

Reduction of Peritoneal Drain-Related Complications after Gastrointestinal Surgery : The Effectiveness of Newly Developed Guidelines for Drain Placement and a Novel Drain Fixation Device

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ABSTRACT

Background : The aim of this study was to evaluate the effectiveness of newly developed guidelines and a novel drain-fixation device to prevent peritoneal drain-related complications.

Patients and methods : A total of 443 gastrointestinal operations were performed at our department from April 2005 through March 2006. Problems with peritoneal drainage occurred in 6 patients (1.4%) : The drains spontaneously became dislodged in 3 patients and retracted into the peritoneal cavity in the other 3 patients. Thereafter, we prepared new guidelines to prevent drain-related complications. We also developed a fixation device for the Duple drain, which we use most frequently. With the guidelines and the drain fixation device, peritoneal drainage was evaluated in 478 gastrointestinal operations performed from April 2006 through March 2007.

Result : No problems with peritoneal drainage occurred during the 1-year surveillance period of April 2006 through March 2007.

Conclusion : Treatment following newly developed guidelines for drain placement and the use of a new drain fixation device were effective in preventing peritoneal drain-related complications.

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Key words : peritoneal drain-related complications, gastrointestinal surgery guideline for drain placement, drain fixation device

INTRODUCTION

Unnecessary peritoneal drainage should be avoided after gastrointestinal surgery. However, if a drain is inserted, efforts should be made to minimize problems with the drain. Drains can become dislodged or retract into the peritoneal cavity and necessitate re-operation¹. Furthermore, there is no standard technique for fixing the peritoneal drain to the skin^{2,3}. In this study, we evaluated a fixation device we developed and guidelines for insertion of per-

itoneal drains after 1 year of surveillance to prevent problems related to peritoneal drains⁴.

PATIENTS AND METHODS

A total of 443 gastrointestinal operations were performed in the Department of Gastrointestinal Surgery, Daisan Hospital, The Jikei University School of Medicine, Tokyo, Japan, from April 2005 through March 2006 (Table 1). Penrose and Duple drains are often used in our department.

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Table 1. Gastrointestinal operations performed at our Department during the 1-year period of 2005 and 2006

Operated organs	2005 (case)	2006 (case)
Esophagus	11 (8)	4 (4)
Gastroduodenal	87 (60)	80 (58)
Small intestine	24 (10)	41 (15)
Appendix	53 (18)	35 (17)
Colon	67 (20)	61 (17)
Rectum	56 (38)	75 (43)
Anus	22 (2)	35 (3)
Liver	21 (18)	23 (20)
Bile duct	5 (5)	26 (24)
Gallbladder	80 (43)	80 (38)
Pancreas	14 (14)	15 (15)
Spleen	3 (3)	3 (3)
Total	443 (239)	478 (257)

*The number in parentheses means the patients with a drain.

Before the present study, we routinely placed drains but were concerned about possible bleeding and anastomotic leakage after gastrointestinal operations, except uncomplicated cholecystectomy, appendectomy, and small intestine resection. Moreover, suture-fixation of the drain to the skin was most often performed with a cutting needle and 2-0 nylon ligated with 3 nonslip knots.

Problems with peritoneal drainage occurred in 6 patients (1.4%) during the 1-year surveillance period. The drain spontaneously became dislodged in 3 patients and retracted into the peritoneal cavity in the other 3 patients.

The causes of these problems were loosening of the skin-fixation sutures in 5 patients and tearing of the drain in 1 patient. In 4 patients the drain was maintained for a prolonged period owing to anastomotic insufficiency or postoperative complications, such as bile leakage, which were due to careless fixation during drain replacement in 2 patients. Of the 6 patients with drain problems, 3 patients (50%) required drain re-insertion via laparotomy.

The results of this surveillance suggest that spontaneous dislodgement of the peritoneal drain or its retraction into the peritoneal cavity necessitates re-insertion and that long-term drain retention due to postoperative complications and careless fixation during drain replacement increase the risk of drain-related problems (Table 2).

We performed a questionnaire survey of all 12 surgeons in our department concerning "measures against problems concerning peritoneal drainage after gastroenterological surgery." The letter sent to the surgeons was as follows :

Dear fellow members of the Department of Gastrointestinal Surgery :

The Risk Management Committee has instructed us to evaluate safe methods for drain fixation and to present conclusions regarding our department. The committee will use the responses to prepare a manual. We invite your opinions concerning any issue, including patients who do not require drainage, drain types, open or

Table 2. Problems with peritoneal drainage during the 1-year period of 2005

	Case 1	case 2	case 3	case 4	case 5	case 6
Operative procedure	Partial hepatectomy Cholecystectomy	Distal gastrectomy	PD*	Sigmoidectomy	SLAR**	Hepatectomy
Type of drain	Replaced penrose	Penrose	Duple	Duple	Duple	Replaced neraton
Fixation	Suture-fixation	Suture-fixation	Suture-fixation	Suture-fixation	Fixation without suture ligation	Fixation without suture ligation
Position	Right subphrenic	Winslow	Right subphrenic	Anastomotic site	Anastomotic site	Right subphrenic
Retention days	35	1	3	9	34	16
Postoperative complications	Bile leakage	None	None	Leakage	Leakage	Bile leakage
Problem	Dislodgement***	Retraction****	Dislodgement	Dislodgement	Retraction	Retraction
Cause of problem	Loosening of the suture fixing	Loosening of the suture fixing	Loosening of the suture fixing	Drain tear	Loosening of the suture fixing	Loosening of the suture fixing caused of fragile skin
Measures against problems	Observation	Re-insertion by laparotomy	Observation	Re-insertion without laparotomy	Re-insertion by laparotomy	Re-insertion by laparotomy

*PD : pancreatoduodenectomy, **SLAR : super low anterior resection, ***Dislodgement : Spontaneous removal

****Retraction : Dropping into the peritoneal cavity, Permitted for use by Jikeikai Med. J.

closed drains, kinds of fixation suture, fixation methods, and time of drain removal.

