Bowel and bladder continence, wound healing, and functional outcomes in patients who underwent sacrectomy

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Object. Total or partial sacrectomy is a rare procedure in patients with locally invasive tumors involving the sacrum; it may be associated with functional loss, such as bowel and bladder dysfunction and gait abnormality. In this study the authors examined functional outcome following sacrectomy.

Methods. The authors reviewed the charts of 50 consecutive patients who had undergone sacrectomy between July 1993 and August 2002. There were 23 male and 27 female patients whose mean age was 46 years (range 13–86 years). Twelve patients with rectal cancer underwent a separate analysis. The patients without rectal cancer were divided into two groups: those who had undergone colostomy for bowel diversion (Group 1, six cases), and those who had not (Group 2, 34 cases).

In Group 1 patients the median hospital length of stay (LOS) was 48.5 days (the 25th% and 75th percentiles are 26 and 58, respectively), and in Group 2 patients the median LOS was 18.5 days (the 25th and 75th percentiles are 8 and 41, respectively; p = 0.14). In Group 2 (non-rectal cancer without colostomy), LOS was greater in patients in whom a myocutaneous flap was used compared with those in whom no flap was used (36 days compared with 8.5 days, respectively; p = 0.0012); in patients with bowel incontinence the median LOS was significantly longer than that in patients with bowel continence (39 days compared with 8 days, respectively; p = 0.0026). The incidence of bowel incontinence in Group 2 was closely related to the integrity of the S-3 nerve root (p = 0.05).

Conclusions. Awareness of the association between S-3 nerve root resection and bowel and bladder incontinence may help surgeons’ decision-making process.

Key Words • sacrectomy • incontinence • colostomy

Chordoma, chondrosarcoma, meningioma, ependymoma, and giant cell tumors are cancers of relatively low-level malignancy but usually associated with a high potential for local recurrence. Total or partial sacrectomy is the procedure of choice for treatment of these and other locally invasive tumors such as rectal cancer.1,3,4,10,12–16,19 Investigators have shown, however, that neurological dysfunction, such as lower-extremity motor weakness, sensory abnormalities, and bowel, bladder, and sexual dysfunction, can occur following sacrectomy and are associated with the level and extent of spinal nerve severance during the sacrectomy.2 In addition, serious wound complications following sacrectomy have been reported in as many as 25 to 46% of the patients.8,18,20 Depending on the individual surgeon’s preference and knowledge, patients treated with sacrectomy may or may not also undergo a colostomy for bowel diversion. Based on our clinical experience, we have observed more wound infections in patients who experienced postoperative bowel incontinence, which led to wound infection, longer LOS, and delayed healing. Wound-related complications and incontinence can severely affect a patient’s quality of life.

Clinical Material and Methods

After obtaining approval from the institutional review board, we reviewed the clinical records of the 50 patients who underwent sacrectomy at The University of Texas M. D. Anderson Cancer Center between July 1993 and August 2002. Our study was designed to assess the following data: age at operation; diagnosis; treatment with preoperative chemotherapy, radiotherapy, or both; details of the sacrectomy procedure; reason for colostomy and myocutaneous flap procedure; date when healed wound was documented (when unavailable, we used the date of the last available clinic documentation of the unhealed wound); and hospital LOS.

We classified postoperative complications into nine categories: cardiovascular (including hypertension, deep venous thrombosis, arrhythmia, and pulmonary emboli);
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respiratory problems; endocrine complications; gastrointestinal complications; genito-urological and gynecological complications; wound complications; mental status changes; pain; and other. We ascribed an impact factor number to each complication according to its severity: 0, no complication; 1, nonsevere complication; 2, severe complication requiring consulting another service; and 3, severe complication requiring an intensive care unit stay. For each patient, we summed the impact factor values from each complication, and termed it “the complication total score.” Data regarding postsurgery mobility status and the development of bowel or bladder incontinence were also collected during each patient’s initial hospital stay. A patient’s function level was defined according to the FIM score routinely used by a physical therapist. The group of patients reported as ambulatory in this study were those in whom the FIM score was 6 or 7. These patients were able to ambulate more than 150 ft without supervision or assistance of another person; if their FIM score was 6 an assistive device (including a walker, cane, and crutches) could be used. Outpatient follow-up patterns established within 2 years of surgery were recorded as days from 1) discharge to the first follow up; 2) number of days from the discharge to the last follow up; and 3) the number of follow-up visits during the 2-year period. Patients who had undergone hemipelvectomy were excluded from this study. Because patients with rectal cancer are most likely to undergo colostomy, as was shown in our study, colostomy was performed in all 12 with rectal cancer. We therefore analyzed data obtained in these patients separately.

