MULTIVISCERAL RESECTION IN PELVIC MALIGNANCIES

Oncology

Shiva Kumar	MBBS, MS, Mch, Department of surgical oncology, Kidwai memorial Institute of Oncology, Bangalore, Karnataka, India.
Kapil Dev*	MBBS, MS, Mch, Department of surgical oncology, Shalby Multispecialty Hospital, Jaipur, Rajasthan, India. *Corresponding Author
Arun Pandey	MBBS, MS, Mch, Department of surgical oncology, Kidwai memorial Institute of Oncology, Bangalore, Karnataka, India.
Vishnu Kurpad	MBBS, MS, Mch, Department of surgical oncology, Kidwai memorial Institute of Oncology, Bangalore, Karnataka, India.
Prof KV Veerendrakumar	MBBS, MS, Mch, Department of surgical oncology, Kidwai memorial Institute of Oncology, Bangalore, Karnataka, India

ABSTRACT

Introduction: Radical surgical approach to rectal cancer and other pelvic organ cancers have a significant morbidity but impressive results in improvement in loco-regional control of disease. Although, with the advancement of non-surgical modalities of treatment, the outcome has increased but the surgical resection remains the only curative option with the best results in both primary locally advance and localize recurrent rectal cancer. Additional, the symptom control in these patients can be achieved with the resection only with the acceptable morbidity.

Material and methods: A total of 43 patients underwent pelvic exenteration surgery (total, anterior or posterior) at our institute, categorised in two groups as, Group I rectal cancer and Group II non-rectal cancer. In all patients, intra-operative and post-operative parameters including operative time, blood loss, level of resection satisfaction, haemorrhagic or serosanguinous or serous or purulent, post-operative recovery and early complications were noted. Survival was observed as disease free survival and overall survival.

Results: Median age of patients was 49 and 47 years in group I and II respectively. Operative time and intra-operative blood loss was higher in non-rectal cancer patients, but statistical non-significant. The level of resection (R0) was better in group I as 64% vs 55% (p=0.001). Overall post-operative complications were more in group II. Oncological outcome including DFS and OS was better in group I but statistical non-significant. The results were comparable between retrospective and prospective groups. Patients with primary disease had favourable results compared to recurrent disease.

Conclusion: Pelvic exenteration surgery is a feasible treatment option in locally advanced pelvic organ malignancies with a satisfactory long term outcome, and acceptable morbidity. Patients with rectal cancer, especially with primary tumours have better outcomes as compared to other pelvic organ origin cancers. The overall outcome depends on patient selection, completeness of resection, and comprehensive perioperative care.

KEYWORDS

Locally advanced pelvic cancers; Rectal cancer; Recurrent disease; post-operative morbidity

Introduction

Complete surgical resection is an important predictor of long-term survival in locally advanced as well as in recurrent rectal cancer. Total pelvic exenteration was initially recognized for residual or recurrent gynecological malignancies, however, it has been performed in primary or recurrent cancer of the cervix, rectum, vagina, uterine corpus, vulva, prostate, bladder, and for pelvic sarcoma.[1,2] Although, such radical surgical approach to rectal cancer and other pelvic organ cancers have a significant morbidity but impressive results in improvement in loco-regional control of disease. Advance transmural extension of the tumor in these organs will invade into adjoining organs such as bladder, prostate, vagina and uterus. The current standard first line treatment of patients with stage IIC and IIIC, is combined modality including preoperative chemoradiation followed by surgical intervention.[3] Locally advanced and recurrent pelvic tumours causes substantial morbidity such as tenesmus, pain, bleeding, fistula and bowel obstruction. Currently, the extensive surgery for this kind of disease like total, anterior or posterior exenteration with intention to either curative or palliative treatment has partly recognized regrading rectal cancer too, for minimizing the local recurrence. [4-6]

The surgical techniques have enriched over the period since it was described by Brunswick in 1948, results in better outcome regarding quality of life, mortality and morbidity. [7-9] Even with sophistication of treatment, TPE has still a significant morbidity reported as 13% to 64%.[10-12]. Extensive surgical treatment has limited role in recurrent disease comparison to primary disease with reported 5-year survival rates range between 0% to 23% and 32% and 66%, respectively.[5,7,11] We analysed the factors affecting patient selection for TPE, evaluated post-operative morbidity and mortality and oncological outcome.

Material and methods

A total of 43 patients underwent pelvic exenteration surgery (total, anterior or posterior) at our institute in the department of Surgical Oncology over the period of five years during 2011 to 2015. Thus study has been approved for the publication in Institutional Scientific Review Board. The surgical procedure was performed after discussion in multidisciplinary tumour board meetings for patients with primary and/or recurrent pelvic tumours including rectal cancer, cervical, uterine malignancies and soft tissue sarcomas, etc. The surgical option was decided straight forward after primary assessment or after exploration. We reviewed the medical records retrospectively of those patients treated before approval and further, patients who underwent pelvic exenteration surgery were analysed prospectively. Majority of patients were rectal cancer with locally advanced disease, received neoadjuvant treatment either short/ long course radiotherapy (n=5) or chemo-radiation(n=12). Patient had pelvic recurrence after complete of treatment of rectal cancer, with solitary recurrence without other systemic distant disease underwent surgery. Among non-rectal cancer patients, distributed as per table 1.

