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Original Research Article

Factors affecting temporary stoma outcomes at a major Saudi University Hospital

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ABSTRACT

Background: Temporary stoma formation for fecal diversion is commonly performed in surgery. The rate of stoma-related complications is high, and the risk increases in patients with prolonged time to closure. Thus, identifying factors that influence the time to stoma closure and the rate of its complications would aid in implementing preventive measures. We aimed to determine predictors affecting the time to stoma closure and to identify risk factors for developing complications following stoma reversal.
Methods: A retrospective review including all adult patients who underwent stoma closure from 2012-2018 at our institution was conducted. Multivariate regression analysis was used to determine risk factors affecting time to stoma closure and developing complications after reversal surgery.
Results: A total of 63 patients were included. Of those, 50.8% were diagnosed with malignancy. The median time to stoma closure was 222.5 days (interquartile range i.e. IQR 12-2228).
Having an American society of anesthesiologists (ASA) class IV was the only significant predictor of prolonged time to closure. For cancer patients, developing complications following stoma formation surgery, and receiving adjuvant therapy significantly increased the time to stoma reversal. In contrast, cancer patients who underwent multi-organ resection had shorter time to closure. The rate of complications following stoma reversal was 30.2%. Having a colostomy and requiring readmission after stoma formation surgery increased the risk of developing complications related to stoma reversal.
Conclusions: Multiple factors can impact the time to stoma closure and increase the risk of developing complication related to stoma closure. Awareness about these factors and development of preventive strategies is recommended.

Keywords: Surgical stoma, Ostomy, Postoperative complication, Time factors/adverse effects

INTRODUCTION

The number of stoma creation surgeries is rising due to the high incidence of colorectal tumors and inflammatory bowel diseases which are the two most common indications for ostomy creation.[1] Stomas are constructed to divert fecal material from a distal intestinal anastomosis or a diseased bowel segment, thus preventing abdominal sepsis.[2] Despite its benefits, the rate of stoma-related complications is high, reaching up to 26.5%.[3] Several factors were implicated in the development of complications including patient age, body mass index (BMI), locally advanced malignancies, type of stoma, and the method of closure.[3-5] In addition, prolonged time to closure (more than 6 months) of temporary stomas was found to increase the risk of complications and the length of hospital stay, subsequently worsens the patients' quality of life and raising hospital costs.[6-8] Given the implications of prolonged time to stoma closure, identifying risk factors which prolong the time to closure would aid in targeting

them for preventive measures. Therefore, this study was conducted to determine risk factors that affect the time to stoma closure and identify predictors of stoma-closure complications among ostomy patients at our institute.

METHODS

Study participants and data collection

The study proposal was reviewed and approved by the ethical committee of our institution. This is a retrospective study that included all adult patients who underwent stoma closure surgery from 2012 to 2018 at King Abdul-aziz University Hospital (KAUH) in Jeddah, Saudi Arabia.

The data were obtained from the electronic health records and paper charts. The primary operation was defined as the operation when "stoma formation" was done, and "stoma closure surgery" was considered as the secondary operation. Data collected for the cohort included patient characteristics, perioperative and intra-operative characteristics of the primary and secondary procedures. Additional data regarding neoadjuvant and adjuvant therapies for cancer patients were also obtained.

Indications of the primary operation were grouped into 2 main categories; benign diseases which included diverticulitis, ischemic colitis, traumatic bowel perforation, mesenteric ischemia, Crohn's disease, recto-vesical fistula, soft tissue debridement; and malignant diseases including colorectal cancer, uterine sarcoma and ovarian carcinoma. Furthermore, the type of procedures performed in the primary operation were categorized into colon resection procedures (left and right hemicolectomy, sigmoidectomy, Hartman's procedure, and subtotal colectomy), rectal resection procedures (low anterior resection, proctocolectomy, rectal polyp excision), isolated stoma formation without organ resection (diverting stoma, repair of perforation, drainage of intra-abdominal collections with stoma formation), small bowel resection procedures (terminal ileum resection, gangrenous small bowel resection), and multi-organ resection (total abdominal hysterectomy with bilateral salpingo-ophorectomy with right hemicolectomy, debulking and hyperthermic intraperitoneal chemotherapy-HIPEC surgeries). Length of hospitalization (LOH) was calculated from the day of admission to the hospital until the day of discharge. Post-operative complications during hospitalization, stoma-related complications and overall complications were recorded and categorized according to (Clavien Dindo) classification.[9] Overall complications were defined as complications occurring during hospitalization and within 30 days after discharge. Readmissions were considered if they occurred within 30 days of discharge.

