Clinical Experience of Frame Ring Utilization in Applying Interintestinal Anastomoses in Urgent Surgery

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Abstract The problem of restoration of intestinal integrity preserves its importance as the intestinal suture is a basis for digestive tract surgery. Tightness failure in the intestinal suture during gastrointestinal surgery is a threatening and, unfortunately, frequent complication, and it gets especial importance in emergency patients and those with severe concomitant pathologies. The research is carried out on utilization of a metal frame ring in applying interintestinal anastomoses. Clinical utilization of the method developed was preceded with a series of experiments on animals with morphological researches with the use of the device. Seventy operations were performed with utilization of a frame metal ring during application of interintestinal anastomoses. After performing an operation, intestinal peristalsis restored faster. In the postoperative period, all patients undertook study of abdominal exudates to determine for early diagnostics of development of intestinal suture failure. In clinical practice, utilization of a frame ring is indicated in applying primary interintestinal anastomoses in adverse conditions, namely, peritonitis and intestinal obstruction.

Keywords Interintestinal anastomoses · Frame ring

Introduction

The problem of restoration of intestinal integrity preserves its importance as the intestinal suture is a basis for digestive tract surgery. Tightness failure in the intestinal suture during gastrointestinal surgery is a threatening and, unfortunately, frequent complication, and it gets especial importance in emergency patients and those with severe concomitant pathologies. The literature data analysis according to results of enterectomy and colectomy [1–3] has shown that the percent of interintestinal anastomosis failure in emergency surgery does not tend to reduce and makes 4–20 % (i.e., exceeds that for scheduled surgery by several times). A great development of the intestinal suture is associated with use of various materials for its strengthening [4, 5].

Materials and Methods

We carried out a research on utilization of a metal frame ring in applying interintestinal anastomoses (Patent № FAP 00305 2007) [6]. The frame ring in diameter from 2 to 4 cm, a section of 0.6–0.8 mm, can be fixed both in the lumen and outside the interintestinal anastomosis. Clinical utilization of the method developed by us was preceded with a series of experiments on animals with morphological

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Fig. 1 **a.** Formation of the second row of sutures of the back lip of the “side-to-side” anastomosis. **b.** Formation of the second row of sutures of the back lip of the “end-to-end” anastomosis. **c.** Formation of the first row of the anterior lip of the “side-to-side” anastomosis

a. Formation of the second row of sutures of the back lip of the "side-to-side" anastomosis

b. Formation of the second row of sutures of the back lip of the "end-to-end" anastomosis

c. Formation of the first row of the anterior lip of the "side-to-side" anastomosis

researches with the use of the said device. The results of the researches demonstrate that the ring itself is not exposed to any changes, has an even smooth surface, and at contact to tissues does not cause any pathological changes from biostructures adjacent to the ring. Besides, our observations have shown that there are no signs of intestinal obstruction in experimental animals and there is not a single case of intestinal suture failure [7, 8].

Figure 1a–c illustrates the surgery stages.

From 2007 to 2009, 70 operations were performed at our clinic with utilization of a frame metal ring during application of interintestinal anastomoses. Of them 38 were women (54 %) and 32 men (46 %) at the age of 17–86 years, and the mean age was 40–60 years. All patients admitted to the clinic with surgical abdomen or intestinal bleeding: small bowel pathology (a small bowel tumor complicated with perforation or obstruction; Crohn's disease complicated with bleeding or perforation; a strangulated hernia with necrosis of a small bowel, small bowel tuberculosis; mesenteric clottage; Meckel's diverticulitis with necrosis or perforation)—12 cases; pathology of a colon (a colon tumor

complicated with perforation, bleeding, or obstruction; colon diverticulosis complicated with bleeding, perforation, or abscess formation; mesenteric clottage; nonspecific ulcerative colitis with perforation, bleeding; tuberculosis of a colon with degradation)—26 cases; acute intestinal obstruction (adherent, obstructive, a torsion)—25 cases; and injuries of the anterior abdominal wall with damage of a small bowel or colon—7 cases. All operations were performed with application of interintestinal anastomoses: small-small-intestinal anastomosis in 34 (48.6 %) cases, small-large-intestinal anastomosis in 21 (30 %) cases, and large-large-intestinal anastomosis in 15 (21.4 %) cases. It is necessary to note that in 17 (24.3 %) patients surgery was performed on the background of severe peritonitis (fecal, purulent, purulent-fibrinous). Figure 2a–c illustrates intraoperative application of an interintestinal anastomosis.

