RISK OF PERMANENT STOMA AFTER RESECTION OF RECTAL CANCER DEPENDING ON THE DISTANCE BETWEEN THE TUMOUR LOWER EDGE AND ANAL VERGE

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The distance between the anal verge and lower edge of rectal cancer is one of the most important factors affecting the feasibility of sphincter-preserving resection.

The aim of the study was to assess the risk of permanent stoma after resection of rectal tumour depending on the distance between the tumour and the anal verge.

Material and methods. The retrospective analysis covered 884 patients after resection of rectal cancer. The distance between the anal verge and the lowest edge of the tumour was measured during endoscopic examination. Surgical technique was similar in all cases. For statistical analysis, the chi-square test and Fisher exact test were used.

Results. The overall rate of sphincter-preserving procedures was 71.8%, 90.1% of which were anterior resections. The greatest differences between the rate of anterior resections were noted for the segment between the 4th and the 5th centimetres: 30.1% for 4 cm vs 66.7% for 5 cm, p = 0.005. Overall, in 328 patients (37.1%) surgical treatment resulted in a permanent stoma. The number included: 246 (75.0%) patients after abdominosacral resection, 44 (13.4%) patients after the Hartmann procedure, three (0.9%) patients after proctocolectomy, and 28 (8.5%) patients after anterior resection, with a permanent stoma as a result of anastomotic leak. The overall rate of anastomotic leak was 11.7%. Formation of a defunctioning stoma in patients with a low-lying (≤ 6 cm from the anal verge) tumour reduced the risk of symptomatic anastomotic leak: 6.3% vs 20.5%; p = 0.049.

Conclusions. Anterior resection of tumours located ≥ 6 cm from the anal verge is feasible in 90%. Anastomotic leak that requires reoperation increases the risk of permanent colostomy. In selected cases, formation of a defunctioning stoma after resection of low-lying rectal cancer can reduce the risk of permanent colostomy.

Key words: rectal cancer, tumor position, sphincter saving surgery

Maintenance of intestinal continuity is one of the most important issues for the patient with rectal cancer. Concerns about having a permanent intestinal fistula formed sometimes affects the decision whether or not to consent to surgical treatment. When planning treatment, a number of clinical aspects are taken into consideration, such as the patient’s general condition, patency of gastrointestinal tract and tumour staging. One of the most important factors affecting the feasibility of a sphincter-preserving surgery is the location of rectal cancer with respect to the anal verge. If sphincters are infiltrated by the cancer, the only method of radical surgical treatment left is abdominoperineal or abdominosacral resection. Local resection of rectal cancer, especially with the use of the TEM technique (transanal endoscopic microsurgery) gives good functional results and entails low risk.
of complications, but indications for local resection are limited to a strictly selected, and thus sparse, group of patients with early stage tumour (1-5). The rate of reconstructive surgeries after the Hartmann procedure in patients with rectal cancer is low (6, 7). The best chance for maintaining intestinal continuity can be seen in the anterior resection, which, however, entails the risk of leak from a low-lying anastomosis, which can necessitate re-operation and formation of a permanent colostomy.

The aim of this paper was to define the risk of permanent stoma after resection of rectal cancer depending on the distance between the tumour lower edge and anal verge.

MATERIAL AND METHODS

Between January 1996 and December 2003, in the Department of Colorectal Tumours (presently, the Department of Gastrointestinal Tumours, Cancer Centre – Maria Sklodowska-Curie Institute, Warsaw), 979 patients with primary rectal adenocarcinoma were treated surgically. Tumour resection was performed in 884 (90.3%) patients (fig. 1). In 18 cases, synchronous co-occurrence of other malignant tumours was found. Non-neoplastic diseases requiring continuous treatment were ascertained in 53% patients, and the diseases of the circulatory system and diabetes prevailed. In three cases, ulcerative colitis was diagnosed prior to surgery. Patients with stage cT3-4 NX-1 M0 rectal cancer, in whom the tumour was located within 12 cm of the anal verge and was movable, received preoperative high-dose fraction irradiation – 5 Gy in five consecutive days followed by immediate surgery. If the tumour was immovable or tumour infiltration into neighbouring organs was found, conventional preoperative radio-chemotherapy was applied. The decision to apply one of the above mentioned radiotherapy regimens was made after a multidisciplinary consultation between a surgeon, radiotherapist and radiologist. As preoperative radiotherapy was a standard treatment, postoperative irradiation was applied only in 26 cases. Detailed characteristics of patients have been presented in tab. 1.

