Risk Factors of Mortality after Surgical Treatment of Intestinal Obstruction in Patients Having Prior Laparotomy for Non-malignancy

Background. Intestinal obstruction has remained one of the most common surgical emergencies, and its clinical spectrum has shifted in past decades. The factors contributing to its surgical mortality were studied in these selected patients with a view to finding pointers which help surgeons to identify patients with high surgical risk of mortality.

Methods. Those adult patients who had prior laparotomy for non-malignancy and were operated on for intestinal obstruction were included and studied retrospectively. Thirteen possible risk factors, including co-existing medical illness, tachycardia, pre-operative shock, age, bowel ischemia, operative complication, leukocytosis, durations from symptom onset to hospitalization, from hospitalization to operation, and from symptom onset to operation, prior laparotomy number, time interval from last laparotomy to this operation, and operation method, were analyzed using univariate analysis and, then, multivariate analysis to find out the independent risk factors for surgical death.

Results. Adhesion-related etiologies were the most common. Still, one-tenth of cases were not adhesion-related. Obstruction in the small bowel (172/176) was more frequent than in the large bowel (4/176). The surgical mortality rate was 6.8% (12/176). The independent risk factors of mortality after surgical treatment were co-existing medical illness, bowel ischemia, pre-operative shock, and operative complication. Old age seemed to be a risk factor on univariate analysis, but not on multivariate analysis. Duration from symptom onset to hospitalization, from hospitalization to operation, or from symptom onset to operation was not significantly related to surgical mortality.

Conclusions. High-risk patients could be identified by four independent factors: co-existing medical illness, bowel ischemia, pre-operative shock, and operative complication. Old age itself was not an independent risk factor.


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a prior laparotomy for non-malignancy.\textsuperscript{7} Bowel obstruction in patients with out prior laparotomy, ex cluding obstructed colorectal cancer, was of ten re sulted from un-
usual causes and was the most difficult condition for which to make de ci sion for laparotomy.

This study focused on selected patients having a prior laparotomy for non-malignancy and aimed at looking for the pos si ble risk fac tors for mortal ity after su rgi
cal treat ment of IO in these pa tients.

METHODS

We retro spec tively studied all adult patients in our hos pi tal who were op er ated on for IO from 1991 to 1999. The di ag no sis was based on the su rgi cal find ing of prox i-
mal di la ta tion and dist al col lapse of the in tes tine. Partial ob struc tion was not in cluded. Ad ditional ly, pa tients with an in car cer ated ex ter nal her nia, no prior laparotomy, hav-
ing prior laparotomy for ma lig nancy, ob struc tion within 30 days of prior laparotomy, and mesenteric vas cu lar dis-
 ease were ex cluded. There were 176 pa tients re main ing for anal y sis.

Ini tially, con ser va tive ther apy in clud ing fluid and elec tro lyte re sus ci tation and de com pres sion by nasogastric tube was given. An op er a tion was usu ally per formed if pa tients had toxic find ings(s) or did not re cover af ter a pe-
ri od of con ser va tive man age ment. The toxic find ings in-
cluded leukocytosis (white count > 12,000/mm\textsuperscript{3}), fe ver (tem per a ture over 38 °C), tachy car dia (heart rate >
100/min ute), and un toler able ab dom i nal ten der ness. Se-
r i ous med i cal ill nesses in cluded the pres ence of pul monary dis-
 ease (his tory of chronic ob struc tive pul monary dis-
 ease or pul monary tu ber cu losis with de stroyed lung), re-
nal insuffi ciency (ser um creat i nine > 2 mg/DL), ma lig nancy, heart dis ease (his tory of cor o nary heart dis ease, con g estive heart failure, or se rious arrhyth mia), or any other or gan fail ure. Pre op er a tive shock was de fined as a pre op er a tive sys tolic pres sure of less than 100 mmHg, and bowel is che mia as nonviable stran gu la tion caused by vas cu lar im pair ment of the bowel wall.

There were 31 se rious med i cal ill nesses in 30 pa-
tients, in clud ing cardio va sur cal dis ease in 19, pul monary dis ease in 5, chronic renal fail ure in 4 and marked liver cir rh osis in 3.

Thirteen pos si ble risk fac tors, in clud ing co-exis ting medical ill ness, tachy car dia, preop er a tive shock, age, bowel is che mia, opera tive com pli ca tion, leukocytosis, du ra tions from symp tom on set to hos pi tali zation, from hos pi tali zation to op er a tion, and from symp tom on set to op er a tion, pri or laparotomy num ber, time in ter val from last laparotomy to this op er a tion, and op er a tion method, were an a ly zed us ing un vari a tive anal y sis and, then, mul-
ti vari a tive anal y sis to find out the in de pend ent risk fac tors for op er a tive mor tal ity.