Study outcomes

The primary outcomes were factors that affect the time to stoma-closure, and the predictors associated with developing complications at the time of closure. The time to stoma closure was defined as the interval between the dates of the primary and secondary operations.

Statistical analysis

To describe our study participants, we used frequencies for categorical variables, while the mean, median, interquartile range (IQR) and standard deviation were used for continuous variables. Univariate analysis was conducted to identify factors associated with primary study outcomes. Variables with p value of (<0.1) in univariate analysis were included in the multivariate regression model. Linear regression was conducted to identify factors affecting the time to stoma-closure. Logistic regression was performed to determine significant predictors associated with developing complications at the time of the secondary operation. A subgroup regression analysis was conducted for cancer patients. We considered a p value <0.05 to be statistically significant. Statistical analyses were carried out using IBM statistical package for social sciences (SPSS) software version 21.

RESULTS

A total of 63 patients were enrolled in this study. Patients' demographics and clinical characteristics are shown in (Table 1). The mean age of the cohort was 52.7±15.6 years, and most patients were male 35 (55.6%) and non-Saudi 41 (65.1%). The mean BMI at the time of the secondary operation was 25.3±5.9 kg/m^2. Patients who had malignant condition as an indication for their primary operation accounted for 32 (50.8%) of the cohort, half of those patients underwent neoadjuvant therapy 16 (51.6%), and 22 (71%) had adjuvant chemotherapy.

The characteristics of the primary operation are presented in (Table 2). The most commonly performed procedures were rectal resection 21 (33.3%), followed by colon resection 18 (28.6%) and isolated stoma formation 17 (27%). The most common type of stoma created during the primary operation was ileostomy 41 (65.1%). Around half of the procedures 33 (55%) were performed in an emergency setting and the majority were done through an open approach 53 (89.8%). Twenty-one (35.6%) patients developed complications during hospital stay including; bleeding, surgical site infections, wound dehiscence, anastomotic leakage, pulmonary embolism, sepsis, urinary tract infection, pneumonia, and central line infection. The rate of 30-day hospital readmission was 25.4%.

Perioperative characteristics of the secondary operation are shown in (Table 3). The median time to stoma closure was 222.5 days (12-2228). Most of the patients had their stoma closed through the stoma site 47 (82.5%) and the bowel re-anastomosis was most frequently performed using staples 39 (70.9%). The median duration of the secondary operation was 120 minutes (50-409). The rate of overall complications was 30.2%.

Table 1: Demographic and patients' characteristics for patients who underwent stoma closure (n=63).

Categories	Frequency (%)	N
Gender		63
Male	35 (55.6)	
Female	28 (44.4)	
Age		63
Mean	52.7	
SD	15.6	
Nationality		63
Saudi	22 (34.9)	
Non-Saudi	41 (65.1)	
Chronic diseases		63
No	26 (41.3)	
Yes	37 (58.7)	
History of previous abdominal surgeries		63
No	52 (82.5)	
Yes	11 (17.5)	
BMI		
Mean	25.3	
SD	5.9	
Indication for surgery		63
Malignant diseases	32 (50.8)	
Benign diseases	31 (49.2)	
Neoadjuvant therapy		31
No	15 (48.4)	
Yes	16 (51.6)	
Adjuvant therapy		31
No	9 (29)	
Yes	22 (71)	
Received adjuvant therapy before stoma closure		22
No	3 (13.6)	
Yes	19 (86.4)	

