown in Table 3, in the high BMI group, there was no significant difference in operating time between the two methods, even though laparoscopic nephrectomy required longer operating time than the open method in the normal BMI group. In addition, in the high BMI group, estimated blood loss was much higher in patients who underwent an open nephrectomy, despite the fact the operating times were similar to those of the laparoscopic surgery patients. Furthermore, transfusion was not required in laparoscopic nephrectomy for any BMI level, although the high BMI group needed significantly more transfusions than the normal BMI group for open nephrectomy (P = 0.001). These results demonstrated the clinical usefulness of laparoscopic radical nephrectomy in obese patients.

Tumor size was the other significant risk factor for prolonged operating time in open radical nephrectomy (P = 0.020, odds ratio = 1.350). In contrast, in the laparoscopic radical nephrectomy patients, tumor size was not found to be associated with a prolonged operating time. These results also revealed that if the size of the tumor was ≤ 10 cm, laparoscopic nephrectomy could be performed with less restriction due to tumor size than open nephrectomy.

There are several limitations to the present study. We do not make the clear criteria for indication of laparoscopic nephrectomy and open nephrectomy, so it depended on the preference of the attending physicians and patients whether to perform a laparoscopic nephrectomy or open nephrectomy. Thus, it might be one of selection bias in this study, although there was not a difference of backgrounds between the two groups as seen in Table 1. Secondly, there were few patients classified as obese (BMI > 30.0) according to the WHO classification. The obesity rate was only 7.7% overall, 6.5% in the laparoscopic group and 8.8% in the open group. Therefore, whether or not these conclusions are applicable to patients with a very high BMI is still not known and thus should be evaluated in the future. However, apart from a very high BMI, this study has demonstrated that laparoscopic
nephrectomy was of greater benefit than open nephrectomy in overweight patients.

CONCLUSIONS

As BMI increases, both laparoscopic nephrectomy and open nephrectomy become technically more difficult. However, the present data indicate that for patients with a high BMI, the laparoscopic method is comparatively safe and of greater benefit. In addition, we found that laparoscopic nephrectomy could be performed, regardless of the size of the tumor. Therefore, we conclude that laparoscopic nephrectomy is an appropriate therapeutic choice for any patient if the diameter of the tumor is ≤ 10 cm.

Conflict of interest statement

None declared.

References