Original Article

Modified Primary Closure Method Could Decrease Surgical Site Infection Rate of Stoma Wound

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Key Words
Modified primary closure;
Surgical site infection;
Stoma closure wound

Purpose. The most common problem after stoma closure is surgical-site infection (SSI), which is strongly associated with the characteristics of primary wound closure. The aim of this study was to investigate a modified primary wound closure method post stoma closure and evaluate the feasibility for decrease the incidence rate of perioperative SSI.
Methods. Data on all stoma-closure patients performed over a 10-year period were collected retrospectively. The outcome of interest was a diagnosis of stoma-closure SSI as defined by the Centers for Disease Control and Prevention. Surgical techniques including modifications to the suture method, wound irrigation procedure and the addition of loose gauze compression are described. Patient characterizations and related clinical factors were evaluated for their independent effect on SSI rate.
Results. One hundred and nineteen patients undergoing elective stoma closure were identified for evaluation. The patients had a mean age of 64.1 years and 68% of them were male. The preoperative diagnoses comprised colorectal cancer in 73 patients (61.3%) and benign disease in 46 patients (38.7%). The closed stomas included 19 loop ileostomas, 80 loop T-colostomas, 10 loop S-colostomas, and 10 end stomas. SSIs were identified in 2 patients (1.68%).
Conclusions. Our modified primary suture method for stoma closure wound can reduce the incidence rate of surgical site infection while achieving acceptable cosmetic results.

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A temporary loop ileostomy or colostomy is created for fecal diversion or protecting the patient from fecal leakage and pelvic abscess after surgery for colorectal cancer, Fournier's gangrene, or rectovaginal fistula. Stoma closure to restore gastroenteral function is usually performed when the main disease of the patient has subsided.

Common morbidities of stoma closure include acute complications such as wound infection, anastomosis leakage, and acute bowel obstruction, and chronic complications such as incisional herniation and bowel habit change. Stoma closure is a clean-contaminated surgery method and the most common problem after stoma closure is surgical-site infection (SSI), which is strongly associated with the characteristics of primary wound closure[1] and could be up to 40%,[5] but this is preventable and its incidence can decrease with the surgical skill.

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In the primary wound closure method, few issues must be resolved. After the stoma closure, there is a great dead space in the closing wound and the fluid will accumulate inside. Besides this, it is a clean-contamination wound and many bacteria will develop from this growing medium. If we can reduce the dead space and the accumulation of liquid in the closing wound, the healing time of the wound will be shorter. Moreover, we could take certain measures, except for normal saline irrigation only to reduce the growth of bacteria. The aim of this study was to investigate a modified primary wound closure method post stoma closure and evaluate the feasibility for decrease the incidence rate of perioperative SSI.

Material and Method

Loop ileostomy, colostomy, or end stoma was performed on 119 patients using a modified primary stoma-closure method between 2004 and 2013 by a single surgeon. The preoperative assessment included personal history, a physical examination, and biochemistry and radiology tests for evaluating the anesthesia risk. Vital signs and the wound condition were recorded during the follow-up period. All patients underwent a lower gastrointestinal series to confirm the anastomotic integrity before stoma closure, with the exception of those with end stoma. We used laxatives and three way irrigation without prophylactic antibiotics in colon preparation before operation.

Surgical technique

Step 1: Elliptical skin incision and initial exposure

A bulls-eye sharp wedge skin incision was made to the subcutaneous level at 0.1 cm from the stoma edge. Dissection around the stoma wound space was performed to the subcutaneous tissue layer. Interrupted simple sutures (each separated by 0.5 cm) were applied using 4-0 silk on the stoma mucocutaneous end. The operation wound was sterilized using gauze soaked with 10% povidone-iodine antiseptic solution for 1-2 minutes.

Step 2: Stoma takedown and reconstruction

The stoma was taken down after separating it from the fascia and muscle layers. A stoma wedge was resected 0.5 cm from the mucocutaneous junction. The primary stoma closure was implemented using continuous and interrupted suturing. Naturally, side to side anastomosis was performed with staplers post segmental bowel resection if primary stoma closure could not be performed. The fascia defect was repaired with looped polydioxanone (PDS) or 1-0 vicryl interrupted sutures.

Step 3: Wound antibacteria management

The skin wound base was treated using gauze soaked with 10% povidone-iodine antiseptic solution for 1-2 minutes. The wound was irrigated with 500 ml of normal saline followed by a cefazolin saline solution.

