

Novel Blake drain with negative pressure in pediatric laparoscopic surgeries

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Method Article

Keywords: Abdominal surgery, Negative pressure, Drainage tube, Plugging prevent

Posted Date: March 3rd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-284592/v1>

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Abstract

Background A drainage tube is generally retained after an abdominal surgery, especially in cases of postoperative bleeding or exudation. In recent years, negative pressure drainage or vacuum sealing drainage (VSD) has been extensively applied. However, the use of VSD in laparoscopic surgery is still challenging and has been rarely reported.

Purpose: To introduce a novel Blake drain applied with negative pressure in laparoscopic surgeries.

Materials/Methods: Two bar-shaped cuts were made at the end of the drainage tube, with one deeper than the other, and there were no other side holes retained. Thirty patients aged 4-8 years in novel drainage tube (NDT) group received the novel VSD after laparoscopic appendectomy or laparoscopic pyeloplasty, while those in the control traditional drainage tube (TDT) group received traditional drainage using the tube bearing side holes.

Results Tissue plugging and other complications were not observed in patients of NDT group. Significant differences were found in volume of drainage and cases of tissue plugging between NDT and TDT groups ($P < 0.05$).

Conclusions: The novel technique is simple, safe and effective for VSD following laparoscopic surgery. It can prevent plugging of soft tissues into the tube and improve drainage effect.

Background

A drainage tube is necessary to be retained for monitoring postoperative bleeding or exudation. In recent years, negative pressure drainage or vacuum sealing drainage (VSD) has been widely used in wound treatment[1]. However, VSD following a laparoscopic surgery requires to be cautiously applied. A traditional drainage tube has several side holes. Conventional operation may result in plugging of soft tissues into the side holes, thus greatly troubling extubation.

Materials And Methods

Two bar-shaped cuts were made at the end of drainage tube, with a deeper one than the other, and there were no other side holes retained. Thirty patients aged 4-8 years received the novel **Blake drain** after laparoscopic appendectomy or laparoscopic pyeloplasty in the First People's Hospital of Lianyungang. Among them, twenty patients were diagnosed with perforated appendicitis in laparoscopic surgery, with a course of 48-72 h. The whole abdomen was contaminated, and the novel **Blake drain** was performed after visible pus was cleared. Under the guidance of a laparoscope, the end of the drainage tube was pulled into abdomen using a forceps inserted from the other puncture site. Ten patients with laparoscopic pyeloplasty were treated with the same method. The end of the drainage tube was placed near the renal pelvis anastomosis. In the meantime, the patients in TDT group were drained using the traditional

drainage tube bearing side holes. This study was approved by the Ethics Committee of The First People's Hospital of Lianyungang.

Results

A total of 9-271 ml (59.15±61.14 ml) of pus was drained out after laparoscopic appendectomy, and 25-58 ml (31.30±9.96ml) of fluid was drained out after laparoscopic pyeloplasty. Extubation was performed at postoperative 48-72 h. Tissue plugging and other complications were not found in NDT group. There were significant differences in volume of drainage, and cases of plugging between NDT and TDT group ($P<0.05$) (Table 1, Table 2).

Table 1 Postoperative outcomes of NDT and TDT group following laparoscopic appendectomy

	NDT	TDT	<i>p</i> value
Cases (N)	20	20	
Age (Y)	5.80±1.54	5.50±1.19	0.522*
Volume of drainage (milliliters, mean±std dev)	59.15±61.14	28.45±23.55	0.043*
Cases of plugging (N)	0	6	0.008‡

p value<0.05 considered as statistically significant.

*Independent *t* test was performed.

‡ Fisher's exact test was performed.

Table 2 Postoperative outcomes between NDT and TDT groups following laparoscopic pyeloplasty

	NDT	TDT	<i>p</i> value
Cases (N)	10	10	
Age (Y)	6.30±1.57	5.60±1.26	0.354*
Volume of drainage (milliliters, mean±std dev)	31.30±9.96	20.50±8.50	0.018*
Cases of plugging (N)	0	8	0.002‡

p value<0.05 considered as statistically significant.

*Independent *t* test was performed.

‡ Fisher's exact test was performed.

Discussion

In 1954, Redon first proposed VSD that increased drainage efficacy and wound healing rate [2]. In 1995, Qiu et al. applied abdominal VSD for the first time in China [3]. Later, many studies have shown that VSD is effective in controlling abdominal infection, clearing abscess and shortening healing time [4, 5, 6].

In conventional VSD after abdominal surgery, however, foam materials should be placed between the abdominal soft tissues and the side hole of VSD tube. Otherwise, the soft tissues may be exposed to the side hole, triggering focal **necrosis** of the **intestinal wall**. Besides, granulated tissues may also grow into the foam material [7]. However, in laparoscope-guided open surgery, it is unfeasible to put the foam material into or out of the abdomen. In 1983, an original patent was issued, which described a novel drainage method named Blake drain. The inventor's name is Larry W. Blake. The Blake drain's design has

4 open fluted channels to prevent the plugging of draining perforations. The drain today continues to be a popular drain of choice for surgeons in all subspecialties.[8]

We herein report a novel **Blake drain** method by transforming the end of drainage tube. we made two bar-shaped cuts at the end of drainage tube, 4-5 cm long and 2-3 cm long (Figure 1). In this way, the side hole of the tube was transformed into two cuts to prevent the omentum or other soft tissues being incarcerated. The pressure could also be dispersed through both relatively long cuts. Even if the tissues were suctioned, extubation could be quickly and easily performed. The outside of the drain tube was connected with a negative ball. With this technique, foam or other materials were unneeded, which significantly simplified the procedures of VSD. Therefore, this technique is especially suitable for laparoscopic surgeries.