Table 1: Tumour histology and presentation			
	Primary	**Recurrent**	**Total**
Rectal cancer	21	4	25
Cervical cancer	3	6	9
Endometrial carcinoma	2	1	3
Urinary bladder cancer	2	0	2
Sarcoma	2	2	4

Pre-operative assessment

All patients underwent thorough clinical examination, routine baseline biochemical, haematological and coagulation profile, diagnostic investigation (non-invasive and/or invasive), and staging work-up as per institutional protocol. The resectability of tumour confirmed on CECT abdomen and pelvis and MRI pelvis in all cases. Systemic disease ruled out with CECT thorax and/ or PET-CT. Evidence of extra-pelvic disease prior to nCRT, in patients with symptomatic pelvic disease did not considered as contraindication of surgery. Palliative exenteration surgery performed in patients with extra-pelvic disease, borderline resectable disease with intractable pelvic symptoms including pain, bleeding, pressure symptoms and urinary disturbance. Patients with non-rectal cancer, cervical cancer patients received nCRT (54Gy radiotherapy in 25 Fr with weekly cisplatin 50mg/m2).

Surgical procedure
Pelvic exenteration surgery includes resection of rectum with or without anal canal, urinary bladder with distal ureter, uterus with bilateral adnexa in females and regional lymph node dissection.[Figure 1] Faecal diversion achieved by permanent end sigmoid colostomy in patients who underwent resection of anal canal and protective transverse loop colostomy performed in patients who underwent low colo-rectal or colo-anal anastomosis. Urinary diversion performed as incontinent ileal conduit in majority of patients and colonic conduit was also performed in few cases.

Patient characteristics
Patients were categorised in two groups as, Group I rectal cancer and Group II non-rectal cancer. Demographic parameters include age at diagnosis, gender, BMI, performance status, medical co-morbidities, ASA grading noted and analysed in both groups. Results of neoadjuvant treatment also observed.

Peri-operative parameters
In all patients, operative time, blood loss, need of blood transfusion, level of resection satisfaction, need of prolonged ventilation during immediate post-operative period, drain output from abdominal drainage as amount, haemorrhagic or serosanguinous or serous or purulent, intensive care stay, early complications in form of respiratory problem as LRTI, atelectasis, pleural effusion, etc, urinary tract infection, deep venous thrombosis and other significant events noted. Immediate post-operative recovery such as stoma functioning, urine output through urostomy, physical activity, hospital stay, need of intervention for any complication noted.

Histopathology
The level of resection as presence of macroscopic disease over the resection margins after removal of specimen in operative theatre only, was noted as per institute protocol in all patients. After sectioning and processing and preparation of paraffin blocks were studied by the expert in Onco-pathology at our institute. Completeness of resection was divided into R0 (complete resection of tumour), R1 (evidence of microscopic disease at margins of rested specimen), and R2 (residual macroscopic disease) and suspicious recurrent disease in the absence of tumour in the specimen. Pathological staging determined according to AJCC 7th edition cancer staging.[12]

Follow up
The schedule of hospital visit is standardised at institute level and follow up data of all patients were recorded in the case files. On each visit, clinical history regarding any complaint in respect to disease and its treatment, general and systemic examination, and relevant biochemical and radiological investigations has been done in all patients. Specifically, the morbidity due to surgical procedure, like persistent pelvic pain, abnormal bowel habits, difficulty in management of stoma, wound infection and dehiscence, pelvic and perineal abscess, enteric fistula, deep vein thrombosis were recorded. Morbidity was classified into major and minor based on need of hospital readmission and intervention. In-hospital and 30-day mortality was noted. Multivariate analysis was done of significant variables on univariate analysis using Cox regression analysis. The level of significance was defined as p <0.05. All statistical analysis performed with SPSS 21.0 software (SPSS Inc., Illinois, USA).

Results
A total of forty-three patients with various pelvic cancers underwent exenteration surgery between January, 2011 and December, 2015 at our Institute. In the period of 2011 to 2014, twenty-nine patients had

received treatment for rectal and non-rectal cancers, were analysed retrospectively based on the medical records in the Department of Epidemiology at our Institute. From January 2015, fourteen patients underwent surgery, and analysed prospectively regarding all aspects.