Step 4: Primary wound closure and approximation

The open wound was closed using two or three stitches of a retention suture. The wound was well approximated using a simple suture or a vertical mattress suture. The #1.5 silk suture was inserted deep through the fascia layer.

Step 5: Wound dressing

The wound was covered with clean gauze and compressed with four to six packages of loose gauze by medical adhesive tapes for 3 days. Wound care started on the third day postoperation.

Follow-up

The postoperation wound condition was evaluated during hospitalization and then in an outpatient department at 2 weeks, 1 month, 3 months, and 12 months after the operation. The outcome of interest was SSI as defined by the Centers for Disease Control and Prevention. Wound infections were categorized into superficial and deep SSIs.

Superficial incisional SSIs occur within 30 days of the operation and only involve the skin and subcutaneous tissue and one of the following: (1) purulent drainage, (2) organisms isolated from an aseptically

obtained culture of tissue or incisional fluid, (3) symptoms or signs of infection (e.g., pain or tenderness, localized swelling, erythema, or heat), in which case the wound is opened, or (4) diagnosis of superficial incisional SSI by a surgeon or attending physician. Deep incisional SSIs occur when the incisional wound involves the muscle and fascia layers but not the organ space.[2]

Wound healing (e.g., re-epithelization of squamous epithelium),[3] morbidity (e.g., prolonged wound pain and seroma formation, incisional wound herniation), and mortality were also assessed.

Results

Our modified primary stoma-closure method was applied to all 119 patients from November 2004 to October 2013. The baseline values of general demographics variables such as age, gender, body mass index, smoking, and diabetes mellitus were recorded (Table 1). The closed stomas included 19 loop ileostomas, 80 loop T-colostomas, 10 loop S-colostomas, 5 end D-colostomas, 2 end-ileostomas, and 3 end T-colostomas.

The mean operation time was 112 minutes (range 58-395 minutes) and no patient needed additional surgery for wound infection. The recorded morbidities included postoperative adhesion ileus or diarrhea, anastomosis leakage, wound infection, prolonged abdominal wound pain, and incisional hernia. There was no case of mortality related to stoma-closure surgery, and there were no perioperative complications.

Most of the wounds healed rapidly, and stitches were removed about 7 days later. The mean follow-up period was 51.5 months. Six patients were lost to follow-up at 2-4 weeks after surgery. Ninety (75.6%) of the 119 patients received a three-antibiotics combination (cefazolin, gentamicin, and metronidazole) for 3 days.

One adhesion ileus, two incisional hernia, two SSI as wound infection, no postoperative diarrhea, no anastomosis leakage, no prolonged abdominal wound pain were recorded. There were 2 patients developed SSI and the mean wound infection rate was 1.68% (2/119). These 2 infective wounds required wet saline dressing for 7 days due to wound purulent discharge, one of which infected with enterococcus on postoperative day 5 and the other one cultured negative finding. The wounds eventually closed after applying approximation using medical adhesive tape. Two patients, who

Table 1. Demographics of the 119 stoma closure patients

Variable	*n* (%)
Age group	
< 50 years	22 (18.5)
50 to 75 years	50 (42.0)
> 75 years	47 (39.5)
Gender	
Female	38 (31.9)
Male	81 (68.1)
Body mass index, kg/m^2	
< 18.5	7 (5.9)
18.5 to 24.0	56 (47.1)
> 24.0 to 35.0	53 (44.5)
> 35.0	3 (2.5)
Heavy smoker	11 (9.2)
Underlying disease	
Diabetes mellitus	31 (26.1)
Hypertension	47 (39.5)
Cerebral vascular accident	8 (6.7)
American Society of Anesthesiologists score	
I or II	83 (69.7)
III	36 (30.3)
Stoma indication	
Benign disease	46 (38.7)
Malignancy	73 (61.3)
Mean time to stoma closure from creation, days	200.6
≤ 90 days	18 (15.1)
> 90 days	101 (84.9)
Chemotherapy during interval time	38 (31.9)
Type of stoma	
Loop ileostomy	19 (16.0)
Loop colostomy	90 (75.6)
End stomas	10 (8.4)
Anastomosis	
Stapled	21 (17.6)
Hand sewn	98 (82.4)
Duration of surgery, minutes	112.4 [range 58-395]
Postoperation antibiotics	
Triple	90 (75.6)
Other	29 (24.4)
Duration of antibiotics, days	3.49 [range 1-10]
Hospital stay, days	7.92 [range 4-16]

