Operative Blood Loss and Use of Blood Products After Laparoscopic and Conventional Open Colorectal Operations

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Hypothesis: Blood loss, measured by estimated blood loss, drop in hemoglobin levels, and transfusion requirements, is lower in patients undergoing laparoscopic colectomy compared with patients undergoing conventional open colectomy.

Design: Case-matched study.

Setting: A university hospital.

Patients: Patients undergoing laparoscopic colectomy between January 2000 and December 2001 were matched in a prospective database for age, sex, comorbidity, and surgical procedure with patients undergoing open colectomy during the same period.

Main Outcome Measures: Estimated blood loss, drop in hemoglobin levels, and transfusion requirements after surgery were compared.

Results: One hundred forty-seven patients undergoing the same operation using either an open or laparoscopic approach could be matched for age, sex, and diagnosis related grouping. There was no significant difference in American Society of Anesthesiologists class, body mass index, or preoperative and postoperative hemoglobin levels, but the open colectomy group required significantly more units of blood ($P=.003$) to maintain similar hemoglobin levels after surgery. Estimated blood loss ($P<.001$) and the number of patients who received transfusions on the day of surgery ($P=.002$), during the first 48 hours after surgery ($P=.005$), and during the entire hospital stay ($P=.003$) were significantly higher in the open colectomy group.

Conclusion: A laparoscopic approach for colorectal surgery led to significantly less blood loss than matched open colectomy cases.

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SINCE THE FIRST REPORTS OF laparoscopic colectomy (LC), the scope of the technique has widened to encompass the treatment of many colorectal disorders. Advantages of the laparoscopic approach include better cosmesis and less postoperative pain owing to smaller incisions, earlier recovery, and a shorter postoperative hospital stay compared with conventional open colectomy (OC).1,2 A shorter hospital stay translates into lower total costs despite greater comparative operating room costs.3

As telescopic views of the operating field during LC mandate a relatively bloodless field, LC procedures might be expected to lead to less operative blood loss than OC. Studies of blood loss after LC had variable results, with some finding lower operative blood loss and others reporting no significant difference in estimated blood loss (EBL).4-7 This study compares blood loss as measured by EBL, mean drop in hemoglobin levels with surgery, and blood product use in patients undergoing LC or OC. Both groups of patients were managed with the same guidelines for transfusion in the postoperative period.

METHODS

All patients undergoing LC in this study were entered into a database, approved by the institutional review board, along with their age, sex, diagnosis received, and operative procedure. Operative details included operating time, American Society of Anesthesiologists class, body mass index, EBL, and complications, including readmission within 30 days of hospital discharge.

Patients undergoing LC procedures between January 2000 and December 2001 were matched with patients undergoing OC during the same period for age, sex, comorbidity as denoted by the hospital coding system (diagnosis related grouping), and surgical procedure. In the OC group, only patients without a history of major laparotomy (except cholecystectomy, appendectomy, or gynecologic surgery by a lower abdominal incision) were considered for comparison with the LC group.
The significance level for all analyses was \( P < .05 \), and GraphPad InStat software version 3.05, 32 bit for Windows 95/NT, (GraphPad Software, San Diego, Calif) was used.

### RESULTS

One hundred forty-seven patients in the LC group from the database could be matched manually for age, sex, American Society of Anesthesiologists class, body mass index, operations, and complications, including hospital readmission.

#### Statistical Analysis

Preoperative values for hemoglobin level and the corresponding postoperative values taken routinely on the first day after surgery (between 4 AM and 6 AM) were gathered by reviewing the laboratory computer software system (Lastword-4-TD04084; IDX Systems Corp, Burlington, Vt) into which all laboratory results were entered. Details of blood product use were entered into a database (version 5.23; Misys Healthcare Systems, Lawrence, Kan). The number of units of blood transfused on the day of surgery, during the first 48 hours after surgery, and for the duration of the patient’s hospital stay were determined from the database. Patients were compared for operative EBL, duration of surgery, body mass index, American Society of Anesthesiologists class, and all complications, including hospital readmission.

