ORIGINAL ARTICLE

Mortality and Complications After Stoma Closure

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Hypothesis: This study was undertaken to evaluate factors contributing to hospital mortality and complications of stoma closure.

Design: Retrospective cohort study.

Setting: Department of Surgery of a 2500-bed university hospital.

Patients: Consecutive eligible patients who underwent stoma closure were selected from a local registry containing 30 219 patients. The medical records of 587 adult patients were reviewed according to a predefined extraction form. Patients with additional, unrelated surgical interventions or younger than 18 years were excluded. Follow-up was complete for all included patients.

Main Outcome Measures: The primary outcome variable was 30-day mortality; the secondary outcome variable was presence of surgery-related complications within 30 days.

Results: We analyzed 533 patients with stoma closure between 1993 and 2001. The overall stoma closure–related mortality rate was 3% (15 patients); the overall stoma closure–related surgical complications rate was 20% (107 patients). Wound infections (9%) and anastomotic leakage (5%) were the most common surgical complications. Age was the only significant risk factor for survival ($P=.02$). Use of a soft silicone drain for intraperitoneal drainage (odds ratio, 1.62 [95% confidence interval, 1.07-2.45]; $P=.03$) was the only significant risk factor for complications. In patients with carcinoma as the primary disease (odds ratio, 0.61 [95% confidence interval, 0.40 to 0.93]; $P=.02$), we observed significantly fewer complications.

Conclusions: We found considerable mortality and complications after stoma closure. Apart from age, we could not identify any predictor for mortality in patients with stoma closure. Randomized studies are needed to determine whether certain types of drains influence outcome.

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CONSTRUCTION OF A TEMporary stoma is a relatively common surgical procedure. A transient stoma should lower the operative risk and should be closed as soon as possible, but in the literature, the morbidity and mortality rates after ileostomy or colostomy closure are rather high[1-8] (**Table 1**). Several studies have compared colostomy closure with ileostomy closure, finding a multitude of factors influencing the complications of stoma closure, such as the surgeon's experience, perioperative treatment, timing of the operation, and the surgical technique.[11-14]

See Invited Critique at end of article

We reviewed our own experience with stoma closures during a 9-year period to analyze factors determining hospital mortality and complications of this procedure in an effort to recognize any modifications in technique or management that may prove beneficial.

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METHODS

We used the University Hospital of Vienna (Vienna, Austria) Department of Surgery local registry, which records all patients (N=30 219) who have undergone any surgical intervention, to identify all consecutive patients who underwent stoma closure between January 1993 and December 2001. So as not to miss any patients, we also searched the electronic data management system of the hospital, which is totally independent of the local registry. Data were extracted from patients' medical records according to a predefined data extraction sheet. We excluded patients younger than 18 years and patients with an additional, unrelated surgical intervention.

Complications were divided into surgery related requiring reoperation and surgery related with conservative treatment. Wound infections, anastomotic leakage, postopera-

tive ileus, and bleeding were considered surgical complications.

Gastrografin enema, sigmoidoscopy, or colonoscopy were performed in all patients prior to closure. Patients had routine mechanical preparation of the proximal and distal bowel with cessation of oral feeding the day before operation and orthograde lavage with saline solution orally administered and irrigation of the distal loops prior to surgery. All patients underwent single-shot parenteral antibiotic treatment (cefuroxime and metronidazole hydrochloride) immediately prior to operation.

The study was designed as a retrospective cohort study. Several patient-related and surgery-related risk factors were recorded. The primary outcome variable was 30-day mortality; the secondary outcome variable was presence of surgery-related complications within 30 days. Acquisition of patient characteristics was by medical record review and by searching the electronic data management system of the hospital. Data are given as median and 75% interquartile range or number and percentage where adequate. For the univariate comparison of dichotomous data, we used χ^2 analysis or the Fisher exact test, where appropriate. Continuous data were compared with the Mann-Whitney *U* test. Odds ratios and their 95% confidence intervals for the effect of binary risk factors on mortality or surgical complications were calculated. Multivariate logistic regression analysis was planned for adjusted analysis of predictors of mortality or surgical complications. Because there were not multiple predictors of interest in the univariate comparisons, multivariate analysis was not performed. Microsoft Excel 97 (Microsoft, Redmond, Wash) and SPSS for Windows Release 10.0.7 (SPSS Inc, Chicago, Ill) were used for data analysis. A 2-sided P value $< .05$ was considered statistically significant.

