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Prevention of Incisional Surgical Site Infection Using a Subcuticular Absorbable Suture in Elective Surgery for Gastrointestinal Cancer

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This study examined whether subcuticular absorbable sutures actually reduce incisional SSI in patients undergoing surgery for gastrointestinal (GI) cancer. Surgical site infection (SSI) is still a source of major complications in digestive tract surgery. Reportedly, incisional SSI can be reduced using subcuticular suturing. We performed subcuticular suturing using a 4-0 absorbable monofilament in patients undergoing elective surgery for GI cancer beginning in 2008. Using an interrupted technique, sutures were placed 1.5-2.0cm from the edge of the wound, with everted subcuticular sutures created at intervals of 1.5-2.0cm. The control group consisted of cases in which the common subcutaneous suture method using clip. One hundred cases were examined in the subcuticular group. The incidence of SSI was 0% in the subcuticular suture group, compared with 13.9% in the control group; this difference was significant. Incisional SSI can be prevented using the devised subcuticular absorbable sutures in patients undergoing elective surgery for GI cancer.

Key words: Surgical site infection – Subcuticular suture – Absorbable monofilament – Gastrointestinal cancer surgery

Surgical site infection (SSI) is still a source of major complications in digestive tract surgery. The Centers for Disease Control and Prevention (CDC) National Nosocomial Infection Surveillance System (NNIS) risk adjustment index is an internationally recognized method of stratifying the risk of SSI according to three major factors.[1] First, the American Society of Anesthesiologists' score reflects the patient's state of health before surgery.[2] Second, the wound classification reflects the degree of

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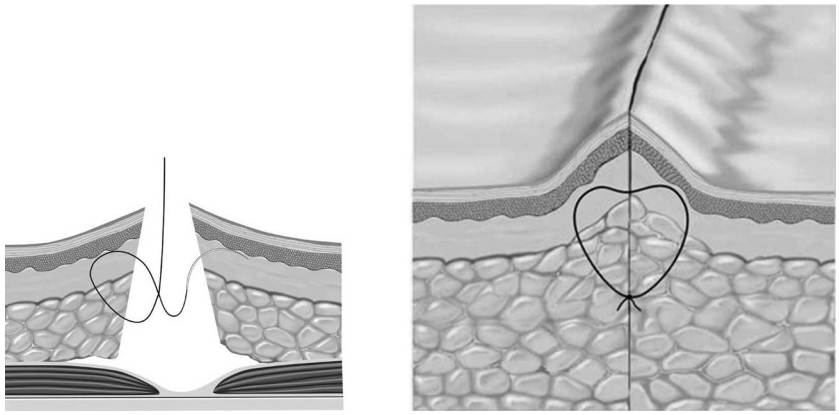

Fig. 1 The closure of layers beneath the fascia was the same in both groups. The subcuticular suturing utilized 4-0 PDSII, providing excellent skin apposition and eversion.

wound contamination. And third, the duration of the operation reflects the technical aspects of surgery. The infection rate increases with an increasing risk index score.[1,3] Excellent surgical technique is widely believed to reduce the risk of SSI.[4–7] In the case of wound closure, such techniques include the maintenance of effective hemostasis while preserving an adequate blood supply, preventing hypothermia, gently handling the tissues, avoiding inadvertent entries into a hollow viscus, removing devitalized (e.g., necrotic or charred) tissues, the appropriate use of drains and suture materials, the eradication of dead space, and the appropriate postoperative management of incisions. Hematoma at the site of a surgical wound is a relatively common complication in elective surgical procedures. In most cases, the hematoma is caused by incomplete preoperative hemostasis, and not the omission of a subcutaneous fat layer suture.[1,8] According to current knowledge, seroma formation is caused by the ultrafiltration of blood serum, lymphatic secretion, the fibrinolytic activity of plasmin (causing the decay of fibrin complexes in the surrounding injured vessels), and tissue exudate formed during early inflammation reactions.[3,9,10] A large dead space also appears to contribute to the formation or a seroma.[3] According to some authors, the presence of suturing material (as extraneous material) in tissues can also increase the risk of surgical site infections.[11–13]

Subcuticular suturing was recently reported to reduce incisional SSI.[14–16] Subcuticular sutures are thought to enable a maintained blood supply and to eradicate dead space in the subcutaneous environment. Therefore, we investigated whether the devised subcuticular suturing actually reduces incisional SSI, compared with the common subcutaneous sutures with clip, in patients undergoing elective surgery for gastrointestinal cancer.

Materials and Methods

Patients with gastric or colorectal cancer (gastric cancer: n = 125, colon cancer: n = 104, rectal cancer: n = 36) in whom elective surgery was performed between January 2008 and June 2013 were enrolled in the present study. The incidence of SSI was then prospectively investigated, excluding cases in which laparoscopic surgery was performed or an artificial anus was constructed.

The method of wound closure was randomly selected as "control" or "subcuticular." In both groups, the peritoneum was closed using 3-0 absorbable sutures. The fascia was then closed using 1 absorbable suture in a layer-to-layer manner. In the control group, the subcutaneous tissue was sutured in a layer-to-layer manner using 3-0 or 4-0 absorbable sutures and with skin clip. In the subcuticular group, subcuticular suturing was performed using a 4-0 absorbable monofilament. This method provides excellent skin edge apposition and eversion. Using an interrupted technique, the suturing was performed 1.5 to 2.0 cm from the edge of the wound, with everted subcuticular sutures created at intervals of 1.5 to 2.0 cm. With this method, the skin is joined using Steri-strips (Fig. 1).