The median age at the time of diagnosis was 49 years, range of 34-62 years in rectal group(Group I) and was similar in no-rectal group (Group II) was 47 years (range 37-67). Sixteen (64%) were male in Group I and in Group II, fifteen (83%) were females. The mean BMI, ECOG status and comorbidities were comparable in both the groups.[Table 2] The prevalence of symptomatic disease was high in Group II compare to Group I as pelvic pain 67% vs 44%, urinary disturbance 33% vs 12% and bleeding 28% vs 12%. In Group I, patients who had received preoperative treatment either radiotherapy or chemo-radiation, 10 out of 17 had radiological response observed. In Group II, patients with recurrent or residual disease 9 out of 18 (50%) had restricted mobility of the primary lesion and with localised rectal infiltration.

Table 2: Demographic characteristics				
Variables		Group I: Rectal cancer N=25	Group II: Non-rectal cancer N=18	Statistics
Gender	Male	16 (64%)	3 (16.7%)	x^2= 43.905; df=1; p=<0.0001
	Female	9 (36%)	15 (83.3%)	
Age [median in Years; range]		49 (34-62)	47 (37-67)	p= 0.15
BMI Mean±SD		23.2±3.2	24.1±3.4	p= 0.34
Comorbidities		9 (36%)	8 (44%)	p= 0.43
ECOG	0	8 (32%)	3 (17%)	x^2= 6.635; df=2; p=0.03
	1	14 (56%)	13 (72%)	
	2	3 (12%)	2 (11%)	
Pre-operative symptoms	Pelvic Pain	11 (44%)	12 (67%)	x^2= 34.352; df=2; p=<0.0001
	Urinary disturbance	3 (12%)	6 (33%)	
	Bleeding	3 (12%)	5 (28%)	
Pre-operative treatment	Radiation therapy ± Chemotherapy	17 (68%)	13 (72%)	x^2= 0.214; df=0; p=0.6
Exenteration surgery	Total	19 (76%)	7 (39%)	x^2= 34.787; df=2; p=<0.0001
	Anterior	NA	3 (17%)	
	Posterior	6 (24%)	8 (44%)	

Pre-operative treatment
A subset of patients had received pre-operative treatment in 68% and 72% in group I and II, respectively.[Table 2] Among patients with recurrent rectal cancer, three patients were underwent anterior resection and one had low anterior resection. One patient presented with sever pelvic pain, who was diagnosed as solitary pelvic recurrence required palliative radiotherapy to pelvic and two patient received second line chemotherapy (six cycle of FOLFIRI) followed by underwent pelvic exenteration surgery.

In Group II, all patients with cervical cancer (n=9) underwent concurrent chemo-radiation (CRT) as the primary treatment as institution protocol and were on regular follow up. These patients diagnosed with residual (n=3) and recurrent (n=6) disease on subsequent clinical examination and pelvic imaging. Thee time interval between completion of the primary treatment CRT and appearance of symptomatic or asymptomatic recurrent disease was 11, 16, 19, 19, 23, 30 months, respectively. Patients with endometrial carcinoma (n=3), two had received pre-operative chemotherapy with primary locally advanced disease and one had stump recurrence. The proportion of patients received pre-operative treatment in both the groups was comparable.

Surgery
The type of surgery, total or anterior/posterior exenteration performed as per presented in Table 2. The difference in median time of surgery was not significant between both groups (259±82 min vs 304±106min; p= 0.09). The median amount of blood loss in both groups was comparable (720±150mL vs 755±135mL; p= 0.2). In majority of the patients, Ileal conduit was performed for urinary diversion in 92% and 94% in group I and II, respectively; rest of the patients had colonic conduit.[Table 3] The adjuvant treatment was given as per protocol.

Table 3: Operative parameters				
Variables		Group I: Rectal cancer N=25	Group II: Non-rectal cancer N=18	Statistics
Operative time Mean±SD (in Minutes)		259±82	304±106	0.09
Estimated blood loss Mean±SD (in mL)		720±150	755±135	0.26
Extent of resection	R0	16 (64%)	10 (55%)	x^2= 12.970; df=2; p=0.001
	R1	7 (28%)	5 (28%)	
	R2	2 (8%)	3 (17%)	
Response of pre-operative therapy	CR	3/17(17.6%)	3/13 (23.1%)	x^2= 0.408; df=1; p=0.52
	PR	7/17 41.1%)	5/13 (38.5%)	
Hospital stay Mean±SD (in days)	ICU stay	3.1±0.97	3.3±1.09	0.41
	Post-op Stay	9.61±2.67	10.2±2.53	0.20
	Total stay	16.9±4.02	16.4±3.34	0.89
Adjuvant treatment	Chemotherapy	17 (68%)	4 (22.2%)	x^2= 10.125; df=1; p=0.001
	chemotherapy + radiation	3 (12%)	3 (16.7%)	

Pathology

The TNM and Wanebo staging were noted for the purpose to decide adjuvant treatment, not included in final analysis. The completeness of resection was detailed in Table 3. Among all patients in both groups 60.1% had complete resection (R0), higher in group I (64% vs 55%; p=0.001). Patients with microscopic positive margin (R1) were similar in both the groups as 28%. Non-rectal cancer group had higher R2 resection as 17% versus 8% than rectal cancer patients. The response with pre-operative treatment was comparable as complete and partial response was 58.7% and 61.6%, respectively. According to TNM stage, adjuvant treatment was given as per our institute protocol.[Table 3]