RESULTS

PATIENT CHARACTERISTICS

The medical records of 587 consecutive patients with stoma closure at the University Hospital of Vienna between January 1993 and December 2001 were identified and reviewed. We included 533 patients in the study; 223(42%) were female, and the median age of all patients was 56 years (interquartile range, 43-68 years). Treatment of rectal carcinoma was the most frequent indication for creating a stoma (44%); perforation (18%), Crohn disease (17%), diverticulitis (17%), peritonitis (13%), ulcerative colitis (11%), and miscellaneous primary diseases (20%) were equally distributed. In 101 patients (19%) with carcinoma of the rectum, preoperative irradiation was performed. Two hundred thirty-four patients (44%) had closure of an ileostomy and 272 patients (51%), of a colostomy. Twenty-seven patients (5%) had combined closure of ileostomy and colostomy. One hundred twenty-five (64%) of 214 patients had a loop colostomy or ileostomy and 47 (36%) of 147 patients had complete diverting colostomy or ileostomy. The median postoperative hospital stay was 11 days (interquartile range, 8-15 days).

OPERATIVE TECHNIQUE

The median interval between stoma construction and stoma closure was 90 days (interquartile range, 60-154 days). All closures were performed by the intraperitoneal method. Four hundred thirty anastomoses (81%) were sutured using absorbable, interrupted, 1-layer, full-thickness sutures; 103 (19%) were stapled.

Table 1. Literature Survey of Morbidity and Mortality Rates After Stoma Closure

Source	No. of Patients	Morbidity, %	Mortality, %
Knox et al,[9] 1971	179	33	2.2
Garnjobst et al,[10] 1978	125	5.6	0
Rosen and Friedman,[7] 1980	153	15	1.4
Freund et al,[11] 1982	114	50	0
Salley et al,[6] 1983	166	2.4	0
Parks and Hastings,[8] 1985	83	41	0
Pittman and Smith,[2] 1985	126	33	0
Köhler et al,[12] 1994	182	31	0.5
Riesener et al,[13] 1997	548	48.2	2
Current study, 2005	533	20	3

One hundred forty-nine colostomy/ileostomies (28%) were reversed by transverse closure, while in 384 (72%), a short-bowel segment was resected and an end-to-end anastomosis was performed.

Drains were inserted at the discretion of the operating surgeon. An intraperitoneal hard rubber or soft silicone drain was used in 351 patients (66%); 182 patients (34%) did not receive a drain. One hundred forty-four stoma closures (27%) were directly supervised operations, and 389 stoma closures (73%) were performed by consultants.

Median duration of surgery was 90 minutes (interquartile range, 60-154 minutes).

OPERATIVE MORTALITY

Overall, 15 patients (N=533) died after stoma closure, resulting in a mortality rate of 3%. Mortality rates were similar for both types of stoma (ileostomy, 2%; colostomy, 3%). The main causes of death were multiorgan failure after several nonsurgical complications in 9 patients and sepsis after anastomotic leakage or other bowel injury in 6 patients. Anastomotic leakage with lethal sepsis occurred in 4 patients after ileostomy closure; iatrogenic small-bowel perforation and spontaneous perforation of the cecum were the causes of death after colostomy closure for 2 patients.

The differences between survivors and nonsurvivors are presented in **Table 2** and **Table 3**. The relative risks are shown in **Figure 1** and **Figure 2**. Age was the only significant risk factor for survival ($P=.02$).

SURGERY-RELATED COMPLICATIONS

Surgery-related complications were observed in 107 patients (20%). Wound infection and anastomotic leakage were the most frequent complications (**Table 4**). Leaks occurred in 29 patients (5%), of whom 17 (3%) required relaparotomy. Twelve patients (2%) responded to conservative treatment.

Ileus occurred in 21 patients (4%), of whom 7 (1%) required a laparotomy. Postoperative bleeding occurred in 11 patients (2%), of whom 7 (1%) required a laparotomy. Wound infections (n=46 [9%]) were found mainly after colostomy closure. The differences be-

