ORIGINAL ARTICLE



En Bloc Resection with Partial Sacrectomy Helps to Achieve R0 Resection in Locally Advanced Rectal Cancer, Experience from a Tertiary Cancer Center

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Abstract

Partial sacrectomy is a radical procedure that benefits a select group of patients with locally advanced primary or recurrent rectal cancer with posterior extension and carries potential for significant morbidity. This study was done to evaluate the morbidity and oncological outcome of patients who underwent partial sacral resection for rectal cancer in a tertiary cancer center. Seventeen patients underwent partial sacrectomy during the period from 2011 to 2015. Eleven patients had primary and six had recurrent rectal cancer. All patients were evaluated with MRI pelvis and metastatic evaluation with CT scan of the chest and abdomen and PET scan in patients with recurrent cancer. All patients had resection below the level of S2/S3 junction or lower. Three patients were females and the remaining were males. Median age was 56 years. Overall morbidity was 76% and most common morbidity was wound related. The mean estimated relapse-free survival (RFS) for patients treated for primary rectal cancer was 20.3 months (95% confidence interval (CI), 12.8–27.9) and the mean estimated overall survival (OS) 23.9 months. Estimated mean RFS for patients who were operated for recurrent rectal cancer was 25.6 months (95% CI, 17.7–33.5) and the median RFS was yet to reach. Estimated mean OS was 29.7 months (95% CI, 15.5–43.8) and the median OS was 39.6 months. Partial sacrectomy below the level of S2/S3 junction is a safe approach to facilitate en bloc resection of locally advanced primary and recurrent rectal cancer extending posteriorly with loss of plane with sacrum. In selected patients, this approach can improve survival at the cost of high morbidity.

Keywords Partial sacrectomy \cdot Rectal cancer \cdot En bloc resection

Introduction

Surgical oncologists occasionally come across patients with involvement of the sacrum in locally advanced primary or recurrent rectal cancer. Surgical resection in such cases needs en bloc

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resection of the rectum with part of the sacrum [1–6]. Partial sacrectomy is a radical procedure with the potential for morbidity like wound break down, infection, neurological deficit, urinary retention, and other complications not directly related to surgery like thromboembolism and myocardial infarction [3–6]. Indication for partial sacrectomy is the posterior extension of the disease breaching the presacral fascia with an indistinct plane with sacrum or direct involvement of the sacrum as assessed by an MRI. The resection of the lower three segments of the sacrum is generally tolerated without a significant neurological deficit or structural instability [1–13]. Commonly, partial sacrectomy is combined with abdominoperineal excision (APE), extralevator abdominoperineal excision (ELAPE), or pelvic exenteration.

The aim of this study was to evaluate the role of sacropelvic resection in primary and recurrent rectal cancers treated in a tertiary cancer center by assessing the surgical morbidity and oncological outcome.



Materials and Methods

This is a retrospective study. Consecutive patients with locally advanced primary or recurrent rectal cancer, who underwent en bloc resection with partial sacrectomy, during the period from 2011 to 2015 were included in the study. We collected the data for the study by reviewing the case files, surgical registers, and images and through telephonic inquiry.

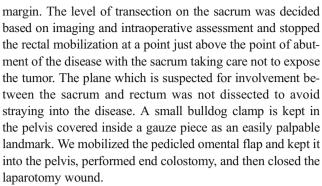
We selected patients for the surgical resection if marginnegative resection was feasible and the patient's general condition as assessed by ECOG performance status is suitable for the radical surgical procedure. Data were collected on demographic profile, stage of the disease, previous treatment history, and the nature of neoadjuvant treatment, the surgical procedure performed previously, current surgical procedure, the surgical morbidity, and oncological outcome. All patients underwent local imaging with MRI pelvis. Patients with primary rectal cancer underwent CT scan of the chest and abdomen and those with recurrent cancers underwent a PET-CT scan as part of the metastatic evaluation.

We treated all patients with primary rectal cancer with neo-adjuvant chemoradiation with radiotherapy to a dose of 50.4 Gy along with oral capecitabine. Patients with recurrent cancers received neoadjuvant chemotherapy. We reevaluated all patients with MRI of the pelvis and CT scan of the chest and abdomen or a PET scan after neoadjuvant therapy before surgery. Surgery was performed at approximately 8 weeks from the date of completion of radiation therapy. Patients with recurrent rectal cancer underwent neoadjuvant chemotherapy with oxaliplatin or irinotecan-based regimen (FOLFOX/FOLFIRI) and were operated at 4 weeks from the last dose of chemotherapy.

