

Surgical Site Infection Rate of PDS-II and Dermabond Versus Vicryl and Silk in Major Abdominal Surgery Using the Pig Liver Resection Model

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Abstract

Aim: PDS-II for peritoneal and subcuticular sutures, followed by Dermabond for skin dressing was commonly used in minimal surgical field, it is still unclear whether subcuticular closure and skin dressing are effective for the major abdominal surgical incision. The purpose was to investigate SSI of PDS-II and Dermabond versus Vicryl and silk in major abdominal surgery using the pig liver resection mode.

Methods: A chevron incision was performed, followed by the left hemi-hepatectomy using pig liver. In group A, the closing of the peritoneum and subcuticular tissue were done using 1 and 3-0 PDS-II. Dermabond was used for skin dressing. In group B, closing materials were using 1-0 vicryl at peritoneal and 2-0 silk at submucosa and skin. We evaluated SSI of the skin incision in both groups.

Results: We evaluated 7 pigs in each groups. In group A, only one of the seven pigs (14.3%) had superficial incisional SSI. In group B, Five out of seven pigs (71.4%) had deep incisional SSI and ventral hernia, and they were died within 10-14 days after surgery. Group A was significantly lower incidence of SSI than group B ($P=0.03$).

Conclusion: PDS-II and Dermabond were effective for abdominal closing.

Key words: Subcuticular suture; Liver resection; Pig; Surgical site infection; Absorbable monofilament

Abbreviation: SSI: Surgical Site Infection; Dermabond; Octyl-2-octylcyanoacrylate

Introduction

The postoperative wound infection after major abdominal surgery was the one of the reasons for increasing medical cost such as, using antibiotics; need to change of gauze or dressing materials several-times in a day, and prolonging hospitalization [1]. Recently, some reports suggested that use of suture (PDS-II: polydioxanone; Ethicon Inc, Somerville, NJ) for subcuticular closure and use of Octyl-2-octylcyanoacrylate (Dermabond; Ethicon Inc, Somerville, NJ) for skin dressing, were effective for good cosmetics as well as for decreasing the occurrence rate of surgical site infection (SSI) after surgery [2-6]. Dermabond provides epidermal wound closure equivalent to commercially available devices with a trend to decreased incidence of wound infection [4] and it has slight antibacterial activity against MRSA [5]. The other hand, Dermabond does not had antibacterial activity against ciprofloxacin-resistant *Pseudomonas aeruginosa* and ciprofloxacin-sensitive *Pseudomonas aeruginosa* [6]. It is still unclear. However, these reports were only using Dermabond to short surgical incisions including children or laceration. Thus it is still unclear whether subcuticular closure and skin dressing are effective for major abdominal surgical field. In this experimental study, we investigated using pig liver resection model whether use of PDS-II for subcuticular closure and Dermabond for skin dressing were effective for skin closing.

Material and Methods

Experimental groups

The study was performed using male pigs, weighing 23-25kg (SEASCO, Saitama, Japan), in accordance with the Guidelines for the Care and Use of Laboratory Animals, Dokkyo Medical University. A

chevron incision was performed under general anesthesia, the left portal vein and artery were ligated, and a left hemi-hepatectomy was performed (approximately 40%) (Figure1). Liver transection was achieved by the crush-clamping method using Pean forceps. During liver transection, each of the exposed Glisson's vessels was ligated with 2-0 or 3-0 silk. Hepatic vein was closed by continuous sutures using 4-0 proline. After resection, we compared with abdominal closing technique in both groups as below. In group A, the peritoneum was closed using 1- PDS-II by interrupted suture. After washing the subcuticular area with 500 ml of the saline, the subcuticular area was closed with 3-0 PDS-II by interrupted sutures in 1 cm interval.

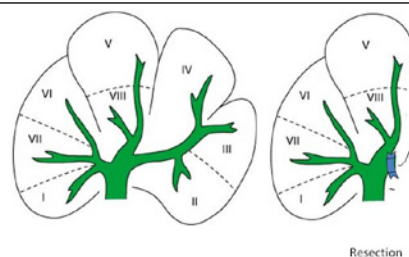


Figure 1: The left portal vein and artery was ligated, and a left hemi-hepatectomy was performed (approximately 40%).

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Figure 2: After subcuticular sutures, dressing was done using Dermabond in group A.



Figure 3: After 7 POD, Dermabond was still covered at the incision (arrows) in group A.



Figure 4: After one month in group A, six of the seven pigs did not reveal any kinds of SSI at the skin incision like this pigs.

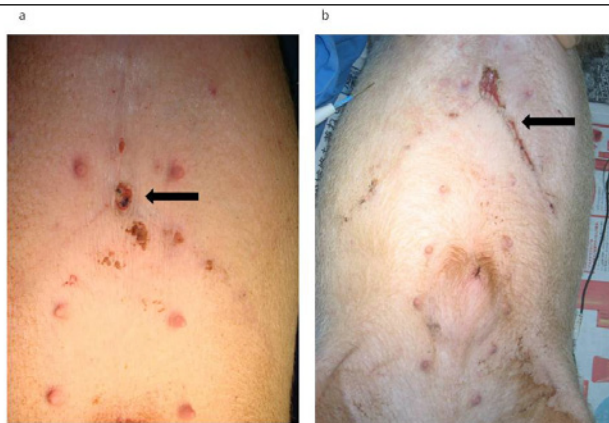


Figure 5: This pig had stitch abscess (a: arrow) at one month after surgery in group A.