Sta tis ti cal anal y sis was car ried out using the chi-
square test for qual i ta tive data and stu dent’s \textit{t} test for
quan ti ta tive data ex ce pt age. The vari an ces of age in the alive and dead groups were quite differ ent. There fore,\textit{Mann-Whitney} \textit{U} test was used to eval u ate the ef fect of age on sur gi cal death. Fin ally, step wise lo gis tic re gres-
sion was used to determ ine the in de pend ent risk fac tors for sur gi cal death. A dif fer ence was con sid ered sta tis ti cally sig ni ficant if \(p < 0.05\).

RESULTS

Over the 9-year pe riod, 176 pa tients were col lected. The me dian age was 66 years (range, 16-93 years). The me dian du ra tions from symp tom on set to hos pi tali zation (den o ted as du ra tion I), from hos pi tali zation to op er a tion (as du ra tion II), and from symp tom on set to op er a tion (as du ra tion III) were 24, 19, and 56 hours, re spec tively. There were 172 pa tients ob struc
ted at the small bowel and 4 pa tients ob struc
ted at the large bowel, in clud ing 2 co lon can cer with ob struc tion. Twelve pa tients had pre-
op er a tive shock. Thirty pa tients had co-exis
ting med i cal ill ness. Bowel is che mia de vel oped in 32 pa tients. Bowel re sec tion was done in 32 pa tients and non-re sec tion in 144. The me di
dian time in ter val from the last laparotomy to the op er a tion for this IO was seven years (range, one
month to 50 years). The et i o logies of ob struc tion were
di verse. A ma jor ity (159/176) were re lated to ad he sion.
The minority (17/176), such as bezoar, tumor, inflammation, and diaphragmatic hernia, were not related to adhesion.

There were 31 serious medical illnesses in 30 patients. Of them, 1 had 2 serious medical illnesses. Cardiovascular disease developed in 19 patients, lung disease in 5, chronic renal insufficiency in 4, and marked liver cirrhosis in 3.

Fifteen patients (8.5%) developed 16 complications. Wound infection was the major complication. Twelve patients (6.8%) died after the operation. Most deaths occurred soon after operation (range: 1-30 days; median: 7 days).

### Table 1. Causes of death

<table>
<thead>
<tr>
<th>Cause</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>10</td>
</tr>
<tr>
<td>uncontrolled systemic sepsis</td>
<td>6</td>
</tr>
<tr>
<td>pneumonia</td>
<td>4</td>
</tr>
<tr>
<td>Fatal arrhythmia</td>
<td>1</td>
</tr>
<tr>
<td>Choking</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 2. Univariate analysis of factors contributing to mortality

<table>
<thead>
<tr>
<th>Factor</th>
<th>Death (n = 12)</th>
<th>Alive (n = 164)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coexisting medical illness</td>
<td>9</td>
<td>21</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>8</td>
<td>38</td>
<td>0.003</td>
</tr>
<tr>
<td>Preoperative shock</td>
<td>4</td>
<td>8</td>
<td>0.005</td>
</tr>
<tr>
<td>Age, mean, years</td>
<td>74</td>
<td>59</td>
<td>0.008</td>
</tr>
<tr>
<td>Bowel ischemia</td>
<td>6</td>
<td>26</td>
<td>0.011</td>
</tr>
<tr>
<td>Operative complication</td>
<td>4</td>
<td>13</td>
<td>0.018</td>
</tr>
<tr>
<td>White count, /mm³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= 12,000</td>
<td>7</td>
<td>69</td>
<td>0.368</td>
</tr>
<tr>
<td>&gt; 12,000</td>
<td>5</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Durations, mean, hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration I&lt;sup&gt;a&lt;/sup&gt;</td>
<td>59</td>
<td>47</td>
<td>0.520</td>
</tr>
<tr>
<td>Duration II&lt;sup&gt;b&lt;/sup&gt;</td>
<td>47</td>
<td>33</td>
<td>0.364</td>
</tr>
<tr>
<td>Duration III&lt;sup&gt;c&lt;/sup&gt;</td>
<td>102</td>
<td>80</td>
<td>0.308</td>
</tr>
<tr>
<td>Prior laparotomy number, mean</td>
<td>1.4</td>
<td>1.3</td>
<td>0.676</td>
</tr>
<tr>
<td>Time interval&lt;sup&gt;d&lt;/sup&gt;, mean, years</td>
<td>10.7</td>
<td>10.9</td>
<td>0.953</td>
</tr>
<tr>
<td>Operation method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resection</td>
<td>4</td>
<td>28</td>
<td>0.237</td>
</tr>
<tr>
<td>Non-resection</td>
<td>8</td>
<td>136</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as number of patients unless stated otherwise.

<sup>a</sup> from symptom onset to hospitalization.

<sup>b</sup> from hospitalization to operation.

<sup>c</sup> from symptom onset to operation.

<sup>d</sup> from last laparotomy to operation for this intestinal obstruction.