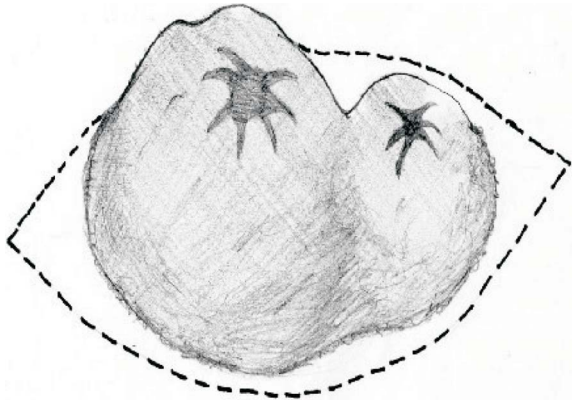

Fig. 1. A bulls-eye sharp wedge skin incision was made to the subcutaneous level at 0.1 cm from the stoma edge.

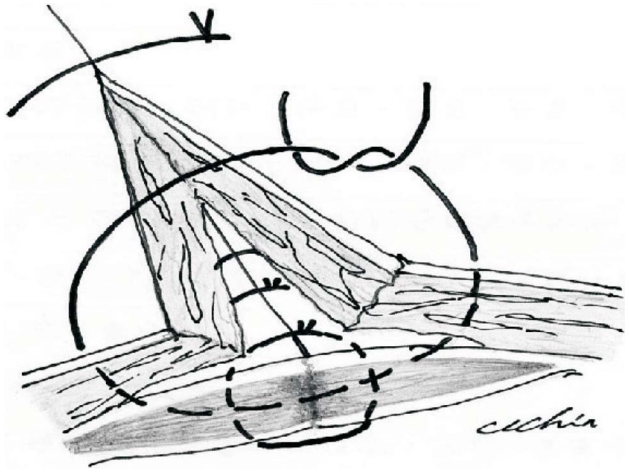

Fig. 2. The open wound was closed with two or three stitches of a retention suture. The wound was well approximated using a #1.5 silk simple suture or a vertical mattress suture through and fixing the fascia layer.

were different from SSI patients, developed an incisional hernia at the stoma site at 9 months after the surgery.

Discussion

Stoma-closure procedure is usually performed when the clinical condition is stable and the patient is suitable for the restoration of enteral function. Simple primary closure of a stoma wound was first described by van de Pavoordt et al.[4] in 1987. The conventional method simplifies subsequent surgical process and wound care, allows good exposure with an elliptical skin incision, shortens the wound healing time, and gives acceptable cosmetic results. However, the SSI rate of the conventional method can be up to 40%.[5]

Post-stoma-closure-related SSI is associated with prolonged healing time and convalescence, increased morbidity (e.g., dehiscence, sepsis, and incisional hernia), patient discomfort, burden on the health-care system, and economic loss to the patient.[6,7] Body mass index, heavy smoking, diabetes mellitus, chronic obstructive pulmonary disease, and immunodeficiency are major patient contributing factors that are known to increase the risk of SSI,[5,6,8,9] but these factors can not be prevented or changed in the short term. In addition to this, the above risk factors has no significant relation to SSI rate in this study. To improve perioperative morbidities, especially wound infection, some techniques related to the skin incision and wound closure had been proposed for decreasing the wound infection rate in stoma closure.

The previous studies that have investigated postoperative antibiotics have produced equivocal results, with there being no definitive conclusions regarding on what and how to use these antibiotics. We empirically applied a three-antibiotics combination of cefazolin, gentamicin, and metronidazole for 3 days[5] and there was no increase in the infection rate. But more prospective studies are needed for determining antibiotics protocols.

Some studies have found controversial improvements in the SSI rate with the subcutaneous implantation of a gentamicin sponge (SSI rate: 10%) or wound irrigation (SSI rate: 3.0 to 58.2%) before closure wound.[6,10,11] The literature[12] reports low rates of wound infection as 8.5% when using the cross-shaped subcuticular circular closure technique, as for the purse-string closure (PSC) method described by Banerjee.[13] Furthermore, modifying the conventional skin closure method with subcutaneous Penrose drainage produced no high-quality evidence for placing a wound drain with 10.5% SSI rate.[1,5] Dead-space resolution was helped by improving wound drainage, but this also created another small wound, had a similar infection rate, and the incubation time differed for different lesions.

