A Modified Spontaneously Closed Defunctioning Tube Ileostomy After Anterior Resection of the Rectum for Rectal Cancer with a Low Colorectal Anastomosis

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Abstract The aim of this study is to introduce a new technique of modified spontaneously closed defunctioning tube ileostomy after anterior resection of the rectum for rectal cancer with a low colorectal anastomosis. Patients with rectal cancer who underwent anterior resection of rectum with a low colorectal anastomosis and chose a modified defunctioning tube ileostomy between March 2012 and August 2013 were retrospectively reviewed. Data on the success of the operation procedures, post-operative hospital stay, and post-operative tube ileostomy-related complications were analyzed. One hundred fifty-two patients (87 males and 65 females; 57.1 ± 17.4 years) undergoing the modified defunctioning tube ileostomy after anterior resection for rectal cancer were included. The post-operative hospital stay was 11.9 ± 3.2 days. The tube was removed on days 22.6 ± 4.1 after operation and the ileostomy wound closed spontaneously within 13.1 ± 1.9 days. Twenty-five patients felt tube-associated pain or discomfort, which was relieved after a period of adaptation and appropriate tube adjustment. Nine patients suffered from tube blockage and were treated successfully with saline irrigation. Two patients had intestinal obstruction, which was resolved with conservative treatment. Three patients developed leakage of the distal anastomosis: two were successfully treated with conservative measures and the other completely recovered after reoperation. The modified spontaneously closed defunctioning tube ileostomy appears efficacious and safe. This technique may be used to

protect the distal anastomosis and simultaneously decrease the ileostomy complications, and minimize the morbidity and mortality associated with stoma takedown.

Keywords Defunctioning tube ileostomy · Anterior resection of the rectum · Rectal cancer · Anastomotic leakage

Introduction

Anastomotic leakage, defined as a defect of the intestinal wall integrity at the colorectal or coloanal anastomotic site leading to a communication between the intra- and extra-luminal compartments, is one of the most serious complications after low anterior resection for rectal cancer, with incidence ranging from 2 to 39 %. It is associated with many factors such as the level of resection, type of intervention, surgical experience, male gender, anastomosis height, pre-operative radiotherapy, and the presence of intra-operative adverse events [1, 2]. A defunctioning ileostomy is performed to protect distal anastomosis and reduce the effect of anastomotic leakage if it occurs in low anterior resection for rectal cancer [3].

Defunctioning ileostomy includes tube ileostomy and loop ileostomy. On the one hand, loop ileostomy, which is commonly used, is associated with stoma-related complications such as discomfort, peristomal inflammation, and dehydration, reoperation to close the stoma, an elevated risk to remain permanent, small bowel obstruction, wound infections, and site hernias [2, 4]. On the other hand, tube ileostomy, which is as an alternative to loop ileostomy, can not only ensure a greater comfort for the patient and an easier management but also decrease the additional surgical procedures for the stoma closure and stoma-related complications, and thus avoid stoma-related morbidity and mortality [5]. However, some limitations of tube ileostomy have been observed, such as

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incomplete fecal diversion, tube-associated pain, and tube blockage, which are mainly due to the different types of tubes used.

In our previous pilot study, we compared a relatively new technique of spontaneously closed defunctioning tube ileostomy with loop ileostomy and observed its favorable efficacy in protecting an elective low colorectal anastomosis [6]. In the present study, we further modified the technique and evaluated its efficacy, safety, and feasibility in a larger cohort of patients.

Patients and Methods

Patients

Adult patients with histologically confirmed rectal cancer who underwent anterior resection of the rectum with a low colorectal anastomosis were screened. Patients with any independent risk factors of anastomotic leakage, including advanced age, concomitant diseases (such as diabetes mellitus, hypertension, and hypoproteinemia), use of corticosteroids, pre-operative radiotherapy, and the presence of intra-operative adverse events were eligible for defunctioning ileostomy. They were asked to choose either defunctioning tube ileostomy or defunctioning loop ileostomy after anterior resection, after the importance, benefits, and risks of defunctioning and the two methods of ileostomy had been explained to them before operation. In the present study, only patients who chose defunctioning tube ileostomy were included.

