SCIENTIFIC PAPER JSLS

A Simple Vacuum Dressing Reduces the Wound Infection Rate of Single-Incision Pediatric Endosurgical Appendectomy

Oliver J. Muensterer, MD, PhD, Richard Keijzer, MD, PhD

ABSTRACT

Background and Objectives: After introducing single-incision pediatric endosurgical (SIPES) appendectomy at our institution, we noticed an increased number of postoperative umbilical infections. This study evaluates the impact of a simple, low-cost wound vacuum dressing on the wound infection rate.

Methods: Umbilical wounds after single-incision laparoscopic appendectomy were covered with standard dressing (approximating strips), or the new umbilical vacuum dressing. A wound infection was defined as an infected umbilicus requiring antibiotics, or incision and drainage. The wound infection rate was compared between both groups. Statistical analysis was performed using Fischer's exact test. Continuous variables were compared using the Student *t* test.

Results: Included in this study were 183 children, 97 of whom were treated with the vacuum dressing. The study populations were no different in terms of age, weight, operative time, blood loss, length of stay, or proportion of acute versus perforated appendicitis. A total of 7 (3.8%) wound infections occurred, 1 in the vacuum dressing group (1%), versus 6 in the conventional dressing group (7%, P=0.038).

Conclusions: This simple, low-cost umbilical vacuum dressing decreased the wound infection rate after SIPES appendectomy, possibly by absorbing secretions from the base of the wound. It may be equally effective for other indications.

Key Words: Single incision laparoscopy, Appendectomy, Wound infection, Vacuum dressing.

Division of Pediatric Surgery, Department of Surgery, University of Alabama at Birmingham, Birmingham, Alabama, USA (Dr Muensterer).

Division of Pediatric Surgery, University of Manitoba, Winnipeg, Manitoba, Canada (Dr Keijzer).

Address correspondence to: Oliver J. Muensterer, MD, PhD, Division of Pediatric Surgery, Weill Cornell Medical College, 525 East 68th Street, Box 209, New York, NY 10065, USA. Telephone 212 746 2705, Fax: 212 746 3884, E-mail: oliver.muensterer@att.net

DOI: 10.4293/108680811X13071180406592

INTRODUCTION

Single-incision laparoscopic appendectomy has become popular in many surgical centers around the world. We introduced the technique at our children's hospital in March 2009 and have coined it "single-incision pediatric endosurgery" (SIPES) in children. Empirically, we perceived an increased umbilical wound infection rate in our patients who underwent SIPES appendectomy.[1]

In an attempt to lower the number of wound infections, we devised a simple, low-cost vacuum dressing to cover the umbilical incision after SIPES appendectomy. In principle, a piece of gauze is placed in the navel, covered with a clear bio-occlusive dressing, and suction is created by evacuating the air around the dressing using a 22-gauge needle passed through the subcutaneous tissue.

The aim of this study was to evaluate the impact of this new vacuum dressing on umbilical wound infection rates in children undergoing SIPES appendectomy.

MATERIALS AND METHODS

From March 2009 until August 2010, the umbilical wounds of all patients undergoing SIPES appendectomy were covered either with a standard dressing (approximating strips) or the new vacuum dressing **(Figure 1)**. The vacuum dressing was left in place for 2 days to allow it to absorb the secretions from the base of the wound **(Figure 2)**. It was then removed either by the parents at home, or by the surgical staff if the patient was still admitted to the hospital at that time. The parents were instructed to leave the approximating strips in place until they fell off spontaneously.

All SIPES appendectomies were performed using an intracorporeal approach (the dissection and stapling at the base of the appendix were carried out inside the abdomen). The appendix was placed in an endoscopic retrieval bag before removal from the abdomen to minimize wound contamination. None of the patients had extracorporeal SIPES appendectomies.