![Fig. 1. Selection of subjects for the study](image-url)
Measurement of distance: anal verge – tumour lower edge

The standard method of measuring the distance between the anal verge and the tumour lower edge was endoscopic examination with a rigid rectoscope. The transrectal (per rectum) physical examination was a single method only if the tumour was located in the anal canal or just over the sphincters, but in such cases the measurement was done independently by two doctors (surgeon and radiotherapist). If radicalization after endoscopic polypectomy was the indication, the site of excised neoplastic polyp was marked with ink prior to surgery, and the assessment of primary location of the tumour with respect to the anal verge was based on the description of endoscopic examination during which non-radical polypectomy was performed. If the preoperative radiotherapy lead to tumour regression and change in distance between the anal verge and the tumour, the measurement made directly prior to the surgery was deemed the right one.

Surgical treatment

Total mesorectal excision was performed when the tumour was located within the distance of 6-7 cm of the anal verge. In the case of higher-located tumours, the whole width of mesorectum was excised to the level of 2-5 cm below the tumour lower edge. In most cases, end-to-end anastomosis was performed with the use of two staplers. Only in six patients (1%) manual anastomosis to the anus was performed. The decision to perform a tightness test for anastomosis, defunctioning stoma and intestinal pouch was solely up to the surgeon. The Hartmann procedure was performed if, in the opinion of the surgeon, there were contraindications for simultaneous formation of...
Risk of permanent stoma after resection of rectal cancer

The abdominoperineal or abdominosacral resection was the treatment of choice if anal sphincters were infiltrated by the tumour. If rectal tumour infiltrated other organs, it was excised in one block with the infiltrated organ (en block resection). Local resection consisted in transanal excision of the neoplastic lesion with full width of the rectal wall. No laparoscopic surgeries or resections with the use of the TEM technique were performed. All surgeries were performed by a team of surgeons specializing in the treatment of colorectal cancer. All complications that arose within 30 days of surgery were recorded. Anastomotic leak was suspected every time when symptoms of diffuse peritonitis, pelvic abscess or presence of gas or pus in the drain were found. The suspicion of leak was verified by physical examination and, if need be, imaging tests (computed tomography). If the patient required reoperation, anastomotic leak was assessed intraoperatively. No imaging tests were performed to confirm anastomotic tightness. In two patients, a morphopathology test revealed neoplastic cells on stapler discs, and as a result, abdominosacral resection was performed within six weeks of anterior resection.

Statistical analysis

For comparative analysis of proportions between the groups of patients, the chi-square test and Fisher’s exact test were used. Continuous variables were compared with the Mann-Whitney U test. All tests were bilateral. The statistically significant difference was defined as p < 0.05. The statistical analysis was made with the use of the STATISTICA software, version 7.

RESULTS

Four patients underwent more than one surgery. In three, initially only a colostomy was formed, and in one, the surgery was limited to an explorative laparotomy. In two cases, anterior resection was feasible after radio-chemotherapy. In two other patients, the Hartmann procedure and abdominoperineal resection were performed. In 782 patients (88.7%), the resection was microscopically radical (R0). In six patients, proctocolectomy was performed, and in three of them – with preservation of sphincters and anastomosis of small intestine to anus. The indication for total resection of the large intestine was: concomitant ulcerative colitis in three cases, co-occurring multiple colon polyps in two patients, and concurrent synchronous tumour in transverse colon in one patient. Local transanal resection of the lesion was feasible only in 11 patients (1.1%). In one patient, despite preoperative radiochemotherapy, local resection was microscopically non-radical.

Sphincter-preserving surgeries

The overall rate of sphincter-preserving procedures was 71.8%, of which the anterior resection was 90.1% (fig. 1). A defunctioning stoma was formed in 68 (11.9%) patients. In 42 cases, loop ileostomy was formed, and in the remaining 26 cases – colostomy in the transverse colon. If the tumour was located within 3 cm of the anal verge, maintenance of intestinal continuity was feasible only in four patients (2.2%). For the distance range > 3 to 6 cm, the rate was 60%; and for the distance over 6 cm – it increased to 87%. Feasibility of the anterior resection increased with the increase of distance between the anal verge and the tumour lower edge (fig. 2). The greatest differences in the rate of anterior resections was observed for the distance range between the 4th and 5th centimetre: 30.1% (95% CI, 12.3-
47.9) for 4 cm, compared with 66.7% (95% CI, 48.1-85.3) for 5 cm, p = 0.005. The overall rate of postoperative complications was 28.6%. The most frequent complications included urinary tract infection (7.2%), abdominal wound abscess (6.2%), intraperitoneal abscess (3.6%) and occlusion (3.4%). Nine patients died (0.9%) in the postoperative period.

