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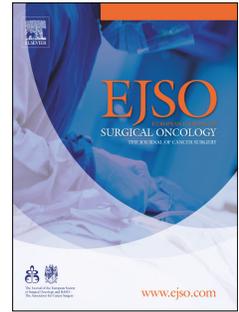
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Original paper**Surgical practices for malignant left-colonic obstruction in Germany**

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I. Gastinger^{2,3}, H. Lippert^{1,3} for the study group *Qualitätssicherung Kolon/Rektum-Karzinome*
(*Primärtumor*) (Quality assurance in primary colorectal carcinoma)

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Abstract

Aim

Data from the multicentric observation study *Kolon/Rektum-Karzinome (Primärtumor)* (primary colorectal carcinoma) are adduced to assess the status of surgical treatment of this condition in Germany and to compare different operative approaches in the emergency treatment of obstructive left-sided colon cancer, especially diversion (Hartmann's procedure) and primary anastomosis.

Patients and methods

Out of 15,911 patients with cancer of the left colon, recorded between 01.01.2000 and 31.12.2004, a total of 743 patients underwent emergency surgery for an obstructive tumour, performed as a radical resection. These patients were compared in respect of their risk profile and post-operative result.

Results

In 57.9% ($n = 430$) a one-stage operation (Group I), in 11.7% ($n = 87$) a primary anastomosis with protective stoma (Group II), and in 30.4% ($n = 226$), Hartmann's procedure (Group III) was performed. In Group III more patients were male, overweight and multimorbid, and more had advanced-stage tumours. The morbidity and hospital mortality (overall hospital mortality, 7.7%; $n = 57$) did not differ significantly between the groups. The insertion of a protective stoma did not affect the rate of anastomotic insufficiency (Group I, 7%; Group II, 8.0%).

Conclusions

Primary anastomosis for emergency left-colon carcinoma obstruction should only be regarded as indicated in cases where the risk profile is favourable. Our results suggest that in advanced obstruction and in high-risk cases Hartmann's procedure should be used. A protective stoma did not appear to confer any advantage.

Key words

Hartmann's procedure • obstructive left colon cancer • emergency surgery • peri-operative outcome

Introduction

In emergency operations for obstruction in which carcinomas are resected from the right and transverse colon, primary anastomosis has become established as the standard for restoring bowel continuity except in high-risk situations. However, there are various possible operative options for the same situation in the left colon. Whenever possible, even in emergencies, an oncologically adequate procedure with systematic lymph-node dissection should be aimed at [1]. After removal of the affected section of the bowel, the discontinuity can be treated by Hartmann's procedure, or continuity can be restored by anastomosis, if necessary with the use of a protective stoma [2, 3, 4, 5, 6, 7, 8]. In spite of the repeatedly reported advantages of primary restitution of continuity [3, 9, 10], the Hartmann operation is still of value [2, 4, 5, 6, 7, 8].

Nevertheless, there is still a paucity of data concerning the relative merits of the various procedures for restoring bowel continuity, and validated results from controlled studies, with corresponding evidence-based recommendations, are not available.

The aim of this investigation was to elucidate the part played in Germany by the surgical treatment of left-colon carcinoma in emergency operations for obstruction, and to find out how much use is made of the Hartmann operation. To do this, we made use of data already available from an evaluated prospective, multicentric observation study with a statistically relevant number of patients.

Methods

- Study -

In the German multicentric study *Qualitätssicherung Kolon/Rektumkarzinome (Primärtumor)* (Quality Assurance in Primary Colorectal Carcinoma), data for patients with colorectal carcinoma were acquired prospectively by the *An-Institut für Qualitätssicherung in der operativen Medizin* at the University of Magdeburg. Data acquisition took place over a period of five years, from January 1st 2000 to December 31st 2004. These data represent the state of treatment of these patients in routine clinical practice, and they cover the entire spectrum of hospital types in Germany. A total of 346 institutions providing treatment at all levels took part in the study.