Allocation to the treatment groups was based on surgeon preference. One surgeon exclusively used the vacuum

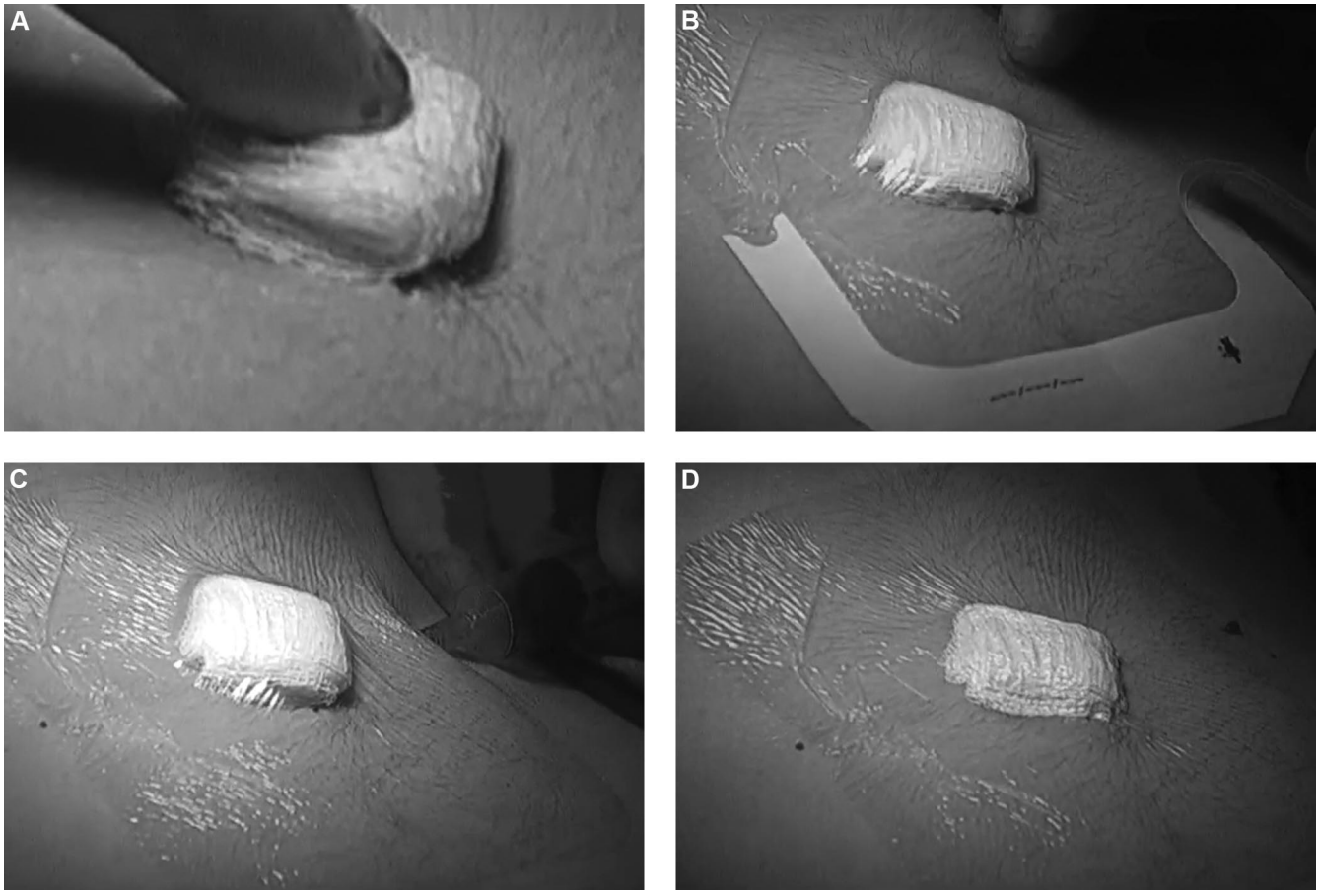

Figure 1. Illustration of the vacuum dressing. After wound closure, a 2" x 2" gauze is folded, placed onto the umbilicus (a), and covered with a bioocclusive dressing (b). A 22-g needle on a 10- mL syringe is passed percutaneously from outside the dressing into the gauze (c), and the air around the gauze is evacuated (d).