Factors associated with the time to stoma closure were analyzed using univariate and multivariate analysis (Table 4). On univariate analysis, significant factors that prolonged the time to closure were isolated stoma formation in the primary operation, having an ASA4 class, and increased duration of hospital stay (LOH). In contrast, higher albumin levels at the time of the primary operation led to decreased time to closure. Variables with p value of (<0.1) on univariate analysis were included in the multivariate regression. ASA class four (OR 1032.0; 95% CI 435.38-1628.63, p=0.0012) remained the only significant predictor of prolonged time to closure on multivariate analysis. Further subgroup analysis of cancer patients was conducted. Overall complications occurring after the primary operation (OR 127.28; 95% CI 17.06-237.50, p=0.0254), and receiving adjuvant therapy (OR 173.59; 95% CI 48.56-298.62, p=0.0084) were significant predictors for prolonged time to closure on multivariate analysis. On the other hand, patients who underwent multiorgan resection had significantly shorter time to closure (OR-256.13, 95% CI (-458.02) - (-54.24), p=0.015).

Table 2: Patients and primary operation characteristics (n=63).

Categories	Frequency (%)	N
Primary operation		63
Colon resection	18 (28.6)	
Rectal resection	21 (33.3)	
Isolated stoma formation	17 (27)	
Small bowel resection	2 (3.2)	
Multiorgan resection	5 (7.9)	
Surgery urgency		60
Elective	27 (45)	
Emergency	33 (55)	
Surgical approach		59
Open	53 (89.8)	
Laparoscopic	6 (10.2)	
ASA		58
1	4 (6.9)	
2	25 (43.1)	
3	26 (44.8)	
4	3 (5.2)	
Use of epidural anesthesia		58
No	27 (46.6)	
Yes	31 (53.4)	
Type of stoma		63
Iliostomy	41 (65.1)	
Colostomy	22 (34.9)	
LOH*		
Mean	25.9	
SD	27.2	
ICU admission		60
No	34 (56.7)	
Yes	26 (43.3)	
Readmission within 30 days		63
No	47 (74.6)	
Yes	16 (25.4)	
Complications during hospitalization*		60
No	38 (64.4)	
Yes	21 (35.6)	
Stoma complications*		56
No	50 (89.3)	
Yes	6 (10.7)	
Overall complications*		60
No	30 (50)	
Yes	30 (50)	

*LOH= length of hospitalization

Logistic regression was performed to determine risk factors for developing complications in the secondary operation (Table 5). Univariate and multivariate analyses showed that patients with colostomy (OR 5.98, 95% CI 1.42-25.21, p=0.0149) and those who required readmission following the primary operation (OR 12.49, 95% CI 2.76-56.48, p=0.0010) had significantly higher risk for complications at the time of stoma reversal.

Table 3. Secondary operation characteristics (n=63).

Categories	Frequency (%)	N
Time to stoma closure (days)		
Median	222.5	
Range	12-2228	
Duration of secondary operation (minutes)		
Median	120	
Range	50-409	
Stoma closure done through		57
Stoma	47 (82.5)	
Midline incision	10 (17.5)	
Bowel re-anastomosis method		55
Staples	39 (70.9)	
Sutures	11 (20.0)	
Both	5 (9.1)	
Albumin level		
Median	30	
Range	13-41	
Hemoglobin level		
Mean (SD)	12.2	
SD	2	
ICU admission		62
No	57 (91.9)	
Yes	5 (8.1)	
Overall complications		63
No	44 (69.8)	
Yes	19 (30.2)	

Table 4. The effect of patients and operation characteristics on the time to closure.

Categories	All patients (N=63) Univariate analysis			Multivariate analysis			Cancer patients (N=32) Univariate analysis			Multivariate analysis		
	OR	CI	P value	OR	CI	P value	OR	CI	P value	OR	CI	P value
Gender												
Male	Ref						Ref					
Female	117.32	-44.36–279	0.1518				76.74	-53.36-206.85	0.2377			
	-0.19	-5.62-5.24	0.9441				0.04	-5.09-5.18	0.9864			
Nationalit-y												
Saudi	Ref						Ref					
Non-Saudi	69.51	-100.63-239.66	0.4170				95.03	-33.38 - 223.44	0.1412			
Chronic diseases												
No	Ref						Ref					
Yes	63.21	-102.86 - 229.29	0.4494				31.09	-97.21 - 159.40	0.6243			
Indication for surgery												
Malignant disease	Ref											
Benign disease	34.07	-129.50 - 197.64	0.6785									
History of previous abdominal surgeries												
No	Ref						Ref					
Yes	-101.71	-314.38 - 110.95	0.3426				- 66.93	-217.93-84.08	0.3726			

Continued.