The individual data were recorded on a standardised questionnaire at each participating hospital. This questionnaire comprises 68 questions to record the important aspects of peri-operative management of the patient: demographic characteristics, pre- and post-operative

tumour status, tumour location, details of the operation and peri-operative treatment, pathological findings, the patient's status at discharge from hospital, and further treatment planned. Hospital mortality was recorded, but not mortality after discharge. The completed questionnaires were subjected to final checking by the hospital's local representative with responsibility for the study. Additionally, the data were also checked for completeness in an annual cross-check between the patients registered in the study and those registered at the hospitals, and plausibility checks were conducted by comparing the study data with the operation reports and patient narratives.

The study was conducted in accordance with the Declaration of Helsinki. Participation in the study was voluntary, and data were recorded anonymously. This was a purely observational study and thus had no influence upon the methods or the course of treatment. For this reason, a vote of the ethics committee was not required. All the patients gave written consent to the acquisition and anonymised evaluation of their data.

The following inclusion criteria applied to the present analysis:

- Tumour location in the left colon: sigmoid colon, descending colon, splenic (left colon) flexure,
- Operation for obstruction,
- Emergency operation (within 24 hours of admission to the hospital),
- Radical resection restricted to the colon.

Exclusion criteria were:

- Rectal carcinoma,
- Emergency operation postponed (24 hours or more after admission),
- Extended radical surgery (subtotal colectomy),
- Segmental resection.

- *Statistics* -

The data were entered into an ACCESS data base and were evaluated with the statistical programme suite SPSS 12.0 (SPSS Inc., Chicago, IL, USA). For the descriptive statistics, frequency testing was performed for the various categorical variables. Differences among the variables in two-dimensional contingency tables were investigated by using the χ^2 test. Differences between groups were considered significant if a two-sided test yielded a *p* value below 0.05. Continuous variables, such as patient's age, were tested by using the robust *t* test.

If more than two groups were present, then one-way analysis of variance (ANOVA) was performed with subsequent multiple comparison by the method of Tukey.

Results

During the study period, data from a total of 31,341 patients were acquired. For 50.8% of these ($n = 15,911$) the tumour was located in the left colon; 6.2% ($n = 982$) were admitted to hospital because of obstruction and underwent emergency operation. In the latter group, 743 patients (75.7%) fulfilled the inclusion criteria and were included in the study; 239 patients were excluded, because of extended radical surgery (subtotal colectomy; $n = 49$), segmental resection ($n = 68$), no resection ($n = 102$) or incomplete data ($n = 20$).

The patients included were classified into three groups, corresponding to the procedure used to restore bowel continuity:

- Group I ($n = 430$): primary anastomosis and one-stage operation
- Group II ($n = 87$): primary anastomosis with protective stoma
- Group III ($n = 226$): Hartmann's procedure.

Patients' characteristics

The ratio of the sexes differed significantly between the three groups of patients (Table 1): in Groups II and III the majority were male, but in Group I most were female. The patients with the Hartmann operation had a slightly greater mean BMI, and almost 60% of them were overweight ($\text{BMI} > 25 \text{ kg/m}^2$), compared with less than 50% for the other two groups. Differences in age were without statistical significance (Table 1).

The risk profiles according to the ASA classification did not differ significantly between the groups (Table 2). Patients in the groups with anastomosis (I and II) had fewer comorbidities and risk factors than those in the Hartmann-resection group (III). Cardiovascular disorders were the most common causes of comorbidities and were the most frequent in Group III.

Operative findings

The assessment of a patient's emergency profile included – apart from obstruction – peritonitis, abscess and haemorrhage. In 12.8% ($n = 29$) of the patients in Group III (Hartmann), peritonitis was found as well as obstruction (Table 3). In Groups I and II (anastomosis), this was significantly less frequently the case. Concomitant haemorrhage and abscesses were rare throughout (Table 3).