We decided for partial sacrectomy if the disease extended posteriorly breaching presacral fascia or radiologically infiltrated the sacrum as assessed by the MRI. Patients with infiltration of the coccyx and up to the lower three segments of the sacrum, where margin-negative resection was possible with partial sacrectomy, were chosen for the procedure. Those patients with involvement of the second and/or first segments of sacrum were excluded due to the high morbidity and functional loss expected with resection of higher segments of the sacrum. The inclusion criteria for the study included patients who underwent surgery for primary and recurrent cancer with partial sacrectomy with curative intent. Extralevator abdominoperineal resections which do not include the sacrum were excluded.

Operative Approach

In 13 of our patients, we used a combined anterior and posterior approach for the procedure. We performed laparotomy and mobilized the rectum with the patient in the lithotomy position. Total mesorectal excision (TME) was performed in primary cancers and we resected recurrent cancers with a clear



Then, the patient is placed prone, in a jack knife position. The perineal incision around the anus is used for perineal dissection and this is extended posteriorly to resect the sacrum. Division of the levator ani provides access into the pelvic cavity and the metallic marker kept inside helps to identify the level of decision. C-arm was used in some cases for identification of the level of division of the sacrum. We divided the sacrum using a chisel and hammer and removed the specimen from the perineal side (Diagram 1).

In four patients in our series, we used a supine-only approach (anterior-only/anterior perineal approach) for the procedure. After mobilization of the rectum in the supine position with legs placed in lithotomy stirrups, perineal dissection starts as in a usual APE. However, the perineal dissection was done immediately posteriorly to the coccyx and the sacrum by detaching the origin of gluteal muscles from its posterior surface till the point of division. The perineal skin incision is not extended posteriorly in this procedure. An adjunct sacral cut was performed from the abdomen using a chisel and hammer and the entire specimen is delivered through the perineal route. The supine-only approach does not require a change of position during surgery. The median operative time for the supine-only approach was 210 min and that for combined supine and prone approach was 240 min.

Those male patients with anterior infiltration of the disease underwent appropriate resection of the urinary structures (prostatectomy, seminal vesicle excision, partial or total cystectomy). Female patients underwent either posterior vaginectomy or posterior pelvic exenteration based on the level and extend of involvement. We used omental flap in all patients to fill up the pelvic cavity, reinforce the vascularity, and help in wound healing.

Statistical Analysis

Qualitative variables were summarized using numbers and percentages. We used Kaplan–Meier method to estimate the overall survival and relapse-free survival. To estimate overall survival, the time to event (death) between the date of surgery and date of last follow-up is considered. Similarly, for the recurrence-free survival, time to event (recurrence) between



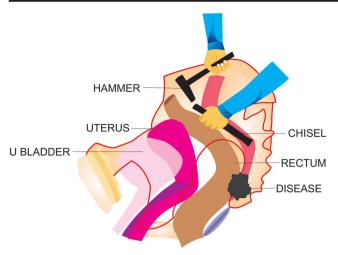


Diagram 1 Sacrum division using a chisel and hammer and the specimen removal from the perineal side

the date of surgery and date of last follow-up is considered. The Kaplan–Meier survival estimates calculated for both primary cancer and recurrent cancer separately, and 95% confidence intervals for overall survival and recurrence-free survival are also estimated.

Statistical software. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. was used for statistical analysis.

Table 2 The number of patients and segments of sacrum resected

Sacral segments resected	Number of patients
Segment 5 alone	6
Segments 4 and 5	10
Segments 3, 4, and 5	1
Total	17

Results

Seventeen patients underwent partial sacrectomy for rectal cancer during the period under the study. Eleven patients in our study had primary rectal cancer and six had recurrent cancer. Three patients (17.65%) were females and 14 (82.35%) were males. The youngest patient was 22 years old and eldest was 79 years. The median age was 56 years and the mean age was 52.4 years. Six patients in our series were diabetic and two had diabetes and hypertension as comorbidities.

The demographic profile, clinic-radiological stage, surgical procedure undertaken, histopathology, and pathological stage of the patients under study are mentioned in Table 1.

The number of patients who had one, two, and three segments of sacrum resected is shown in Table 2.