Wound irrigation with simple saline, povidone-iodine solutions or with saline containing antibiotics is a simple and economically reasonable measure to reduce SSI rates. Previous meta-analysis showed a significant benefit of wound irrigation with any solution in comparison to no irrigation in colorectal surgeries.[11] The estimated effect in reduction of postoperative SSI rates was significant only for wound irrigation with topical antibiotics or povidone-iodine solutions but not for saline in further analysis. In this study, wound irrigation with povidone-iodine solution in step 1 and 3, furthermore, with saline containing antibiotics in step 3 before wound closure. Combine this two kinds of wound irrigation procedure in single surgical wound management would decrease risk of SSI, but need high-quality evidence from future random control trials.

Many colorectal surgeons have used the PSC method described by Banerjee in 1997,[13,14] and this is also used in dermatological surgery after skin cancer excision. This method has decreased the infection rate from 15% to 2% and is associated with a smaller wound scar.[5,15] A long scar might not be necessary with PSC method, but this approach has shortcomings of prolonged wound care time more than 21 days for central wound defect.[5,16]

Our linear closure technique is a modified version of the primary closure method. We decrease bacteria colonization by sterilizing the wound with pure povidone-iodine gauze post stoma closure,[17] and extended suturing with fascia fixation and external compression results in a smaller dead space. The wound edges are approximated well, and excess fluid can still drain out via the loose wound gaps.

The main shortcomings of conventional primary wound closure post stoma closure are the production of a long linear scar and the high infection rate of stoma wounds. Our protocol improved the SSI rate for primary wound closure by modifying the suture method and adding loose gauze compression. The scar over the closure wound is longer than the stoma size for an ellipse incisional wound, and so the cosmetic outcome is not perfect; but perform this method will avoid puckered scar, local hard fibrotic tissue sensation, and prolong wound care period in PSC method. This search has several limitations: it is a retrospective study, there is no control group available for comparative analysis and the sample is small. Larger series and randomized studies may need to compare the PSC method to our novel surgical procedure.

Conclusion

This pilot study suggests that using a modified primary suture method for stoma closure can reduce the SSI rate, and that it is well-controlled and repeatable procedure.

Author's Contribution

The author contributed to the work and first author: Cheng-Yi Huang.

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data of data for the work: Cheng-Yi Huang, Chih-Chien Chin, Yi-Hung Kuo.

Drafting the article or revising it critically for important intellectual content: Chih-Chien Chin, Wen-Shih Huang, Yi-Hung Kuo, Meng-Chiao Hsieh, Kuan-Chu Ho.

Final approval of the version to be published: Cheng-Yi Huang, Chih-Chien Chin.

Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: Cheng-Yi Huang, Chih-Chien Chin, Wen-Shih Huang, Yi-Hung Kuo, Meng-Chiao Hsieh, Kuan-Chu Ho.

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原　著

改良性的原始關閉造口傷口方式可以降低手術部位感染率

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目的　造口關閉後最常見的問題是手術部位傷口感染，這與原始性傷口關閉方式的特性密切相關。本研究的目的是研究一種造口關閉後的改良性原始傷口關閉方式，並評估此方式在降低手術併發的手術部位傷口感染率的可行性。

方法　本研究回溯收集 10 年的造口關閉患者的資料分析，並評估疾病控制和預防中心定義的造口關閉手術部位感染率。本研究描述了相關手術技術，包含對縫合方法的修改，傷口灌洗流程和增加鬆動紗布加壓，並評估分析患者臨床數值和相關臨床因素對手術部位傷口感染率的影響。

結果　本研究收錄 119 名接受選擇性造口關閉的患者，平均年齡為 64.1 歲，其中 68% 為男性。術前診斷包括 73 例結直腸癌 (61.3%) 和 46 例良性疾病 (38.7%)。造口種類包括 19 個迴腸造口，80 個橫結腸造口，10 個乙狀結腸造口和 10 個末端造口。在這之中，有 2 名患者發生了手術部位傷口感染 (1.68%)。

結論　我們改良的造口關閉後原始傷口縫合方法可以降低手術部位傷口感染的發生率，同時達到可接受的外觀。

關鍵詞　改良性的原始關閉方式、手術部位傷口感染、造口關閉傷口。