The remaining 38 patients without rectal cancer were divided into two groups: those who underwent colostomy for bowel diversion (Group 1, six cases) and those who did not (Group 2, 32 cases). The data were first summarized descriptively. In addition, time to wound healing was compared using the Wilcoxon rank-sum test and categorical variables were compared using the chi-square or Fisher exact tests. Survival analysis was performed to compare the number of days to healing, as there were censored data (in the case in which there was no documentation of a healed wound, we used the date of the last available clinical documentation of the unhealed wound). We used multivariate analysis of variance (myocutaneous flap, bowel continence, and colostomy) and ranked the variables of hospital stay and the complication total score to assess the effect of multiple factors on the hospital LOS.

**Results**

**Patient Characteristics**

The histological diagnoses of the 50 patients are listed in Table 1. The details of the surgical procedure and follow-up pattern are presented in Table 2. All patients with rectal cancer underwent colostomy due to their disease, whereas those without rectal cancer underwent colostomy for various reasons. Most myocutaneous flap procedures (in 28 of 31 cases) were performed because a large defect was present, and most (30 of 31) were undertaken as a primary procedure. Ten of 12 patients with rectal cancer underwent sacrectomy via an anterior approach, whereas 29 of 38 without rectal cancer underwent sacrectomy via a posterior approach. Characteristics of patients without rectal cancer are summarized in Table 3. The mean age of patients who underwent colostomy (Group 1) and those who did not undergo colostomy (Group 2) was 49 ± 16 and 43 ± 20 years, respectively (p > 0.50). The incidence of preoperative radiotherapy, preoperative chemotherapy, and myocutaneous flap procedures, as well as the median complication total score were not significantly different between these two groups (p = 0.13, p > 0.99, p = 0.38, and p = 0.28, respectively; Table 3). Neurosurgeons performed 32 (64%) of 50 of the surgeries, orthopedic surgeons performed 15 (30%), and other surgeons performed the remaining three (6%).

**Hospital LOS in Non–Rectal Cancer Patients**

The median hospital LOS in Group 1 was 48.5 days, whereas in Group 2 it was 18.5 days (p = 0.14; Fig. 1). Because of censored data (exact time to healing was not known), we used survival analysis to determine differences in wound healing durations, and these were not significantly different (p = 0.6) between the two groups. It has been suggested that the use of a myocutaneous flap could reduce wound complications. In patients without rectal cancer who did not undergo colostomy (Group 2), myocutaneous flap was associated with significantly longer LOS (36 and 8.5 days for those with and without a flap, respectively [p = 0.0012]), but this did not affect the wound healing time significantly (p = 0.48) (Fig. 2). Also in Group 2 patients, bowel incontinence significantly lengthened the duration of hospitalization (39 days for those with bowel incontinence compared with 8 days for those without bowel incontinence; p = 0.0026); there was a trend toward greater wound-healing time (93.5 days

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**TABLE 1**

Summary of histological diagnoses in all patients undergoing sacrectomy

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>No. of Cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>chordoma</td>
<td>18 (36)</td>
</tr>
<tr>
<td>colorectal tumor</td>
<td>12 (24)</td>
</tr>
<tr>
<td>giant cell tumor</td>
<td>3 (6)</td>
</tr>
<tr>
<td>sarcoma</td>
<td>11 (22)</td>
</tr>
<tr>
<td>other*</td>
<td>6 (12)</td>
</tr>
<tr>
<td>total</td>
<td>50</td>
</tr>
</tbody>
</table>

* Other tumors included neuroblastoma, ganglioma, schwannoma, and desmoid tumor.

**TABLE 2**

Summary of details obtained in patients without rectal cancer

<table>
<thead>
<tr>
<th>Group No. (%)</th>
<th>1</th>
<th>2</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of cases</td>
<td>6</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>age (yrs)*</td>
<td>48.7 ± 15.8</td>
<td>43.3 ± 20.1</td>
<td>&gt;0.50</td>
</tr>
<tr>
<td>preop chemotherapy</td>
<td>1/6 (16.7)</td>
<td>8/32 (25)</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>preop radiotherapy</td>
<td>3/6 (50)</td>
<td>6/32 (18.8)</td>
<td>0.13</td>
</tr>
<tr>
<td>myocutaneous flap</td>
<td>5/6 (83)</td>
<td>19/32 (59)</td>
<td>0.38</td>
</tr>
</tbody>
</table>

* Age is presented as the mean ± standard deviation.

