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ORIGINAL SCIENTIFIC REPORT

Complications After Ostomy Surgery: Emergencies and Obese Patients are at Risk—Data from the Berlin OStomy Study (BOSS)

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Abstract

Background Complications are common after ostomy surgery. Data from the **B**erlin **OS**tomy **S**tudy were evaluated to determine risk factors for complications.

Patients and methods Patients with a bowel ostomy were questioned using a questionnaire concerning patients' characteristics and history as well as the ostomy and its complications. The questionnaire also contained a nine-fielded abdominal sketch to determine the exact ostomy location.

Results Over 42 months, 2647 patients completed the questionnaire. Obese patients and patients after emergency surgery were more prone to ostomy-related complications. This result was independent of the kind of ostomy (small bowel ostomy or colostomy) and of the abdominal location. The overall ostomy complication rate was 55.6%.

Conclusion Significantly more complications were recorded after emergency surgery and in obese patients than after elective surgery and in non-obese patients, respectively. There was no preferential abdominal location for avoiding general ostomy complications. The results emphasized the importance of preoperative ostomy site marking by qualified personnel such as ostomy nurses or surgeons to reduce complication rates by respecting individual abdominal configurations. With an increasing prevalence of obesity, ostomy surgery will become even more challenging in the future. A division of the abdominal wall into nine regions might be helpful and more precise for describing and examining ostomy-related complications in the future.

Chris Braumann and Verena Müller contributed equally and both are considered first authors.
Questionnaires were distributed and collected by the homecare company PubliCare® GmbH, Am Wassermann 20–22; 50 829 Köln, Germany.

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Introduction

As shown by previously obtained data (**B**erlin **OS**tomy **S**tudy), we demonstrated that complications after ostomy surgery are high and that they decrease quality of life (QoL) [1, 2]. Furthermore, it appeared that patients after emergency surgery were more prone to complications than were patients after elective surgery [2, 3].

In contrast to emergency procedures, in elective operations, the accurate placement of a potential ostomy is planned and marked. Therefore, it is important to preoperatively designate proper ostomy placement while considering body mass factors and patient physique [4, 5]. The marking should be performed by an ostomy nurse or an experienced ostomy surgeon [6]. Despite the evidence that it provides better outcomes, ostomy site marking is not

carried out in every case (emergency and elective). Sometimes, the patient is not able to move to a standing or sitting position due to her or his deteriorated condition. Nevertheless, on some occasions, the marking is simply forgotten before the patient is brought to the operating room or has already been placed under general anesthesia.

Efforts have been undertaken to identify an easy way to determine the best possible ostomy site for cases in which adequate preoperative marking has not been performed [7]. Unfortunately, methods using fixed anatomical landmarks have not yet proven successful as an alternative to preoperative marking. Additionally, there are conflicting data regarding how to place an ostomy in relation to the rectus sheath [8–10]. According to the literature, approximately 15% of elective potential ostomy patients did not have the ostomy site marked before surgery [11]. To improve the care of these patients and to prevent ostomy-related complications, we wanted to determine whether certain anatomical abdominal areas are prone to ostomy-related complications and therefore should be avoided. Furthermore, the influences of the urgency of the surgery (emergency versus elective) and of body weight on ostomy-related complications were examined. Therefore, BOSS-subgroup data were analyzed.

Patients and methods

The subgroup was selected from the population of the Berlin OStomy Study (BOSS); hence, some of the Patients and Methods section is identical to the previously published article (in which QoL was the main indicator) [2].

Inclusion and exclusion criteria

The presence of an ostomy was the main inclusion criterion in this cross-sectional study. To obtain nationwide access to patients, cooperation was established with PubliCare®, one of the largest homecare companies in Germany. PubliCare® has expertise in the care of patients with an ostomy throughout Germany, Austria and Switzerland. From the PubliCare® database, patients were randomly selected and surveyed. Patients were listed in the homecare company's database independently of the demand for care. Patients were excluded if they refused to participate or were under the age of 16 years. Consent was obtained from all patients.