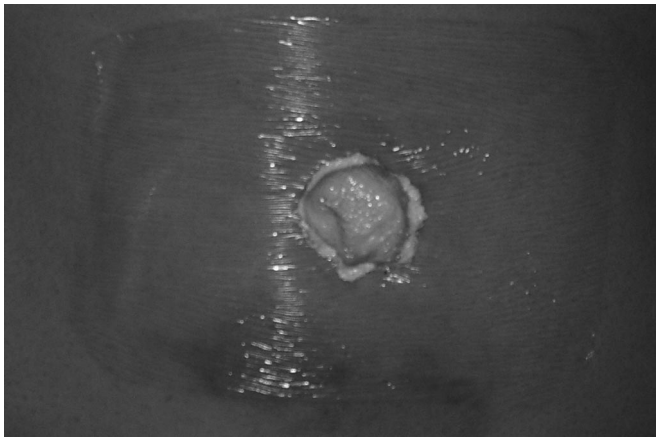

Figure 2. After 2 days, the gauze is saturated with secretions aspirated from the base of the wound by the vacuum created under the dressing.

dressing, while all others in the group used the standard approximating strip dressing.

A wound infection was defined as an infected umbilicus (erythema, increasing tenderness, purulent drainage), requiring either postoperative treatment with antibiotics, or incision and drainage. The wound infection rate was compared between patients with the vacuum dressing and those with standard dressing.

Statistical analysis was performed using Fischer's exact test. Continuous variables were compared using the Student *t* test, and a $P<0.05$ was considered statistically significant.

RESULTS

Over the 17-month study period, 183 children were included in this study, 97 of whom were treated with the

Table 1.
Comparison of the Characteristics of the Study Groups

Total (n=183)	Conventional (n=86)	Vacuum (n=97)	P
Age (months)	136±49	133±49	.65
Patient weight (kg)	46.8±21.3	47.2±21.7	.90
Operation time (min)	39.3±4.3	38.5±12.8	.68
Estimated blood loss (mL)	4.7±7.7	3.6±2.6	.20
Length of stay (days)	2.1±3.0	2.0±2.5	.79
Diagnosis (n)			
Acute	70	73	.09
Perforated	7	12	.13
Interval	9	12	.17

vacuum dressing. There were no differences in the demographics of the study population in terms of age, weight, operative time, blood loss, length of stay, or proportion of acute versus perforated appendicitis **(Table 1)**.

In 21 cases (11%), one or more additional trocars were added during the procedure at the discretion of the attending pediatric surgeon. None of the cases were converted to the open technique.

A total of 7 wound infections (3.8%) occurred in all patients (5 in acute appendicitis, 2 in perforated appendicitis, none after interval appendectomy). Wound infections were noted in one patient with acute appendicitis in the vacuum dressing group (1%, **Figure 3**), and in 6 patients in the conventional dressing group (7%, P=0.038).

DISCUSSION

Single-incision laparoscopic appendectomy is performed either as an intra- or extraabdominal procedure. In our center, all SIPES appendectomies are performed using an intraabdominal approach, whereby the appendix is dissected and stapled off at its base inside the abdomen, and then removed through the umbilical incision. We either place the appendix in an endoscopic retrieval bag or use a proprietary trocar so that the appendix itself does not contaminate the wound edges. In the extraabdominal operation,[2] the appendix is mobilized and externalized through the umbilicus. It is then stapled or ligated externally, and the cecum with the appendiceal stump is returned to its anatomical position inside the abdomen.

In previous publications,[3-5] an increased wound infection rate of 4% to 7% for single-incision appendectomies has been described, strikingly higher than the generally accepted rate of around 1% for conventional laparoscopic appendectomy.[6,7] Our own preliminary analysis showed similar results.[1]

Figure 3. Wound infection in the vacuum dressing group. It resolved with a course of oral clindamycin for 7 days.