Table 1 Age and gender of the patients, surgical procedure, histopathology, and clinical and pathological stage of the cancer

Ser. no	Age	Sex	Clinical stage	Surgical procedure	Histopathology	Pathological stage
1	22	M	cT4BN0M0	ELAPE + PS + right seminal vesicle excision + partial prostatectomy	Poorly differentiated adenocarcinoma	ypT2N1M0
2	36	M	cT4BN1M0	TPE + PS + neobladder reconstruction	Signet ring cell carcinoma	ypT4bN1aM1a
3	40	F	cT4BN2BM0	ELAPE + posterior vaginectomy + sacrococcygectomy	Poorly differentiated adenocarcinoma	ypT4aN0M0
4	42	M	cT3N0M0	TPE + PS	Moderately differentiated adenocarcinoma	ypT4bN0M0
5	51	M	cT4N0M0	Modified PE + PS	Moderately differentiated adenocarcinoma	ypT3N0M0
6	53	F	cT4BN1M0	PPE + PS + left ureteric resection and re-implantation	Moderately differentiated adenocarcinoma	ypT2N0M0
7	56	M	cT3N1M0	APE + PS	Moderately differentiated adenocarcinoma	ypT3N0M0
8	57	M	cT4BN1M1	APE + bilateral seminal vesicle excision + liver metastasectomy + PS	Moderately differentiated adenocarcinoma	ypT2N0M0
9	61	M	cT4BN2M0	ELAPE + prostatectomy + seminal vesicle excision + appendectomy + PS	Large cell neuroendocrine carcinoma	ypT3N1M0
10	66	F	cT4BN0M0	PPE + ELAPE	Moderately differentiated adenocarcinoma	ypT3N1cM1
11	72	M	cT4BN1M0	ELAPE + PS + partial prostatectomy	Moderately differentiated adenocarcinoma	ypT0N0M0
12	24	M	rT4BN0M0	ELAPE + seminal vesicle excision + peritonectomy + PS	Poorly differentiated adenocarcinoma	ypT0N0M0
13	48	M	rT2N0M1	ELAPE + PS	Moderately differentiated adenocarcinoma	ypT2N0M0
14	58	M	rT4BN1M0	ELAPE + PS	Moderately differentiated adenocarcinoma	Not Available
15	58	M	rT4BN1M0	ELAPE + radical cysto-prostatectomy	Moderately differentiated adenocarcinoma	ypT0N0M0
16	68	M	rT4BN0M0	Salvage ELAPE + PS	Moderately differentiated adenocarcinoma	ypT4bN2aM0
17	79	M	rT3N0M0	ELAPE + PS	Well-differentiated adenocarcinoma	ypT3N0M0

APE, abdominoperineal excision; ELAPE, extralevator abdominoperineal excision; PS, partial sacrectomy; TPE, total pelvic exenteration; Modified PE, modified pelvic exenteration



Table 3 Incidence of morbidity

Classification of the morbidity (Clavien-Dindo)	Nature of complication	Number of cases $(n = 17)$	Percentage
IIIa	Wound breakdown/bladder morbidity	11	64.7
IIIb	Wound breakdown (required surgical correction under anesthesia)	1	5.88
V	Death from pulmonary embolism	1	5.88
Total		13	76.47

In 13 patients, preoperative MRI scan showed disease extending to the sacrum. In four cases, extension of the fibrosis involving the sacrum was intraoperative finding and was not differentiated from disease. In all patients, microscopically negative margin was achieved. Three patients had a complete pathologic response. In all the specimens, we found that the sacrum was pathologically free of tumor. The average number of nodes dissected was 4.7 in primary cases and 4 in recurrent rectal cancers. Pathologically positives nodes were identified in three (27.3%) primary cases and one (16.7%) recurrent case.

Morbidity

Mean duration of hospital stay was 15.76 days. Overall morbidity was 76%. The incidence of 30-day morbidity as per the Clavien-Dindo classification is shown in Table 3.

Wound morbidity was the commonest surgical complication. This was followed by neurogenic bladder morbidity which was seen in six (35.3%).

Survival

Out of 11 patients with primary rectal cancer, details of 9 patients are available. Three are alive and disease free. Cancer-specific mortality happened in three patients and the remaining three died of unrelated causes. One patient died in the early postoperative period from pulmonary embolism and another patient committed suicide after surviving for a year. Three out of the six patients treated for recurrent rectal cancer are alive and disease free. One patient died of peritoneal disease. Two patients died of unrelated causes.