This modified technique of defunctioning tube ileostomy was approved by the Ethical Committee of The First Affiliated Hospital of the College of Medicine, Zhejiang University. All patients gave written informed consent for the operation procedures including anterior resection and defunctioning tube ileostomy.

Modified Spontaneously Closed Defunctioning Tube Ileostomy

Standard procedures were performed for anterior resection of the rectum, which involved a total mesorectal excision (TME) with autonomic nerve preservation. Afterwards, defunctioning tube ileostomy was performed, during which, a modified trachea cannula (7[#] or 7.5[#], Hangzhou, China) was prepared first (the latter half of cannula was cut) (Fig. 1a). Then, the place where the cannula was to be inserted was located in the ileum about 10–20 cm proximal to the ileocecal valve, and a double purse-string suture was made in advance (Fig. 1b, c). When the cannula was inserted and fixed by the suture, a balloon (a sacculus attached to the trachea cannula) was inflated with about 10 ml of normal saline to occupy most of the ileum lumen without impairing the blood supply of the

bowel wall (Fig. 1d). The slim catheter for inflation was knotted, and the tail of the catheter was cut. Then, the tube was pulled out through the lower right abdominal wall and fixed into the parietal peritoneum by a purse string (Fig. 1e). A suction drain was inserted into the pelvis, and the abdominal wall wounds were closed layer by layer. At last, the ostomy bag was used (Fig. 1f). In our previous study, we used the tube ileostomy with a reversible single-row stapled occlusion of the distal ileum in order to gain complete fecal diversion, and observed that the tube ileostomy procedure was safe and efficacious for defunctioning an elective low colorectal anastomosis [6]. In the present study, we omitted the reversible single-row stapled occlusion of the distal ileum. The balloon was deflated by cutting the slim catheter for inflation, and then, the tube was removed between day 21 and day 28 after operation.

Measurements of Efficacy and Safety and Data Analysis

All patients were monitored closely for the success of the operation procedures. Intra-operative parameters, post-operative data, and post-operative tube ileostomy-related complications were also recorded. In addition, all patients were asked to visit our outpatient department every 2 weeks after being discharged. Numerical data are expressed as mean $\pm$ standard deviation (SD), with the range when necessary. Efficacy and safety data were presented in a descriptive manner.

Results

Characteristics of Patients and Procedures

Between March 2012 and August 2013, 152 patients (87 males; 65 females) undergoing anterior resection for rectal cancer within 6.3 $\pm$ 2.8 (4–10) cm of the anal verge were recruited for defunctioning tube ileostomy. The age range was 57.1 $\pm$ 17.4 (39–76) years. The patients were followed up for 17 $\pm$ 3.4 (7–26) months.

The operational procedures including anterior resection and defunctioning tube ileostomy were performed successfully on all patients. The post-operative hospital stay was 11.9 $\pm$ 3.2 (8–25) days. The tube was removed on days 22.6 $\pm$ 4.1 (21–28) after operation and the ileostomy wound closed spontaneously within 13.1 $\pm$ 1.9 (7–14) days.