Table 2. Patient-Related Risk Factors for 30-Day Mortality After Stoma Closure*

Risk Factor	Survivors (n = 518)	Nonsurvivors (n = 15)	*P* Value†
Age, y, median (interquartile range)	56 (43-68)	61 (55-75)	.02
Sex			
Female	214 (41)	6 (40)	
Male	304 (59)	9 (60)	.19
Stoma			
Colostomy	289 (56)	10 (67)	.44
Ileostomy	255 (49)	6 (40)	.60
Ileostomy/colostomy	26 (5)	1 (7)	.55
Stoma type			
Diverting	187 (36)	7 (47)	
Loop	331 (64)	8 (53)	.42
Reason for stoma construction			
Carcinoma	226 (44)	7 (47)	.80
Perforation	94 (18)	3 (20)	.74
Crohn disease	87 (17)	1 (7)	.48
Diverticulitis	85 (16)	4 (27)	.29
Peritonitis	64 (12)	3 (20)	.42
Ulcerative colitis	56 (11)	1 (7)	.99
Miscellaneous	103 (20)	3 (20)	.99
Preoperative irradiation	96 (19)	5 (33)	.18

*Values are expressed as number (percentage) of patients unless otherwise indicated. Categories are not mutually exclusive.
†For the comparison of survivors vs nonsurvivors.

Table 3. Operation Technique–Related Risk Factors for 30-Day Mortality After Stoma Closure*

Risk Factor	Survivors (n = 518)	Nonsurvivors (n = 15)	*P* Value†
Interval from construction to closure, d, median (interquartile range)	90 (62-154)	96 (56-153)	.63
Type of anastomosis			
End-to-end anastomosis	371 (72)	13 (87)	
Simple closure	147 (28)	2 (13)	.25
Surgeon's experience			
Trainee	139 (27)	5 (33)	
Consultant	379 (73)	10 (67)	.56
Suture technique			
Stapled anastomosis	99 (19)	4 (27)	
Hand sutured	419 (81)	11 (73)	.51
Drainage			
Soft silicone drain	268 (52)	10 (67)	.30
Hard rubber drain	87 (17)	2 (13)	.99
Without drainage	178 (34)	4 (27)	.78
Duration of surgery, min, median (interquartile range)	90 (60-150)	139 (59-218)	.29

*Values are expressed as number (percentage) of patients unless otherwise indicated. Categories are not mutually exclusive.
†For the comparison of survivors vs nonsurvivors.

tween patients with and without complications are presented in **Table 5** and **Table 6**. The relative risks are shown in **Figure 3** and **Figure 4**.

Using a soft silicone drain for peritoneal drainage (odds ratio, 1.62 [95% confidence interval, 1.07-2.45]; *P* = .03) was the only significant risk factor for complications. In patients with carcinoma as the primary disease (odds ratio, 0.61 [95% confidence interval, 0.40-0.93]; *P* = .02), we observed significantly fewer complications.

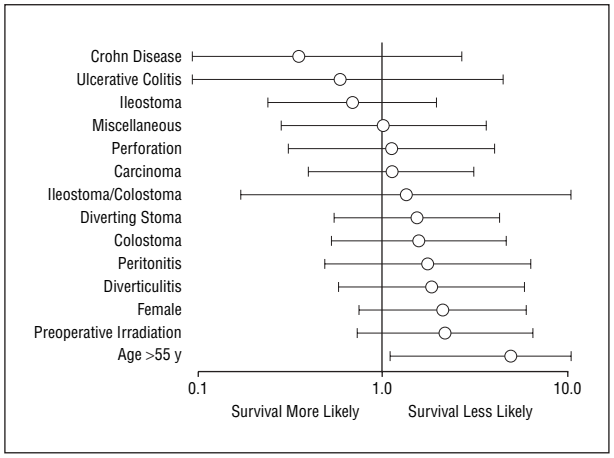

Figure 1. Patient-related risk factors for mortality. Circles represent odds ratios and error bars represent 95% confidence intervals for relative risk of survival.

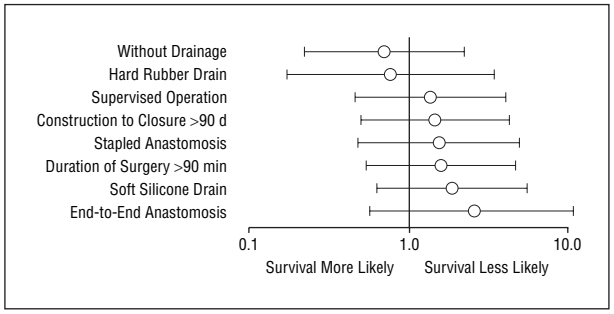

Figure 2. Operation technique–related risk factors for mortality Circles represent odds ratios and error bars represent 95% confidence intervals for relative risk of survival.

