Anal closure before final draping reduces perineal wound surgical site infections in abdominoperineal resection

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Background
Wound infection is one of the most common complications following abdominoperineal resection. In some studies, it was assumed that it can reach up to 66% among the operated patients. It not only affects the pathway of wound healing but can also delay the beginning of postoperative chemotherapy. It may also leave lifelong adverse consequences such as pain, sitting disability, and tingling.

Patients and methods
A prospective randomized controlled study was performed on 52 patients who were eligible for abdominoperineal resection for either low rectal or anal canal carcinoma admitted to Helwan University Hospital, Nasser Institute Hospital, and 15th May Hospital between January 2018 and January 2022. Inclusion criteria were both male and female participants in the ages of 18 and 80 years who were diagnosed with low rectal or anal canal cancers. Exclusion criteria were patients who had inoperable, multicentric, recurring anorectal cancers. All of the patients were informed about the details of the study and the procedure preoperatively and signed an informed written consent. The same team of surgeons operated all the cases, and the classic operation of resecting the rectum with complete mesorectal excision was done through the classic abdominal route. Based on the steps for preparation of the perineal phase of the abdominoperineal resection, participants were allocated randomly into two groups.
Group A included 27 patients in whom the anal closure was done first after primary skin cleansing and then final skin cleansing and draping was done. Group B included 25 patients in whom anal closure was done after final skin cleansing and draping.

Results
Group A included 27 (51.9%) patients who had their anal closure done before the final draping, and group B included 25 (48.1%) patients who had their anal closure done after the final draping. Their mean±SD age was 54.3±9.69 years (55 and 53.5 years for groups A and B, respectively). Their preoperative comorbidities included diabetes mellitus in 20 (38.5%) patients, with 12 (44%) and eight (32%) in groups A and B, respectively; hypertension in 18 (34.6%) patients; and chronic heart diseases in six (11.5%) patients. Their BMI was ~27.87±3.2 kg/m^2. Surgical site infection (SSI) was statistically significantly lower in group A in comparison with group B (11.1 and 36%, respectively; *P* value 0.03). We further divided the incisional SSI into superficial and deep. Deep SSI was not found in any cases among group A, whereas it was observed in three (12%) cases in group B. Moreover, superficial SSI was found in only three (11.1%) cases in group A, whereas it was observed in six (24%) cases in group B.

Conclusion
Anal closure performed before perineal draping decreased field contamination and subsequent SSI and healing time.

Keywords:
abdominoperineal, anal carcinoma, perineal wound, rectal carcinoma, surgical site infection

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Introduction

Wound infection is one of the most common complications following abdominoperineal resection. In some studies, it was assumed that it can reach up to 66% among the operated patients [1,2]. It not only affects the pathway of wound healing but can also delay the beginning of postoperative chemotherapy [3]. It may also leave lifelong bad consequences such as pain, sitting disability, and tingling [4]. A major factor contributing to the high incidence of perineal surgical site infection (SSI) is the contamination of

the perirectal skin, and measures to minimize this contamination could reduce such incidence [5].

In 2017, the Centers for Disease Control and Prevention published updated guidelines for SSI prevention, and specific interventions were recommended for colorectal surgery [6]. General risk factors for postoperative wound infection include a high BMI [7], poor nutritional status [8], diabetes mellitus [9], and advanced age [10], whereas the surgical risk factors include a prolonged operation time [11], massive bleeding [12], and intraoperative blood transfusion [13]. Large amounts of empty space in the pelvic cavity following large-scale destruction of the pelvic floor, high bacterial counts in the perineal area, and the closure of the perineal wounds with tension were considered factors contributing to complications [14,15]. Many steps have been adopted in previous trials to minimize this problem in the form of prophylactic antibiotic coverage, proper use of intra and extra-abdominal drains, and proper wound care [5].

The aim of our research was to study whether changing the order of the step of anal closure before the final perineal draping could decrease soiling and field contamination and to see if this minor alteration will affect the incidence of both superficial and deep SSIs and the rate of wound healing or not.

Patients and methods

A prospective randomized controlled study was performed on 52 patients who were eligible for abdominoperineal resection for either low rectal or anal canal carcinoma admitted to Helwan University Hospital, Nasser Institute Hospital, and 15th May Hospital between January 2018 and January 2022. All the patients were informed about the details of the study and the procedure preoperatively and sign an informed written consent. The same team of surgeons operated all the cases, and the classic operation of resecting the rectum with complete mesorectal excision was done through the classic abdominal route. Based on the steps for preparation of the perineal phase of the abdominoperineal resection, participants were allocated randomly into two groups.