Data acquisition

After surgery, usually, an ostomy nurse/stoma therapist from the hospital established contact between the patients and a homecare company. All stoma therapists were registered nurses with an additional qualification for stoma and wound management. Every year, the therapists received special training and updates in taking care of ostomies and their complications. Ostomy nurses visited patients to deliver and collect the questionnaires and to assess the ostomy. The personal contact was essential to the high participation rate. The return quota was 88% (2647 completed out of 3000 delivered questionnaires).

Patient characteristics (sex, height, size, date of operation and completion of the questionnaire), information about the ostomy and its complications as well as the urgency of the operation (emergency or elective surgery) were collected. Emergency surgery was defined as any surgery necessary within 6 h [12]. Recorded stoma-related complications were parastomal dermal irritations, prolapse or retraction and parastomal hernia or fistula. Patients and therapists graded the severity of these complications on a five-point Likert-type scale with "1" being the least and "5" being the most severe.

Location of ostomy

To determine location-dependent ostomy complications, the patients were asked to draw the position of their ostomy in a nine-fielded abdominal sketch (Fig. 1). If they were unable to do this unassisted, the ostomy nurse aided them in the ostomy assessment. The nine-fielded grid was that used in the peritoneal carcinosis index developed by Jacquet and Sugarbaker [13]. We chose a classification with nine regions to increase the explanatory power of complications related to the ostomy location. A quadrant-based classification appeared to be too imprecise for determining locational differences.

Definition of overweight and obesity

Body mass index (BMI) is defined as the ratio of body mass (kg) to the square of body height (m^2). Overweight was defined as BMI $> 25 < 30$ kg/m^2, and obesity was defined as BMI > 30 kg/m^2. Obesity was further divided into three classes: class I = BMI $> 30 < 35$ kg/m^2, class II = BMI $> 35 < 40$ kg/m^2 and class III = BMI > 40 kg/m^2.

Statistical analysis

The statistical analysis was conducted by Medistat® (a statistical company located in Kiel, Germany). The Kolmogorov–Smirnov test was used to test for normal distribution. To compare means, the *t* test was used for normally distributed values, and the Kruskal–Wallis test is used for non-normally distributed values.

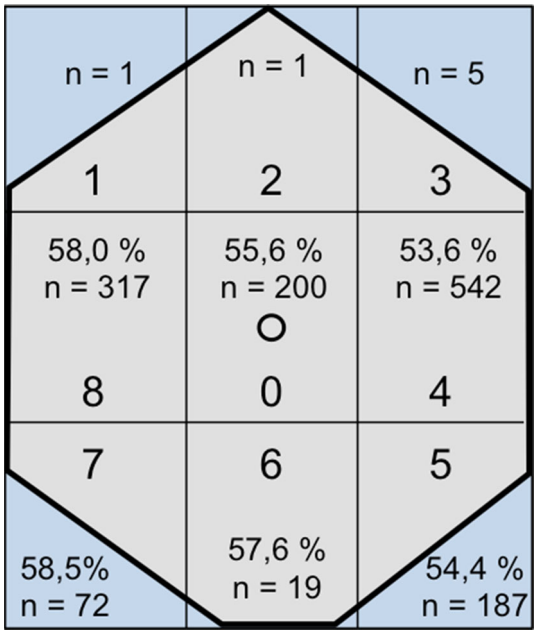

Fig. 1 Nine-fielded grid used to determine overall complication rates at various ostomy locations. Patients used this sketch to show the ostomy location. The number of all patients (total $n = 1344$) with complications depending on the ostomy location is shown. Complication rates are given as percentages. There was no significant difference in complication rates based on ostomy location. No complication rates were provided in fields 1–3 due to limited numbers of patients

For significant results obtained using the Kruskal–Wallis test, post hoc analysis was performed using the Mann–Whitney test (Bonferroni correction).

A multivariate analysis was performed to determine the dependency of stoma-related complications on the urgency of the operation, the BMI and the location of the ostomy. A p value < 0.05 was considered statistically significant.

Results

Over 42 months, 2647 patients completed the questionnaire. Sixty-four patients were excluded because of missing data concerning their ostomies. The overall QoL data have been published [2].