Categories	All patients (N=63) Univariate analysis			Multivariate analysis			Cancer patients (N=32) Univariate analysis			Multivariate analysis		
	OR	CI	P value	OR	CI	P value	OR	CI	P value	OR	CI	P value
Primary operation												
Colon resection	Ref						Ref					
Rectal resection	46.71	-153.44-246.85	0.6421				-82.89	-229.25-63.46	0.2558			
Isolated stoma formation*	220.61	6.52-434.71	0.0436	272.67	-17.78-563.11	0.0650	-284.14	-640.42-72.13	0.1135			
Small bowel resection	-135.89	-600.33-328.55	0.5603									
Multiorgan resection**	-114.99	-429.99-200.01	0.4678				-235.64	-444.53-26.76	0.0284	-256.13	-458.02-54.24	0.015
Urgency of primary operation												
Elective	Ref						Ref					
Emergency	16.49	-153.21 - 186.19	0.8465				19.20	-122.50-160.91	0.7836			
Approach of primary operation												
Open	Ref						Ref					
Laparosco-pic	81.84	-203.80 - 367.48	0.5683				-45.76	-270.81-179.30	0.6799			
ASA at primary operation												
1	Ref						Ref					
2	24.62	-298.64-347.88	0.8792				-24.50	-297.30-248.30	0.8550			
3	47.96	-274.44-370.36	0.7667				-30.64	-310.24-248.97	0.8236			
4*	703.50	245.04-1161.96	0.0033	1032.01	435.38-1628.63	0.0012	179	-266.48-624.48	0.4164			
Use of epidural anesthesia												
Yes	Ref						Ref					
No	-136.58	-307.15-33.99	0.1143				-34.89	-182.14-112.37	0.6312			
Type of stoma												
Ileostomy	Ref						Ref					
Colostomy*	152.43	-16.00 - 320.86	0.0753	-200.10	-442.13-41.94	0.1023	120.89	-47.43-289.21	0.1528			
ICU admission after primary operation												
No	Ref						Ref					
Yes*	-167.57	-332.16-2.98	0.0461	-79.96	-294.66-134.75	0.4553	-81.38	-208.19-45.43	0.1996			
Complicat-ions during hospitaliz-ation												
No	Ref						Ref					
Yes*	171.68	-1.90 345.25	0.0525	90.61	-114.40-295.61	0.3763	99.11	-33.95-232.18	0.1383			

Continued.

Categories	All patients (N=63) Univariate analysis			Multivariate analysis			Cancer patients (N=32) Univariate analysis			Multivariate analysis		
	OR	CI	P value	OR	CI	P value	OR	CI	P value	OR	CI	P value
Overall complicati-ons after primary operation (within 30 postoperat-ive days)												
No	Ref						Ref					
Yes**	109.80	-56.58-276.18	0.1917				104.75	-18.40-227.91	0.0925	127.28	17.06-237.50	0.0254
LOH of primary operation*	3.46	0.36-6.56	0.0293	-0.67	-5.26-3.93	0.7705	0.62	-3.44-4.67	0.7578			
Stoma related complications												
No	Ref						Ref					
Yes*	274.15	-5.45-553.76	0.0545	177.78	-155.80-511.36	0.2872	-123.69	-352.19-104.81	0.2760			
Readmissi-on after primary operation (within 30 days)												
No	Ref						Ref					
Yes	41.75	-149.09-232.59	0.6632				91.93	-40.20-224.06	0.1657			
BMI	6.51	-11.85-24.88	0.4785				4.28	-8.66-17.22	0.4972			
Hemoglob-in level	-25.37	-57.81-7.08	0.1230				-8.31	-41.23-24.61	0.6096			
Albumin level*	-14.11	-25.36-2.87	0.0148	-5.46	-17.49-6.58	0.3643	-0.074	-13.32-11.84	0.9057			
Neoadjuvant therapy												
No							Ref					
Yes							-35.92	-163.43-91.58	0.5689			
Adjuvant therapy												
No							Ref					
Yes**							141.43	10.87-271.99	0.0347	173.59	48.56-298.62	0.0084
Adjuvant therapy before stoma closure												
No							Ref					
Yes							129.28	-59.07-317.63	0.1677			

LOH: length of hospitalization

Table 5. The impact of patients and operation characteristics on complications at the time of secondary operation.