Group A included 27 patients in whom the anal closure was done first after primary skin cleansing and then final skin cleansing and draping was done.

Group B included 25 patients in whom anal closure was done after final skin cleansing and draping.

The method of skin cleansing and draping was standardized in all patients from both groups, according to our infection control unit recommendations as follows: skin preparation is undertaken by applying 10% povidone–iodine solution with friction over the perineum and surrounding areas for 3–4 min using a sterile gauze swab in one direction painting, and disposable sterile surgical drapes was used for all cases.

Data were collected from both groups in the form of operative time, blood loss, comorbidities, neoadjuvant chemoradiation, and BMI. All patients were followed up regarding the incidence of SSI and the time needed for complete wound healing in both groups. These follow-up periods extend till complete wound healing was achieved for every patient. SSIs were classified and diagnosed according to the widely accepted classification of center of disease control and prevention for SSI into incisional SSI and organ/space SSI. The incisional SSI is further classified into superficial and deep incisional SSI according to the extent of infection either to skin and subcutaneous tissue only or to deep tissues, such as fascial and muscle layers; this also includes infection involving both superficial and deep incision sites and organ/space SSI draining through incision [16].

Inclusion criteria

Both male and female participants in the ages of 18 and 80 years who have been diagnosed with low rectal or anal canal cancers, operable patients of anorectal carcinoma, patients who continuously followed up after surgery, as well as cooperative patients were included.

Exclusion criteria

Patients who had inoperable, multicentric, recurring anorectal cancers and participant who were unable to participate or unavailable during the study were excluded.

Randomization

Internet-based software was used to generate a sequence of numbers for allocation. Individual group assignments were then enclosed in opaque, serially numbered envelopes according to the generated sequence. After a patient is enrolled, the next envelope in the sequence is opened, revealing the group in a random manner.

Statistical analysis

Data were collected, revised, coded, and entered into the Statistical Package for the Social Sciences (SPSS)

version 23.0 (SPSS Inc., Chicago, IL, USA). Qualitative data were presented as frequencies and percent. χ^2 and Fisher's exact tests were used to test for the significance of difference. Quantitative data were presented as mean and SD, whereas for the significance of differences, independent samples *t* test was used for normally distributed data and Mann–Whitney test for non-normal data. The accepted level of significance was set at two-tailed *P* value less than 0.05.

Ethical approval

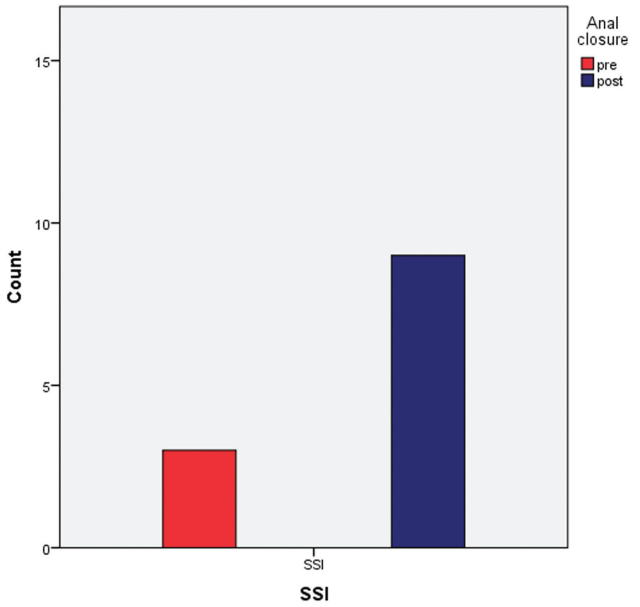
This research was performed at the Department of General Surgery, Helwan University Hospital, Nasser Institute Hospital. Ethical Committee approval and written, informed consent were obtained from all participants.

