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Original article

Total mesorectal excision (TME) enhances the effectiveness of the abdominosacral resection of the rectum (ASAR) in low-rectal cancer patients

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Introduction. Our experience suggests that modern abdominosacral amputation of the rectum (ASAR) provides new perspectives for the surgery of low-rectal cancers. Although ASAR has been modified with advances in modern surgery, its implementation with total mesorectal excision (TME) seems to have the highest impact on therapeutic success. Hence, the purpose of our retrospective analysis has been to compare the outcomes in lower rectal cancer patients treated by means of the older modification of ASAR and ASAR combined with TME.
Material and method. Low-rectal cancer patients operated on between 1982 and 1997 (group A, n=144) and between 1998 and 2003 (group B, n=68) were subjected to analysis. Depending on the period analyzed, the primary tumor was removed by means of conventional ASAR (group A) or ASAR combined with TME (group B).
Results. One hundred and sixty cases were used for an analysis based on exclusion criteria, including 114 patients from group A and 46 cases from group B. The groups differed significantly as to postoperative morbidity (40.4% and 10.9%, respectively), observed (38.6% vs 67.4%) and relative 5-year survivals (44.5% vs 72.7%), and cumulative 5-year local recurrence rates (28.1% vs 4.3%).
Conclusion. The combined use of the modern ASAR technique in addition with TME has markedly improved the outcomes in low-rectal cancer patients.

Key words: rectal cancer, APR, ASAR, ASR, TME, total mesorectal excision, abdominoperineal resection

Introduction

Contrary to mid- and upper-rectal cancers, the therapy of low-rectal tumors confronts numerous difficulties that are mostly related to a limited surgical approach. This has been reflected in significantly worse survivals and more frequent local recurrences observed in low-rectal cancer cases operated on by means of routinely performed abdominoperineal excision (APR) [1-6].

Potential reasons for such unfavorable prognosis include either a higher frequency of circumferential resection margin (CRM) involvement in APR-operated cases or the possible existence of a different pattern of lymph node involvement in low-rectal carcinomas [7]. Characteristically, the frequency of CRM involvement in APR-treated patients has not diminished with total mesorectal excision (TME) [5]. Moreover, it was concluded that the wound of APR may be a prerequisite for perineal recurrence, which may often be caused by implantation [8].

Our experience suggests that abdominosacral amputation of the rectum (ASAR) yields new perspectives for the surgical therapy of low-rectal cancers. The percentages of overall survivals and the frequencies of local recurrences in patients who had undergone ASAR (initially described by the misnomer "abdominosacral resection – ASR") were comparable to the outcomes in mid- and upper-rectal cancer cases treated by means of anterior resection (AR) [9].

The sacral approach to the rectum was initially described by Kocher over a century ago. Shortly after Kraske adopted this technique for rectal tumor resection. However the therapeutic results achieved in sacral approach-operated cases were not satisfactory and the frequency of local recurrences ranged from 50% to 100% [10,11]. Consequently, the technique was virtually abandoned and replaced by Miles's APR [12]. Accordingly, relevant literature contains only a few reports on the application of the sacral approach (mostly described as abdominosacral resection – ASR) in rectal cancer patients – mainly for recurrent disease [13-19]. Additionally, several Japanese authors used the term "ASR" for a quite different technique dedicated to the surgical treatment of recurrent rectal cancer [20].

In the Regional Comprehensive Cancer Center in Wroclaw (RCCC, Poland) the abdominosacral approach has been used in the primary treatment of low-rectal cancers since the clinic was established in 1954. The original technique by Kocher, however, was modified in accordance with the the advances in modern

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surgery, which resulted in a marked improvement of the therapeutic results. The implementation of TME rules seems to have the highest impact on therapeutic success since it has diminished the frequency of CRM involvement [21]. As a result, in 1998 we worked out a modern procedure, initially called ASR. Facing numerous misunderstandings, we have finally decided to describe it as abdominosacral amputation of the rectum (ASAR).

The goal of our study was to assess the real impact of implementation of TME rules on the efficiency of ASAR. Hence, the purpose of our retrospective analysis was to compare the outcomes in low-rectal cancer patients treated by means of conventional ASAR or its current modification combined with TME.

Material and methods

Participants

Low-rectal cancer patients (i.e. with lesions located less than 6 cm from the anorectal junction), qualified for surgery and operated on by the same surgical team at RCCC between January 1st, 1982 and December 31st, 1997 (group A, n=144) and between May 5th, 1998 (after learning curve optimization) and April 30th, 2003 (group B, n=68), were subjected to analysis. The location of the tumor, measured from the anorectal juncton (cm), as well as tumor penetration depth and local lymph node involvement, were determined in all patients. All data were obtained from patients' records archived at the RCCC in Wroclaw.