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compared with 34 days; \( p = 0.07 \), as shown in Fig. 3. Furthermore, when using survival analysis, we found that wound-healing duration was significantly greater in patients with bowel incontinence \( \left( p = 0.033 \right) \). Using Spearman correlation coefficients, we found that the complication total score correlated significantly with the hospital LOS in Group 2 patients \( \left( \text{correlation coefficient 0.64, } p < 0.0001 \right) \).

Using multivariate analysis, we found in the non–rectal cancer patients, use of a myocutaneous flap and the complication total score were independent predictors of longer LOS \( \left( p = 0.006 \text{ and } 0.0001, \text{ respectively} \right) \), and that a colostomy was not a predictor. Using the same analyses for Group 2 \( \left( \text{no rectal cancer or colostomy} \right) \), we found the complication total score, use of a flap, and bowel incontinence were all independent predictors of prolonged LOS \( \left( p = 0.0068, 0.025, \text{ and } 0.018, \text{ respectively} \right) \).

**Association Between Nerve Root Integrity and Continence**

We observed a strong association between S-3 nerve root integrity and continence. In Group 2 patients, the incidence of bowel incontinence increased dramatically in conjunction with the number of S-3 nerve roots sacrificed \( \left( p = 0.05; \text{Fig. 4} \right) \). Two \( \left( 25\% \right) \) of eight patients with intact bilateral S-3 nerve roots reported bowel incontinence; three \( \left( 37.5\% \right) \) of eight patients who underwent unilateral S-3 nerve root resection reported bowel incontinence, whereas 12 \( \left( 75\% \right) \) of 16 who underwent bilateral S-3 nerve root resection reported bowel incontinence. Bowel and bladder functions were closely related (Table 3). Thirty of 32 patients exhibited consistent bowel and bladder function \( \left( 16 \text{ with both bowel and bladder incontinence and } 14 \text{ with both bowel and bladder continence} \right) \); only one patient experienced bowel incontinence with normal bladder function, and only one patient exhibited bladder incontinence with normal bowel function. In addition, there were no significant intersex differences in Group 2 patients in terms of bowel or bladder function with respect to incontinence or the number of S-3 nerve roots sacrificed.

**Mobility After Sacrectomy**

Muscles supplied by the S-1 and higher nerve roots likely affect lower-extremity strength and, therefore, a patient’s mobility. Six \( \left( 50\% \right) \) of 12 patients in whom the S-1 nerve root was sacrificed unilaterally or bilaterally were able to ambulate more than 150 ft with or without an assistive device compared with 29 \( \left( 76\% \right) \) of 38 patients in whom S-1 nerve roots were intact \( \left( p = 0.15; \text{Fig. 5} \right) \).

**Comparison of Inpatient Rehabilitation and Discharge Destination**

Among the 12 patients with rectal cancer, all underwent colostomy, two experienced normal bladder function, three suffered bowel incontinence, and seven underwent a bladder diversion procedure. The mean age was not significantly different between patients with rectal cancer and those without \( \left( 50 \text{ and } 44 \text{ years, respectively; } p = 0.33 \right) \). The median number of days comprising hospital LOS and wound healing seemed to be slightly fewer for rectal cancer patients, but it was not statistically significant \( \left( p = 0.16 \text{ and } 0.27, \text{ respectively; } \text{Fig. 6} \right) \). Twenty-five of 50 patients underwent acute inpatient rehabilitation therapy in our rehabilitation unit. The rate of inpatient rehabilitation was not significantly different between patients with and without rectal cancer \( \left( p = 0.74 \right) \). The intergroup discharge destination was also not different significantly: 92% of those without rectal cancer returned home, whereas 91.7% of those with rectal cancer went home \( \left( p > 0.99 \right) \).
Discussion