Results

Patient characteristics

A total of 52 patients were included in our study. However, two patients from group B were lost to follow-up and were excluded from the study. The patients included were 29 (55.8%) males and 23 (44.2%) females, without significant differences between groups regarding male-to-female ratio. All patients having low rectal or anal canal cancers and met the inclusion criteria were included. Patients were allocated randomly into two groups: in group A, 27 (51.9%) patients were included, and they had their anal closure done before the final draping, whereas in group B, 25 (48.1%) patients were included, and they had their anal closure done after the final draping. Their mean age was 54.3±9.69 years (55 and 53.5 years in groups A and B, respectively). Their preoperative comorbidities included diabetes mellitus in 20 (38.5%) patients [12 (44%) and eight (32%) patients in groups A and B, respectively], hypertension in 18 (34.6%) patients, and chronic heart diseases in six (11.5%) patients. Their BMI was ~27.87±3.2 kg/m^2 without any significant differences between the two groups in all mentioned characteristics. Neoadjuvant chemoradiation was given in any case with positive lymph nodes or tumor stage T3 and above, which represents most of our cases (98.1%). The rest of the demographic data are mentioned in Table 1.

Figure 1



Incidence of SSI between groups A and B.

Table 1 Difference between the two groups

Characteristics	Total	Pre	Post	*P* value
Cases [*n* (%)]	52	27 (51.9)	25 (48.1)	NA
Age (years) (mean±SD)	54.3±9.69)	55±9.75)	53.5±9.74)	0.5
Sex male/female [*n* (%)]	29/23 (55.8/44.2)	15/12 (55.6/44.4)	14/11 (56/44)	0.9
BMI (kg/m^2) (mean±SD)	27.87±3.2)	27.67±2.74)	28.08±3.68)	0.64
Comorbidities [*n* (%)]				
Hypertension	18 (34.6)	11 (40.7)	7 (28)	0.5
Diabetes	20 (38.5)	12 (44.4)	8 (32)	0.5
CHD	6 (11.5)	4 (14.8)	2 (8)	0.6
Neoadjuvant chemoradiation[*n* (%)]	51 (98.1)	27 (100)	24 (96)	0.48
Steroid therapy [*n* (%)]	1 (1.9)	0	1 (4)	0.48
Operative time (min) (mean±SD)	190.6±28.3	191.3±26.4	189.8±30.8	0.84
Blood loss (ml) (mean±SD)	351.3±154.9	336.3±171.2	367.6±136.6	0.47
Incisional SSI [*n* (%)]				
Superficial	9 (17.3)	3 (11.1)	6 (24)	0.03
Deep	3 (5.8)	0	3 (12)	
Total	12 (23.1)	3 (11.1)	9 (36)	
Wound healing (days) (mean±SD)	52.5±67	31.8±34.3	74.9±85.3	0.019

CHD, coronary heart disease; NA, not applicable.

Operative and postoperative data

SSI was statistically significantly lower in group A in comparison with group B (11.1% in comparison to 36%), with a *P* value of 0.03 (Fig. 1). We further divided the incisional SSI into superficial and deep. Deep SSI was not found in any cases among group A, whereas it was observed in three (12%) cases in group B. Moreover, superficial SSI was found in only three (11.1%) cases in group A, whereas it was observed in six (24%) cases in group B (Fig. 2).

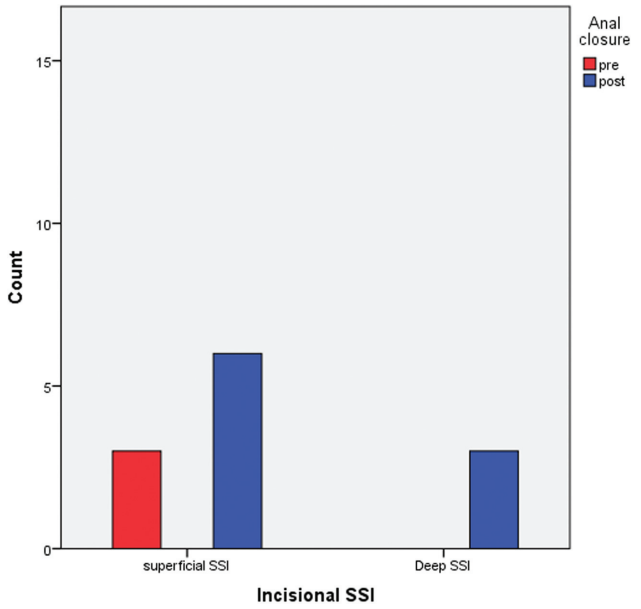
The total number of days needed for complete wound healing was statistically significantly lower in the group A (31.8±34.3 days) in comparison with group B (74.9 ±85.3 days), with a significant *P* value of 0.019 (Table 1).