Peri-operative morbidity

The mean ICU stay was comparable in both the groups (3.1±0.97 days vs 3.3±1.09 days; p=0.4).The overall complications were comparable in both the groups (56% vs 66.7%; p=0.14) The most common minor complication during early post-operative period and ICU stay was wound infection more with the perineal wound infection 36% and 50% in group I and II, respectively. Next, pulmonary complications were most prevalent in all groups and subgroups in form of lower tract infection, atelectasis, and pleural effusion. Two patients in rectal group one patient in non-rectal group had colostomy complication (stoma bleeding, retraction and necrosis in 1-1 patient). Two patients had purulent fluid in abdominal drain, later they had complete abdominal wound dehiscence. One of them deteriorated with conservative management and expired on day 8 post-operative with septicaemia. Two patients with perineal wound infection needed intervention as drainage, debridement and re-suturing. Overall hospital stay, hospital re-admission was comparable in both groups (16% versus 22.2%; p=0.36). The cause of re-admission in rectal group was subacute intestinal obstruction (50%), dehydration and generalized weakness. Conversely, in non-rectal group common causes rendered to hospitalization were generalized weakness (n=2), SAIO, unexplained pyrexia and DVT. The 30-day mortality including hospital mortality was seen in non-rectal group evident as 5.5% versus 0% in rectal cancer group.[Table 4]

Table 4: Morbidity and mortality				
Complication		Group I: Rectal cancer N=25	Group II: Non-rectal cancer N=18	Statistics
Total (number of patients)		14 (56%)	12 (66.7%)	x^2= 2.112; df=0; p=0.14
Wound infection		9 (36%)	9 (50%)	
Burst abdomen		0	2 (11.1%)	
Pulmonary complication	Pneumonitis	1 (4%)	1 (5.5%)	
	Atelectasis	2 (8%)	3 (16.7%)	
	Pleural effusion	1(4%)	2 (11.1%)	
Stoma complication		2 (8%)	2 (11.1%)	
Urostomy related	Urine leak	1 (4%)	2 (11.1%)	
	Other	2 (8%)	2 (11.1%)	
DVT		1 (4%)	1 (5.5%)	
Hospital mortality		0	1 (5.5%)	
30-Days mortality		0	0	
Hospital re-admission		4 (16%)	4 (22.2%)	x^2= 0.812; df=0; p=0.36

Primary versus recurrent disease

The operative time, amount of blood loss, post-operative hospital stay, morbidity and re-admission were better in prospective series with a narrow margin; statistical insignificant. The completeness of resection in patient with primary disease was significantly superior than patients with recurrent disease (R0+R1 was 93.3% versus 76.9%; p=0.003).

Table 5: Primary versus recurrent disease				
Variables		Primary disease N=30	Recurrent disease N=13	Statistics
Operative time in min (mean±SD)		250±89	326±109	0.03
Blood loss in mL (mean±SD)		710±184	790±196	0.07
Extent of resection	R0,R1	27 (93.3%)	10 (76.9%)	x^2= 8.824; df=1; p=0.003
	R2	2 (6.7%)	3 (23.1%)	
Post-op hospital stay		9.3±2.43	10.4±2.36	0.23
Morbidity		17 (56%)	9 (69%)	0.07
Hospital readmission		5 (16.7%)	3 923.1%)	0.37

Discussion

Pelvic organ cancer especially rectum and cervix has significant impact on quality of life, not only with disease but treatment sequels also. Over the last few decades, the incidence of these cancers in younger patients is increasing by 2.6% to 15%, with more significantly increment in developing world.[13] These cancers have high propensity to adhere or invade into adjacent organs. Locally advanced rectal cancer accounts for approximately 25% to 50% on presentation.[14,15] With the multimodality curative treatment has local recurrence observed up to 35% of patients, those have poor survival.[16-18] Patients with untreated locally advanced disease and local recurrent rectal cancer have median survival less than one year and 5-year survival less than 5%.[19-21] Although, with the advancement of non-surgical modalities of treatment, the outcome has increased but the surgical resection remains the only curative option with the best results in both primary locally advance and localize recurrent rectal cancer. Additional, the symptom control in these patients can be achieve with the resection only with the acceptable morbidity.[16,22,23] Initially, pelvic exenteration surgery developed for the palliation in locally advanced cervical cancer in the scenario of unavailability of the comprehensive radiation techniques and sophisticated chemotherapy. It was associated with higher perioperative mortality up to more than 25% and negligible long term survival.[8] Currently, better patient selection with advanced imaging, improved surgical technique, enhanced perioperative care, and transformed multidisciplinary team approach have headed to better perioperative morbidity and mortality.[24]

