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Outcome of Bladder Preservation Techniques in Patients Undergoing Pelvic Exenteration for Locally Advanced and Recurrent Malignancies

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Abstract

Introduction: Pelvic exenteration is a potential curative treatment option for locally advanced primary tumors and recurrent tumors of the small pelvis. Total pelvic exenteration is an extensive operation that involves en bloc resection of multiple organs. Several surgical techniques are available for urinary diversion following extensive surgery. In some cases, bladder-preservation is possible with subsequent urinary diversion. This retrospectively series analysis and compares bladder-preserving techniques with cycstectomies with morbidity, mortality and quality of life.

Material and Methods: Between 2013 and 2017 a total pelvic exenteration was performed in 28 patients. Factors such as tumor entity, morbidity, mortality, sacrectomy and bladder-preservation were analyzed.

Results: A total of 28 patients were operated. N=15 were male, n=13 were female. N=12 received a bladder-preservation surgery. The mean age was 62 years. The median hospital stay was 38 days. The median follow-up was 15 months. There was a total of 10 surgical morbidities. The mortality rate was 21%.

Conclusion: Bladder-preservation in pelvic exenteration is possible and is not associated with a higher R1 or R2 resection. However, surgical morbidity following this technique is high and must therefore bet be considered critically prior to surgery. Therefore, we recommend a urinary diversion (e.g. ileal conduit) in all patients undergoing pelvic exenteration for locally advanced or recurrent tumors.

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Introduction

Pelvic exenteration as a treatment for pelvic malignancies was first described by Brunschwig in 1948 [1]. It was intended as a palliative measure for agonising symptoms. Over the past decades, however, pelvic exenteration was propagated in multiple cohort studies as a curative treatment option for locally advanced and recurrent malignancies. The basis for this radical surgical treatment is a R0-resection. Brunschwig implanted the ureters into the colon after exenteration of the pelvis. The lethality was reported to be 20% while the surviving patients were confronted with ascending urinary tract infections and difficulties in handling the stoma [1]. Bricker published in 1950 the technical procedure of dividing fecal and urine diversion. This was performed by a simple non-refluxing ureteroileal anastomosis known as an ileal conduit [2,3]. In the following decades the extent of surgical resection was increased including the extralevatory and dorsal plane. While Brunschwig operated on gynecological tumors only, colorectal surgeons further developed the procedure by including resection of the sacrum and coccyx [4]. Over the past two decades the rate of morbidity following pelvic exenteration was significantly reduced by continuous improvements in perioperative medicine and reconstructive surgery. Along with long time survival and disease free survival, the matter of quality of life has become increasingly important, challenging surgeons with continuously improving the surgical procedure by implementing sphincter preserving techniques and urogenital reconstruction. Past studies have evaluated different approaches for bladder preservation in the treatment of malignancies of the pelvis. However, a superior technique could not be identified until this day [5]. Continuous improvement of CT and MRI scans and better understanding of bladder functionality and nerval innervation let to an increased rate of bladder preservation in the treatment of pelvic malignancies [6,7]. Bladder preserving approaches improves quality of life and should always be considered as an option when feasible.

Patients and Methods

Between 2013 and 2016 n=28 patients underwent a pelvic exenteration for an underlying pelvic malignancy. 15 out of those patients were male and 13 were female. The mean age was 62 years. The median hospital stay was 38 days. The mean follow-up was 15 months. All patients received a preoperative chemoradiotherapy either for the primary tumor or the recurrence. 12 patients were diagnosed with a recurrent rectal cancer, 3 patients with a primary rectal cancer, 4 patients with a re-recurrent rectal cancer, 1 patient with a re-re-recurrent rectal cancer, 1 patient with a primary anal cancer and 1 patient with a recurrent anal cancer. Based upon CT and MRI findings, all patients were diagnosed with a R0-resectable tumor and the possibility of bladder preservation. In all cases, no metastases were diagnosed. Statistical analysis was performed with IBM SPSS Statistics Version 24 for Macintosh. Continuous variables were expressed as medians. Categorical variables were compared using Fisher's exact test or chi-square test. Multivariate logistic regression was performed by including factors with a p value <0.05 in the univariate analysis. Statistical significance was defined as $p<0.05$.

Surgical procedure

A Computed Tomography (CT) and or Magnetic Resonance Imaging (MRI) were performed in all patients prior to surgery. Exclusion criteria were distant metastasis, infiltration of the pelvic wall and a sacral infiltration beyond S2.