The mean of estimated overall survival (OS) and relapsefree survival (RFS) of patients with primary and recurrent rectal cancers in months with 95% confidence interval (CI) is shown in Table 4 below. The survival curves are shown in Figs. 1, 2, 3, and 4.

Table 4 Mean of estimated overall survival (OS) and relapse-free survival (RFS) of patients with primary and recurrent rectal cancers

Primary/recurrent rectal cancer	Estimated OS in months (95% CI)		Estimated RFS in months (95% CI)	
rectar cancer	Mean	Median	Mean	Median
Primary cancer Recurrent cancer	23.9 (16.5–31.3) 29.7 (15.5–43.8)	28.9 (18.3–39.5) 39.6	20.3 (12.8–27.9) 25.6 (17.7–33.5)	23.8 Yet to reach median



Pattern of Recurrence

Details of 15 patients are available. Recurrence was found in six patients of whom two had local recurrence and four had distant metastasis. Sites of distant metastasis were the liver (two cases), brain (one case), and peritoneal metastasis (one case). Local recurrence was found in the presacral area in the two patients.

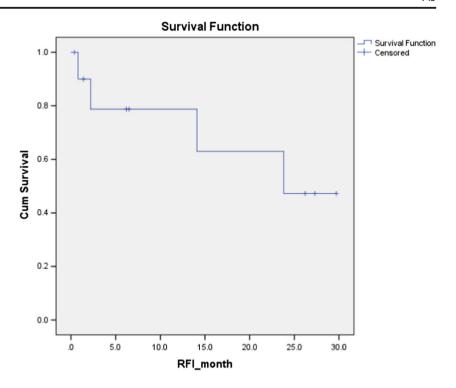
Discussion

Posteriorly fixed rectal cancers pose a difficult oncological challenge. En bloc resection including partial sacrectomy is the only way to achieve margin negative curative resection in patients with extramesorectal disease extending posteriorly to involve presacral fascia or the bony cortex of the sacrum. The en bloc resection of rectal cancer with partial sacrectomy was first described by Wanebo and Marcove in 1981 [13]. A select group of patients with locally advanced primary or recurrent rectal cancer with posterior tumor extension benefits from partial sacrectomy and is potentially long-term survivors if R0 resection is achievable.

The technical feasibility, safety, and acceptable oncological outcome of sacropelvic resection for primary and recurrent rectal cancer have been further described by several authors [1–14]. The procedure is highly demanding and carries a high incidence of morbidity.

Majority of the authors have described sacral resections below S2/S3 junction. As the neural fibers end above this level, resection below this does not result in a significant motor deficit. Involvement of the proximal sacrum is uncommon in rectal cancer. Resection of the first two segments of the sacrum leads to a higher functional deficit, bleeding, and pelvic instability [15, 16]. A few authors have published their experience with high sacrectomy showing that this approach is feasible and gives favorable functional and oncological

Fig. 1 Relapse-free survival for primary rectal cancers



outcome in experienced hands [5, 12, 17]. Considering the higher chance of distant failure and low survival in patients with such extensive involvement, such morbid resections are generally not favored especially in recurrent disease [18–20]. Evans et al. have described a method of removal of the anterior body and foramina of the sacrum with preservation of neural fibers instead of the conventional en bloc removal of

sacrum for patients with involvement of the higher segments [21].

Commonly used technique for en bloc partial sacrectomy is a combined anterior and posterior approach using supine lithotomy and prone positions. The prone approach is more convenient to the surgeon as this gives a direct and easy approach to the posterior surface of the sacrum. However, this requires

Fig. 2 Overall survival for primary rectal cancers

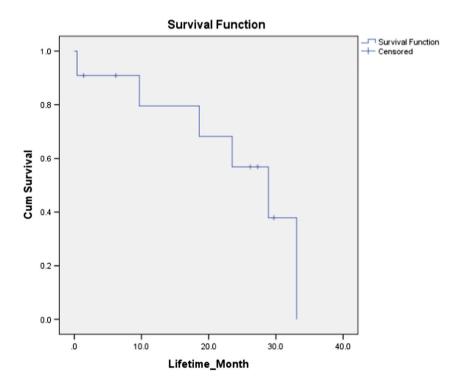
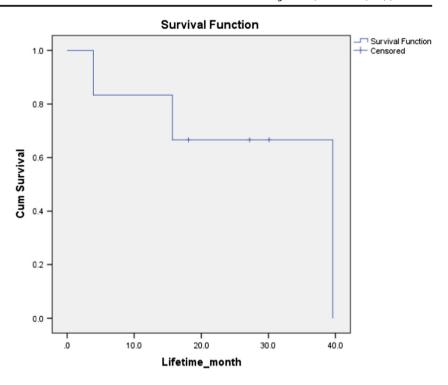