Colorectal anastomosis leak

The overall rate of anastomotic leak after anterior resection was 11.7%, and it was dependent on the distance between the tumour and the anal verge (fig. 3). The highest risk of symptomatic leak occurred when the tumour was located within 6 cm of the anal verge, and concerned especially those cases in which anastomosis was not protected with a temporary stoma (tab. 2). Formation of a defunctioning stoma in case of a low-lying rectal tumour (≤ 6 cm from the anal verge), reduced the risk of symptomatic anastomotic leak over three times: 6.3% (3/48) (95% CI, 0–19.9) vs. 20.5% (27/132) (95% CI, 9.1–32.1); p = 0.064, but was of no significance in case of surgeries for tumours located over 6 cm from the anal verge (p = 0.152). Of 67 patients with clinical symptoms of colorectal anastomotic leak following anterior resection, 17 (25.4%) were treated conservatively. In 50 (74.6%), relaparotomy was performed, of which in 12, only lavage and drainage of peritoneal cavity was performed during reoperation. Intraoperative indications for stoma formation were found in 38 patients. In this group, there were two patients who already had a defunctioning stoma, but because of peritonitis symptoms following dehiscence of anastomosis, the surgeon decided to disconnect it and form a permanent colostomy. In the remaining 36 patients, stoma was formed only if anastomotic leak occurred. Of 68 patients in whom anterior resection was performed with a defunctioning stoma, restoration of intestinal continuity was feasible in 61 (89.7%). If stoma was formed only when anastomotic leak occurred, the rate of restoration of intestinal continuity dropped to 22.2%; p < 0.001.

Table 2. Risk of anastomotic leakage and permanent colostomy depending on distance between tumour and anal verge

<table>
<thead>
<tr>
<th>Distance between anal verge and tumour lower edge (%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 6 cm</td>
<td>&gt; 6 cm</td>
</tr>
<tr>
<td>Anterior resection (in total)</td>
<td></td>
</tr>
<tr>
<td>– anastomotic leakage</td>
<td>16.7 (30/180)</td>
</tr>
<tr>
<td>– permanent colostomy</td>
<td>8.9 (16/180)</td>
</tr>
<tr>
<td>Anterior resection with defunctioning stoma</td>
<td></td>
</tr>
<tr>
<td>– anastomotic leakage</td>
<td>6.3 (3/48)</td>
</tr>
<tr>
<td>– permanent colostomy</td>
<td>8.3 (4/48)^</td>
</tr>
<tr>
<td>Anterior resection without defunctioning stoma</td>
<td></td>
</tr>
<tr>
<td>– anastomotic leakage</td>
<td>20.5 (27/132)</td>
</tr>
<tr>
<td>– permanent colostomy</td>
<td>9.1 (12/132)#</td>
</tr>
</tbody>
</table>

^ – one patient – resection R1
# – two patients – no consent to surgery restoring intestinal continuity
Risk of permanent colostomy depending on the distance between the lower edge of rectal tumour and anal verge

Of 884 patients in whom rectal cancer resection was performed, in 328 (37.1%) surgical treatment ended with a permanent intestinal fistula. The number comprised: 246 (75%) patients after abdominoperineal resection, 44 (13.4%) patients after the Hartmann procedure, three (0.9%) patients after proctocolectomy and 28 (8.5%) patients with a permanent stoma due to leak from colorectal anastomosis following anterior resection. If the distance between the tumour lower edge and anal verge was up to 3 cm, the rate of abdominoperineal resection was 97.5%. With the increase of distance between the anal verge and the tumour lower edge, the rate of abdominosacral resections decreased. The Hartmann procedure was performed in 49 patients in whom the tumour was situated at the distance of 4-15 cm from the anal verge. The most frequent indication for resection with the use of the Hartmann procedure was postradiation reaction in the rectal stump, which, in the opinion of the surgeon, precluded anastomosis (tab. 3). Only in five patients (10.2%) intestinal continuity was restored later. In none of these patients the tumour was located lower than 6 cm from the anal verge (6, 7, 8, 12 and 14 cm). One patient died due to complications after reconstructive surgery. When the tumour was located at the distance of 0-12 cm from the anal verge, the risk of permanent stoma after anterior resection remained at the similar level (4.3–5.3%), and only when it was located higher did it drop to 1.8% (fig. 4). Formation of a defunctioning intestinal fistula resulted in reduced risk of permanent intestinal fistula, when tumours located within 6 cm of the anal verge were resected (tab. 4). In 10.3% of patients (7 of 68) after anterior resection with formation of a defunctioning stoma, intestinal continuity was never restored. One patient underwent microscopically non-radical anterior resection (R1 – circumferential margin involvement), and developed recurrence of the neoplastic process in the pelvis. In two patients, anastomotic dehiscence necessitated replacement of a defunctioning stoma with a permanent one, and two other patients did not consent to repeated surgical treatment. Two patients who developed metastasis prior to closure of the defunctioning stoma were lost to follow-up.