Before 1999 – irrespective of the clinical stage – preoperative radiotherapy was not performed in low-rectal cancer patients treated at the RCCC. Between 1999 and 2002 all low-rectal patients with T3 and T4 tumors, upon acceptance, received either long radiochemotherapy (28 x 1.8 Gy, 5-fluorouracil + leucovorin) or short radiotherapy (5 x 5 Gy) preoperatively. These were the cases included in the randomized trial of the Polish Colorectal Group. Currently, since 2003, short preoperative radiotherapy is performed on all T3 and T4 low rectal tumors which are mobile, whereas non-mobile tumors undergo long preoperative radiochemotherapy.

Former approach to abdominosacral amputation of the rectum

In group A patients, following colonic lavage and antibiotic bowel preparation (oral sulphonamide) midline laparotomy was performed with the patient in a supine position. After identification and division of the inferior mesenteric artery and vein, the bowel was divided at the sigmoid colon. After permanent colostomy formation, the specimen was placed in traction to simplify entering the endopelvic fascia. In order to enter the endopelvic fascia the pelvic peritoneum was incised around the rectal stump. After urether visualization and the division of the presacral space on the level of the sacral promontory, a combined sharp and blunt dissection was performed by inserting the hand into the loose areolar tissue between the mesorectum and sacral bone, up to the pelvic floor. The dissection was performed without direct vision and without visualization of the hypogastric nerves and the autonomic nerve plexus along the pelvic wall sides. In all cases the so-called lateral ligaments were recognized, clamped, divided and ligated. When the specimen was mobilized to the floor of the pelvis: anteriorly – at the retrovesical space and posteriorly – at the level of the coccyx, the abdominal stage was completed. The specimen with a small swab stitched onto the end of the rectal stump was placed in the minor pelvis, with the swab positioned on the sacral side. The reperitonealisation of the minor pelvis above the rectal specimen and closing of the abdominal wall completed the anterior part of the dissection.

The posterior (sacral) part of the dissection was carried out in the prone jack-knife position. The incision around the anus was prolonged towards the sacral bone approximately to the S3-S4 level. After separating S4 and/or S5 with the coccyx and the dissection of Waldeyer's fascia, the rectal stump with the tumor was removed from the pelvis. The dead space under the reperitonealisated pelvis floor was plugged with two long gauze pads. Finally the perineosacral wound was closed in two layers, with a drainage tube and two long gauze pads left to fill up the empty space and support the "new" pelvic floor. Catgut sutures for the fat and silk ones for the skin were used. The drain was removed two to three days following surgery, and tampons seven to 12 days after the operation. Antibiotics (penicillin and streptomycin) were used perioperatively and continued up to the day when the tampons were removed from the wound.

Current TME-derived approach to abdominosacral amputation of the rectum

In group B patients, the initial abdominal dissection (TME technique) stopped at the top of the levator muscle. After colostomy formation, the rectal specimen together with the tumor was left in the minor pelvis, and the abdominal cavity was closed in multiple layers. The sacral stage was performed after positioning the patient in the prone jackknife position. The anus was stitched. Subsequently, the skin was incised around the anus and the cut was elongated towards the sacral bone. The insertions of glutei muscles were cut from the last two sacral vertebrae. The coccygeal bone and last sacral vertebra (if necessary) were separated with the aid of a gouge and removed. Subsequently, the presacral and Waldeyer's (rectosacral) fascia and the parietal lamina of the pelvic fascia were cut. The rectal specimen together with the tumor and surrounding mesorectum were removed via the resulting opening. Subsequently, the anal levators were cut with the simultaneous ligation of the surrounding vessels. The rectum was cut off from the prostate or vagina under direct vision. In cases of adherence or invasion of the primary tumor to those organs, an *en bloc* resection was performed whenever feasible. The perineal wound was closed in multiple layers with a drain left in for two to three days. Cephalosporines and metronidazol were administered perioperatively only.

Therapeutic result analysis

Exclusion criteria from the analysis of survival included: 1) stage I (Dukes A) cases, 2) suboptimal (R1 and R2) local resections or metastatic disease found at surgery [22], 3) pre- or postoperative radiotherapy, 4) preoperative radiochemotherapy, 5) postoperative chemotherapy, and 6) cases lost to follow-up or incomplete follow-up documentation. Patients were followed up routinely at three-month intervals for the first two years, at six-month intervals for the next two years, and annually thereafter. Postoperative evaluation included: 1) physical examination, 2) carcinoembryonic antigen (CEA) level determinations, 3) ultrasound of the liver and chest radiographs (six and 12 months post surgery and once a year thereafter or whenever recurrence was suspected), and 4) computerized tomography scans and bone scans (if recurrence was suspected, particularly when increasing CEA levels were detected). The percentages of 5-year overall (observed and relative) survivals, as well as the frequencies of local recurrence, were determined for all patients. Overall survival was defined as the time from the date of primary treatment to the date of death, and local recurrence as the presence of a tumor in the pelvis or perineum.