Table 4. Surgery-Related Complications of Stoma Closure in 533 Patients*

Complication	Total	Reoperated	Conservative Treatment
Anastomotic leakage	29 (5)	17 (3)	12 (2)
Ileus	21 (4)	7 (1)	14 (3)
Postoperative bleeding	11 (2)	7 (1)	4 (0.8)
Wound infection	46 (9)	3 (0.6)	43 (8)
Total	**107** (20)	**34** (6)	**73** (14)

*Values are expressed as number (percentage) of patients.

COMMENT

Temporary stoma creation is an essential part of emergency and elective colonic surgery and therefore used quite commonly. Among reported series, morbidity and mortality rates of stoma closure in routinely performed stoma creation are often disputed.[15] Generalization from published reports is difficult because of conflicting results among the reported series, with many differences in the definition of compli-

Table 5. Patient-Related Risk Factors for Complications After Stoma Closure*

Risk Factor	Without Complications (n = 413)	With Complications (n = 120)	*P* Value†
Age, y, median (interquartile range)	56 (42-68)	56 (47-69)	.32
Sex			
Female	182 (44)	41 (35)	
Male	231 (56)	79 (65)	.07
Stoma			
Colostomy	235 (57)	64 (54)	.60
Ileostomy	203 (49)	58 (49)	.99
Ileostomy/colostomy	24 (6)	3 (3)	.23
Stoma type			
Diverting	150 (36)	44 (37)	
Loop	263 (64)	76 (63)	.91
Reason for stoma construction			
Carcinoma	192 (46)	41 (35)	.02
Perforation	71 (17)	26 (22)	.28
Crohn disease	74 (18)	14 (12)	.13
Diverticulitis	73 (18)	16 (13)	.33
Peritonitis	49 (12)	18 (15)	.35
Ulcerative colitis	49 (12)	8 (7)	.13
Miscellaneous	78 (19)	28 (24)	.30
Preoperative irradiation	82 (20)	19 (16)	.43

*Values are expressed as number (percentage) of patients unless otherwise indicated. Categories are not mutually exclusive.
†For the comparison of survivors vs nonsurvivors.

Table 6. Operation Technique–Related Risk Factors for Complications After Stoma Closure*

Risk Factor	Without Complications (n = 413)	With Complications (n = 120)	*P* Value†
Interval from construction to closure, d, median (interquartile range)	90 (62-152)	90 (60-163)	.81
Type of anastomosis			
End-to-end anastomosis	292 (71)	92 (77)	
Simple closure	121 (29)	28 (23)	.17
Surgeon's experience			
Trainee	110 (27)	34 (28)	
Consultant	303 (73)	86 (72)	.73
Suture technique			
Stapled anastomosis	80 (19)	23 (19)	
Hand sutured	333 (81)	97 (81)	.99
Drainage			
Soft silicone drain	205 (50)	73 (61)	.03
Hard rubber drain	75 (18)	14 (12)	.13
Without drainage	148 (36)	34 (29)	.16
Duration of surgery, min, median (interquartile range)	90 (60-150)	100 (60-180)	.24

*Values are expressed as number (percentage) of patients unless otherwise indicated. Categories are not mutually exclusive.
†For the comparison of survivors vs nonsurvivors.

cations. Therefore, reported morbidity rates after closure of temporary stomas vary widely, from 2.4% to 48.2%[2,6-13] (Table 1).

A literature survey (1971-1978) of 1739 patients revealed a morbidity rate of 29.4% (minimum, 5.6%; maximum, 49%).[16] Bozzetti et al[5] calculated in a literature review of 3707 patients a median morbidity rate of 27.5% and mortality rate of 0.8% (minimum, 0.5%; maximum, 4.5%).

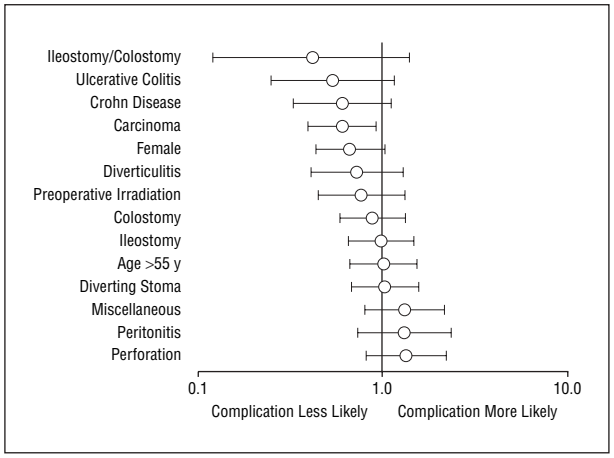

Figure 3. Patient-related risk factors for complications. Circles represent odds ratios and error bars represent 95% confidence intervals for relative risk of complications.