The vacuum principle has been evaluated extensively in both adults and children as a treatment of chronic, complicated, or infected wounds.[8] In this study, we used the principle of vacuum wound care as a prophylactic measure to prevent infection. Theoretically, the dressing facilitates clearance of secretions from the base of the wound, and thereby decreases the chance of subcutaneous fluid collection, which may become infected.

To evaluate the degree of negative pressure produced by the vacuum dressing, a simple self-experiment was performed by the authors applying a vacuum dressing and measuring the negative pressure obtained by a liquid column. In 5 such trial runs, the resulting pressure ranged from -48cm to -60cm H_2O, which is about half of the pressure produced by pump-activated commercially available vacuum dressings.

A substantial limitation to our study is the lack of randomization, with treatment group allocation purely based on surgeon's choice. However, because one surgeon exclusively used the vacuum dressing, and all other surgeons exclusively used approximation strips, there should be no patient selection bias. In our department, appendectomies are assigned to surgeons purely on the basis of who is on call. Also, SIPES appendectomy was performed in all appendectomies including acute, perforated, or interval cases, limiting the effect of selection bias.

Since completion of this study, some of the other pediatric surgeons in our group have adapted the vacuum dressing

after SIPES appendectomy. In 56 SIPES appendectomies since then, 1 wound infection has been recorded (1.8%). However, a comparison in this patient cohort is impracticable, because not all vacuum dressings were explicitly documented in the operative note.

This study demonstrates that a simple, low-cost vacuum dressing has the potential of lowering the wound infection rate in SIPES appendectomy. It may be useful for other indications, such as cholecystectomies or splenectomies, although the effect may be attenuated due to the lower overall wound infection rate of such procedures. Based on the preliminary findings of this study, a prospective randomized clinical trial comparing vacuum and standard dressing for SIPES appendectomy is in preparation.

References:

1. Muensterer OJ, Puga Nougues C, Adibe OO, Amin SR, Georgeson KE, Harmon CM. Appendectomy using single-incision pediatric endosurgery for acute and perforated appendicitis. *Surg Endosc*. 2010 Dec;24(12):3201–3204. Epub 2010 May 19.

2. Valla J, Ordorica-Flores RM, Steyaert H, et al. Umbilical one-puncture laparoscopic-assisted appendectomy in children. *Surg Endosc*. 1999;13:83–85.

3. Saber AA, Elgamal MH, El-Ghazaly TH, Dewoolkar AV, Akl A. Simple technique for single incision transumbilical laparoscopic appendectomy. *Int J Surg*. 2010;8:128–130.

4. Lee J, Baek J, Kim W. Laparoscopic transumbilical single-port appendectomy: initial experience and comparison with three-port appendectomy. *Surg Laparosc Endosc Percutan Tech*. 2010;20:100–103.

5. Kim HJ, Lee JI, Lee YS, et al. Single-port transumbilical laparoscopic appendectomy: 43 consecutive cases. *Surg Endosc*. 2010 Nov;24(11):2765–2769. Epub 2010 Apr 16.

6. Lujan Mompean JA, Robles Campos R, Parrilla Paricio P, Soria Aledo V, Garcia Ayllon J. Laparoscopic versus open appendicectomy: a prospective assessment. *Br J Surg*. 1994;81:133–135.

7. el Ghoneimi A, Valla JS, Limonne B, et al. Laparoscopic appendectomy in children: report of 1,379 cases. *J Pediatr Surg*. 1994 Jun;29(6):786–789.

8. Baharestani M, Amjad I, Bookout K, et al. V.A.C. Therapy in the management of paediatric wounds: clinical review and experience. *Int Wound J*. 2009;6 Suppl 1:1–26,. Presented with honorable mention at the 19th SLS Annual Meeting and Endo Expo, New York, New York, September 2010.