Statistical analysis

Categoric variables were compared with the chi-squared test, and continuous variables with the Mann-Whitney *U* test, where appropriate. Survivals were obtained by the Kaplan-Meier method and compared with the log-rank test. Calculations were performed using Statistica 5, Version 97 (StatSoft®, Poland, p≤0,05).

Results

Based on our exclusion criteria 20.8% (n=30) and 32.4% (n=22) of the cases in groups A and B were excluded from the analysis of survival, respectively (Table I). Consequently, 160 "pure surgical" cases remained for further analysis.

The patients who underwent different operative procedures were comparable in terms of distributions of age, gender, tumor infiltration depth, regional lymph node involvement and median distance of the tumor from the anal verge (Table II).

Forty-four of the 114 patients from the group operated on between 1982 and 1997 survived five years following surgery, which corresponds to 38.6% and 44.5% of the observed and relative survivals respectively. In group B in turn, 31/46 patients survived five years post surgery, which accounts for 67.4% and 72.7% of the observed and relative survivals respectively.

The difference between observed or relative survivals of both groups was statistically significant (p=0.002 and p=0.007 respectively).

The cumulative 5-year local recurrence rate of patients from groups A and B was 28.1% (n=32/114) and 4,3% (n=2/46) respectively. This difference was also statistically significant (p=0.003).

Overall postoperative morbidity (wound infections of various degrees, dehiscence and delayed healing) differed significantly between the A and B groups and amounted to 40.4% (n=46/114) and 10.9% (n=5/46) respectively (p<0.001). High frequency of wound infections was worthy of attention in group A patients. These infections were related to the gauze pads left in the wound for at least for seven days.

Tab. I. Cases that underwent primary modification of ASAR (group A) or ASAR combined with TME (group B) but were excluded from the analysis of survival

Exclusion criterion	Primary ASAR (group A. *n*=144)	ASAR with TME (group B. *n*=68)	*p* value
Stage I (Dukes A) cases	2 (1.4%)	0	0.212
Suboptimal resections/metastases	9 (6.2%)	5 (7.4%)	0.765
Pre- or postoperative radiotherapy	0	6 (8.8%)	<0.001
Preoperative radiochemotherapy	0	5 (7.4%)	<0.001
Postoperative chemotherapy[a]	12 (8.3%)	5 (7.4%)	0.845
Lost to follow-up/incomplete documentation	7 (4.9%)	1 (1.5%)	0.190
TOTAL	30 (20.8%)	22 (32.4%)	0.026

[a]5-fluorouracil + leucovorin

Tab. II. Comparison between patients who underwent primary modification of ASAR (group A) or ASAR combined with TME (group B)

	Primary ASAR (group A. *n*=114)	ASAR with TME (group B. *n*=46)	*p* value
Males	69 (60.5%)	28 (60.9%)	0.921
T3-T4, N1-N2 (Dukes C)	50 (43.9%)	21 (45.7%)	0.473
T3–T4, N0 (Dukes B)	64 (56.1%)	25 (54.3%)	0.471
Median age (range)	65 (33-84)	68 (39-81)	0.292
Median distance to anorectal junction (range)	3.0 cm (0-5 cm)	2.5 cm (0-5 cm)	0.133
Morbidity	46 (40.4%)	5 (10.9%)	<0.001
5-year observed survival	44 (38.6%)	31 (67.4%)	0.002
5-year relative survival	44.5%	72.7%	0.007
Local recurrence rate	32 (28.1%)	2 (4.3%)	0.003

Discussion

In 2007 we published survival and local recurrence data of low-rectal cancer patients operated on by means of the modern abdominosacral approach (ASAR, described as ASR previously). Then we had demonstrated that the technique significantly predominated routinely used APR [9].

Our current analysis has revealed that the therapeutic results achieved in low-rectal cancer patients operated on by ASAR between 1998 and 2003 were significantly better as compared to those patients who had undergone a similar type of surgery between 1982 and 1997. Together with TME implementation, the percentages of observed and relative 5-year survivals have increased by 28.8% and 28.2%, respectively, whereas the frequencies of isolated local recurrence and postoperative morbidity have decreased by 23.8% and 29.5%, respectively. This was consonant with our hypothesis according to which the implementation of TME resulted in marked improvement of the therapeutic efficiency of ASAR. Characteristically, the effects of a potent confounder – a (neo)adjuvant therapy – were avoided in our study since all the cases exposed to pre- or postoperative radiotherapy or preoperative radiochemotherapy were not subject to analysis. Consequently, only those patients undergoing surgery alone were subjected to therapeutic result analysis.

