

Conference paper

Compression Anastomoses Formation on the Digestive Tract Organs by Using TiNi Devices

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Abstract

The article contains the results of a study of nickelid titanium devices used for the formation of compression anastomoses in patients with digestive system diseases and describes the techniques of compression fistula formation using these devices. Besides, the article presents clinical experience in the formation of anastomoses between the organs of gastrointestinal tract for the treatment of eighty-seven patients with various pathologies of digestive organs. One hundred and nine compression anastomoses were applied in our clinic. Anastomotic dehiscence was found in three cases (2,7%) which are described in details in the article. In all patients, the devices evacuated from the digestive tract in a natural way. The average period of device rejection accounted for 14 days. Fibrotic scope examination performed after an operation showed that created anastomoses corresponded to the dimensions of used structures. A soft scar by primary healing type was formed on the parts with compression anastomosis. Using nickelid titanium devices for the formation of compression anastomoses between the gastrointestinal organs will improve the quality of fistula formation, reduce mortality and postoperative complications.

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1 Introduction

Treatment of digestive disorders is one of the most difficult problems of modern surgery. Anastomosis formation is the foundation of digestive tract surgeries. The direct outcome of a surgery depends on the quality of fistula formation.

According to the literature and the results of our own research, anastomoses formed with the use of various compression devices have the significant advantage. Unlike the manual and mechanical sutures, where the formation of anastomoses occurs through secondary intension [1,11, 13], healing of compression anastomoses occurs through primary intension with a complete organ apposition along the entire circumference of the anastomosis. Various structures are proposed to create compression anastomoses [4, 8, 9]. Nickelid titanium devices have become widely used for the creation of compression anastomoses [2, 3, 5, 6, 7, 10, 12, 13]. For 25 years the department of advanced level surgery at Siberian State Medical University (SSMU) (Tomsk) has been applying shape memory nickelid titanium devices for digestive tract surgeries. Our department together with the Scientific Research Institute of implants and shape memory materials (Tomsk) developed these devices and methods of forming the compression anastomosis. This article provides a summary of long-term clinical application of nickelid titanium devices in the formation of fistulae between the gastrointestinal organs. This work is devoted to the synthesis and analysis of the many years results of clinical use TiNi devices in the formation of fistulae in the gastrointestinal organs.

2 Experimental

Together with engineers of the Scientific Research Institute of implants and shape memory materials (Tomsk) we developed shape memory nickelid titanium devices to form compression anastomoses. Three structures were applied in the clinic to form compression anastomoses between the organs of the gastrointestinal tract.

One of the first structures, which was used to form compression anastomosis was ellipsoidal device consisting of two rolled up loops of nickelid titanium wire (fig.1). When cooling the structure loops came in opposite directions at 30 degrees and were immersed in the formed holes of connected hollow organs. When heating loops turned back to their previous shape, bringing together the walls of organs, and providing compression to the walls with the further formation of a

compression anastomosis between hollow organs and spontaneous evacuation of the device [12].

The second structure (fig. 2) was represented by two linear jaws connected by a ring-shaped element, allowing to open jaws almost in parallel to each other [14].

In order to form anastomoses with the valve characteristics a special device was developed and used in the clinic. The device was made of two loops of nickelid titanium wire; the ends of loops are bent from their plane in opposite directions (fig. 3). Compression is not performed in the place of bent back loops, and the tissue is not compressed, so the valve is formed in a fistula zone [12].



Fig. 1. TiNi ellipsoidal device

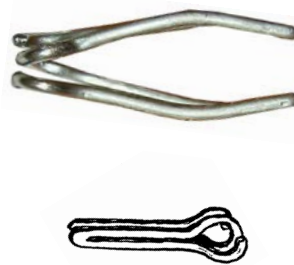


Fig. 2. TiNi linear device



Fig. 3. Nickelid titanium device for compression valve anastomosis formation

All implants had been previously tested on animals. During the experiment we selected optimal parameters of pressure on tissues, determined the mechanical strength of anastomoses, their bacterial permeability, and investigated morphogenesis of created anastomoses.

Clinical studies were conducted in surgery clinic of SiberianStateMedicalUniversity (SiberianStateMedicalUniversity) (Tomsk). Eighty-seven patients with different pathologies of the digestive system were operated on and one hundred compression anastomosis between the organs of gastrointestinal tract with the use of shape memory nickelid titanium implants were formed.

Operations were carried out in patients with various disorders of the digestive system. All patients were divided into two groups with benign diseases (54 patients (62%)), and malignancies (33 patients (38%)) associated with biliary secretory failure and problems with gastrointestinal transit.

Among patients with benign diseases twenty-six patients (48%) with choledocholithiasis underwent the surgery and fifteen patients (28%) with biliary strictures were operated on. Six patients (11%) had a pancreatic disease.

Four patients were operated because of pancreatic cysts: two of them underwent an internal cyst drainage operation by forming a compression anastomosis between the stomach and the cyst; the other two patients were imposed pancreatico-jejunoanastomosis and bypass hepaticojejunostomy in conjunction with compression Brown's enteroenteroanastomosis. Two patients were operated on because of pancreatic pseudotumor.