Tumour location

Of all tumours, 71.2% ($n = 529$) were located in the sigmoid colon, 17.5% ($n = 130$) in the descending colon, and 11.3% ($n = 84$) in the left colonic flexure. In Group I, sigmoid carcinoma was relatively infrequent (Table 1).

An analysis of dependence of the operative procedure upon the tumour location shows that, among patients receiving radical surgery, those with sigmoid carcinoma were treated by the Hartmann procedure twice as frequently (36.3%) as those with carcinoma of the left flexure (15.5%) or the descending colon (16.2%).

Tumour classification and stage

Patients with Hartmann's resection (Group III) were more likely to have locally advanced tumours with a pT4 classification and tumour infiltration of neighbouring organs (pT4b); details are given in Table 4. The most favourable distribution pattern in respect of pT classification was found in the patients of Group II. There was no significant difference between the three groups in respect of invasion of locoregional lymph nodes or histological tumour grading (grading was somewhat poorer in Group III). Synchronous distant metastases (tumour stage IV) were found most frequently among the patients with Hartmann resection (Group III). The most favourable distribution of tumour stages was seen among the patients of Group II (Table 4).

Complications

The need of relaparotomy and the rates of *intra-operative*, *general*, and *surgical* complications were comparable, without statistically demonstrable differences between the groups (Table 5).

In the two groups with anastomosis, anastomotic insufficiency (AI) occurred with close to equal frequency (Group I, 7%, $n = 30$; Group II, 8.0%, $n = 7$). The protective stoma did not lead to a decrease in the number of findings requiring operation (Group I, 5.6% ($n = 24$); Group II, 5.7% ($n = 5$)).

Hospital mortality for the entire patient group was 7.7% ($n = 57$) and was lowest in Group III; differences were not statistically significant.

Discussion

In an emergency operation for obstruction that is due to left-colon carcinoma, there are – after the necessary operation with systematic lymph-node dissection – various possible procedural options for reconstruction. These include the restoration of bowel continuity by primary anastomosis (if necessary with the use of a protective stoma) and Hartmann's procedure. However, few data on this operative step are available, and there is a lack of validated results from controlled studies in order to allow the formulation of evidence-based recommendations. Among these possibilities, the positioning of interventional bridging procedures – which have not been considered in the present analysis – has likewise not been assessed [11].

We therefore present a selection of data from the prospective, multicentric observation study “Quality Assurance in Primary Colorectal Carcinoma”, involving a statistically relevant number of patients with left-colon carcinoma. The aim of the study was to provide an analysis of these data leading to recommendations for surgical practice.

During the period studied, 6.2% of all patients with a tumour located in the left colon were operated upon in an emergency procedure because of obstruction. This is an important difference from rectal surgery, in which only a relatively small number of patients (1.7%) are operated upon in an emergency situation [5].

- Patients' characteristics, operative findings & tumour location -

In all, 743 patients met the criteria for inclusion in the present analysis. In most cases (57.9%; $n = 430$) primary restoration of bowel continuity by anastomosis was performed. In addition to these, 11.7% ($n = 87$) were treated by primary anastomosis with the use of the protective stoma and in 30.4% ($n = 226$) resection by Hartmann's method was performed.

In the data analysed, the patient's sex emerged as an important factor influencing the choice of the reconstruction procedure. For men, Hartmann's resection and, when anastomosis was performed, the use of a protective stoma was considerably more frequent than for women. The patient's BMI also played a part in this choice: overweight patients were more likely to be treated by Hartmann's method. The age of the patients did not affect the decision of how best to restore bowel continuity.

Patients with a primary anastomosis (Groups I and II) tended to have low ASA scores and accordingly, in comparison with patients treated by Hartmann resection, they suffered less frequently from comorbidities. However, the differences were not great, and most of the disorders concerned were cardiovascular.

A decisive factor in the decision of the operating surgeon for or against the Hartmann procedure, and one that was not taken into account in this study, is the degree of obstruction. The diagnosis of obstruction can range from a high-grade stenosis with incipient obstruction to a complete blockage of the bowel with pronounced distension, possibly together with peritonitis with or without perforation of the intestinal wall. An indication of the fact that patients with a Hartmann resection often had more severe obstruction is given by the fact that in 12.7% of these patients the obstruction was aggravated by peritonitis; this was found twice as frequently as in patients who received primary anastomosis.

