

The “Volcano” Technique vs Primary Closure of Diverting Stoma-Abdominal Wall Defect in Obese Patients; a Prospective Controlled Study

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Background: Surgical site-infection (SSI) is common in abdominal wall wounds at site of stoma take-down, especially in obese patients. The aim of the study is to compare the proposed “Volcano” technique with the classical primary closure in obese patients as regards the incidence of SSI and short-term cosmetic outcome after one month.

Patients and method: 20 “Obese” patients with diverting fecal stomas, whose stoma aperture was closed using the “volcano” technique, were compared to the last 20 matched patients, whose stoma aperture was closed using the primary closure technique, from the database as regards the incidence of SSI and the short-term cosmetic outcome of the postoperative wound.

Results: One case of SSI was noticed in the study group in comparison to 3 cases in the control group. The resulted scar in the study group was smaller and more cosmetically appealing.

Conclusion: The “Volcano” technique is feasible with better outcome for cases of stoma reversal.

Key words: Diverting stoma, volcano technique, surgical site infection.

Introduction

Surgical site infections (SSIs) are infections of the incision, organ or space that occur after surgery.¹ It is very common after stoma reversal reaching up to 41% in some studies.² Identified risk factors include fascial dehiscence, SSI after primary operation, smoking and thicker subcutaneous fat.^{2,3} Several strategies were proposed to decrease that risk including closure over a drain and purse-string closure.³

Obesity is a major risk factor for SSIs⁴ via affecting systemic host defenses.⁵ Obesity is positively correlated with the rate of SSIs.⁶ Therefore, preoperative weight loss is recommended especially in cases of colorectal surgery.⁷

In 1997, Banerjee proposed a purse-string skin-closure technique during stoma reversal operations. Lim et al., in 2010, introduced the gunsight suture (GS).⁸ Both techniques aim to improve the cosmetic outcome of the operation while allowing a central defect for drainage to reduce the incidence of SSIs. Admitting that fascial and skin closure following stoma reversal are crucial, Krenzien et al. introduced the “vulkan” or “volcano” technique in 2017, putting consecutive circular subcutaneous sutures, the first of which includes the fascial layer of underlying abdominal wall muscle to decrease the dead space where postoperative seroma builds up.⁹ In their study, Krenzien et al. focused on the feasibility of the proposed technique only when being applied to a variety of patients. In an attempt to study that technique deeper, limiting the inclusion criteria to obese patients (With BMI more than 30 kg/m² according to the definition of the WHO) would be the protocol of the study.

Patients and method

Having the study protocol approved by the ethical committee of surgical department, faculty of medicine, Ain Shams University, 20 obese patients (Having a BMI more than 30 kg/m²) with fecal diverting stomata (Whether ileostomy or colostomy) of any form (Whether end or loop) were recruited for the study as long as they were candidates for stoma reversal and fit for general anesthesia (ASA I or II). Being performed in a tertiary hospital for adults, all patients were more than 18 years old. Patients with ASA score more than II were excluded as those patients had many co-morbidities requiring the least possible to be done intraoperatively to decrease the anesthesia time. Patients with co-morbidities affecting wound healing (E.g., connective tissue disease) and those with immunosuppression (Whether induced by drugs or due to systemic pathology) were also, excluded being more liable to SSIs (Whose incidence of occurrence is the study aim) due to etiologies other than the surgical technique and obesity. This implied to exclude patients diverted for malignant pathologies (Due to the role of radio/chemotherapy in management of colorectal cancer). Finally, patients with clinically detected parastomal hernias were excluded (Extensive dissection would be needed for hernia repair, whether a mesh would be applied or not). The study group was compared to a control group of correlated patients (Concerning the demographic factors, co-morbidities and indication of diversion) from the database who had undergone linear incision closure of their stoma aperture after reversal.

In all patients, the bowel continuity was initially restored, either in a handsewn or stapled manner

(According to the surgeon's preference), via midline or local peristomal incision. Then, approximation of the external oblique aponeurosis (Or the anterior rectus sheath in case of transrectus stomata) was done using PDS loop 0. The wound was irrigated with normal saline, then povidone iodine with hydrogen peroxide 20% that would be dried using gauze. Following that step, each of the study and control group was distinguished:

For the study group, the "Volcano" technique was done in the same manner described by Krenzien et al. 9 i.e., purse-string sutures in the subcutaneous fat were taken in three consecutive layers using vicryl 0 sutures for the lower two layers and prolene 2/0 for the skin, forming a triple crown. No drain was inserted depending on the "small secondary defect" in the center of the wound that was around 25 mm. The defect was filled with saline-soaked gauze, providing a moist environment for wound healing. The gauze was removed on the second postoperative day and dressing was done using povidone iodine leaving a saline-soaked gauze with its tip inside the wound until serous exudate stopped (About 2 to 4 days).