Although, rectal cancers with stage T3 and above, and enlarged mesenteric lymph nodes on imaging are candidate for the pre-operative radiotherapy followed by surgery but the rate of down staging is reported up to 75%.[3] The presence of the circumferential positive margin remarks the inadequacy of the surgical clearance, needed to be more extensive resection. This suboptimal resection results in poor loco-regional control, early recurrence and unfavourable long term outcome.[25-28] Thus, comprehensive resection of the tumor with a aim of negative pathological margins in locally invasive disease even with the resection of the adjacent organs. This surgical procedure has been explained and recommended for various pelvic malignancies in several retrospective reports and review articles.[29,30] The objectives of present study were to identification and evaluation of clinical usefulness for rectal cancer in the era of multimodality treatment with the incorporation of modern imaging and oncological therapy. The number of the patients in present study has significant in each cohort to analyse the various parameters. This study is one of the largest series of the patients with a number of forty-three who underwent pelvic exenterative surgery for various malignancies at a single centre. The recent epidemiology trends showed that rectal cancer occurs in young individuals with advanced disease more with an aggressive natural history.[3,13] In present study, the median age at diagnosis in rectal cancer group was 49 years, also same in another group; lower compared to previous published reports with range from 45 to 64 years.[29] It showed the same epidemiological shift in this subcontinent population also.

Patients with symptomatic disease, good performance status, well-motivated for the extensive surgery have better results. Majority of

non-rectal cancer patients underwent exenteration surgery had symptomatic disease compared to rectal cancer patients. Patients with rectal cancer eligible for the exenteration, are more primary locally advanced disease who had received pre-operative treatment compared to local recurrent rectal cancer.[31] Among non-rectal cancer group, most common indication is cervical cancer approximately 50% of the all patients other than rectum. Although, the primary treatment of cervical cancer is radiotherapy with or without chemotherapy through stage I to IV. The incidence of residual disease after completion of chemo-radiation is reported up to 25%, who have only local disease without distant metastasis.[32] These patients have life disturbing symptoms including persistent pelvic pain, discharge, bleeding and urinary disturbance with or without fistula. In other subset of patients with cervical cancer, who had complete response with primary chemo-radiation and experience of central recurrence after a period of time can be a candidate of exenteration surgery. In our series, two-third patients with cervical cancer have been received complete radiotherapy/chemo-radiation and developed local recurrence and one-third had evidence of significant residual disease causing symptoms at the time of baseline clinical and radiological assessment after completion of primary treatment.

The performance status and clinical profile of the patients are the leading factors to guide planning of extensive surgery. Selection of the patient is depends on overall preoperative assessment, including imaging for local extent of the disease as well as to rule out distant spread, level of the motivation and education, and overall physiological and psychological status. In our series, all patients underwent suitable imaging and preoperative counselling for post-operative sequel. The excellence of the surgeon in mastery of the pelvic anatomy, knowledge of interdisciplinary pelvic oncology comprising colorectal cancer, urological cancer, gynaecological cancer, in addition plastic surgery.[33-35] At our centre, all extensive surgeries had done by the Professors of the speciality.

The complete pathological response with neoadjuvant treatment is associated with an improved prognosis in rectal cancer as well as gynaecological cancers.[36] Even with partial response also has impact on survival with better surgical clearance. Patients with partial response with neo-adjuvant treatment, with significant residual disease and morbidity, are the appropriate candidate for exenteration surgery. They have impressive results with the surgical treatment reducing risk of local recurrence with equivocal survival outcome.[37,38] In our series, majority of the patients had received pre-operative treatment either chemotherapy/radiotherapy or chemo-radiation. Patients in non-rectal group, cervical cancer with residual or recurrent disease, recurrent endometrial cancer, and sarcomas were not entertained with re-irradiation before surgery to avoid the increased toxicity of surrounding healthy tissues. Moriya et al and Ike et al observed the detrimental results pre-operative re-irradiation irrespective of the previous radiation therapy. There was no evidence to improve the surgical clearance and survival differences.[39,40] Thus, local recurrent rectal cancer patients received pre-operative chemotherapy.

Compromised resection margin is a negative prognostic factor as similar as in standard comprehensive surgery.[39,41,42] The decision making of exenteration surgery is strongly follow the high possibility of negative margin resection because these extensive resection are not the ideal option for the palliation. Conversely, the cautious pre-operative imaging to predict the level of resection is mandatory to perform the surgery with a cost of significant morbidity. The multidisciplinary team decision should be considered in individual case for the exenteration.[43] The pelvic sidewall involvement is considered as an absolute contraindication for the extensive surgery due to its inability to get the negative margin resection and poor local disease control.[27,44] In contrast to that, recent reports by Jurado et al, Hockel et al and Austin et al, showed the advantage of extended endo-pelvic resection in patients with local recurrence confined to lateral pelvic wall with 5-year recurrence free survival more than 60% and disease specific overall survival more than 50%.[45-47] Therefore, the extended lateral pelvic wall dissection may be safe and feasible as a salvage procedure with curative intent in selected patients.