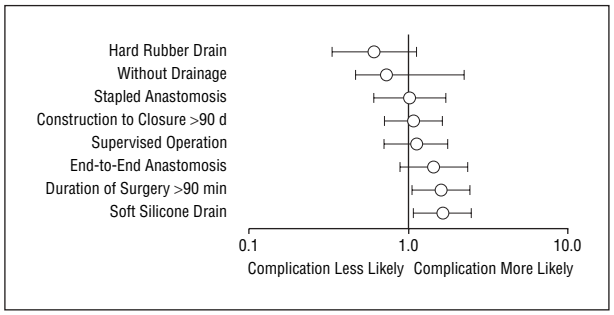

Figure 4. Operation technique–related risk factors for complications. Circles represent odds ratios and error bars represent 95% confidence intervals for relative risk of complications.

Our definition of morbidity was restricted to surgical complications requiring reoperation and surgical complications without need for revision. Our operative complications rate was comparable with other studies; systemic complications were not considered important complications, which explains the higher complication rates (almost 50%) in other publications.

A higher incidence of operative mortality (3%) was recorded in this study than reported by others. Univariate analysis showed that operations in elderly patients were significantly associated with a higher incidence of hospital mortality. General health of the patient influences the outcome of any medical intervention; therefore, it is not surprising that a stoma constructed in a patient whose general condition is poor seems to carry the highest mortality. Aging affects almost all aspects of the healing process; elderly patients have a higher incidence of systemic medical conditions and the ratio of emergency to elective surgery is higher.

Patient-related risk factors for complications were not identified. Univariate analysis showed that patients with carcinoma as the primary disease had significantly fewer complications, probably because of differences in emergency and elective colonic surgery for primary operation. In a separate post hoc analysis of patients with carcinoma as the rea-

son for creating a stoma, preoperative irradiation showed no significance on complications and mortality.

Duration of surgery, the surgeon's experience,[4,16] operative technique,[4,11,12] and interval between primary operation and stoma closure[6,8,9,11,17] were not identified as operative technique–related risk factors for mortality and complications. Only use of a soft silicone drain influenced significantly ($P=.03$) the incidence of surgery-related complications.

Intraperitoneal drains have been associated with higher anastomotic leak rates in colostomy closures. Dolan et al[18] did not drain any colostomy closures and had a 1.6% incidence of anastomotic leak. Rosen and Friedman[7] drained all colostomy closures and had a 5% incidence of fecal fistulas but no abdominal abscesses. Yakimets[19] had 2 anastomotic leaks in 6 patients (33%) with intraperitoneal drains and none in 65 patients without drains.

In conclusion, the present study confirms the high complication and mortality rates associated with stoma closure. Apart from age, we could not identify any strong predictor for mortality in patients with stoma closure. Noteworthy complications were more frequent in patients who had soft silicone drains. For clinical practice it might be beneficial to be cautious in reconstructing stomata in older patients. Randomized studies are needed to determine to what extent different drains influence outcome in these patients.

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Invited Critique

Stoma closure is so often considered a "minor" procedure, but as clearly and appropriately pointed out in this article, it is associated with significant morbidity and mortality. This should not be unexpected because these patients are undergoing bowel operations and therefore should be accorded the same considerations and respect as any other patients undergoing bowel operation. A review of this large series afforded the authors the opportunity to adequately assess the morbidity from stoma closure. It was not surprising that the use of soft silicone drains was identified as a risk factor. Although not specifically mentioned by the authors, it would appear to be related to anastomotic leaks. Canalis and Ravitch[1] many years ago clearly demonstrated that wrapping anastomoses with drains promoted anastomotic dehiscence, and hence, those surgeons who drain to "identify" the leak are indeed creating a self-fulfilling prophecy. The authors reported "ileus" in 4% of patients, and one presumes these were cases of small-bowel obstruction; if so, they should more appropriately be labeled as such. Indeed, small-bowel obstruction following stoma closure is a well-recognized problem, but not all these patients require further laparotomy. Another complication not mentioned that might have been expected in a series this size is enterocutaneous fistula. Although the authors found no difference in stoma closure using a hand-sutured vs stapled anastomosis, other surgeons, including myself, have favored stapled closure of ileostomies because we believe the anastomotic complication rate is reduced. A recognized risk factor for closure is hypoalbuminemia, but the authors did not address this factor. Nevertheless, the authors are to be complimented on bringing our attention to the morbidity of this procedure.

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