After cleaning the skin, dressing was using Dermabond (Figure 2). In group B, we performed by conventional suture technique which was using 1-0 Vicryl (Ethicon Inc, Somerville, NJ) by interrupted suture for the peritoneal and fastia, and the skin and subcutaneous were

closed with 2-0 silk by interrupted sutures. After operation, pigs were taken care in the lab unit, and oral intake was allowed after one postoperative day. We did not administer to them any kind of antibiotics orally or intravenously after surgery. We looked into pig abdominal incision every day and evaluated skin condition. Primary end point was SSI at one month after surgery.

Criteria for SSI [7]

Infection involving only skin or subcutaneous tissue of the incision was diagnosed when at least one of the following findings was observed: 1. purulent drainage, with or without laboratory confirmation, from the superficial incision. 2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision. 3. At least one of the following signs of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision deliberately opened by surgeon. 4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

The following conditions were not considered as SSI:

1. Stitch abscess (minimal inflammation and discharge confined to the points of suture penetration).
2. Incisional SSI that extends into the fascial and muscle layers.

Deep Incisional SSI

Infection involving deep soft tissues (e.g., fascial and muscle layers) of the incision was diagnosed when at least one of the following findings was observed:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces.
3. Diagnosis of deep incisional SSI by a surgeon.

Notes:

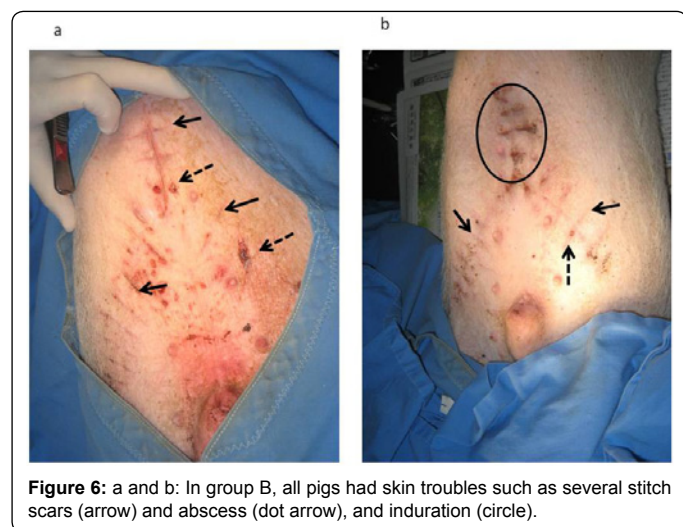
1. Report infection that involves both superficial and deep incision sites as deep incisional SSI.
2. Report an organ/space SSI that drains through the incision as a deep incisional SSI.

Statistical Analysis

All values are expressed as means $\pm$ S.D. Parameters was evaluated using Chi square and student t test. Differences between the two groups were evaluated using analysis of variance with $P < 0.05$ considered to be significant.

Results

Fourteen pigs in group A and seven pigs in group B were evaluated. In group A, there were no deaths with wound related infection. Pigs did not reveal any kind of erythema, induration and SSI, in addition, Dermabond was still covered at the incision (Figure 3). Six of the seven pigs did not reveal any problem at the skin incision (Figure 4). Only one pig (14.3%) had SSI, stitch abscess and incisional scar (Figure 5). In group B, all of the seven pig's skin sutures were lost on within 7 days after surgery. Two out of the seven pigs were alive one month after surgery, they had only stitch scar and abscess, and induration (Figure 6 a and b). Five out of the seven (71.4%) pigs had sever deep incisional SSI and ventral hernia (Figure 7), cultures of pus obtained revealed infection by pseudomonas aeruginosa (4 pigs) or Escherichia coli (one pig). Finally, five pigs developed burst abdomen later died of consequence of sepsis 10-14 days after operation. Group A was significantly lower rate of SSI than group B ($p=0.03$).



Discussion

We have reported short term (3-7 days) pig resection model in the past, however, it is very difficult to make a long term (more than 7 days) model [8,9], due to the occurrence of deep SSI in all pigs. All of the peritoneal and skin incisions were closed using Vicryl (Ethicon Inc, Somerville, NJ) and silk. Also there were several issues concerning this pig liver resection model for protecting SSI; 1). Sanitation of Pigs' care units was insufficient; we were not able to disinfect the abdominal incision everyday 2). Skin suture such as stitch and stapler and film dressing, were not effective for pigs, as they tend to remove them themselves using legs or rubbing abdomen on the floor after surgery. Therefore we applied PDS-II for peritoneal and subcuticular closing sutures and Dermabond for skin cover. These materials were made if unnecessary to disinfect the abdominal incision everyday, low risk for SSI and decreasing SSI ratio, and Dermabond protected skin incision from pig attack. Also this closing method was not need longer time than usual manner. The both materials were impressive

and will be especially useful for pig liver resection model. Applied to human cases, perhaps wound disinfection will be unnecessary to be carried out everyday, and medical cost and hospitalization can perhaps be reduced. However, the only problem was wound closing cost. Average cost per pig was US\$ 434.43±10.9 in group A, and was US\$ 169.83±6.9 in group B, respectively. These numbers were significant difference between two groups ($p=0.0001$). Therefore, this difference maybe is not a big issue because when the patient had SSI after surgery; the total medical cost was probably higher than this wound closing cost.

In addition, application of PDS and Dermabond are expected to have favorable results in the cosmetics, as to prevent the incisional fibrosis and keroid. In consideration of outcome of this experimental study. However this study had limitation, because it is not compared to all of medical cost and hospital stay in both groups, also not evaluated detail of wound condition and healing at every day, so we will be applying these materials to human and compared to conventional wound closing in cases of long operation and wide open incision, such as liver resection and pancreato-duodenectomy in near future.

Conclusion

From this result, the PDS-II and Dermabond demonstrated a decreased infection rate as compared to Vicryl and Silk, which may make it a viable option for closure of major abdominal surgery.

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