Categories		All patients (N=63) Univariate analysis			Multivariate analysis		
		OR	CI	P value	OR	CI	P value
Gender	Male	Ref					
	Female	1.60	0.54-4.74	0.3918			
Age		0.99	0.95 - 1.02	0.4854			
Nationality	Saudi	Ref					
	Non-Saudi	1.24	0.39-3.89	0.715			
Chronic diseases	No	Ref					
	Yes	0.51	0.17-1.53	0.232			
Indication for primary operation	Malignant disease	Ref					
	Benign disease	1.65	0.56 - 4.89	0.3665			

Continued.

Categories		All patients (N=63) Univariate analysis OR	CI	P value	Multivariate analysis OR	CI	P value
History of previous abdominal surgeries	No	Ref					
	Yes	1.41	0.36-5.53	0.623			
Primary operation	Colon resection	Ref					
	Rectal resection	0.33	0.07 - 1.60	0.1693			
	Stoma formation	1.40	0.35 - 5.54	0.6317			
	Small bowel resection	2.00	0.11 - 37.83	0.6440			
	Multiorgan resection	1.33	0.17 - 10.25	0.7822			
Urgency of primary operation	Elective	Ref					
	Emergency	1.52	0.47-4.91	0.483			
Approach of primary operation	Open	Ref					
	Laparoscopic	1.16	0.19-6.97	0.874			
Type of stoma	Ileostomy	Ref					
	Colostomy*	2.96	0.97 - 9.07	0.0570	5.98	1.42 - 25.21	0.0149
Complications related to primary operation	No	Ref					
	Yes	2.32	0.72 - 7.41	0.1569			
Duration of secondary operation		1.01	1.00 - 1.01	0.1155			
Closure of stoma done through	Stoma site	Ref					
	Midline incision	2.62	0.65 - 10.55	0.1767			
Method of bowel re-anastomosis	Staples	Ref		0.203			
	Sutures	2.42	0.60 - 9.68	0.2126			
	Both	4.35	0.63 - 29.91	0.1351			
BMI		0.97	0.87-1.08	0.545			
Hemoglobin level		0.98	0.78 – 1.22	0.8296			
Albumin level		0.99	0.92-1.07	0.8497			
Time to closure		1.00	1.00 – 1.00	0.2585			
Readmission	No	Ref					
	Yes*	7.04	2.02 - 24.46	0.0021	12.49	2.76 - 56.48	0.0010
Neoadjuvant therapy	No						
	Yes						
Adjuvant therapy	No						
	Yes						

DISCUSSION

Temporary fecal diversion plays an important role in emergency and elective intestinal surgeries.[10] For example, temporary stomas are frequently used to minimize the risk of anastomotic leak when colorectal or colo-anal anastomoses are formed.[11,12] Closure of a temporary stoma is anticipated after a period of eight to twelve weeks, which allows for the resolution of inflammation, recovery from the initial operation, and softening of the adhesions.[13] Closure of a temporary stoma is associated with a risk for complications.[14,15] Multiple factors influencing these complications have been reported including; patient's age >70 years, BMI >30, and the presence of locally advanced malignancies.[3-5,8,16-22] In addition, prolonged time to closure (more than 6 months) of temporary stomas was found to increase the risk of complications and the length of hospital stay, subsequently worsens the patients' quality of life and raising hospital costs.[6-8] Understanding risk factors for the development of these complications would aid in targeting them for preventive measures thus, improve patients' outcomes. As the time to stoma closure is considered an important predictor for complications, determining the factors which prolong the time to closure is important.

In this study, the median time to stoma closure was found to be 222.5 days (7.4 months). Based on the results in the literature, the average median time to closure reported to be between 2.5-6 months.[8,13-15,22] The median time to closure in this study is considered longer than the reported medians in the previous studies. This could be due to the public nature of our center and the high demand as well as the higher BMI of our population; thus, most of the patients asked to lose weight before stoma reversal in some instances.