Answers were received from all doctors. On the basis of the completed questionnaires and a review of the literature, the following guidelines for the insertion of peritoneal drains were prepared.

1. Do not insert unnecessary drains.

Drains were not placed routinely during gastrointestinal operations owing to concerns about postoperative bleeding and anastomotic leakage. However, drain placement is thought to be necessary for total gastrectomy, low anterior resection, hepatectomy, pancreatectomy, and operations for gastrointestinal perforation.

2. Remove the drain as early as possible

The drain should be removed as soon as the abnormality resolves and on the basis of the amount of exudate (100 ml or less per day) and its properties (no signs of bleeding, infection, or macroscopic contamination of bile or pancreatic juice).

3. The length of the skin incision should be identical to the size of the drain.

4. Suture-fixation of the drain to the skin should be performed with a round needle and 2-0 nylon ligated with 5 or more nonslip knots at 2 different places.

5. Leave 5 cm or more of the drain beyond the level of the skin.

6. Do not use safety pins.

7. If the drain must be in place for 1 week or longer, it should be re-fixed.

Important concepts in peritoneal drain fixation are: 1) tight fixation between the suture and the drain, and 2) no migration of the drain even with loosening of the suture. We developed a fixation device for the Dupple drain⁵, which is used frequently (Fig. 1). For fixation, the drain is passed through the fixation device (Fig. 2). There are 4 needle holes in the horizontal plate of the skin-fixation device, and the skin and the skin-fixation plate are fixed by 2 to 4 stitches. There are 2 needle holes at an angle of 90°



Fig. 1. Our developed fixation device for the Dupple drain. Reproduced with permission of the ANZ Journal of Surgery.



Fig. 2. For fixation, the drain is passed through the fixation device.

on the sidewall of the fixation device, and, by passing the suture through these holes, the drain is secured to the fixation device by fixation sutures (Fig. 3). Also, there is significant friction between the drain and the fixation device, and the skin-fixation plate prevents the drain from retracting into the peritoneal cavity if the sutures are broken. The extra cost of the fixation device is ¥500. The device decreases in price by about ¥100 if it is made in large quantities.



Fig. 3. The skin and the skin fixation plate are fixed by 2 to 4 stitches, and the drain is secured to the fixation device by fixation sutures. Reproduced with permission of the Jikeikai Medical Journal.

With these guidelines and the drain fixation device, a total 478 gastrointestinal operations were performed and evaluated during the surveillance period of April 2006 through March 2007 (Table 1).

RESULTS

No problems with peritoneal drainage occurred during the surveillance period. Moreover, no drain-related complications were recognized by the Risk Management Committee. The rate of drain-related complications was significantly lower when the guidelines and the drain-fixation device were used (0 of 478 cases [0%]) than when they were not used (6 of 443 cases [1.4%], $p=0.009$).

DISCUSSION

As a basic principle of risk management, it is important to design a “safe system” that prevents accidents without special effort⁶. Both software and hardware must be renovated to design a “safe system.” The accident rate does not decrease simply by urging the staff to be careful. Concerning software, we prepared a manual for the procedure entitled *The Peritoneal Drain Fixation Method* on the basis of surgeons’ opinions expressed in a questionnaire survey and a review of the literature^{7–10}. Drainage has disadvantages, such as retrograde infection, organ

compression, and adhesion. Therefore, fixation between the drain and the skin can be improved, and subcutaneous infection can be prevented by avoiding the placement of unnecessary drains¹¹, removing drains early if there is no problematic exudation¹², and making a skin incision no larger than the drain.

The suture-fixation of the drain to the skin with a round needle and 2-0 nylon ligated with 5 or more nonslip knots at 2 different places can prevent tearing of the drain or loosening of the suture. If the part of the drain left outside the wound is short, the drain is likely to retract into the peritoneal cavity with loosening of the suture; therefore, at least 5 cm of the drain should be kept outside of the body. The use of safety pins should be avoided because of the possibility of drain damage and infection. If the drain is maintained for 1 week or longer, the fixation suture and skin at the fixation site will be weakened; therefore, re-suturing for securing fixation is recommended.

Concerning hardware, we have developed a drain fixation device with the concepts of 1) strengthening fixation between the suture and drain, and 2) preventing migration of the drain even if the sutures loosen¹³. A search of Pub Med with the key words “drain-fixation device” yielded only 32 articles. Moreover, we were not able to find any drain-fixation devices that decrease the rate of drain problems, such as dislodgement or retraction into the peritoneal cavity.

Manuals of many drain tubes state, “do not directly apply a needle or suture to the drain tube,” to prevent tearing of the drain owing to inadequate suturing with a cutting needle or chronic tension of the suture. We believe that drain tears can be prevented by the use of a round needle and a fixation device with central suture-fixation of the drain tube.

In conclusion, spontaneous dislodgement of the peritoneal drain or its retraction into the peritoneal cavity often necessitates re-operation. Long-term placement of a drain because of postoperative complications and careless fixation at drain placement increases the risk of drain-related problems. The 7 principles of peritoneal drain fixation and drain fixation device can reduce drain-associated problems.

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