The mean operative time was nonsignificantly slightly higher in group A in comparison with group B (191.3 ±26.4 min and 189.8±30.8 min, respectively; *P*=0.84). Moreover, the mean amount of total blood loss was nonsignificantly lower in group A than in group B (336.3±171.2 ml and 367.6±136.6 ml, respectively; *P*=0.47).

Analysis of other factors

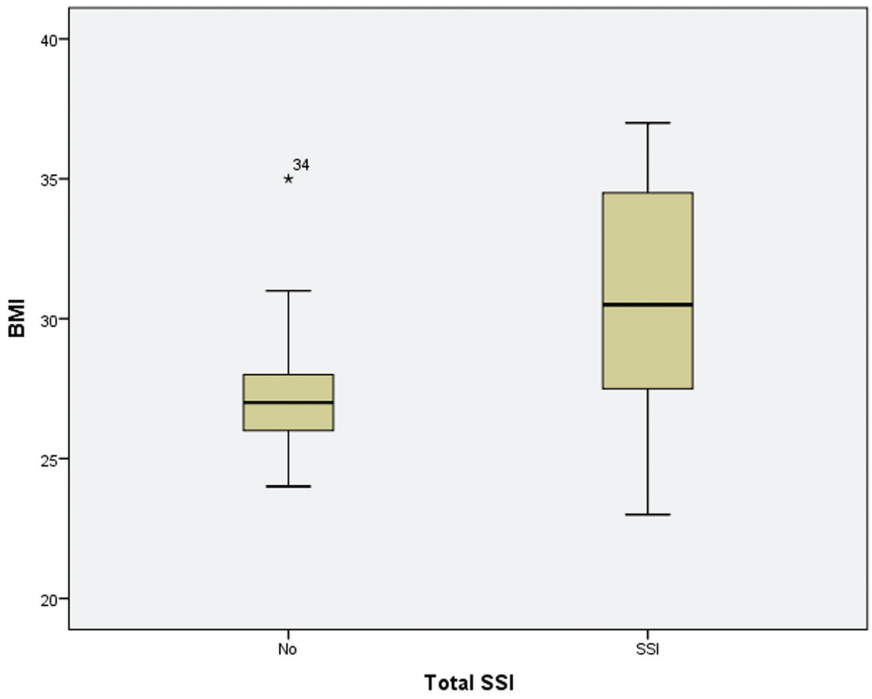
Further statistical analysis of the whole data outside the study groups' distribution and comparison revealed many other variables that were found to be statistically significant in affecting the occurrence of SSI. The mean BMI was significantly high in those who had SSI in comparison with those who did not have SSI (30.5±4.48 and 27±2.23 kg/m^2, respectively; *P* =0.011) (Fig. 3). Diabetes mellitus and coronary heart disease (CHD) were the statistically significant comorbidities related SSI. Diabetes mellitus was only found in 10 (25%) patients among those who did not suffer SSI, whereas it occurred in 10 (83.3%) patients

Figure 2



Incidence of superficial and deep SSI in groups A and B.

Figure 3



Relation between BMI and SSI.

Table 2 Variables affecting surgical site infection

Characteristic	Total	SSI	No SSI	*P* value
Cases [*n* (%)]	52	12 (23.1)	40 (76.9)	NA
BMI (kg/m^2) (mean±SD)	27.87±3.2	30.5±4.48	27±2.23	0.011
Comorbidities [*n* (%)]				
Hypertension	18 (34.6)	6 (50)	12 (30)	0.3
Diabetes	20 (38.5)	10 (83.3)	10 (25)	<0.001
CHD	6 (11.5)	4 (33)	2 (5)	0.02
Blood loss (ml) (mean±SD)	351.3±154.9	420±150.6	330.7±151	0.08
Operative time (min) (mean±SD)	190.6±28.3	207.5±33.2	185.5±25	0.085

CHD, coronary heart disease; NA, not applicable.

among those who had SSI, with a *P* value of less than 0.001. CHD existed in four (33%) patients who had SSI, whereas only two (5%) patients among those who did not have SSI had CHD, with a *P* value of 0.02 (Table 2).

The mean amount of total blood loss was insignificantly lower in the group that did not have SSI in comparison with those who had postoperative SSI (330.7±151 and 420±150.6 ml, respectively; *P*=0.08). Moreover, the mean operative time was shorter in those who did not have SSI in comparison with those who had SSI postoperatively (185.5±25 and 207.5±33.2 min, respectively; *P*=0.085) (Table 2).