Factors affecting the time to stoma closure were determined in this study, patients with ASA class four at the time of the primary operation had longer time to stoma closure. Those patients often have multiple comorbidities which might prolong their complete recovery and tolerance for further surgery, therefore delaying the time to stoma closure. Furthermore, patients with high ASA are more likely to develop complications after operations, which is considered an important factor for delayed stoma closure.[24-26]

Stomas in patients with malignancies had delayed closure compared to benign conditions such as diverticulitis.[23] Therefore, a subgroup analysis for cancer patients was conducted in our study to determine predictors of time to closure. We found that receiving adjuvant treatment and developing complications related to stoma creation are risk factors for prolonged time to closure in cancer patients. Studies in the literature have also reported both factors as predictors for delayed closure among cancer patients.[8,14,27] In David and coworkers' study, the mean time to closure was longer in patients who required adjuvant chemotherapy (40 weeks) as compared to patients who did not require adjuvant treatment with mean time to closure of (29.5 weeks, $p \leq 0.001$).[28] Moreover, causes for delayed stoma closure (more than 6 months) in rectal cancer patients were requiring adjuvant chemotherapy and developing complications following the primary operation ($P<0.005$).[8] In contrast, the only predictor for shorter time to closure in cancer patients was the type of primary operation, patients who underwent multi-organ resection significantly had shorter time to stoma closure. It has not – to our knowledge – been reported before as a factor influencing the time to stoma closure.

Stoma reversal surgery is associated with a risk of complications. In a previous study, the overall stoma closure–related surgical complications rate was 20%, surgical site infections (9%) and anastomotic leakage (5%) were the most common surgical complications.[15] The rate of stoma closure complications in our study is 30.2%. Factors contributing to stoma closure complications were reported such as the surgical technique, not receiving antibiotic prophylaxis, patient's age >70 years, and prolonged time to closure.[8,16-22] In this study, patients with colostomies showed higher risk for stoma closure complications. Some studies in the literature proved that fecal diversion using ileostomy is superior to colostomy in terms of morbidity. Higher risk of complications was reported after closure of colostomies as shown in a previous study with 55% of patients who underwent colostomy closure developed complications compared to 20% of ileostomy patients.[29]

In contrast, a previous systematic review which studied the stoma closure outcome measures including; occlusion, wound infection, anastomotic leak, fistula, and hernia reported that the cumulative analysis for these outcomes showed no significant difference between colostomy and ileostomy (OR 1.02; 95% CI 0.56–1.86).[30]

In this study, readmission after the primary operation is a significant predictor for complications at the time of the secondary operation. It has not – to our knowledge – been reported before as a factor for stoma closure complications. Further research need to be conducted to determine the impact of readmission following the primary operation on stoma closure outcomes.

Limitations of this study is its retrospective nature as well as the small number of patients included. Although, the study was conducted at a single center, our institution is considered a large tertiary referral center in the area and accepts a wide range of patient population.

Collectively, our study results indicate that multiple factors influence the time to stoma closure including patients' ASA, in addition to adjuvant treatment, complications related to stoma formation and multiorgan resection during primary operation in cancer patients. Risk for stoma closure complications is higher among colostomy patients and patients who required readmission after stoma formation. Complications related to stoma closure surgery has a high rate of occurrence, it impacts the patients' full recovery, and may require further intervention for management and contributes to mortality.[31] Therefore, development of a perioperative preventive strategies could enhance patients' outcomes; this can be achieved by modifying the factors leading to these complications such as, lowering the rate of readmissions to a minimum, and choosing an ileostomy for diversion rather than a colostomy when indicated.

Furthermore, as delayed time to stoma closure was reported in the literature as a significant predictor for complications, controlling the modifiable factors contributing to delayed closure such as; scheduling stoma closure prior to adjuvant therapy or to consider scheduling the operation between the treatment cycles could enhance the outcomes of stoma closure. It is essential that surgeons are aware of these factors and individualize the treatment strategy to each patient. Preoperative counseling about stoma closure surgery should include the possibility of complications, understanding the predictors for complications, and factors implicated in scheduling stoma closure.

CONCLUSION

Multiple factors can impact the time to stoma closure and increase the risk of developing complication related to stoma closure. Awareness about these contributing factors and development of strategies to modify them is recommended.

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