Another factor influencing the decision to conduct primary anastomosis was the exact site of the tumour in the left colon. For tumours of the left flexure and the descending colon, continuity-preserving operations were more likely to be performed. Hartmann's resection was more than twice as frequently performed in the case of carcinomas of the sigmoid colon than in those of the left flexure or descending colon, and here too the procedures with primary anastomosis were more common.

- Tumour classification and stage -

Patients with the Hartmann resection were more likely to have tumours with progressive local extension than were those in the other groups – with a trend towards a worse tumour grading. The pN classifications of the three patient groups were similar. Patients with synchronous distant metastases were found more frequently in the group with Hartmann resection. The (relatively) most favourable distribution of tumour stages was found among the patients with primary anastomosis and a protective stoma. In accordance with the large number of locally progressive and metastasising tumours, Hartmann resection was more frequently associated with residual tumours (R1 or R2).

- Complications -

The spectra of complications in the three patient groups were comparable. The rates of intra-operative complications did not differ, while general post-operative complications were slightly higher among patients with Hartmann resection, though without statistical significance. Surgical complications also arose with comparable frequency, most often after continuity-preserving resection with a protective stoma. The rate of anastomotic leakage after the emergency operation for an obstruction in the left colon was 7% ($n = 30$) among patients with primary anastomosis and 8% ($n = 7$) among patients with an additional protective stoma, with almost identical rates of findings requiring operation (5.6% vs. 5.7%). This result argues against the use of a protective stoma after left-colon resection. In the low anterior resection of

rectal cancer, a protective stoma does not reduce the rate of anastomotic leakage, but it does reduce the rate of leakage requiring re-operation [12, 13]; however, in the present analysis of emergency operation for acute obstruction of the left colon, a corresponding trend could not be demonstrated. This may be due to the fact that anastomoses following colon resections – compared with rectal carcinoma – are intraperitoneal and thus require re-operation in cases of insufficiency. In the context of this observational study type, this result must be interpreted with caution. It is probable that a stoma was performed in more difficult cases or in those with risk factors for fistulas (discrepancy in diameter, limited blood supply, failure of pneumatic test etc.). The frequency of relaparotomy did not differ among the patient groups with anastomosis. It was somewhat lower in the group with Hartmann resection, but without statistical significance.

Hospital mortality was 7.7% overall ($n = 57$) and was thus lower than reported in the literature [2, 4, 6, 7, 8, 14], with only marginal and statistically insignificant differences between the groups. The hospital mortality after Hartmann resection was slightly lower than in the other groups, although patients in this group were disadvantaged in respect both of risk profile and of tumour status.

- Experiences & Recommendations -

Thus, on the basis of the data evaluated in the present multicentric observation study, the curative Hartmann procedure can be recommended especially for high-risk patients with obstruction in the left colon, above all because of the low mortality rate. In cases of additional tumour perforation, with faeculent peritonitis this is the procedure of choice. Results of a survey of emergency left-colon treatment, conducted by Goyal *et al.* and involving 500 general surgeons in the USA, support this [15]. For high-risk patients with a tumour obstruction, 94% of the surgeons interviewed would perform a Hartmann resection, either by Hartmann's procedure or as a transverse colostomy. In the low-risk group, 53% of those interviewed would prefer a single operation (sigmoid resection, subtotal hemicolectomy) with or without intra-operative gastric lavage.