In present study, 56% patients had achieved negative margin and 35% had R1 (microscopic positive) resection, which was comparable with previous reports.

The presence of nodal disease is also associated with higher local recurrence, which can be minimize the poor result with standard complete nodal dissection including mesorectal and lateral pelvic lymph nodes.[48] The major drawback of pelvic exenteration surgery is associated significant morbidity, reported in various reports from 37% to 100% (median 57%).[29] The common complication including wound infection, intra-abdominal collection, pelvic abscess, pulmonary complications, lower urinary tract infection during early post-operative period. Stoma related complications such as prolapse, retraction, necrosis and bleeding are also seen with a significant rate. Among late complications, incisional, perineal and peristomal hernia, renal failure, deep vein thrombosis, pulmonary embolism and pressure ulcers. In present study, overall rate of complications 35% slightly lower than previous reports which was a strong factor for prolong post-operative hospital stay and increase overall cost of the treatment. We noted a single in-hospital or within 30-days death (2.3%) during post-operative period with an evident surgical complication, which is comparable to the rate observed in literature as 0% to 13%.[49-51] The superior results of our study have several reasons including patient selection, young age, male gender, post-operative ICU care, and judiciously used antibiotics and nutrition. Previous reports mainly prospective and included patients treated over a long duration, which might had heterogeneity in treatment and outcome. Incorporation of newer adjuvant treatment also influenced the outcomes over the period of time.

Rectal cancer versus non-rectal cancer
Although, the pelvic exenteration surgery originally was evolved for cervical cancer, in recent times it has become more popular for locally advanced primary rectal cancers and locally recurrent rectal cancers. The outcome of this extensive surgery is mainly based on several retrospective series, which included all types of pelvic malignancies. We compared the outcomes in patients of rectal cancer with non-rectal cancers, which showed that the results were more favourable in patients undergoing exenteration surgery for rectal-origin cancers, similar to the results presented by Kuhrt et al.[52] Operative parameters including median operative time, blood loss, and difficulty in dissection were more favourable in rectal cancer group than in the non-rectal cancer group, but statistically not significant. Contrary to our study, Kuhrt et al observed the dissection in patients with rectal cancers to be more difficult than in non-colorectal cancer patients.[52] The overall morbidity in the two groups was comparable, but was less in the rectal cancer patients(39% vs 53%; p=0.07), which may be because the patients in the non-rectal cancer group were likely to have received preoperative chemo-radiation, higher number of patients with cancer related complication such as fistula, perineal abscess, etc, and more patients with recurrent disease. In series by Kuhrt et al, a higher number of patients underwent preoperative chemo-radiation treatment in the colorectal cancer group, with a proportionately higher morbidity compared to the other group. In present study had a few limitations, such as its small sample size, even fewer patients with individual organ cancers in the non-rectal cancer group, an inability to assess the measurement of QOL and patient selection. Thus, to make the results conclusive, a prospective study including an adequate sample size of cases in each subgroup related to various pelvic organ origin malignancies is needed.

Conclusion
Pelvic exenteration surgery is a feasible treatment option in locally advanced pelvic organ malignancies with a satisfactory long term outcome, and acceptable morbidity. Patients with rectal cancer, especially with primary tumours have better outcomes as compared to other pelvic organ origin cancers. The overall outcome depends on patient selection, completeness of resection, and comprehensive perioperative care. Future studies are needed to achieve robust evidence, based on large prospective studies.
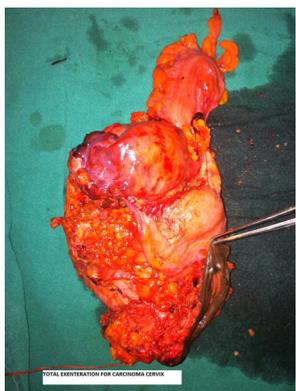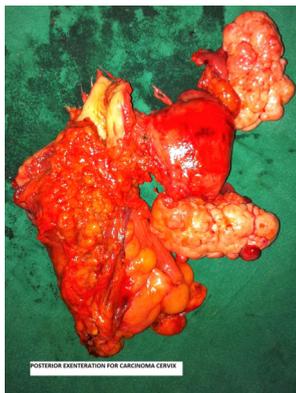
of Epidemiology and statistics of our institute.

Conflict of interest
The authors have no conflicts of interest to declare.