Surgical therapy of low-rectal cancers is complicated, mostly due to the limited approach to the primary tumor. The APR technique enables the resection of low rectal tumors [12] but does not give such satisfactory results as the ones obtained in mid- and upper-rectal cancers operated on by means of AR [6]. Consequently it was postulated that APR is a nonradical operation and that strong consideration should be given to the option of performing a more radical surgery [6].

APR-related restrictions became obvious after Heald et al. [21] had implemented the technique of TME. The idea of TME is to widen the rectal excision on the surrounding tissues, which may be infiltrated by cancer cells and which, consequently, give rise to isolated local recurrence [21]. According to Heald the intramesorectal way is the only spreading route for rectal cancer [23]. Miles hypothesized, however, that the spread of rectal cancer occurs through the lymphatics in all directions, including the ishiorectal fat via the nodes located around the inferior hemorrhoidal vessels [12]. That concept seems to be at least partly confirmed by our recent findings on the existence of an extramesorectal route of lymphatic drainage in lower-rectal tumors [7]. Consequently, the surgical approach to APR would not be wide enough to remove all tissues critical for preventing local recurrence.

Another evident problem in low-rectal patients who underwent APR is the so-called "surgical waisting", bringing the tumor within the close proximity of the circumferential resection margin [24]. As a result, even the implementation of TME did not markedly improve the local recurrence rates in low-rectal patients subjected to APR [25, 26].

The current modification of ASAR seems to be a successful combination of Miles's [12] and Heald's [23] concepts on the lymphatic spread of low-rectal cancer. It is modern, more radical than APR, performed totally under direct vision and – by its wider surgical approach and implementation of TME rules – enables the removal of the entire rectum as a cylinder following the mesorectal plane from above and encompassing the levator plane from below, with no risk of surgical waisting [23].

The evident advantage of ASAR is its free surgical approach to the lower rectum. It is enabled by the prone jack-knife position and the complete resection of the coccygeal bone and – if necessary – partial sacrectomy. As has already been mentioned, the sacral approach to the minor pelvis is not a new technique, and efforts towards implementing its application for rectal tumor resection were made a long time ago. However, the knowledge of oncological aseptics was limited and the surgeries of Kocher, Kraske and their students had failed because of the marked frequencies of local recurrences [10, 11]. Also, modern episodes of the application of ASR in low-rectal cancer patients did not produce the expected results. In all the aforementioned situations, however, ASR was performed in cases of recurrent rectal cancers, previously removed by means of APR. Hence, any maintenance of oncological aseptics was virtually impossible due to the advanced neoplastic process, which frequently involved the sacrum [13-19].

Also, the technique of ASAR that was originally implemented at our center in 1954 did not provide satisfactory results. It was modified and improved with time. The significance of ASAR, was its combination with TME in 1998. At present only a sharp excision under direct vision is acceptable. Since this technique does not allow for reperitonealisation of the pelvic floor, the perineal wound has to be closed tightly, with a drain left in the presacral space for two to three days.

The association between the unlimited sacral approach and the experience of Heald et al. [21] have allowed for the simultaneous removal of the lower rectum and all the surrounding tissues that are potentially critical for local recurrence without surgical waisting in the abdominosacral specimen at the level of the tumor. Total excisions of the coccygeorectal ligament, anal levators and constrictors, and the tissues of the infra-levator compartment significantly decrease the probability of any neoplastic deposits left in the minor pelvis, and consequently the rate of CRM involvement is markedly lower. In his paper on the role of the proper TME technique, MacFarlane concluded that the majority of carcinomas which recur initially within the pelvis could probably have been cured by properly performed surgery, which is better than the traditional blind approach combined with radio- and chemotherapy [27]. This hypothesis appears to be proved by the results of our present study with the ASAR-TME procedure and

a similar technique, described as a cylinder extended posterior abdominoperineal resection, which has recently proposed by Holm et al. [28]. Although their results improved markedly in terms of risk of inadvertent bowel perforation and CRM involvement, the available follow-up time was still too short, and the cohort too small to draw any firm conclusions on whether this surgical approach in APR actually reduces the risk of local recurrence and improves survivals. In contrast, we have much more data and experience regarding the application of ASAR in low-rectal patients [9]. Our previous studies have demonstrated that ASAR, which is currently used in our center, is associated with a low ratio of postoperative complications, which occur as infrequently as in APR- or AR-operated patients or are even of rarer evidence [9]. Consequently, if our experience will be confirmed by multicentered randomized trials, the ASAR technique described herein should provide new, attractive perspectives for the surgical therapy of lower-rectal cancers.

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