An argument against the Hartmann resection that is not easily dismissed is that the re-attachment operation is often an additional and often difficult and highly invasive second procedure, that in itself has a non-negligible morbidity and mortality. According to the literature, the rate of post-operative complications is between 29% [16] and 54.8% [17], with an early mortality between 0% [17] and 3.8% [18]. The corresponding variation in anastomotic insufficiency is between 2.5% [19] and 16% [20]. Aydin *et al.* [21] report rates

of surgical and general complications after a Hartmann-stoma reconnection following operation for diverticulosis that were between 43.8% and 9.1%, associated with a post-discharge re-admission rate of 7.2% and an early post-operative mortality of 1.7%. Furthermore, in many instances, after a Hartmann resection the second step of restoring continuity is not carried out at all [2, 4, 6, 7, 8]. Boland *et al.* [22] report that the restoration was associated with extensive lysis of adhesions in 69% of cases, with minor complications in 40% and major complications in 38% of patients, a early mortality of 3% and failure of the planned restoration in 8% of cases due to intra-operative problems.

- *Conclusion* -

In an emergency situation with a left-colon obstruction caused by carcinoma, primary anastomosis is indicated, where the patient has a low risk profile without concomitant peritonitis, and the tumour is local and easily resectable. Where there is uncertainty, in cases of advanced obstruction and in the presence of major risk factors the Hartmann procedure should be adopted. Anastomotic protection by a stoma did not, according to our data, confer any advantage. These data from an observational study show again the need for a multicentric, prospective, randomised study with a large patient population and a high statistical power in order to find the optimum treatment for this condition.

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Tables

Table 1. Demographic data, Tumour location

	Patient group <i>n</i> (%)			<i>p</i>
	Primary anastomosis		Hartmann resection	
	One-stage operation	Protective stoma		
	Group I 430 (100)	Group II 87 (100)	Group III 226 (100)	
Age, years (mean ± SD ¹)	70.5 ± 13.2	68.6 ± 11.9	71.2 ± 12.6	0.243
Age (95% confidence interval)	69.2–71.8	66.0–71.1	69.6–71.1	
BMI, kg/m ² (mean ± SD ¹)	25.2 ± 4.2	25.1 ± 4.3	26.1 ± 4.0	0.02²
BMI category <i>n</i> (%)				<0.001
18.5 kg/m ²	9 (2.1)	6 (6.9)	7 (3.1)	
18.5–25 kg/m ²	211 (49.1)	39 (44.8)	77 (34.1)	
> 25–30 kg/m ²	142 (33.0)	34 (39.1)	90 (39.8)	
> 30–35 kg/m ²	34 (7.9)	6 (6.9)	38 (16.8)	
> 35 kg/m ²	5 (1.2)	2 (2.3)	2 (0.9)	
No information	29 (6.7)	0	12 (5.3)	
Ratio of sexes M/F	0.83	1.21	1.38	0.006
ASA classification <i>n</i> (%)				0.116
ASA I	37 (8.6)	5 (5.7)	7 (3.1)	
ASA II	151 (35.1)	31 (35.6)	78 (34.5)	
ASA III	193 (44.9)	45 (51.7)	111 (49.1)	
ASA IV	49 (11.4)	6 (6.9)	30 (13.3)	
Tumour location				
Splenic flexure (<i>N</i> = 84)	66 (15.3)	5 (5.7)	13 (5.8)	<0.001³
Descending colon (<i>N</i> = 130)	97 (22.6)	12 (13.8)	21 (9.3)	<0.001³
Sigmoid colon (<i>N</i> = 529)	267 (62.1)	70 (80.5)	192 (85.0)	<0.001³

¹ Standard deviation² Comparison of Group III with Group I³ Group I vs. Groups II and III

Table 2. Risk factors and comorbidities by patient group

Risk factors, comorbidities	Patient group <i>n</i> (%)			<i>p</i>
	Group I <i>N</i> = 430	Group II <i>N</i> = 87	Group III <i>N</i> = 226	
At least one factor	357 (84.2)	70 (81.4)	202 (90.2)	0.035 ¹
Cardiovascular	279 (65.8)	47 (54.7)	162 (72.3)	0.012
Pulmonary	75 (17.7)	17 (19.8)	40 (17.9)	0.899
Renal	26 (6.1)	2 (2.3)	19 (8.5)	0.132
Hepatic	8 (1.9)	1 (1.2)	5 (2.2)	0.826
IDDM	33 (7.8)	3 (3.5)	12 (5.4)	0.235
NIDDM	43 (10.1)	7 (8.1)	27 (12.1)	0.564
Nicotine	18 (4.2)	8 (9.3)	13 (5.8)	0.150
Alcohol	7 (1.7)	7 (8.1)	11 (4.9)	0.003
Varicosis	27 (6.4)	6 (7.0)	23 (10.3)	0.200