POSTERIOR EXENTERATION FOR CARCINOMA CERVIX

TOTAL EXENTERATION FOR CARCINOMA CERVIX

POSTERIOR EXENTERATION FOR CARCINOMA RECTUM

REFERENCES
1. Kecmanovic DM, Pavlov MJ, Kovacevic PA, Sepetkovski AV, Ceranic MS, Stamenkovic AB. Management of advanced pelvic cancer by exenteration. Eur J Surg Oncol 2003; 29:743–6.
2. Lopes A, Poletto AH, Carvalho AL, Ribeiro EA, Granja NM, Rossi BM. Pelvic exenteration and sphincter preservation in the treatment of soft tissue sarcomas. Eur J Surg Oncol 2004;30:972–5.
3. Libutti SK, Willett CG, Saltz LB, Levine RA. Cancer of the rectum. In: Devita, Hellman and Rosenberg's Cancer principles and practice of Oncology. Ed 10th. Lippincott Williams and Wilkins. 2015 pp 823-841.
4. Law WL, Chu KW, Choi HK. Total pelvic exenteration for locally advanced rectal cancer. J Am Coll Surg 2000;190:78–83.
5. Yamada K, Ishizawa T, Niwa K, Chuman Y, Aikou T. Pelvic exenteration and sacral resection for locally advanced primary and recurrent rectal cancer. Dis Colon Rectum 2002;45:1078– 84.
6. Temple WJ, Saettler EB. Locally recurrent rectal cancer: role of composite resection of extensive pelvic tumors with strategies for minimizing risk of recurrence. Surg Oncol 2000;73(1):47-58.
7. de Wilt JH, van Leeuwen DH, Logmans A, et al (2007) Pelvic exenteration for primary and recurrent gynaecological malignancies. Eur J Obstet Gynecol Reprod Biol 2007;134:243–8.
8. Brunschwig A. Complete excision of pelvic viscera for advanced carcinoma. Cancer 1948;1:177.
9. Chen HS, Sheen-Chen SM. Total pelvic exenteration for primary local advanced colorectal cancer. World J Surg 2001;25:1546– 9.
10. Saito N, Koda K, Takiguchi N, et al. Curative surgery for local pelvic recurrence of rectal cancer. Dig Surg 2003;20:192–200.
11. Vermaas M, Ferenschild FT, Verhoef C, et al. Total pelvic exenteration for primary locally advanced and locally recurrent rectal cancer. Eur J Surg Oncol 2007;33:452–458.
12. Greene FL, Page DL, Fleming ID, et al. editors. AJCC Cancer Staging Manual. American Joint Committee. 7th ed. New York, NY: Springer, 2010.
13. Meyer JE, Narang T, Schnoll-sussman FH, Pochapin MB, Christos PJ, Sherr Dl. increasing incidence of rectal cancer in patients aged younger than 40 years: an analysis of the surveillance, epidemiology, and end results database. Cancer 2010;116:4354–4359.
14. Australian Institute of Health and Welfare (AIHW). Rectosigmoid Junction and Rectum for Australia. Canberra, australia: AIHW; 2009.
15. Mercury study Group. Diagnostic accuracy of preoperative magnetic resonance imaging in predicting curative resection of rectal cancer: prospective observational study. BMJ 2006;333:779.
16. Sagar PM, Pemberton JH. surgical management of locally recurrent rectal cancer. Br J Surg 1996;83:293–304.
17. Heriot AG, Kumar D. Rectal cancer recurrence: factors and mechanisms. Colorectal Dis 2000;2:126–36.
18. Abulafi AM, Williams NS. Local recurrence of colorectal cancer: the problem, mechanisms, management and adjuvant therapy. Br J Surg 1994;81:7–19.
19. Solum AM, Riffenburgh RH, Johnstone PA. Survival of patients with untreated rectal cancer. J Surg Oncol 2004;87:157–61.
20. Carlsson U, Lasson A, Ekelund G. Recurrence rates after curative surgery for rectal carcinoma, with special reference to their accuracy. Dis Colon Rectum 1987;30:431–4.
21. Arnott SJ. The value of combined 5-fluorouracil and x-ray therapy in the palliation of locally recurrent and inoperable rectal carcinoma. Clin Radiol 1975;26:177–82.
22. Ito Y, Ohtsu A, Ishikura S, et al. Efficacy of chemoradiotherapy on pain relief in patients with intrapelvic recurrence of rectal cancer. Jpn J Clin Oncol 2003;33:180–5.
23. Heriot AG, Tekkis PP, Darzi A, Mackay J. Surgery for local recurrence of rectal cancer. Colorectal Dis 2006;8:733–47.
24. Lopez MJ, Standiford SB, Skibba JL. Total pelvic exenteration. A 50-year experience at the ellis fischel Cancer Center. Arch Surg 1994;129:390–5.
25. Van Cutsem E. Optimizing administration of epidermal growth factor receptor-targeted agents in the treatment of colorectal cancer. Clin Colorectal Cancer 2007;6(suppl 2):s60–s65.
26. Harji DP, Griffiths B, Mcarthur DR, Sagar PM. Surgery for recurrent rectal cancer; higher and wider? Colorectal Dis. doi: 10.1111/j.1463-1318.2012.03076.x.