Types of ostomies

In total, 1790 patients had a colostomy, and 756 had a small bowel ostomy or stoma (SBS). Thirty-seven patients had a fecal and a urinary diversion, and 13 patients had two fecal ostomies. Those 50 patients were excluded from further analysis.

Influence of the urgency of operation

In detail, 1474 patients were operated on electively, while 691 patients underwent emergency surgery. In 482 patients, no information could be obtained regarding the urgency of their surgery. Complications included skin irritations, parastomal hernias, stoma prolapse, stoma retraction and fistulas.

At the time of questioning, the overall rate of complications was 55.6%. Emergency surgery led to significantly higher complication rates than did elective surgery (61.6 vs. 52.7%, $p < 0.0001$). This difference was analyzed independent of the kind/type of ostomy (Table 1).

Skin irritations were observed in almost one-third of all patients (32.9%). After emergency surgery, 41.4% of the patients had skin irritations; this value compares with 29.0% after elective surgery ($p < 0.0001$).

In case of emergency colostomy, skin irritations were seen in 34.4% of patients, compared to 22.3% that received their colostomy electively ($p < 0.0001$). Nevertheless, the skin irritation rate was lower in patients receiving a colostomy than in patients receiving SBS. After an emergency operation with SBS, 56.2% of patients suffered skin irritations, while 44.7% of SBS patients after elective surgery had skin irritations ($p = 0.006$).

Complications were graded on a five-point Likert scale concerning severity and manageability. Skin irritations after emergency surgery were more severe than those after elective surgery ($p < 0.001$). Skin irritations in colostomy patients were graded 1 or 2 in 74.2% (emergency) and 85.3% (elective) of cases and were graded 3–5 in 25.8% (emergency) and 14.7% (elective; $p = 0.001$) of cases. Grades 1 or 2 were seen in SBS patients in 51.3% (emergency) and 66.0% (elective) of cases, and grades 3–5 were seen in 48.7% (emergency) and 34.0% (elective; $p < 0.001$) of cases.

Stoma prolapses occurred with the same frequency and severity in the colostomy and SBS patients and in the emergency or elective surgery patients.

Stoma retraction was more often seen after emergency surgery than after elective surgery (18.7 vs. 13.6%; $p = 0.002$). This difference was due to a higher rate of SBS retractions than of colostomy retractions (21.0 vs. 12.5%; $p = 0.005$). Differences between emergency and elective colostomy (17.8 vs. 14.0%; $p = 0.055$) were not statistically significant. In SBS patients, the management of retraction was more difficult (Grade 3–5) after emergency surgery than after elective surgery (19.2 vs. 10%; $p = 0.002$). Again, no differences concerning the severity of complications were observed in colostomy patients.

Table 1 Ostomy complication rates after elective and emergency surgery

	Elective surgery *n* (%)	Emergency surgery *n* (%)	Total *n* (%)	*p* value
Overall complications				
Small Bowel Ostomy	243 (56.3)	139 (66.2)	382 (59.5)	0.016
Colostomy	531 (51.3)	283 (59.3)	814 (53.8)	0.004
Skin irritations				
Small Bowel Ostomy	193 (44.7)	118 (56.2)	311 (48.4)	0.006
Colostomy	231 (22.3)	164 (34.4)	395 (26.1)	<0.001
Stoma prolapse				
Small Bowel Ostomy	32 (7.4)	24 (11.4)	56 (8.7)	ns
Colostomy	76 (7.3)	35 (7.3)	111 (7.3)	ns
Stoma retraction				
Small Bowel Ostomy	54 (12.5)	44 (21.0)	98 (15.3)	0.005
Colostomy	145 (14.0)	85 (17.8)	230 (15.2)	ns
Parastomal hernia				
Small Bowel Ostomy	60 (13.9)	29 (13.8)	89 (13.9)	ns
Colostomy	288 (27.8)	142 (29.8)	430 (28.4)	ns

$p > 0.05$ was considered not significant (ns)

Parastomal hernias were more common in colostomy (28.4%) than in SBS (13.9%) patients. Although no differences in frequency were detected in terms of the urgency of the surgery (emergency colostomy 29.8% vs. elective colostomy 27.8%; $p = 0.515$), the severity of the complication was influenced by the urgency. Grades 3–5 after emergency surgery were observed in 27% of patients with paracolostomal hernia versus in 21.5% of patients after elective surgery ($p < 0.05$).