Going to the control group, primary repair technique with drain insertion was adopted after fascial closure i.e., two-layer closure using vicryl 0 simple interrupted sutures was adopted to close the subcutaneous tissue in a linear pattern and prolene 2/0 sutures were used for simple interrupted closure of the skin after inserting a Redevac drain size 18. Subcuticular closure of the wound was not applied as the wound was of clean contaminated type (According to the WHO classification).

During the postoperative period, all patients were put on the enhanced recovery after surgery (ERAS) program; oral fluids were started gradually after full recovery from anesthesia guided by the tolerability of the patient to oral intake. Prophylactic third generation cephalosporins were prescribed for two days postoperatively. Wounds were not exposed for 2 days as long as there was no soakness of the wound dressing. For the control group, the efflux of the drain was recorded every day, paying attention to the amount and color of the effluent. The drain was removed when the amount of the efflux was less than 30 cc in 24h period.

Patients were often discharged on postoperative day 5-7, on regular diet, with no signs of vital instability (As regards pulse, blood pressure and temperature) nor signs of peritonitis (Rigid abdomen, nausea, vomiting) that could point to intestinal anastomotic complications. They were seen regularly on a weekly basis at the outpatient clinic by the surgical team for one month.

The primary endpoint of the study was the incidence of SSIs in both groups as well as the

cosmesis of the scar of the colostomy site after one month (Measured in terms of patient satisfaction, the size of the wound). For all patients, the degree of satisfaction about the wound at the previous site of colostomy at the fourth postoperative week, was determined on a scale of 1 to 5. The dimensions and shape of the colostomy site wound were recorded and compared between correlated patients in each of the study and control group. Concerning the recruited control group patients, they were phoned, and the required data were collected.

Results

The study included 20 patients defined as being obese according to the WHO definition i.e., having a BMI more than 30, presenting to our hospital from September 2019 till March 2021. Those patients were compared to correlated patients retrieved from the database during the last five-year interval. The demographic data of the patients are shown in **(Table 1)**. The average BMI of the patients was 36.5 kg/m². More details about the form of stoma are shown in **(Table 2)**. The indications for diversion are shown in **(Table 3)**. During the postoperative follow-up, 4 patients developed SSIs: 1 in the study group (A case with end colostomy for ruptured diverticular disease) and 3 in the control group (A case with loop ileostomy for multiple traumatic small bowel injury due to penetrating stab wounds and 2 cases of end colostomies due to ruptured diverticular disease). Hyperemic edges of the wound were noticed between the third and fifth postoperative day with tenderness on wound palpation. Frequent dressing (Twice daily) was done to those patients with wound expression to avoid infected seroma collection within the wound. One of those patients in the control group (A case with end colostomy for ruptured diverticular disease) began to show frank pus on wound expression within 48 hours despite having the drain nearly draining nothing. For that patient, two sutures were removed for better expression of the pus out of the wound and extended course of antibiotics (Third generation cephalosporins with metronidazole) was started for five days. Eventually, the wound infection was controlled, and the patient was discharged on the tenth postoperative day.

The postoperative visits of the whole 40 patients (20 patients in each of the control and study group) were uneventful. For the control group, sutures were removed on postoperative day 21 except for the patient who developed purulent wound infection, where suture removal was postponed for one week i.e., sutures were removed one month after the sound operation.

The scar of the colostomy site in the study group was noticed to have shrunken to a circular one of a diameter ranging from 15 to 35 mm "Fig1" , in

contrast to the control group, where a linear scar ranging from 60 to 115 mm (And average width 5 to 20 mm) developed. On a "5-Point Likert" Scale, the degree of patients` satisfaction was better for

the study group than the control group. In the study group, the average degree of satisfaction was 4. This was found to be between 2 and 3 in the other arm of the research. **(Table 4).**



Fig 1: Closure wound immediately postoperative.

Table 1: Demographic data

	Study group (N=20)	Control group (N=20)
Age	35-50 (~43)	33-56 (~44)
Gender	Males=16 (40%)	Females=24 (60%)
BMI	33-39 (~36.5)	32-39 (~36.7)

Table 2: Forms of stoma

	Ileostomies (n=22)		Colostomies (n=18)	
Form	Loop=22		End=18	
Site of stoma exit	Transrectus=16	Pararectus=6	Transrectus=6	Pararectus=12

Table 3: Indication of diversion

Indication of diversion (n)	Number of cases (n=40)	
Iatrogenic large bowel injury (14)	6 (covering loop)	8 (end colostomies)
Ruptured diverticular disease (6)	2 (covering loop)	4 (end colostomies)
Multiple traumatic small bowel injuries (8)	8 (covering loop)	
Bleeding colonic polyposis (2)	-----	2 (end colostomies)
Gangrenous sigmoid volvulus (6)	2 (covering loop)	4 (end colostomies)
Gangrenous cecum due to appendicitis (4)	4 (covering loop)	-----