To achieve local control of rectal cancer and other tumors associated with a high risk of recurrence, extensive surgery, including sacrectomy, may be necessary. This procedure, however, is associated with serious wound complications that have been shown to occur in 25 to 46% of patients.8,18,20 One group has shown that preoperative radiotherapy increases the risk of wound infection by 10 to 20%.9 Therefore, we compared the frequency of preoperative radiotherapy in the two groups of patients without rectal cancer and found that the incidence was higher in Group 1 patients (those who had undergone colostomy), but the difference was not statistically significant. Other investigators have shown that elderly patients who had received preoperative radiation treatment were at greater risk of wound morbidity.9 There was no significant trend toward an association with older age in Group 1 in our study. A primary myocutaneous flap can be used to cover large pelvic defects in some patients, and this procedure has been reported to reduce acute wound complications as well as lower the incidence of readmission and repeated operation for wound complications.7,11 In our study, a flap closure procedure was associated with longer hospital LOS but not a significantly greater number of days required for wound healing in the non–rectal cancer patients. In our study myocutaneous flaps were performed mostly in patients with a large defect (in 29 of 31 cases), although two flap closure procedures were performed for high-risk patients who had undergone preoperative radiotherapy. In Group 1 patients (those without rectal cancer) there was a higher incidence of flap closure surgeries, although this was not significantly different from the rate observed in Group 2. The rate of postoperative complications was not significantly different between the two groups of patients without rectal cancer. Multivariate analysis showed that the complication total score and the need for a flap closure procedure were independent predictors for prolonged hospital LOS (in the non–rectal cancer patient group). Although we had no control over the size of the defect—and therefore the choice of performing the flap closure—we can continue to prevent the postoperative complications to shorten the hospital LOS. In similar analyses for Group 2 patients, the complication total score, the need for a flap closure procedure, and the presence of bowel incontinence were all independent predictors of prolonged hospital LOS. Examination of these data further indicated that careful preoperative assessment for bowel incontinence is very important.

Based on our clinical experience, we suspected that the wound healing would be delayed in patients who had not undergone colostomy because of bowel and bladder incontinence; thus, we further analyzed the effect of bowel function in Group 2 and found that it did significantly lengthen hospital LOS (39 and 8 days for bowel incontinent patients and bowel continent patients, respectively; p = 0.0026); survival analysis also showed that it lengthened wound healing time (p = 0.033). These results support our hypothesis that bowel incontinence contributes to prolonged hospital LOS and delayed wound healing. The underlying reasons could be the incidence of wound contamination and, thereby, infection as well as the psychological and social impacts of bowel incontinence.

The authors of previous reports have shown that sacral nerve root integrity is closely associated with bowel and bladder function.5,6,17 Our findings underscore the importance of preserving S-3 nerve root integrity. The incidences of bowel incontinence after unilateral S-3 nerve root resection (37.5%) and after bilateral S-3 nerve root resections (75%) are slightly higher than those previously reported.17 In our study, bowel and bladder function and dysfunction were closely related. Because of the high incidence of bowel/bladder incontinence in patients who underwent S-3 nerve root resection, particularly bilateral resection, it is important for surgeons to consult a physical medicine and rehabilitation specialist preoperatively, assess the feasibility of bowel training (including cogni-
tion, upper-extremity function, compliance, and social support), and consider a bowel diversion procedure in selected cases in this patient population.

We found that the majority of the patients who undergo sacrectomy retain fair mobility function by the time they are discharged. When uni- or bilateral S-1 sacral nerve root sacrifice was performed, six (50%) of 12 patients were ambulatory, whereas 29 (76%) of 38 with an intact root sacrifice were able to ambulate with or without an assistive device.

When patients with and without rectal cancer were compared, we also found no significant difference in hospital LOS, number of days required for wound healing, need for acute inpatient rehabilitation, or discharge destination. Given the multiple rehabilitation issues (including mobility, activity of daily living, bowel and bladder management, and wound care) in postsacrectomy patients, we strongly recommend that they undergo acute inpatient rehabilitation.

One shortcoming of our study was its retrospective design. In some cases wound healing time might not be accurate because the patient was lost to follow up or because the interval between discharge and follow-up visit comprised a long period. In Group 1 the sample size of the patients without rectal cancer was relatively small (six cases), and this may have masked the benefit of colostomy for these patients. Even in our large comprehensive cancer center, it took approximately 10 years to collect a sample size of 50 patients. A prospective study may need to be a collaborative study of patients treated at multiple institutions.

Conclusions

Sacrectomy is an aggressive treatment associated with a high risk of wound complication. We found that patients in whom the S-3 nerve root is sacrificed bilaterally, the incidence of bowel incontinence was 75%, and this was associated with longer hospital LOS and delayed wound healing. Therefore, a bowel diversion procedure should be considered in selected cases when bilateral S-3 nerve root resection is indicated and bowel function retraining appears to be difficult. Further study is needed to compare the long-term quality of life in patients who have undergone colostomy and those with bowel incontinence.

References


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