Abdominal approach: The surgical exploration begins by an explorative laparotomy in lithotomy position, followed by an adhesiolysis to exclude a peritoneal carcinomatosis. The left and right ureter are surgically prepared, displayed and marked with a suture and in some cases supplied with a double-J-stent. This is followed by a lymphadenectomy along the iliac vessels with an en-bloc resection of the pelvic peritoneum. In case of rectal recurrences, the preparation is widened outside the mesorectal fascia with potential resection of the dorsal lying coccyx and sacrum. In patients undergoing bladder preservation the superior vesical artery is preserved. The mobilization of the ureters is performed until they open into the urinary bladder. The ventral preparation is dependent on the tumor entity and may include the resection of the seminal vesicle and prostate. In cases of locally advanced recurrences a preservation of the rectal sphincter is in most cases not possible. Laterally, the dissection of the iliac internal artery is again dependent on the extent of the tumor. If possible, one tries to preserve the gluteal superior artery for subsequent perineal reconstruction. Following completion of surgical preparation, the resection margins are marked by gauze pads. The sacrum and coccyx are also marked for subsequent resection during the posterior approach.

Posterior approach: The posterior approach is carried out with the patient in the prone position. A posterior midline incision is made around the anus followed by the dissection of the gluteus maximus muscles and the muscular pelvic floor to identify the corresponding layer. Once the gauze pads can be identified, the sacrum will be resected. The ventral preparation along the urethra can be completed. The complete specimen can now be removed and send for histological analysis of resection margins. The posterior approach is completed once the perineal wound is sutured. The patient is then brought back into supine position. A colostomy and if needed an ileal or colonic urinary conduit are fashioned. The surgery ends by placing an omental-plasty into the small pelvis and closure of the abdomen.

Table 1: Morbidity and Mortality.

Complications	*N*
Grade I	
Paralytic Ileus	1
Bladder Dysfunction	4
Grade II	
Pneumonia	1
Pulmonary Embolism	1
Wound infection	4
Stroke	1
Grade IIIa	-
Grade IIIb	
Ureteral leak	6
Enteral fistula	3
Postoperative bleeding	3
Wound dehiscence	1
Grade IVa	-
Grade IVb	-
Grade V	6

Urinary diversion

All patients with bladder preservation received a suprapubic cystostomy. A cystography was performed 14 to 21 days after the surgical procedure. If negative, the cystostomy was removed. A Psoas-Hitch/Boariplasty was performed in all patients who received an intraoperative resection of the distal part of the ureter.

Results

Patient demographics

A total of 28 patients (13 female; 62.17 ± 11.74 years old; range, 39 to 83 years) were included in the study. The mean hospital stay was 41 days. 12 patients were diagnosed with a recurrent rectal cancer, seven with a recurrent anal cancer, four with a re-recurrent rectal cancer, three with a locally advances rectal cancer, one with a locally advanced anal cancer and one with a re-re-recurrent rectal cancer. In 12 (24.9%) out of 28 patients the bladder was preserved. 16 (57.1%) out of 28 patients received a sacrectomy.

Morbidity and mortality

There were a total of 10 morbidities which occurred in a total of 25 patients (Table 1). The overall mortality was 21.4%. The most common post-operative complication was a ureteral leak in six (50%) out of 12 patients, followed by post-operative bladder dysfunction (33.3%) and post-operative wound infection (14.2%). 13 patients had complications that required surgery.

Relationship between diagnosis and bladder preservation

Twelve patients with a recurrent rectal cancer underwent surgery. In two patients the bladder was preserved and in 10 patients the bladder was removed. The statistical analysis revealed that patients with a recurrent rectal cancer were associated with a significant higher likelihood of having their bladder removed, with $p<0.05$ (Table 2). In contrary, seven patients with a recurrent anal cancer had their bladder only removed in two cases. Although not statistically significant, patients with a recurrent anal cancer are more likely to undergo a bladder-preserving surgery ($p=0.093$). There was no correlation between the other diagnosis and its impact on bladder preservation/resection. Nevertheless, the above-mentioned effects of diagnosis on bladder preservation have to be considered with caution, due to the small sample sizes.

Outcome of bladder preservation

The bladder was preserved in 12 out of 28 patients. The analysis

Table 2: Relationship between diagnosis and bladder preservation.

	Bladder preservation		
Diagnosis	yes	no	N (total)
Primary rectal cancer	2	1	3
Recurrent rectal cancer	2	10	12
Re-recurrent rectal cancer	2	2	4
Re-re-recurrent rectal cancer	0	1	1
Primary anal cancer	1	0	1
Recurrent anal cancer	5	2	7

Table 3: Outcome of bladder preservation.