The rates of fistula were generally low. Only 1.7% of all patients had a fistula (colostomy 0.7%, SBS 3.9%). The differences between emergency and elective surgery were significant (2.0 vs. 0.9%, $p = 0.05$). The severity was not influenced significantly by the urgency of surgery.

Influence of the ostomy location

Concerning ostomy sites and the occurrence of complications, the rates did not differ among the different sites (elective surgery $p = 0.15$; emergency surgery $p = 0.13$).

The nine-fielded grid was used by 2344 patients to specify the exact ostomy location. Of these patients, 1344 had an ostomy-related complication.

Most ostomies (83.7%) were located in lower abdomen (left or right, regions 5 and 7), the flank (regions 4 and 8) or near the umbilicus (region 0; Fig. 1). The ostomy was rarely placed in the upper part of the abdomen (regions 1–3) or suprapubically (region 6). Multivariate analysis revealed no differences in complications among the different locations after emergency or elective surgery (elective surgery $p = 0.15$; emergency surgery $p = 0.13$).

Influence of BMI

For weight-related analysis, 2110 patients provided sufficient information and were examined further. Obese patients were more prone to complications than the others. The higher the body mass index (BMI) was, the higher the complication rate was. This result was independent of the kind or location of the ostomy.

Complications were seen in 48.6% of patients with normal BMI (18.5–25). Ostomy complications were found in 53.6% of patients after emergency surgery and in 46.2% of patients after elective surgery. Patients with a BMI above 40 had significantly higher rates of complications ($p < 0.001$). After emergency surgery, 88.9% of obese patients suffered from ostomy-related complications; this value compares with 66.9% after elective surgery. More detailed information is presented in Table 2.

The severity of complications was influenced by BMI. Parastomal hernias were more severe in both groups of patients, colostomy and SBS patients, and stoma retractions were more common in colostomy patients. Higher BMI was not only associated with more complications, but the complications that occurred were also more severe ($p < 0.001$).

Discussion

In an emergency, many variables cannot be influenced: the time, the on-call-surgeons' experience, the patients' (comorbid) conditions and preconditions or intraoperative findings. These factors increase the risk for perioperative

Table 2 Overall ostomy complication rates with respect to BMI (body mass index). (a) Patients grouped according to ostomy type. (b) Patients grouped according to the urgency of surgery, independent of ostomy type

	BMI [kg/m^2]						
	<18.5	18.6–25	25.1–29.9	30–34.9	35–40	>40	Total
(a)							
Small Bowel Ostomy patients with complications (%)	52.4	53.7	59.2	73.0	75.0	100.0	57.3
Colostomy patients with complications (%)	46.4	46.6	58.1	62.2	69.6	72.2	53.8
(b)							
Patients after elective surgery with complications (%)	50.9	46.2	58.2	62.1	69.7	66.7	53.2
Patients after emergency surgery with complications (%)	48.4	53.6	64.9	74.2	76.2	88.9	60.5

complications, morbidity and mortality. Complications may deteriorate a patient's long-term QoL. Some factors cannot be altered, but some variables can be influenced to decrease complication rates and thus to improve QoL.

We demonstrated that complication rates were higher after emergency surgery than after elective surgery. Particularly, skin irritations and stoma retractions were observed more often. Furthermore, specific complications including skin irritations, paracolostomal hernia and stoma retraction in SBS patients were not only more frequent but also more severe after emergency surgery. Although studies have proven that preoperative ostomy site marking by an ostomy nurse or trained surgeon helps to improve QoL and reduced ostomy-related complication rates [4, 14, 15], it has been estimated that approximately 20% of emergency patients undergo no preoperative marking [11].

Patients are occasionally unable to sit or even stand, thus limiting the quality of preoperative marking. Our experience is that marking is often simply forgotten during preoperative preparation or the possibility of an ostomy being needed during the course of surgery is not considered. Nevertheless, in some cases, the intraoperative findings (e.g., the rigidity/length of the mesentery or a thick abdominal wall in obese patients) limit the possibilities for optimal placement of the ostomy.

