Research Article

Comparison of the effectiveness of the use of magnetic interintestinal anastomosis with single-barreled and double-barreled stoma for children

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ABSTRACT

This article includes the study of changes in the body of children with single-barreled and double-barreled intestinal stoma with the use of magnetic compressional interintestinal anastomosis and their comparison with each other. The goal of the research was a comparative evaluation of the efficiency of usage magnetic interintestinal anastomosis with single-barreled and double-barreled stoma for children. This research work is based on the analysis of the results of the treatment of 44 children in whom surgical interventions ended with the formation of a single-barreled and double-barreled intestinal enterostomy. Results of treating children with single-barreled enterostomy with the formation of magnetic compressional interintestinal anastomosis attests of a decrease in frequency of post-surgical complications such as hyperemia and skin maceration from 83% to 25%, average weight loss from 18.1% to 9.9%, suture cleavage and wound suppuration from 75% to 45%, quick normalization of laboratory test results, and early stoma liquidation in children with single-barreled enterotomy.

KEY WORDS: Double-barreled, Magnetic anastomosis, Single-barreled

INTRODUCTION

Often, surgical interventions in pediatric surgical practice end with the excretion of an entero- or colostomy to the anterior abdominal wall during various complications of the abdominal organs. This can be a complication of acute surgical diseases of the abdominal organs, traumatic injuries of the intestines, as well as reconstructive interventions on the colon.[1-3] The formation of an intestinal stoma for a number of patients is the first stage of a planned multistep surgical treatment[4-8] and in other cases depending on health reasons.[9-12] However, today, there is no consensus on the choice of ways to help patients with various pathologies and complications of the abdominal organs.

A number of authors conducted a morphofunctional study of a disabled intestinal section,[13-15] which revealed a pronounced uneven atrophy of the mucous membrane in the outlet section of the intestine, sclerosis, edema, pronounced congestion of the vessels of the submucosal layer, and inhibition of motor-evacuation function. In general, all these factors are unfavorable harbingers of organic changes in the intestinal wall when it is long off from function; moreover, the long existence of an intestinal stoma leads to a lag in the physical development of children; therefore, the timing of the restoration of intestinal continuity during entero- and colostomas remains a subject of discussion for decades. In recent years, the work on the formation of magnetic anastomoses for the connection of hollow organs[10-12,15] has come to light. These studies revealed a number of significant advantages over the connection of traditional manual intestinal suture. According to foreign and domestic literature, also in scientific studies of reconstructive surgery on the intestine accompanied by a large number of complications: The failure of anastomotic sutures, postoperative wound suppuration, anastomositis.[7,11,14] At the same time, the numbers of post-operative mortality according to a number of authors vary from 1–4% to 36–50%.[5,6] Therefore, today, there remains the controversial question about the timing and methods of recovery operations and their impact on the development of early and late post-operative complications. At present, there are data in literature on the use of

Access this article online

Website: jprsolutions.info | ISSN: 0975-7619

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Received on: 12-08-2018; Revised on: 18-09-2018; Accepted on: 25-10-2018

magnetic compression interintestinal anastomosis in intestinal fistulas in adults,[3,4] but methods for using magnetic compression interintestinal anastomosis for children, namely single-barreled stoma, their post-ostomy complications, imposition of a magnetic interintestinal anastomosis with a single-stem stoma, and development methods, have not been studied. The foregoing was the basis for studying changes in the body of children with single-stemmed and double-barreled intestinal stoma with the use of magnetic compression interintestinal anastomosis and their comparison between each other. The aim of the study of this work is to compare the effectiveness of the use of a magnetic compression interintestinal anastomosis with single-barreled and double-barreled enterostomy in children.

Objectives of the Study

The objectives of the study were as follows:

1. To develop a method for applying a terminal single-barrel enterostomy for children with intraoperative formation of a magnetic compression interintestinal anastomosis and to determine the results of its use.
2. To study the results of the surgical treatment of children with double-barreled and single-barrel enterostomy with the use of magnetic compression interintestinal anastomosis.