Perforated appendicitis is common in children. Their omentum has not yet fully developed, and the appendix tissue is much thinner than that of adults. As a result, abdominal contamination becomes much more severe in children with perforated appendicitis, making postoperative drainage always necessary [9]. VSD has been extensively in clinical application, but its use in laparoscopic surgeries is rarely reported. In the present study, we treated 20 cases of laparoscopic appendectomy with this novel Blake drain. To convenience the drainage, the end of the drainage tube is inserted into the Douglas pouch, a site far below the omentum. Early off-bed activities can also promote apocenososis through the tube. After that, we tried this technique in laparoscopic pyeloplasty that is always challenged by the lodged tube. In a case prior to this study, for example, we used ureteroscope to remove the drainage tube that had suctioned the omentum tissues into its side holes. Notably, in pyeoplasty treated with this novel Blake drain, the end of tube was still fixed near the renal pelvis stoma, and tissue plugging and other complications were not found, highly suggestive of its effectiveness and safety.

The novel technique is simple, safe and effective for VSD following laparoscopic surgery. It can prevent plugging of soft tissues into the tube.

Abbreviations

VSD: Vacuum sealing drainage

NDT: Novel drainage tube

TDT: Traditional drainage tube

Declarations

Ethics approval and consent to participate

All authors declare their participation and they meet the current ICMJE criteria for authorship.

Consent to publish

The author confirms:

- that the work described has not been published before;
- that it is not under consideration for publication elsewhere;
- that its publication has been approved by all co-authors, if any;
- that its publication has been approved (tacitly or explicitly) by the responsible authorities at the institution where the work is carried out.

The author agrees to publish in the Journal indicated below and also in English by BMC surgery journal.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are available in the Shaodong Gu repository

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors certify that there is no conflict of interest with any individual/organization for the present work.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' Contributions

Acknowledgements

The authors gratefully acknowledge the trust and support given by the patient's parents.

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Figures

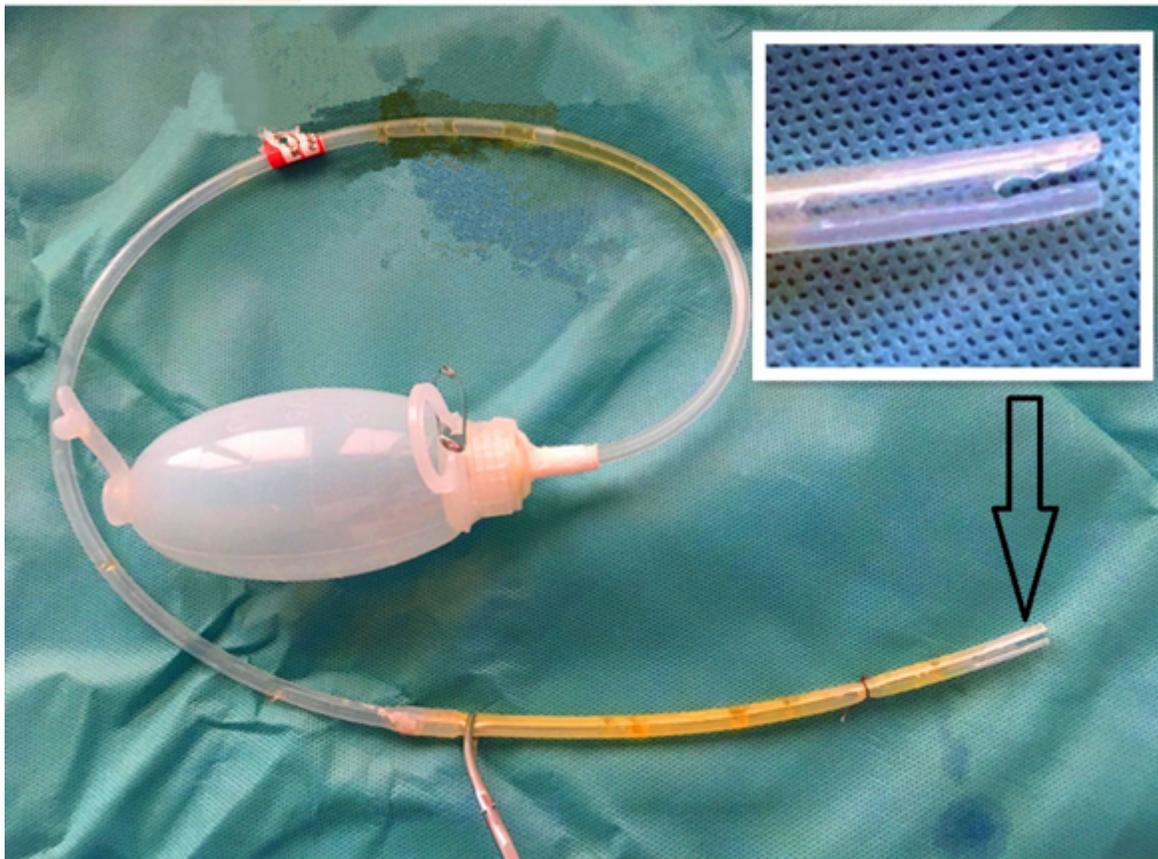


Figure 1

The novel Blake drain with negative pressure. Two bar-shaped cuts were made at the end of the drainage tube, with one deeper than the other, and there were no other side holes retained.