Efficacy and Tube Ileostomy-Related Complications

Tube ileostomy-related complications included tube-related pain or discomfort ($n=25$, 16.4 %), tube blockage ($n=9$, 5.9 %), intestinal obstruction ($n=2$, 1.3 %), and anastomotic leakage ($n=3$, 2.0 %). Tube-related pain or discomfort was

Fig. 1 The operational process of the modified spontaneously closed defunctioning tube ileostomy. **a** A modified trachea cannula (7[#] or 7.5[#]) was prepared first (the latter half of cannula was cut). **b** The place where the cannula was to be inserted was located in the ileum about 10–20 cm proximal to the ileocecal valve. **c** A double purse-string suture was made in advance. **d** When the cannula was inserted and fixed by the suture, a balloon (a saccule attached to the trachea cannula) was inflated with about

10 ml of normal saline to occupy most of the ileum lumen without impairing the blood supply of the bowel wall. **e** The tube was pulled out through the lower right abdominal wall and fixed in the parietal peritoneum by a purse string. **f** A suction drain was inserted into the pelvis, and the abdominal wall wounds were closed layer by layer. At last, the ostomy bag was used

relieved after a period of adaptation and appropriate tube adjustment. The nine patients who suffered from tube blockage were treated successfully with saline irrigation. The two patients who had intestinal obstruction were completely recovered by conservative treatment. Of the three patients who developed leakage of the distal anastomosis, two had dehiscences about 0.5 and 1.0 cm, respectively, in anastomosis as observed by digital rectal examination 7 days after the operation but without obvious clinical symptoms. The dehiscences were with conservative treatment 1 month later. In the third patient, a large dehiscence of 2.5 cm in anastomosis was observed by digital rectal examination and obvious inflammation and effusion around the anastomosis by enhanced computerized tomography. The patient experienced high fever and abdominal pain 6 days after the operation but without obvious peritonitis. The patient underwent reoperation after failure of conservative treatment, and the tube ileostomy was converted to loop ileostomy in situ. The patient recovered 10 days afterward. All patients survived during the period of following up, and there was no evidence of serious ileostomy-related complications.

Discussion

Anastomotic leakage is one of the most serious complications after low anterior resection for rectal cancer, which is associated with increased reoperation rate, prolonged hospital stay, increased septic complications, stenotic anastomosis, and local recurrence of rectal cancer, and thus increased morbidity and mortality [2]. Defunctioning ileostomy in low anterior

resection for rectal cancer plays a great role in protecting distal anastomosis and reducing the effects of anastomotic leakage [2, 4, 7].

Loop ileostomy was first reported by Turnbull and Weakley in 1996 and has gained popularity as a method of fecal diversion. A multicenter randomized controlled trial performed by Matthiessen et al. [8] reported that symptomatic leakage developed in 10.3 and 28.0 % of patients with and those without a defunctioning loop stoma, respectively, and urgent abdominal reoperation was needed in 8.6 and 25.4 %, respectively. The prospective randomized study by Chude et al. [7] also observed similar results. Therefore, defunctioning loop ileostomy was strongly recommended as a routine procedure in patients undergoing lower rectal cancer surgery. However, other studies reported that loop ileostomy may increase morbidity and mortality [2]. The outstanding problem is that patients with defunctioning loop ileostomy need a second operation to close the stoma, which carries additional risk of developing complications, including bowel obstruction, wound infections, anastomotic leakage, site hernias, and being a permanent stoma [4, 9, 10]. Additionally, stoma-related complications are usually reported [2, 5]. Tube ileostomy was first reported in 1959 for children and first introduced in 1985 for adults. In 1993, Winslet et al. [11] used transcecal ileal diversion with a 28F Foley catheter to defunction an elective distal colonic anastomosis and achieved satisfactory results. In 2011, Ansari et al. [12] retrospectively reviewed 20 patients with tube ileostomy in the 3-year period and concluded that tube ileostomy was effective and safe in protecting intestinal anastomosis/repair. In 2012, Rondelli et al. [2] retrospectively compared conventional loop

ileostomy ($n=68$) with tube ileostomy ($n=75$) for transitory fecal diversion after low colorectal anastomosis, and found that tube ileostomy seemed to be a valid alternative to the conventional ileostomy. Compared with loop ileostomy, tube ileostomy can decrease the stoma-related complications, make patients more comfortable, provide an easier management, and totally avoid the morbidity and mortality associated with reoperation for the stoma takedown.

