A Simple Method of Intestinal Anastomosis (Ileocolostomy) in Rats

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Abstract: A simple method of ileocolostomy was performed in rats. The colon near the cecum was ligated, including its arteries and veins. Main artery and vein of the cecum were ligated. Then, the cecum was cut out. A longitudinal incision was made on the anti-mesenteric side of the proximal end of the colon, approximately 7–8 mm long. A 21-G needle was inserted toward the incision 2 cm away from the proximal end of the anti-mesenteric side of the colon. A nylon suture was knotted once to the distal end of the ileum and was introduced into the tip of the needle which had previously been passed through the colon. Then, the needle was removed. The suture was pulled to introduce the distal end of the ileum into the colonic lumen. Then, the suture was knotted once on the colon again to fix the ileum to the colon. The incision in the proximal end of the colon was not closed. At the 2nd week after the operation, X-ray examinations demonstrated that the ileocolonic passages with no leakage at the anastomotic site were quite satisfactory. At the 4th week after the operation, there were no macroscopic or microscopic complications at the anastomotic site. The mucosal and serosal epithelia of the ileum and colon continued smoothly. This simple method may be very effective in preparing anastomosis in the gastrointestinal tract, especially in small laboratory animals for nutritional and surgical experiments.

Key words: anastomosis, cecectomy, ileocolostomy, rat, sutureless

Introduction

Intestinal resections and anastomosis in laboratory animals have been performed for experiments of nutrition [10, 21, 27], physiology [20, 24] and surgery [1, 23, 26], or for preparing disease models such as short bowel syndrome [7, 8, 12, 14, 22]. The surgical procedures are always required to be simple, rapid and safe.

Several methods have been accepted for surgery of the gastrointestinal tract, both with and without sutures. Although the sutureless methods are simple and rapid, they require some special devices or materials such as a biofragmentable stent with a stent placement device [4, 5], staples with a stapler [6, 17], a biofragmentable ring with an inserting device and a purse-string suture [9, 13], a metal ring with temperature-dependent shape.
memory [16], and a biofragmentable tube with elastic rings [2]. Thus, suturing by hand is still being applied in surgery, even though many stitches and fine techniques are required for this method [3, 11, 15, 18, 19, 25].

In the present study we report a simple method of intestinal anastomosis, ileocolostomy, in rats.

Materials and Methods

Animals

Ten male Wistar (Crj) rats, 12 weeks of age, obtained from Charles River Japan, Inc., Kanagawa, Japan, were used in this study. All procedures in this study were in accordance with the guidelines approved by the Animal Research Committee of Azabu University.

Housing conditions

The animals were kept in a room equipped with a barrier system at the Research Institute of Biosciences, Azabu University. They were kept separately in polycarbonate cages (CL-0106-1: 310 × 360 × 175 mm; CLEA Japan, Tokyo) with wood shavings. The room was air-conditioned at a temperature of 22 ± 1°C and a humidity of 55 ± 5%, and light was supplied for 14 hours a day, from 6:00 to 20:00. Animals were fed ad libitum with laboratory rations (mouse and rat chow; CE-2, CLEA Japan, Tokyo) and clean, fresh water. Animals were all checked and judged to be clinically healthy before use in the study. They were not fasted before the operation.

Surgical procedures

Animals were anesthetized with sodium pentobarbital (50 mg/kg i.p.). The abdominal wall was shaved and sanitized. A mid-line incision of about 3 cm was made in the abdominal wall. Gauze swabs were used as towels at the edge of the incision. The surgical procedures of the ileocolostomy were as follows (Fig. 1). The cecum, ileum and colon were brought out of the abdomen onto the gauze. Before the cecum was cut out, its main artery and vein were ligated, and the ileac artery and vein near the distal end of the ileum were ligated. The colon was also ligated near its proximal end, including the colonic artery and vein. These ligations were made by means of 4-0 silk suture. Then, the cecum was excised. A 15-cm-long 7-0 nylon suture was transfixed through the ileac wall at the distal end of its anti-mesenteric side, and was tied to it (A). At the proximal end of the anti-mesenteric side of the colon, a longitudinal incision of approximately 7–8 mm was made (B). The colonic contents within a few centimeters of the incision were washed out by saline. A 21-G needle was inserted toward the incision of the colon, 2 cm from its proximal end (D). The nylon suture connected to the ileac end was introduced into the tip of the needle which had been previously inserted into the colon (E). Then, the needle was removed from the colon. The nylon suture was pulled (see arrow) to introduce the distal end of the ileum into the colonic lumen (F). Then, the suture was passed again through the seromuscular layer of the colon and was tied to it by an interrupted suture (G). The distal end of the ileum and the proximal end of the colon were fixed to each other by this interrupted suture.
SUTURELESS ILEOCOLOSTOMY