Table 4: Study results

	The study group (n=20)	The control group (n=20)
SSIs incidence	1/20 (5%)	3/20 (15%)
Size of the scar	15-35 mm (~24)	60-115 mm (~80)
Patient satisfaction	3-5 (~4)	2-3 (~2.5)

Discussion

Obesity has become a pandemic in modern era 10 associated with detrimental effect on wounds and wound healing leaving the obese patient more susceptible to wound infection and delayed wound healing.¹¹ Heading to a common procedure in surgery like temporary fecal diversion and delayed reversal of that stoma, with an already estimated high rate of wound infection (Up to 40% in some studies),¹² obesity can worsen the case. The technique of stoma-site defect closure, as an important factor contributing to wound infection occurrence, was extensively studied in literature and several strategies have been suggested. Of those strategies, purse-string closure and primary closure are the most commonly performed and reported in the literature.³ Many authors advocate purse-string closure, reporting a nearly zero % infection rate with that technique.¹³ In our study, we decided to analyze the results of this technique when applied to obese patients scheduled for stoma reversal. Primary closure of the stoma site defect with drain application after washing the wound with betadine and hydrogen peroxide is the standard procedure in our institute, and so, we recruited the last 20 patients (Correlated to the 20 patients recruited for the volcano technique closure study arm as regards the demographic factors, co-morbidities and indication of diversion) from our database as our control arm. It was obvious that the incidence of SSIs was higher in the control group having 3 cases out of 20 (i.e., 15%) with only 1 case in the study group (i.e., 5%). Postoperative wound care is an important factor for this event. However, because the same protocol was adopted for all patients as regards wound dressing protocol and postoperative prophylactic antibiotics regimen, this factor is nearly pacified making wound closure technique the main contributor. The incidence of SSIs after primary closure of stoma wound recorded in our control group goes with the findings recorded in the literature when the same technique was tested (24-38%).¹⁴⁻¹⁶ This relatively high incidence rate can be attributed to two main reasons (Other than the perioperative causes): obesity (Referred to as the thick subcutaneous fat in literature) and the degree of fascial dehiscence.^{3,17} Having the wound closed, also, in a continuous pattern leads to accumulating subcutaneous exudate that could not be well drained completely despite the presence of a wound drain 18. In the study group, one case developed SSI in the form of edge hyperemia i.e., the incidence was 5%, which is again in concordance with the internationally reported rates (0-5%).^{13,18} Having the underlying dead space nearly obliterated except for the mid-wound opening of the purse-string (I.e., the aperture of the volcano); subsequently, preventing the accumulation of subcutaneous seroma, is the most probable cause.¹⁸

The cosmetic sequela of the operation is an important factor affecting the whole impact of the operation on the patient life, at least, the rehabilitation program and patient`s compliance to it. It is well established that the smaller the scar size, the better its cosmetic aspect is. In this aspect, the proposed "volcano" technique has an upper hand, reducing the scar from 8 cm to about 2.5 cm.

The "Volcano" technique has additional advantage over the classic purse-string closure technique. The additional purse-string sutures placed within the subcutaneous tissue allows for better drainage of the postoperative seroma; having the subcutaneous layer, also, drained via the middle aperture. Having the subcutaneous tissue closed in a fashion similar to the skin allows for better cosmetic results especially at the wound edges.

It is relevant to state that depending on healing by secondary intention in the study group would cause a delay in wound healing time. This was obvious in our study, at least, in the time needed for wound epithelialization (About 3-5 days in the control group in comparison to the study group needing about 20-25 days). However, wound dressing in a simple method as using a gauze with the tip just inside the wound, was accepted by the patients for having a smaller wound with better cosmetic end result.

Finally, despite being not one of our primary endpoints, it is worth to state that the operative time needed for applying any of the two techniques didn`t show a significant difference (15 minutes for the study group in comparison for 10 minutes for the control group).

Conclusion

The "volcano" technique is a feasible method for closure of abdominal wall defects left after stoma reversal in obese patients as long as the cosmetic results and the SSIs are concerned.

Limitations

Intending to study a technique that still not popular, at least within our institute, the study had to be on a limited number of patients (only 20 patients). Projection of the study results upon the general population mandates to apply such a technique on a larger sample size. To compare our results to correlated patients retrieved from the database, arises the concerns about selection bias, although the surgical team was unified. SSIs depend on many factors other than the technique and the perioperative status of the patient, the socioeconomic status and compliance of the patient to the given postoperative instructions are some of those factors. Studying the technique on a wider sample size would, at least statistically, decrease the contribution of such factors. Finally, the use of

phone questionnaire in retrieving the data of the control group might be of concern. However, that method was the most applicable method to obtain the data from patients having done their operation up to five years before; keeping in mind that our endpoint was the overall patient satisfaction about the cosmesis of the wound.

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