¹*p* = **0.035** for difference between Groups I and III and also between Groups II and III; (I vs. II *p* = 0.521)

IDDM: insulin-dependent diabetes mellitus; NIDDM: non-insulin-dependent diabetes mellitus

Table 3. Abdominal complications

Additional finding	Patient group <i>n</i> (%)			<i>p</i>
	Group I <i>N</i> = 430	Group II <i>N</i> = 87	Group III <i>N</i> = 226	
Peritonitis	27 (6.3)	6 (6.9)	29 (12.8)	0.014
Abscess	4 (0.9)	0	1 (0.4)	0.55
Haemorrhage	3 (0.7)	2 (2.3)	2 (0.9)	0.368

Table 4. Tumour classification (*TNM Classification*)

	Patient group <i>n</i> (%)			<i>p</i>
	Group I <i>N</i> = 430	Group II <i>N</i> = 87	Group III <i>N</i> = 226	
<i>pT</i> (primary tumour, pathological classification)				
pT1	0	1 (1.1)	0	0.008
pT2	13 (3.0)	5 (5.7)	3 (1.3)	
pT3	322 (74.9)	68 (78.2)	160 (70.8)	
pT4	95 (22.1)	13 (14.9)	63 (27.9)	
– of these pT4b	–63 (14.7)	–10 (11.5)	–41 (18.1)	<0.001
<i>pN</i> (regional lymph nodes, pathological classification)				
pN0	180 (42.3)	41 (47.1)	94 (42.2)	0.79
pN1	134 (31.5)	26 (29.9)	77 (34.5)	
pN2	112 (26.3)	20 (23.0)	52 (23.3)	
<i>TNM stage groups</i>				
UICC ¹ I	12 (2.8)	5 (5.7)	2 (0.9)	0.045
UICC II	160 (37.3)	35 (40.2)	83 (36.9)	
UICC III	193 (45.0)	33 (37.9)	89 (39.6)	
UICC IV	64 (14.9)	14 (16.1)	51 (22.7)	
<i>Histopathological grading</i>				
G1	15 (3.5)	6 (7.1)	4 (1.8)	0.054
G2	338 (79.3)	64 (75.3)	168 (74.3)	
G3	73 (17.1)	15 (17.6)	54 (23.9)	
G4	0	0	0	
<i>R</i> (Residual tumour classification)				
R0	361 (84.0)	72 (82.8)	164 (72.6)	0.003
R1 or R2	69 (16.1)	15 (17.2)	62 (27.4)	

¹ UICC: Union Internationale Contre le Cancer

Table 5. Morbidity and mortality

Morbidity / Mortality	Patient group				<i>p</i>
	All patients <i>N</i> = 743	Group I <i>N</i> = 430	Group II <i>N</i> = 87	Group III <i>N</i> = 226	
Intra-operative complications <i>n</i> (%)	64 (8.6)	39 (9.1)	5 (5.7)	20 (8.8)	0.595
General complications <i>n</i> (%)	226 (30.4)	122 (28.4)	22 (25.3)	82 (36.3)	0.061
Specific complications <i>n</i> (%)	191 (25.7)	103 (24.0)	27 (31.0)	61 (27.0)	0.336
Relaparotomy <i>n</i> (%)	78 (10.5)	48 (11.2)	10 (11.5)	20 (8.8)	0.618
Hospital mortality <i>n</i> (%)	34 (7.9)	34 (7.9)	7 (8.0)	16 (7.1)	0.922

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