27. Heriot AG, Byrne CM, Lee P, et al. Extended radical resection: the choice for locally recurrent rectal cancer. Dis Colon Rectum 2008;51:284–91.
28. Wells BJ, Stotland P, Ko MA, et al. Results of an aggressive approach to resection of locally recurrent rectal cancer. Ann Surg Oncol 2007;14:390–5.
29. Yang TX, Morris DL, Chua TC. Pelvic Exenteration for Rectal Cancer: A Systematic Review. Diseases of the Colon & ReCtum 2013; 56(4): 519-31.
30. Moffat FL Jr, Falk RE. Radical surgery for extensive rectal cancer: is it worthwhile? Recent Results Cancer Res 1998;146:71–83.
31. Mohan HM, Evans MD, Larkin JO, Beynon J, Winter DC. Multivisceral resection in colorectal cancer: a systematic review. Ann Surg Oncol 2013;20(9):2929-36. doi: 10.1245/s10434-013-2967-9.
32. Parkin DM, Pisani P, Ferlay J. Global cancer statistics. CA Cancer J Clin 1999;49:33–64.
33. Pawlik TM, Skibber JM, Rodriguez-Bigas MA. Pelvic exenteration for advanced pelvic malignancies. Ann Surg Oncol 2006;13:612–23.
34. Domes TS, Colquhoun PH, Taylor B, et al. Total pelvic exenteration for rectal cancer: outcomes and prognostic factors. Can J Surg 2011;54:387–93.
35. Lopez MJ. Multivisceral resections for colorectal cancer. J Surg Oncol 2001;76:1–5.
36. Martin ST, Heneghan HM, Winter DC. Systematic review and meta-analysis of outcomes following pathological complete response to neoadjuvant chemoradiotherapy for rectal cancer. Br J Surg 2012;99:918–28.
37. Smith FM, Chang KH, Sheahan K, Hyland J, O'Connell PR, Winter DC. The surgical significance of residual mucosal abnormalities in rectal cancer following neoadjuvant chemoradiotherapy. Br J Surg. 2012;99:993–1001.
38. Fiorica F, Cartei F, Licata A, et al. Can chemotherapy concomitantly delivered with radiotherapy improve survival of patients with resectable rectal cancer? a meta-analysis of literature data. Cancer Treat Rev 2010;36:539–49.
39. Ike H, Shimada H, Yamaguchi S, Ichikawa Y, fujii S, Ohki S. Outcome of total pelvic exenteration for primary rectal cancer. Dis Colon Rectum 2003;46:474–80.
40. Moriya Y, Akasu T, Fujita S, Yamamoto S. Total pelvic exenteration with distal sacrectomy for fixed recurrent rectal cancer in the pelvis. Dis Colon Rectum 2004;47:2047–53.
41. Derici H, Unalp HR, Kamer E, Bozdag AD, Tansug T, Nazli O, et al. Multivisceral resections for locally advanced rectal cancer. Colorectal Dis 2008;10:453–9.
42. Shirouzu K, Isomoto H, Kakegawa T. Total pelvic exenteration for locally advanced colorectal carcinoma. Br J Surg 1996;83:32–5.
43. Davies ML, Harris D, Davies M, Lucas M, Drew P, Beynon J. Selection criteria for the radical treatment of locally advanced rectal cancer. Int J Surg Oncol 2011;2011:678506.
44. Moore HG, Shoup M, Riedel E, et al. Colorectal cancer pelvic recurrences: determinants of resectability. Dis Colon Rectum 2004;47:1599–606.
45. Jurado M, Alcázar JL, Martinez-monge R. Resectability rates of previously irradiated recurrent cervical cancer (PiRCC) treated with pelvic exenteration: is still the clinical involvement of the pelvis wall a real contraindication? a twenty-year experience. Gynecol Oncol 2010;116:38–43.
46. Höckel M. Laterally extended endopelvic resection (leeR)–principles and practice. Gynecol Oncol 2008;111(2 suppl):s13–s17.
47. Austin KK, solomon MJ. Pelvic exenteration with en bloc iliac vessel resection for lateral pelvic wall involvement. Dis Colon Rectum 2009;52:1223–33.
48. Dev K, Jaglan N, Gurawalia J, et al. Lateral Pelvic Lymph Node Dissection in Rectal Cancer. Optimal Treatment?. Colorec Cancer 2015, 1:1. doi: 10.21767/2471-9943.100004
49. Harris DA, Davies M, Lucas MG, Drew P, Carr ND, Beynon J. Multivisceral resection for primary locally advanced rectal carcinoma. Br J Surg 2011;98:582–8.
50. Paun BC, Cassie S, MacLean AR, Dixon E, Buie WD. Postoperative complications following surgery for rectal cancer. Ann Surg 2010;251:807–18.
51. Lehnert T, Methner M, Pollok A, Schaible A, Hinz U, Herfarth C. Multivisceral resection for locally advanced primary colon and rectal cancer: an analysis of prognostic factors in 201 patients. Ann Surg 2002;235:217–25.
52. Kuhrt MP, Chokshi RV, Arrese D, Martin EW Jr. Retrospective review of pelvic malignancies undergoing total pelvic exenteration. World J Surg Oncol 2012;10:110.