The 143 patients in the matched groups were comparable in age, sex, American Society of Anesthesiologists class (Table 1), diagnoses (benign or malignant) (Table 2). Patients who underwent OC had a significantly longer operating time and length of hospital stay than those undergoing LC. The 2 groups had similar preoperative and postoperative levels of hemoglobin. Patients who underwent LC had significantly less blood loss, as measured by the EBL, and a significantly lower use of blood products and transfusion rate. There was no significant difference in hemoglobin level drop, which was not unexpected because many patients received transfusions prior to the routine 6 AM hemoglobin level sample the day after surgery and were therefore increased to a similar level of hemoglobin. The number of units transfused during the first 48 hours after surgery and during the total hospital stay were also significantly lower in the LC group.

Other potentially confounding factors were also evaluated. Table 3 presents the number of units of blood transfused in the postoperative period in the LC and OC groups. The distribution of units of blood required by patients was similar in the 2 groups \( (P = .14) \). The mean \( \pm SD \) age of the patients who received transfusions was 51 \( \pm 22 \) years in the LC group and 56 \( \pm 19 \) years in the OC group. The recommended standard transfusion trigger for the institution is to give packed red blood cells to patients with a hemoglobin level lower than 7 g/dL, unless the patient has a hist-

### Table 1. Characteristics of the Matched Patients Who Underwent Surgery by the Laparoscopic and Open Approaches*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Laparoscopic Procedures ( (n = 143) )</th>
<th>Open Procedures ( (n = 143) )</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y†</td>
<td>53 ± 17</td>
<td>54 ± 16</td>
<td>.12</td>
</tr>
<tr>
<td>No. of female patients</td>
<td>74</td>
<td>74</td>
<td>.99</td>
</tr>
<tr>
<td>Body mass index, kg/m²†</td>
<td>25.7 ± 4.3</td>
<td>26.7 ± 6.2</td>
<td>.20</td>
</tr>
<tr>
<td>Operation time, min‡</td>
<td>90 (IQR 70-123.8)</td>
<td>120 (IQR 90-148.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Length of stay, d‡</td>
<td>3 (IQR 2-4)</td>
<td>6 (IQR 5-9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Estimated blood loss‡</td>
<td>100 (IQR 50-150)</td>
<td>200 (IQR 100-450)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Preoperative hemoglobin level, g/dL‡</td>
<td>13.8 (IQR 12.7-14.8)</td>
<td>13.5 (IQR 11.9-14.7)</td>
<td>.12</td>
</tr>
<tr>
<td>Postoperative hemoglobin level, g/dL‡</td>
<td>10.9 ± 1.8</td>
<td>10.8 ± 1.7</td>
<td>.65</td>
</tr>
<tr>
<td>Hemoglobin level drop, g/dL‡</td>
<td>2.6 ± 1.6</td>
<td>2.3 ± 1.7</td>
<td>.24</td>
</tr>
<tr>
<td>Day of surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units of red blood cells transfused‡‡</td>
<td>0.03 ± 0.25; 0 (0-2)</td>
<td>0.24 ± 0.77; 0 (0-4)</td>
<td>.003</td>
</tr>
<tr>
<td>No. of patients receiving transfusion (No. of units)</td>
<td>3 (5)</td>
<td>17 (35)</td>
<td>.029</td>
</tr>
<tr>
<td>Day of surgery and 48 h after</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units of red blood cells transfused‡‡</td>
<td>0.10 ± 0.48; 0 (0-4)</td>
<td>0.35 ± 0.95; 0 (0-6)</td>
<td>.003</td>
</tr>
<tr>
<td>No. of patients receiving transfusion (No. of units)</td>
<td>7 (14)</td>
<td>22 (50)</td>
<td>.005</td>
</tr>
<tr>
<td>Duration of stay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units of red blood cells transfused‡‡</td>
<td>0.16 ± 0.60; 0 (0-4)</td>
<td>0.66 ± 1.83; 0 (0-16)</td>
<td>.004</td>
</tr>
<tr>
<td>No. of patients receiving transfusion (No of units)</td>
<td>11 (23)</td>
<td>29 (92)</td>
<td>.038</td>
</tr>
</tbody>
</table>

Abbreviation: IQR, interquartile range.