However, limitations were observed for tube ileostomy in the previous studies because of the use of various tubes (i.e., abdomen drain tube [5], Foley catheter [12], jejunostomy tube [2, 3]). For example, abdomen drain tube could not gain complete fecal diversion due to lack of the balloon, whereas Foley catheter and jejunostomy tube undergo frequent tube blockage owing to the thinner internal diameter. In order to find a more convenient and safer method of ileostomy which has similar protection but with less morbidity, we have attempted to design and modify the spontaneously closed protective tube ileostomy over the past 4 years. In our previous pilot study, we used the tube ileostomy with a reversible single-row stapled occlusion of the distal ileum in order to gain complete fecal diversion, and observed that the tube ileostomy procedure was safer and more efficacious for defunctioning an elective low colorectal anastomosis compared with the conventional loop ileostomy [6]. In the present study, we omitted the reversible single-row stapled occlusion of the distal ileum and observed similar safety and efficacy profiles. The advantages of this modification included more convenience to perform the operation and avoidance of the occurrence of intestinal obstruction due to the stapled occlusion of the distal ileum.

An appropriately designed inflated balloon of the cannula is very important for fecal diversion. If the inflated balloon is too small, the stool will easily enter the colon through the space between the balloon and ileal wall which leads to failure of defunctioning. Conversely, ileal ischemia may occur. In the present study, we injected about 10 ml of normal saline into the balloon until the ileum serosa turned a little pale and gained a satisfactory fecal diversion. Even though the anastomotic leakage might have occurred, the stool was difficult to enter the colon due to good fecal diversion of tube ileostomy, and it would have enough time for the leakage to heal. Indeed, in the present study, the leakages healed in two of the three patients with conservative treatment. However, if there is a large space between the balloon and ileal wall, the stool will be more likely to pass into the colon. Similarly, if the anastomotic leakage is large, it is likely that defunctioning will fail; in the present study, tube ileostomy had to be converted to loop ileostomy in situ in one patient who developed a dehiscence of >2.5 cm. Because the high-risk period of anastomotic leakage is about 7–12 days after surgery [13, 14], the tube ileostomy must play its due role in protecting the colorectal anastomosis before its removal. Therefore, the timing for removal of the ileostomy tube is also important. In the present study, we removed the tube between days 21 and 28 after

operation, which was similar to the results of other studies [5, 12]. According to our experience, the criteria for removal of the ileostomy tube included the following: (1) a period of at least 14 days after operation, (2) passage of gas by the anus or anal defecation, and (3) digital examination excluding anastomotic leakage.

The blockage of the tube has been reported to be a major problem of tube ileostomy. If the tube gets blocked or does not drain freely, intestinal obstruction occurs. The blockage can be managed with saline irrigation, and thus, it is treatable. We proposed that the blockage may be associated with diet and the diameter of the tube, and digestible diet and large enough diameter of the tube would decrease the risk of blockage. Therefore, in the present study, the tube we used for ileostomy was the trachea cannula (7[#] or 7.5[#]), which was larger than the Foley catheter [5, 12] or jejunostomy tube [3] and did not need twice-daily irrigation as reported in other studies [12]. In the present study, only nine patients (5.9 %) suffered from tube blockage, which was much less than that (16.6 %) reported by Patil et al. who used abdomen drain tube [5]; all the nine patients were successfully treated with saline irrigation.

In conclusion, the novel modified spontaneously closed defunctioning tube ileostomy we introduced appears efficacious and safe. This technique may be used to protect the distal anastomosis and simultaneously decrease the ileostomy complications, and thus minimize the morbidity and mortality associated with stoma takedown. Further large-scale well-designed, randomized controlled trials are needed to further verify the efficacy and safety by comparing tube ileostomy as an alternative to conventional loop ileostomy as a diversion procedure after low anterior resection for rectal cancer.

Conflict of Interest The authors declare that they have no competing interests.

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