Anti-mesenteric side of the colon, a longitudinal incision of approximately 7–8 mm was made. The colonic contents within a few centimeters of the incision were washed out by saline. A 21-G needle was inserted toward the incision of the colon, 2 cm from its proximal end. The nylon suture connected to the ileac end was introduced into the tip of the needle which had been previously inserted into the colon. Then, the needle was removed from the colon. The nylon suture was pulled to introduce the distal end of the ileum into the colonic lumen. Then, the suture was passed again through the seromuscular layer of the colon and was tied to it by an interrupted suture. The distal end of the ileum and the proximal end of the colon were fixed to each other by this interrupted suture. The incision of the colon was not closed, but was left as it was. After the operation, the ileum and colon were placed back into the abdomen. Then, the peritoneal and muscular layers, and the skin of the abdominal wall were closed by a continuous suture and Michel’s wound clips, respectively. The animals were kept on a heating pad until they recovered. They were served only sugar water (5%) on the day of the operation. During the next three days after the operation, food was also served to them at about one-third the volume, compared with before the operation. On the 5th day after the operation and thereafter, food and fresh water were served to them ad libitum. The animals’ conditions were carefully checked daily. Rats showing signs of complications were euthanised, and autopsies were performed.

X-ray examination

At the 2nd week after the operation, some animals were anesthetized by ether and injected with 3 ml of 20% barium sulfate through an anal catheter. After this injection, 3 ml of air was also injected in the same way. Then, X-ray observation was performed to determine whether the anastomosis had been successful or not.

Histology

At the 4th week after the operation, the animals were anesthetized with sodium pentobarbital (50 mg/kg i.p.) and were then sacrificed by exsanguination from the abdominal aorta. The anastomotic site between the ileum and colon was observed macroscopically. These sites were removed and fixed in Bouin’s fluid for histological observations. Fixed materials were dehydrated in a graded series of ethanol, embedded in paraffin, sectioned at 6 µm, and stained with hematoxylin-eosin.

Results

Anastomotic complications were observed in 2 of the 10 rats. One died on the second day after the operation, and the cause was determined to be anastomotic leakage. The other died on the 12th day after the operation, this one from a narrow passage. The other rats did not show any complications after the operation. At the 2nd week after the operation, X-ray examination demonstrated that the anastomosis be-
between the ileum and the colon was quite satisfactory. There was no incidence of anastomotic leakage (Fig. 2). At the 4th week after the operation, macroscopic observations indicated no signs of ruptures or obstructions at the anastomotic site (Fig. 3). The mucosal surface of the ileum and that of the colon at the anastomotic site were smoothly connected to each other (Fig. 4). Microscopically, the mucosal-epithelial cells of the ileum and colon were smoothly continuous with each other, but the tunica muscularis of the ileum and colon were not (Fig. 5). The part of the ileum that was introduced into the colonic lumen at the initial stage of the operation was totally absorbed by 4 weeks after the operation.

**Discussion**

Two of the ten rats in present study encountered anastomotic complications and died. However, the others survived, and showed no incidence of anastomotic leakage, narrow passage or enterostasis. In the rats in which anastomosis was established, the serosa and mucosa at the anastomotic site were not interrupted but were smoothly continuous. This trial study demonstrates that anastomosis between the ileum and the colon can be established with only one stitch in rats.

In intestinal anastomosis surgery, conventional end-to-end anastomosis requires many stitches and fine techniques, including inverted or everted techniques, single- or double-layer procedures, continuous or interrupted suture, and various combinations. For example, a reported end-to-end anastomosis in a rat small intestine was carried out with 8 interrupted stitches [15], and sleeve anastomosis with more than 8 interrupted sutures [2, 25]. In sutureless anastomosis with fibrin glue, although the thread is removed from the anastomotic site in a few minutes, the thread is required at least temporarily [16, 18]. Other sutureless methods
using some special devices are being developed, but the devices were designed for humans, not for small laboratory animals such as rats or mice [4–6, 9, 13, 17]. Our method does not require any special devices or fine techniques. Moreover, this method is advantageous because it saves operating time.

In gastrointestinal tract surgery, there may be complications after anastomotic operations such as leaks, adhesions, stenosis and abscess formation at the anastomotic site [1, 4, 18, 19, 25]. In a pilot experiment, we made an incision in the colon and introduced about 2 cm of the ileum into the colonic lumen as described earlier. Then, the seromuscular layers of the colon and ileum were stitched together at 6 positions to close the incision. After surgery, most of the rats were dead from anastomotic complications of the narrow passage (not with leakage), in little more than a week. These postoperative deaths might have been caused by disturbance to the intestinal mobility of the overlapped ileum and colon areas. Therefore, the incision was not stitched in the present study. This procedure might allow for more mobility and motility of the colon and ileum such as relaxation or contraction. Also, this procedure greatly reduced post operative complications.

In conclusion this sutureless method is simple and effective for preparing anastomosis in the gastrointestinal tract of small laboratory animals, such as mice and rats.

References