\*Values were determined using the Wilcoxon matched pairs test or the paired \( t \) test depending on data type.

‡Values are expressed as mean ± SD.

†Values are expressed as median (range).

§Values were determined using the Fisher exact test.
Surgery using the laparoscopic approach is performed increasingly for a variety of colorectal disorders. Despite numerous advantages, the role of laparoscopy in the treatment of benign and malignant colorectal disorders is still under evaluation. The main advantages include reduced pain during the postoperative period, earlier recovery of ileus, earlier discharge from the hospital, and earlier recovery and return to normal activity. Most studies report that LC takes longer to perform than OC, although some suggest that the operative length may be comparable. There is no uniform consensus on the relative blood loss when patients are operated on using the 2 procedures. While some studies found EBL during LC was significantly lower than during OC, others found the loss to be comparable. The reason for this difference may be that these studies compare the EBL as a sole measure of blood loss during surgery. The EBL has been previously reported to be an inconsistent estimate of blood loss. Further, the number of patients undergoing LC in the individual studies was small, varying from 7 to 80 patients.

This study compares blood loss for 143 patients with colorectal disorders undergoing LC with a similar number of patients undergoing OC during the same period. Data from this institution support improvements in length of hospital stay, costs, and complications with no significant increase in operative times. In this study, patients who were comparable in age, sex, comorbidity (diagnosis related grouping), diagnosis, body mass index, and American Society of Anesthesiologists class had less operative blood loss after LC than OC. This was manifested as significantly lower EBL and use of blood products in the setting of a similar postoperative hemoglobin level drop. The hemoglobin level reduction is similar because most transfusions have already occurred during surgery or in the early postoperative period, sometimes without formal complete blood cell count and based on an estimate of EBL or blood gas analysis.

Previous studies have found that the incidence of complications after the 2 procedures is similar. Therefore, we excluded from the study the 2 patients in the OC group who needed reoperation for bleeding because including such patients could potentially lead to a spurious finding of increased blood loss in the OC group. As blood loss during surgery can sometimes manifest after a lag period, we also compared the number of units transfused and the transfusion rate for both groups of patients in the first 48 hours after surgery and for the duration of their hospital stay. To reduce bias, we also excluded patients in the OC group who had a previous major laparotomy because more extensive surgery is sometimes indicated in these patients and such patients may not be candidates for a laparoscopic approach. The possibility of the data being skewed owing to a small number of patients in the OC group receiving a large amount of blood was also excluded (Table 3). The number of patients with malignant disorders was similar in the 2 groups, which strengthens the comparability of the groups because patients with malignancy may be more likely to bleed during surgery when compared with patients with benign disorders. The relative number of pa-
patients with a hematocrit lower than 36% was similar in the 2 groups. This was also supported by the similarity of the transfusion rate when the hematocrit was lower than 36% or was higher than 36% in the 2 groups. There was no significant difference in preoperative hematocrit between the OC and LC groups (P = .12), which suggests that the higher need for transfusion in the OC group was not due to lower baseline values prior to surgery. A similar number of patients underwent transfusion prior to surgery in the 2 groups; thus, the transfusion need was related to surgery and not the preexisting disease.

This study specifically evaluated whether LC reduces intraoperative blood loss when compared with matched OC cases. Laparoscopic colectomy for carefully matched patients undergoing OC and LC leads to less operative blood loss and less use of blood products when compared with OC.

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REFERENCES