Discussion

Perineal wound complications are a long-lasting issue for APR patients. Removal of the rectum, anus, and sometimes nearby organs results in a large empty space, which is conducive to fluid accumulation and bacterial growth [2]. Large amounts of empty space in the pelvic cavity following large-scale destruction of the pelvic floor, high bacterial counts in the perineal area, and the closure of the perineal wounds with tension were considered factors contributing to complications. Moreover, the addition of preoperative radiotherapy may also cause tissue damage and reduce the blood supply to this area [15,17]. Perineal wound complications include superficial or deep infection, abscess formation, wound disruption, hematoma formation, or persistent sinus discharge. All such reasons may interfere with wound healing and lead to its delay. The drawback of delayed perineal wound healing is an increased risk of prolonged hospital stay with its effect either physically or psychologically on the patient as well as a delay to any postoperative form of treatment planned for the patient. If we can reduce the risk of delayed perineal wound healing by decreasing the incidence of SSI, the incidence of prolonged hospital stay will also decrease, and thus the total medical costs will decrease, and the treatment strategy will go as planned after such an intervention. Delayed perineal wound healing is thought to be associated with decreased quality of life, increased health care costs, and poor survival [18]. In our study, we adopted the new technique of anal closure before the final draping done to the perineal area with the hope of decreasing the incidence of perineal wound infection and thus fastening the time needed for these wounds to heal.

In our study, the occurrence of SSI whether superficial or deep was significantly lower in the group managed with the new technique [three (11.1%) cases in comparison with nine (36%) cases], with a *P* value of 0.03. This was also reflected on the mean healing time of the wounds; in our study, group A time took 31.8±34.3 days and group B took 74.9±85.3 days for healing, which was statistically significant, with a *P* value of 0.019. The mean perineal wound healing time in group A was less than that mentioned by Althumairi *et al.* [19] (47.95 days) and that mentioned by Chang *et al.* [20] (46.38 days).

In patients with perineal wound infection, the isolated bacteria were anaerobic bacteria and gram-negative bacilli, which are enteric pathogens [5]. In particular, the perirectal skin is highly likely to be contaminated with feces. Therefore, the skin around the anus should be carefully washed after the anal canal is closed to minimize the range of fecal contamination because conventional disinfection procedures are inadequate.

Malnutrition, smoking, COPD, and obesity makes patients vulnerable to poor wound healing [18,21]. In our study, we have chosen three common comorbidities to see their effect on SSI of the perineal wounds. The existence of diabetes mellitus and chronic heart diseases were significantly lower in

those who had no SSI in comparison with those who had SSI (25% in comparison with 83.3 and 5% in comparison with 33%, respectively) with a *P* value of less than 0.001 and 0.02, respectively.

In the 1970s, chemical bowel preparation was adopted to decrease the bacterial count in the intestine. In the 1980s, oral antimicrobial agents (kanamycin, neomycin, metronidazole, or erythromycin) were speculated to disturb the intestinal flora. This led to an outbreak of methicillin-resistant *Staphylococcus aureus* infection, so chemical bowel preparation was no longer recommended preoperatively [22]. At present, however, oral antimicrobial agents given 1 day before surgery are considered to effectively decrease the risk of SSI, without inducing resistant bacteria or microbial substitution [23–25]. Mechanical bowel preparation has been reported not to substantially alter the number of intestinal bacteria, and a multicenter randomized trial and a meta-analysis found no evidence supporting its effectiveness. Mechanical bowel preparation is therefore not recommended before elective colorectal surgery [26,27]. In the absence of antimicrobial prophylaxis, SSI develops in ~40% of patients who undergo surgery for colorectal cancer, as compared with only 11% in patients who receive appropriate antimicrobial prophylaxis [25]. Therefore, appropriate antimicrobial prophylaxis is necessary. The guideline for prevention of SSI issued by the Centers for Disease Control and Prevention recommends preoperative antimicrobial prophylaxis, supported by evidence level 1A [6].

Kitai and colleagues mentioned that more than 50% of causative organisms are normal intestinal flora, and the skin around the anus can be contaminated with stools. Because conventional preoperative disinfection of the perianal skin does not eliminate all areas of contamination, the region should be washed well with a brush to minimize areas contaminated with stools [28]. This is the basis upon which we adopted the technique of anal closure before the final draping done in the perineal area to decrease the SSI. Postoperative wound complications are expensive. The costs include prolonged hospital stays, readmissions, surgery, home nursing care, repeated wound dressing, materials costs, and outpatient visits.

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Conflicts of interest
There are no conflicts of interest.

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