Enteric and biliary fistulas were removed in two patients (4%) by forming compression fistulojejunoanastomosis. Five patients (9%) with Crohn's disease, acute mesenteric thrombosis, strangulated hernia, dolichosigmoid, stricture of the sigmoid colon were made a resection of a small and large intestine along with reconstruction of intestinal continuity by forming compression enteroenteroanastomosis using the developed devices.

Among patients with malignant diseases eighteen patients (55%) with pancreatic cancer, seven patients (21%) with gastric cancer, 5 patients (15%) with colon cancer and three patients (9%) with the common bile duct cancer were operated on.

X-ray examination was conducted in the postoperative period to study the migration of the device. Endoscopic examination of compression anastomosis formed in the stomach and duodenum, was performed 10-15 days after the operation. Then endoscopic examinations were performed when indicated.

3 Results and discussion

When forming compression anastomoses between gastrointestinal organs three devices were used.

One hundred and nine compression anastomosis were formed in eighty-seven patients in the clinic. The major part of anastomoses (100) was formed using ellipsoidal structure, four anastomosis were made by using a linear nickellid titanium device and five anastomoses were created with a valve.

The types and the number of formed compression anastomoses are presented in the Table 1.

Table 1. Compression anastomoses applied in advanced level surgery

Nº	Type of compression anastomoses	Number of fistulas
1	Choledoduodeno-anastomosis	40 (36,6%)
2	Enteroenteroanastomosis	31 (28,4%)
3	Cholecystoentero-anastomosis	12 (11%)
4	Gastro jejunal anastomosis	9 (8,2%)
5	Choledochojejuno-anastomosis	5 (4,6%)
6	Colonic anastomosis	4 (3,6%)
7	Cystogastroanastomosis	2 (1,8%)
8	Ileotransverse anastomosis	2 (1,8%)
9	Fistuloenteroanastomosis	3 (2,7%)
10	Cholecystocholedocho-anastomosis	1 (0,9%)
	Total	109

Anastomotic leak occurred in three cases, which accounted for 2.7%: when forming choledochojejuno-, choledochoduodeno-anastomoses and one colonic anastomosis.

In the first case, the patient of 64 years old with cholelithiasis, Mirizzi syndrome, choledocholithiasis, obstructive jaundice underwent endoscopic papillosphincterotomy and concrement extraction from the common bile duct. Subsequently, after an attempt to perform a laparoscopic cholecystectomy and complete intersection of the common bile duct, a laparotomy and cholecystectomy with the separation of the gallbladder and the common bile duct were carried out. End-to-side compression choledochojejuno-anastomosis with the use of the

ellipsoidal nickelid titanium indwelling drainage device with the formation of Brown's enteroenteroanastomosis was created. When performing relaparotomy insufficiency of choledochojejuno-anastomosis sutures was found. The structure was removed, and choledochojejuno-anastomosis with transabdominal drainage of the common bile duct was created. During the postoperative period the outer enteric fistula was formed. The patient was operated on 6 months later and a compression-valve fistulojejunoanastomosis with the nickelid titanium device was imposed. Anastomosis was removed. The patient recovered.

In the second case, the patient of 50 years old was operated on because of cholelithiasis and obstructive jaundice. Compression choledochoduodeno-anastomosis was performed with the use of ellipsoidal device. Five days later relaparotomy was carried out; on the front wall in the projection of manual portion failure was detected and the structure was removed, the anastomosis was taken out, the duodenum and the common bile duct wall were sutured, external drainage of the bile ducts was performed. The patient recovered.

The third failure of compression anastomosis was noted when performing resection of transverse colon and creating a side-to-side type anastomosis by using an ellipsoidal nickelid titanium device. Patient of 70 years old was operated on because of a malignant neoplasm of the transverse colon, tumor perforation and paracolic abscess. During the application of a compression colonic anastomosis additional technique was used to increase the lumen of primary patency: compressed tissues in the lumen of the two jaws were cut by scissors. Later one of the dissected tissue edges went beyond loops what was the cause of a failure. After that, additional dissection of tissue in the area of formation of the anastomosis was not carried out. We refused using this technique.

Here is another example. One patient with choledocholithiasis, jaundice, gallbladder empyema underwent cholecystectomy, choledochotomy with imposing a supraduodenal compression choledochoduodeno-anastomosis. When readmitting the patient had complaints of a pain, fever, and chills. Endoscopic retrograde cholangiopancreatography was performed. Accumulation of ointment-like bile and concrements were found in the common bile duct. Dimensions of anastomosis were the same. In the area of the anastomosis ligature with imposing cholesterol was applied. A ligature and the ointment-like mass were removed. The pain went away.

All patients recovered. There were not fatal outcomes. In all patients, the devices evacuated from the digestive tract naturally. On average the period of structure rejection accounted for 14 days.

When performing fiberoptic scope examination right after an operation, it was noted that the anastomotic dimensions corresponded to the dimensions of the used structures. A soft scar by primary healing type was formed on the parts with compression anastomosis

4 Summary

The suggested methods of forming compression anastomosis between the organs of the gastrointestinal tract by using the nickelid titanium device for treatment of patients with various diseases of the digestive system will simplify and reduce the time of imposing anastomoses, improve the quality of the formation of fistulas, reduce mortality and postoperative complications. Today, the formation of compression anastomosis with the use of nickelid titanium structures has more advantages as compared to anastomoses formed by manual stitching, and this technique deserves special attention.

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