Fig. 3 Overall survival for recurrent rectal cancers



change of position during the surgical procedure and is more time consuming. The anesthetic concerns of ventilating in prone position are another disadvantage of this technique.

We used anterior-only approach (anterior perineal approach/supine-only approach) in four of our patients where the entire surgery was performed keeping the patient in a lithotomy position. A folded towel placed behind the low back

gives a better access to the posterior surface of the sacrum. We avoided the posterior extension of the perineal incision usually used for sacrectomy. We found that this method is suitable for resection of lower segments of sacrum (S4/S5). Melton et al., Roldan et al., and others have described this technique before [8, 22, 23]. We had been using this technique since 2011. The anterior perineal method is found to be faster as it does not

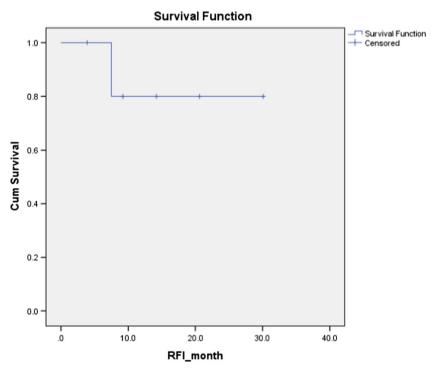


Fig. 4 Relapse-free survival for recurrent rectal cancers



require change in position during the surgery. However, it is technically more demanding especially in patients with higher body mass index. The method is not suitable for patients who require higher sacral division above S2/S3 junction and those who need spinopelvic stabilization or soft tissue reconstruction of the perineum and low back with muscle flaps.

In our series, 13 patients had suspicious radiological extension of the disease posteriorly. Clinical involvement with adherence to the sacrum was present in all patients assessed intraoperatively. In spite of this, we did not identify cortical bone invasion in the final pathologic evaluation in any of our patients.

In the pathological analysis, only a fraction of patients with clinical and/or radiological evidence of posterior extension of the disease have their sacrum invaded by cancer. In the literature, the cortical bone involvement is reported occasionally in recurrent cancers [8, 11, 24]. The cortical bone is almost never invaded by cancer in locally advanced primary rectal cancer [24]. It is difficult to interpret the MRI and PET scan after completion of neoadjuvant chemoradiation therapy, where the post-radiation changes mimic the disease. The fear of inadvertently entering the disease and subsequent increase in the risk of local recurrence necessitates en bloc resection. In view of the rarity of the involvement of the cortex of the sacrum in advanced primary rectal cancer, we feel that the threshold for resecting sacrum should be kept high in such patients. An attempt at resection of presacral fascia alone is a reasonable option to achieve R0 resection in carefully selected patients to reduce the morbidity associated with sacral resection. However, the surgeon should keep a low threshold for en bloc resection of the sacrum, since dissection in the presacral plane can sometimes cause severe bleeding which is very difficult to control.

Overall survival of the patients in our series is lower compared to other series in the literature [1, 7–9, 25]. With the small number of patients and heterogeneity of the population, it is difficult to interpret the results. Some of the factors that probably influenced the survival adversely in our series are (1) inclusion of two patients with liver metastasis, (2) early post-operative death in one patient from pulmonary embolism, (3) suicide by a patient, (4) inclusion of a patient with neuroendocrine carcinoma who had early metastasis and death in the study, (5) liberal approach to case selection especially in young patients with poorly differentiated tumors, and (6) the lower number of cases. Better case selection based on age, disease biology, and relapse-free interval has helped us to achieve better results in the case of recurrent rectal cancers compared to primary rectal cancers in this study.

Conclusion

En bloc resection of rectum along with part of the sacrum is the optimum approach for surgical resection in selected cases of locally advanced rectal cancers with posterior extramesorectal extension. This approach is associated with significant morbidity and hence is best practiced in institutes with sufficient expertise.

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