The subcutaneous fat tissue thickness was measured using computed tomography. For the patients who had undergone gastric surgery, the measurements were performed at the thinnest and thickest regions of the upper median incision. For the patients who had undergone colorectal surgery, similar measurements were performed at the lower median incision.

*Table 1 Statistical analysis of preoperative and surgical variables**

Factors	Control group	Subcuticular group	*P*
Subjects, n	165	100	
Sex, M:F	99:66	68:32	0.191
Age, y	69.1 ± 10.7	67.7 ± 9.9	0.102
Operation time, min	226.1 ± 79.2	234.6 ± 74.6	0.253
Blood loss, mL	365.9 ± 544.1	357.4 ± 302.0	0.202
BMI (mean)	22.0 ± 3.5	22.5 ± 3.5	0.141
Thickness of fat tissue	18.2 ± 7.3	18.9 ± 7.4	0.280
Incidence of SSI	13.9% (23/165)	0.0% (0/100)	<0.001*

*$P < 0.05$.

Several faculty surgeons who are specialists in gastrointestinal surgery performed the surgical procedures. A single surgeon performed all the wound closures, including the new subcuticular suturing technique. The main outcome of interest was the incidence of postoperative SSI (including superficial and deep) diagnosed within a 30-day postoperative period. We diagnosed SSI according to the criteria of the NNIS.[1]

Informed consent was obtained from all the patients prior to surgery. The study protocol conformed to the ethical guidelines established by the 1975 Declaration of Helsinki.

All the statistical analyses were performed using statistical software (SPSS 17.0, SAS, Cary, North Carolina). Values of $P < 0.05$ were considered statistically significant.

Results

The incidence of SSI in the control group (n = 165) was 13.9%, whereas the incidence of SSI in the subcuticular group (n = 100) was 0%; this difference was significant ($P < 0.001$; Table 1).

The subcuticular suturing technique did not lead to surgical site infection in patients undergoing surgery for gastric or colorectal cancer. In addition, measurements performed using computed tomography confirmed that the subcuticular suturing technique minimized the dead space within the wound.

No significant differences in sex, age, blood loss, operation time, body mass index, or subcutaneous fat tissue thickness were seen between the two groups (Table 1).

Discussion

This study concerns a technique for eradicating subcutaneous dead space and optimizing the management of postoperative incisions. Incisional SSI in elective gastrointestinal cancer surgery appears to be preventable using subcuticular suturing. Recently, subcuticular sutures have been reported to reduce the incidence of incisional SSI.[14–16] The suturing of fat tissue during wound closure is a classical surgical procedure that, by closing the potential dead space, is understood to decrease the risk of fluid collection in the wound and infectious complications.[17–20] However, fragile fat tissue cannot be joined in the same manner as peritoneal, fascial, or skin layers.[21] Stitches segment the fat layer, which can result in multiple, separate fluid deposits. In obese patients, subcutaneous suturing is usually performed to match the skin edges better, but such suturing is never perfect and ischemia can cause tissue decomposition. Moreover, the presence of extraneous material can increase the risk of bacterial infection.[22] One of the main factors influencing wound healing is the blood supply to the wound. The measurement of blood flow in patients treated with three different abdominal closure techniques (clips, mattress sutures, and subcuticular sutures) showed significantly higher blood flow values in wounds closed with subcuticular sutures.[23] The objectives of surgical incision closure are safety, effective healing, and excellent cosmesis. Incision closure techniques can involve the use of a variety of suture materials, percutaneous metal staples, tissue glues, and adhesive dressings. Percutaneous suturing provides excellent wound-edge apposition and is easy to perform. However, its disadvantages include the need for suture removal, discomfort associated with suture removal, bacterial migration along the suture tracts, skin irritation, and scarring. Subcuticular suturing reduces skin irritation while providing excellent skin-edge apposition and eversion. This technique decreases wound tension and scar formation. By virtue of the subcuticular suture placement, suture track formation and the percutaneous migration of bacteria into the wound do not occur.[13] Typical closures are closely approximated with good edge eversion and no clinically significant inflammation.[1,3,24] The use of an appropriate material is also an important factor in preventing incisional SSI. Synthetic absorbable sutures are less reactive and have more tensile strength than sutures made from natural sources, such as catgut. Some synthetic absorbable sutures, such as those made of polydixanone and polyglyconate, retain their tensile strength for long periods, making them useful in

areas with high dynamic and static tensions.[24] We have used a 4-0 absorbable monofilament, which minimizes the foreign body in the dermal area. Eradicating dead space is also an important factor.[1,3] Subcuticular suturing enables excellent skin apposition, eversion, and the eradication of dead space. For the previous argument, we consider the most important factor reducing SSI are the blood supply under skin, dead space in subcutaneous layer and foreign body within that layer to adaptate the open wound. In terms of the time required to perform these techniques, only a few minutes were required for the use of a stapler, whereas this subcuticular suturing method required about 10 minutes. An antibiotic monofilament would be optimal, but when costs are considered, our technique and materials are sufficient.[25] According to the Japan Nosocomial Infections Surveillance, the incidence of SSI after gastrointestinal surgery was 12.8% in 2012, 9.2% after gastric surgery, 13.7% after colonic surgery, and 16.3% after rectal surgery.[26] In the current study, none of the patients treated with this subcuticular suturing developed SSI. We consider the most important factor in reducing the incidence of SSI to be the subcuticular space and its condition, and this new method can be used to eradicate dead space and to prevent SSI after gastric and colorectal cancer surgery.

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