	Ureteral leak		
Bladder preservation	yes	no	N (total)
yes	4	8	12
no	0	16	16

Table 4: Bladder status, Sacrectomy and Mortality.

	Bladder dysfunction		
Bladder preservation	yes	no	N (total)
yes	4	8	12
no	0	16	16

revealed that there is an association between bladder preservation and postoperative ureteral leak, with $p<0.05$ (Table 3). It also showed that bladder preservation technique is associated with a significant higher recurrence of postoperative bladder dysfunction, with $p<0.05$ (Table 4).

Bladder status, sacrectomy and mortality

Sixteen out of 28 patients received a simultaneous sacrectomy. Five patients deceased (31.2%). In 16 out of 28 patients the bladder was removed. Five patients deceased (31.2%). Statistical analysis did not reveal a relationship between sacrectomy, bladder status and mortality.

Discussion

Following extended pelvic exenteration patients' bodily functions are usually impaired. To keep the impairment at a minimum, organ-sparing surgery might be helpful. Hence, the location and extension of locally advanced primary tumors and/or recurrences influence the post-operative outcome. Although it is clear that organs without infiltration can be technically preserved, it ultimately depends on its blood supply and nerval innervation. The vegetative nerval system is essential for bladder and intestinal function. Therefore, one must decide what type of reconstruction and subsequent functionality is the best outcome for the patient prior to resection. After bladder resection a mean of permanent urinary diversion is necessary. This however, was not the primary investigation of this study. Different surgical approaches are available for urinary diversion; however, none of the reconstructive approaches were identified as superior [8]. Organ-sparing and reconstructive techniques regarding pelvic exenteration have huge psychosocial consequences. Several studies have shown that there is a high incidence of depression, sexual dysfunction, social isolation, and incidence of anxiety following pelvic exenteration, especially in younger patients who received two stoma bags and or genital resection [9]. Being aware of those psychological consequences, an organ-sparing technique seems crucial. As mentioned above, apart from the technical feasibility, blood supply and nerval innervation are key factors for organ-sparing surgery. In our collective, the major criteria for bladder-preservation was the possibility of a R0-resection. Thus, it can be explained that bladder-preservation was more likely in locally advanced primary tumors but less likely in recurrences (2/12). Contrary to published cohort analysis describing a high amount of bladder-preservation pelvic exenteration for gynecological tumors, we had to resect the plexus hypogastricus inferior in most cases. This explains the relatively high amount of bladder dysfunction following bladder-preservation in our cohort analysis (4/12) [10]. Kato described a technique in preserving the nerval innervation for dorsal pelvic exenteration [11]. This technique however, was not possible in our cases, since most patients needed a sacrectomy (S2) for a R0-resection (n=16). Also, we were not able to reconstruct some of the encouraging results published by other research groups [12]. Campbell SC published a small series with 11 patients receiving an enbloc resection of prostate and proctosigmoidectomies for locally infiltrative rectal carcinoma [13]. They also reported about the disease-free-survival following this enbloc technique. Similar results were also reported by Wiig [14]. Unfortunately, we cannot confirm the results published by Saito regarding a 5-year-survival rate of 10% for local re-recurrences as our follow-up was too short. Regarding postoperative morbidity, bladder-preservation seems to be a risk factor although lacking statistical significance in this study. However, the fact that bladder dysfunction and ureteral leak are the most common postoperative complication in this collective would likely make it statistical significant in a bigger patient collective. In contrast to other publications, the amount of patients receiving sacrectomies was high in our collective (16/25). This might also explain the high morbidity and mortality following bladder-preservation.

Conclusion

In our series, patients who have undergone pelvic exenterative surgery for various malignancies of the small pelvic have been evaluated for the possibility of bladder preservation. In principle, bladder preservation is technically possible in a relevant part of the patients. This means that an R0-resection of the primary and or recurrent tumor is also possible with bladder preservation. The postoperative morbidity with regard to bladder dysfunction and ureteral leak has to be included prior to planning the surgery. Unfortunately, data on long-term survival and disease-free survival are not available in this series. Previous published data shows, that following R0-resection a disease-free survival is possible. From our analysis, we cannot deduce any statistical significant association between bladder preservation, morbidity and mortality. Deciding between a bladder-preservation technique or a total pelvic exenteration is ultimately to be made depending on the experience of the surgeon, the institution and the imaging findings of the tumor. The already established reconstructive surgical approaches regarding the urinary tract, the inner genitalia and the pelvic floor have led to a differentiated and widely scattered surgical procedure. The various surgical options must be discussed in detail with the patient preoperative. Advantages and disadvantages have to be explained in detail. An evidence-based approach is not possible due to the weak available published data.

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