### Table 3. Factors contributing to surgical death on stepwise logistic regression analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>p value</th>
<th>Odds ratio (95% C.I.)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-existing medical illness</td>
<td>58.33</td>
<td>&lt; 0.001</td>
<td>58 (6.04-563.47)</td>
</tr>
<tr>
<td>Bowel ischemia</td>
<td>37.29</td>
<td>0.002</td>
<td>37 (3.59-387.30)</td>
</tr>
<tr>
<td>Preoperative shock</td>
<td>16.21</td>
<td>0.016</td>
<td>16 (1.67-157.43)</td>
</tr>
<tr>
<td>Operative complication</td>
<td>9.21</td>
<td>0.018</td>
<td>9 (1.46-58.08)</td>
</tr>
</tbody>
</table>

<sup>a</sup> confidence interval.
days) and resulted from uncontrolled systemic sepsis (Table 1).

On univariate analysis (Table 2), several factors, including old age, bowel ischemia, preoperative shock, co-existing medical illness, tachycardia, and operative complication, were significantly correlated with surgical death. To find out the most useful predictive factors, logistic regression was applied to the variables related to mortality. This showed that co-existing medical illness, bowel ischemia, preoperative shock, and operative complication were independent risk factors that significantly contributed to surgical death (Table 3). Old age and tachycardia showed a significant correlation with co-existing medical illness, the surgical risk factor with poorest prognosis (Table 4).

**DISCUSSION**

The mortality rate of IO has decreased from 60% reported by Miller in 1929 to a level of 5 to 10 per cent presently. The surgical mortality rate in the series was 6.8%. However, patients undergoing surgery for IO are elderly and more ill than before. In this study, we found that half of dead patients died of uncontrolled systemic sepsis. Davis and Sperling reported more than half of the deaths occurred as a result of sepsis. The normal flora of the small bowel is symbiotic with man and essential to life. Once IO has occurred, an overgrowth or alteration of the normal microflora ensues. More over, we noted congestion, edema, and subsequent restriction of arterial in flow lead to a break down of the barrier normally prohibiting access of the normal flora and their products to the general circulation. This could account for both the high incidence of infectious problems in these patients and the reason why half or more of the dead died of sepsis.

Some authors reported that delay of treatment was a major factor of unsuccessful outcome and suggested operation as early as possible. However, others proposed that a reasonable delay in operating did not increase mortality or morbidity. Indeed, if patients were operated earlier, the strangulated cases could be treated with minimal delay. However, the obstructions that could spontaneously recover after non-operative management might be unnecessarily operated on. The spontaneous resolution rate of IO varied from 20% to 73%, depending on the specific sub set of patients analyzed. The timing of operation for IO remains a challenge to the surgeon. In this series, durations from symptom onset to hospitalization, from hospitalization to operation, or from symptom onset to operation were longer in patients who were dead than in those who were alive. But, it was not significantly correlated to surgical mortality (Table 2).

Old age has been regarded as a risk factor for surgical death in IO. In our series, patients who died were older than those who lived. Old age was a risk factor in the univariate analysis (Table 2). Old age seemed to be a risk factor, but it turned out not to be an independent risk factor in multivariate analysis. It was not the age itself, but
the fact that older patients were more frequently associated with medical illness that resulted in the higher surgical mortality (Table 4). Those older patients who were not associated with a debilitating medical problem were not a poorer surgical risk. Therefore, old age itself was not an independent risk factor of operation for IO in these patients.

The incidence of associated medical illness was 17% in this study. Medical illness has always been regarded as a negative factor in many scoring systems to obtain a predicted mortality rate.1,4,5 Fevang et al.4 reported a surgical death rate of 13% in patients with premorbid illness versus 2% in patients without premorbid illness. We found a death rate of 30% (9/30) in patients associated with medical illness versus 2.1% (3/146) in patients without medical illness. Of the 4 independent risk factors, co-existing medical illness had the strongest correlation with surgical death.

The adverse effect of bowel ischemia on survival has been known for many years. We found a death rate of 18.8% in patients with bowel ischemia, compared with 4.2% in patients without bowel ischemia. Fevang et al.4 reported a significant difference between nonviable strangulation and death: the death rate was 16% in the nonviable strangulation group versus 4% in the non-strangulation group. Similar results were obtained in other studies.4,5

The surgical complication rate in this study was 8.5%. The vast majority of complications were wound infection, most developing in patients who had enterotomy or bowel resection. There was only 1 postoperative complication of pulmonary problem in these Taiwanese patients, in contrast to Western society, in which pulmonary problem was the major postoperative complication.10 The feature of most complications being minor ones could explain why the complication had significant but weak correlation with surgical mortality.

Co-existing disease, bowel ischemia, preoperative shock, and operative complication were the independent risk factors for surgical death in multivariate analysis (Table 3). This study confirmed the value of four independent variables - co-existing medical illness, bowel ischemia, preoperative shock, and operative complication - in identifying high-risk patients among the selected cases.

REFERENCES

16. Shatila AH, Chamberlain BE, Webb WR. Cur rent status of di-