Decompression of the anastomosis area in the early post-operative period was carried out with early enteral alimentation, medicamental stimulation of gastrointestinal peristalsis, decompression of the colon with a colonic tube, utilization of oil microclyster, and early activation of

Fig. 2 **a.** Application of a metal skeleton during formation of the posterior lip of the anastomosis **b.** Formation of the second row of the posterior and anterior lip of the anastomosis **c.** Formation of the second row of the posterior and anterior lip of the anastomosis

a. Application of a metal skeleton during formation of the posterior lip of the anastomosis

b. Formation of the second row of the posterior and anterior lip of the anastomosis

c. Formation of the second row of the posterior and anterior lip of the anastomosis

patients. Intestinal peristalsis restored in 36–48 h (1.5 times faster). Independent bowel movement was observed on postoperative days 3–4. The body temperature normalized by days 3–5; however, the dynamics of body temperature rates was directly contrary during development of purulent complication, and the figures reached their maximum by days 4–5 of the postoperative period. Normalization of a leukocyte count occurred by postoperative days 5–6. In the postoperative period, all patients undertook USI monitoring of the abdominal cavity, study of abdominal exudate to determine levels of ammonia, amylase on days 2–3, 5, and 7 for early diagnostics of development of intestinal suture failure. The concentration of ammonia in the abdominal exudate in patients without signs of suture failure did not exceed 100 $\mu\text{mol NH}_3/\text{L}$ and that of amylase was not higher than 30–32 $\text{mg}\cdot\text{ml}/\text{h}$. The levels of ammonia and amylase were raised even in minor anastomosis failure. We could suggest on a probability of failure occurrence

proceeding from the rise in the rates and choose a subsequent relevant management of patients.

To identify the state of the interintestinal anastomosis in the early postoperative period, a passage of barium in the Gastrointestinal tract was performed on days 7–10, which demonstrated a satisfactory state of the anastomosis and its function; intestinal peristalsis was satisfactory and barium passage was not delayed. In the postoperative period, two patients had partial percutaneous pyesis of a postoperative wound. All patients were discharged on days 10–11 after surgery. They were recommended to undertake subsequent treatment for the main disease if it was necessary and be followed up by a relevant specialist (the oncologist or phthisiatrician). In 1, 3, 6, and 12 months after surgery, all patients undertook colonofibroscopy and irrigography in anastomoses of the small bowel and colon, and colon-colon anastomoses, and barium passage in small-

Fig. 3 **a.** Colonofibroscopy (**a**) and (**b**): large-large-intestinal anastomosis region in 1 month after surgery. **c.** Colonofibroscopy: large-large-intestinal anastomosis region in 6 month after surgery

a. Colonofibroscopy (**a**) and (**b**): large-large-intestinal anastomosis region in 1 month after surgery.

c. Colonofibroscopy: large-large-intestinal anastomosis region in 6 month after surgery.

small bowel anastomoses (Figs. 3a–c and 4). The state of the interintestinal anastomoses was satisfactory, the patency remained intact; no signs of anastomosis, stenosis, erosive, or ulcerative damage were found.

Thus, experimental researches have shown that utilization of a frame ring strengthens mechanical durability and raises tightness, which prevents intestinal suture failure. In the clinical practice, utilization of a frame ring is indicated in applying primary interintestinal anastomoses in adverse conditions, namely, peritonitis, intestinal obstruction,

expressed inflammatory, and infiltration changes in an organ.

In conclusion, it is necessary to note that the problem of prevention of interintestinal anastomosis failure in surgery of the small bowel and colon is determined with a wide range of regions of application, and results of immediate surgery outcomes depend entirely on scrupulous complex performance of all preventive measures developed, among which a leading position should be given to modern technologies, materials, and medical products. That in its turn will make it possible to

Fig. 4 Irrigography in 3 months after surgery: the region of the anastomosis is free, no signs of anastomositis or contrast delay are present

Irrigography in 3 months after surgery: the region of the anastomosis is free, no signs of anastomositis or contrast delay are present.

reduce a number of complications, postoperative lethality, and terms of staying of patients in hospital.

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