DISCUSSION

There were three factors affecting the risk of permanent colostomy following rectal cancer

![Fig. 4. Risk of permanent intestinal fistula in relation to distance between anal verge and the tumour lower margin](image)

Table 3. Causes of the Hartmann procedure

<table>
<thead>
<tr>
<th>Cause of Hartmann procedure</th>
<th>Hartmann procedure n = 49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irradiation-induced changes precluding anastomosis</td>
<td>26 (53.1%)</td>
</tr>
<tr>
<td>Advanced neoplastic disease</td>
<td>9 (18.4%)</td>
</tr>
<tr>
<td>Concomitant non-neoplastic diseases</td>
<td>7 (14.3%)</td>
</tr>
<tr>
<td>Intraoperative complications (tumour rupture, infection)</td>
<td>3 (6.1%)</td>
</tr>
<tr>
<td>Synchronous resection of small intestine and liver parenchyma</td>
<td>2 (4.1%)</td>
</tr>
<tr>
<td>Other synchronous malignant tumour</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>1 (2%)</td>
</tr>
</tbody>
</table>
resection: the necessity to perform abdominoperineal resection, the low rate of restoration of intestinal continuity after the Hartmann procedure, and anastomotic leak following colorectal anastomosis requiring reoperation and formation of a stoma (fig. 4). The role of these factors changed with the increase of distance between the anal verge and the tumour lower edge. The chance to reduce the rate of abdominosacral resections for low-lying rectal tumours was seen in preoperative radiochemotherapy; it was hoped that the reduction of the tumour size would make sphincter-preserving surgery feasible. A metaanalysis based on ten randomized clinical trials, including 4,596 patients in total, showed that although preoperative radio-chemotherapy leads to reduction of the tumour mass, it does not cause significant increase in the rate of anterior resections (8). Another factor that can lead to reduction in the rate of abdominoperineal resection can be shortening of the distal margin of intestine resection to the necessary minimum. According to current guidelines for surgical treatment of rectal cancer, 1 cm proximal margin in case of low-lying tumours is allowed, as far as it makes a sphincter-preserving surgery feasible (9).

Since the beginning of this century, a growing number of reports proving that the low margin of intestine resection of less than 1 cm is sufficient for achieving oncological radicality has been appearing (10, 11). The study results have also shown that in 50% of patients with tumour located within 4-5 cm of the anal verge a sphincter-preserving surgery was feasible (fig. 2). However, the sphincter-preserving surgery does not guarantee restoration of intestinal continuity. The cause of such a situation should be seen in a low rate of reconstruction of intestinal continuity after the Hartmann procedure and in high risk of leak from a low colorectal anastomosis after anterior resection. In our material, intestinal continuity after the Hartmann procedure was restored only in 10.2% of patients. A similarly low rate of restoration (0-35%) has been reported by other authors (6, 7, 12). It probably results from the fact that postoperative and postradiation changes in the pelvis minor preclude safe dissection of the rectal stump and its preparation for anastomosis.