To achieve better outcomes, it is essential to have an abdominal surgeon available who performs ostomy surgery on a regular basis, not only in emergencies. Increased surgeon specialization and efforts to reduce costs in healthcare systems maintain structural risks for patients. Therefore, at certain times, there might not be a visceral/colorectal specialist available. In addition to the challenges and risks for patients suffering from complications, economic damage results from avoidable complications after surgery [16, 17].

There is a rising prevalence of obesity in Germany and in many other countries. Obesity is associated with increased all-cause mortality and reduces QoL [18, 19]. Surgical site infections are more frequent in obese patients [20, 21] There is evidence that stoma-related complications, including stoma retraction and parastomal hernia rates, are also higher in obese individuals [11, 22–24]. Our data demonstrated that ostomy-related complication rates were indeed higher in this population. BMI > 30 was an independent risk factor for complications including skin irritations, parastomal hernias and stoma retractions. The higher the BMI was, the higher the risk of complications; higher BMI also made it more difficult to manage parastomal hernias and colostomal retractions.

Obesity is associated with increased risks for colorectal cancer and diverticulitis and diverticulitis bleeding, two diseases that might lead to surgery requiring the formation of an ostomy [25, 26]. Therefore, not only is the prevalence of obesity increasing, but there is also a disproportionately higher rate of patients requiring ostomy surgery with a higher risk of suffering from ostomy-related complications.

This study also aimed to identify better ostomy locations; however, we were unable to determine any that could be recommended. There were no significant differences among the different abdominal locations of the stoma in cases of ostomy-related complications. This observation was valid for both obese and non-obese patients. The lack of differences between locations together with the high overall complication rate underlines the importance of the preoperative marking to position the ostomy while respecting the individual abdominal configuration. However, in obese patients, the ostomy should be placed in the upper abdomen for easier management [5, 27].

The power of this study was limited by its observational nature. The questioning and assessment of the patients and the ostomy were performed postoperatively, and the dissemination of the ostomy locations was not equal. The location of the ostomy was given and, though reduced, even with a nine-fielded grid, inaccuracies remained concerning the exact location, e.g., regarding its location in a central area or at the edge of the region.

The level of care from the ostomy nurse was not recorded. This might have led to a bias, since more care in some patients might result in fewer complications.

Another limitation is the rate of missing data. Though partially compensated by the large cohort, in the different subgroups, a missing data rate of 15–20% was observed. Furthermore, the statement that marking the ostomy sites preoperatively is advantageous concerning complication rates can only be deduced from the literature. This finding was not recorded in our study, in which patients were marked before surgery.

There have been efforts to develop standard ostomy sites in case the preoperative marking is missing, but fixed anatomic landmarks are not able to prevent complications [7, 28]. It appears important to consider the relation of the ostomy to the rectus muscle; however, the gold standard remains the preoperative siting of the ostomy [15]. If an ostomy must be placed in field 0 (umbilicus), it should be placed only at the edge of this field for reasons of ostomy management.

Ostomies deteriorate QoL, and ostomy-related complications impair QoL even further. On the one hand, new operative strategies in emergency surgery might be able to avoid ostomies, even in severe diseases such as perforated diverticular disease [29, 30]; on the other, ostomies will still be necessary in certain cases and might be the safer option in some cases. For further research on ostomy-related topics, especially ostomy complications, we advocate the use of our nine-fielded grid for a more exact distinction among ostomy locations.

Our data demonstrate the influence of body weight—and thus the body constitution—on ostomy-related complications. In conclusion, there was no preferential abdominal location to avoid complications, and conversely, no placement had relevant advantages. Nevertheless, the importance of preoperative ostomy site marking by qualified personnel, such as ostomy nurses, to reduce complication rates must be considered standard. Individualization and patient-tailored treatment remains key to avoiding complications.

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Compliance with ethical standards

Conflict of interest None of the authors declare a conflict of interest.

Informed consent The Declaration of Helsinki was observed, and consent was obtained from all patients.

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