Other causes can be: relapse of neoplastic disease, high risk of postoperative complications or situations in which the Hartmann procedure was performed as a definitive surgery due to metastasis. Feasibility of the anterior resection, which is the only surgery which, in the majority of cases, provides a chance for restoration of intestinal continuity, increases with the increase of distance between the lower tumour margin and the anal verge (13, 14, 15). The factor that in this case determines the risk of a permanent colostomy is the leak from a low anastomosis, which requires reoperation. Low location of the tumour is a crucial risk factor for symptomatic anastomotic leak, especially in the situation where anastomosis is not protected by a stoma. However, it should be mentioned that in our material 25% of patients (17/67) with symptomatic leak from colorectal anastomosis were treated conservatively, and in 18% patients (12/67) reoperation was limited to inserting a drain into the abdominal cavity and pelvis. In the subgroup of conservatively treated patients, in four a defunctioning stoma had already been formed, and it was closed several months after surgery. As a result, in all patients from this subgroup, surgical treatment ended without a stoma. At the same time, when anastomotic leak necessitated reoperation to form a stoma, the feasibility of restoration of intestinal continuity was then little (tab. 4). Maggiori et al. (12) present results of treatment of anastomotic leak after anterior resection in 41 patients with rectal cancer. The risk of permanent colostomy was 13% when anastomosis was not disconnected, compared with a 100% risk when anastomosis was disconnected (p = 0.007).

<table>
<thead>
<tr>
<th>Distance between tumour lower edge and anal verge</th>
<th>% (number of patients with permanent stoma after anterior resection/total number of patients)</th>
<th>p=</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 cm</td>
<td>8.3 (4/48)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;6-9 cm</td>
<td>13.3 (2/15)</td>
<td>0.070</td>
</tr>
<tr>
<td>&gt;9 cm</td>
<td>20 (1/5)</td>
<td>0.325</td>
</tr>
</tbody>
</table>

Table 4. Risk of permanent intestinal fistula after anterior resection
The results we present, as well as other authors’ observations we refer to, show how essential it is to aim at a possibly lowest rate of anastomotic leak requiring reoperation. It seems that formation of a defunctioning stoma can be such a method. Two metaanalyses of the role of the defunctioning stoma, which have appeared in recent years, show that it significantly reduces the risk of symptomatic anastomotic leak (16, 17). However, one should remember that surgical closure of a defunctioning stoma also entails the risk of postoperative complications (18, 19). In addition, some of defunctioning stomas never get closed (14, 20).

Thus there is still the open question of the high rate of leak from colorectal anastomosis, and the resulting risk of a permanent intestinal fistula being a sufficient reason for routine formation of a defunctioning stoma during resection of low-lying rectal cancer. The analysis of the presented material does not provide the answer to this question. The fact that in 80% of patients after anterior resection of a low-lying tumour, without formation of a defunctioning stoma, symptoms of anastomotic leak did not occur, and surgical treatment ended with preserved intestinal continuity seems vital; like the fact that in 10% of patients in whom a defunctioning stoma was formed, intestinal continuity was never restored. The results of a Swedish, multicentre, randomized study of the risk of permanent stoma after anterior resection, which included a six-year follow-up, show that the rate of unclosed defunctioning ileostomies is even higher than in this work – 16.4% (21). Other authors refer to similar data, indicating at the same time that in the majority of cases the stoma formed as a defunctioning stoma, in fact becomes a permanent stoma due to complicating leak after colorectal anastomosis (22).

The results presented in this paper should be subjected to critical analysis due to significant limitations resulting from the nature of the study. First, due to retrospective nature of the study, the analysis does not account for factors other than the distance between the tumour and the anal verge, but that can increase the risk of anastomotic leak. Second, the analysis does not account for factors that could affect the fact that, irrespective of tumour location, surgeries with formation of a permanent colostomy were planned; for instance, as a result of abnormal function of anal sphincters. Third, the distance between the anal verge and the tumour was measured during rectal endoscopy with a rigid rectoscope, which could be burdened with error due to mechanical distension of the intestine fragment below the tumour. The best examination method for determining tumour location with respect to the anal verge would be the magnetic resonance imaging or computed tomography scan of the pelvis. Thus, the conclusions flowing from the presented material should be treated as an incentive to further investigate into the feasibility of radical treatment of rectal cancer with preservation of intestinal continuity.

When summarizing the presented results, it should be noted that the chance for maintaining intestinal continuity during surgery for low-lying rectal cancer to a large extent depends on technical feasibility of anterior resection. In centres specializing in surgical treatment of rectal cancer, feasibility of anterior resection of tumours located between the 4th and 5th cm from the anal verge is ca 50% and increases to ca. 90% in case of tumours located at the distance of ≥ 6 cm. A vital factor which can increase the risk of permanent colostomy is leak after colorectal anastomosis requiring reoperation. In some patients with rectal cancer located ≤ 6 cm from the anal verge, formation of a temporary defunctioning stoma during anterior resection can reduce the risk of a permanent colostomy.

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