MATERIALS AND METHODS

This research work is based on the analysis of the results of the treatment of 44 children in whom surgical interventions resulted in the formation of a single-barreled and double-barreled intestinal enterostomy. The patients were treated in the city children's hospital of Turkestan and the regional children's clinical hospital of Shymkent. The examined children were divided into two groups; the main group of patients consisted of 20 children who were superimposed with a magnetic intestinal anastomosis (MCIA) with a single-barreled enterostomy. The control group consisted of 24 children, which imposed MCIA with a double-barreled enterostomy. The average age of children with single-barreled enterostomy was 6.0 + 0.43 and with double-barreled enterostomy amounted to 6.79 + 0.48. General characteristics of children by type of surgery, age, and sex are presented in Table 1.

Table 1: Distribution of patients by age and sex

Stoma types	Single-barreled stoma *n*=20 (%)		Double-barreled stoma *n*=24 (%)	
	Gender		Gender	
	Boys	Girls	Boys	Girls
Age				
3–7	9 (45)	5 (25)	8 (33)	6 (25)
7–11	4 (20)	2 (10)	4 (17)	6 (25)
Total	13 (65)	7 (35)	12 (50)	12 (50)

Most of the children who required enterostoma formation were patients with intestinal obstruction, acute surgical diseases, and traumatic injuries of the abdominal organs, which are presented in Table 2.

As the data show, given in Table 2 in our study, a large percentage were children with intestinal obstruction (52.6%), a rupture of the intestine (38.7%), etc. These pathological processes most often result in severe complications that lead to gross changes of necrotic nature in the intestinal wall, which, in turn, lead to the necessity of imposing a preventive intestinal stoma.

Clinical monitoring of the condition of 44 children with single-barreled and double-barreled intestinal enterostomy was carried out according to the following criteria: Assessment of general condition, respiratory rate and heart rate, stoma excretion, post-operative suture condition, complete blood count (hemoglobin, erythrocytes, hematocrit, white blood cells, and ESR), biochemical changes (total protein, bilirubin, sugar, creatinine, urea, aspartate transaminase, and alanine transaminase [ALT] transaminases), electrolyte content in blood plasma (Na, K, and Cl), duration of the hospital stay, and complications (maceration of the skin, weight loss, joints discrepancy, and dehydration).

To create a magnetic interintestinal anastomosis in a double-barreled and single-barreled enterostomy, magnetic elements were used from a samarium-cobalt alloy, which were made at the Institute of Metal Physics of the Ural Branch of the Russian Academy of Sciences. The magnetic field strength between the magnetic elements is 0.1–0.2 T. The voltage is 2–3.5 g/1 mm pressure surface.

RESULTS

Technique of removal of double-barreled enterostomy

The method of removing a double-barreled enterostomy is as follows: After creating a double-barreled intestinal stoma and reorganization under visual control in the abdominal cavity, through the mouth of the stoma, magnetic elements corresponding to the diameter of the intestine are inserted into the leading and outgoing loop of the stoma and are fixed 4–6 cm from the anterior abdominal wall, lateral pre-stitched walls of the auxiliary and diverting loop. After that, the abdominal cavity is sutured. Kapron ligatures from magnets are fixed on the anterior abdominal wall. Magnetic plates are removed after 5–8 days after the formation of the anastomosis. This study was the first case in Kazakhstan when a single-barreled and double-barreled stoma with bypass interintestinal magnetic anastomosis were used, which was developed by the author and patented in the Republic of Kazakhstan with No. 16759 on September 22, 2004. In our study, this type of stoma was used in 24 children with various pathologies of the abdominal organs [Figures 1 and 2].

Table 2: Distribution of the examined children by nosological forms

Nosological form that caused the formation of intestinal stomas	Total number of observations	Percentage of total
Intestinal obstruction	23	52.6
Intestinal breaks	17	38.7
Meckel's diverticulum	4	8.7
Total	44	100

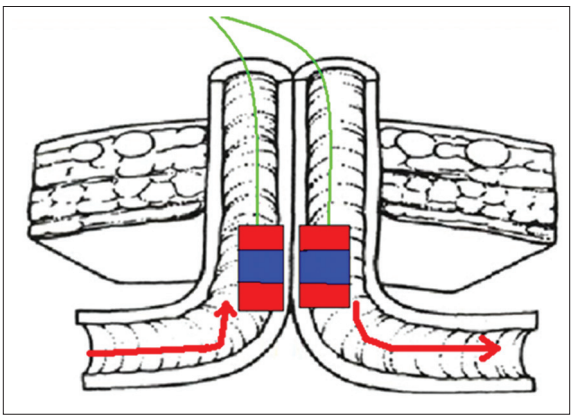

Figure 1: The technique for removing double-barreled enterostomy

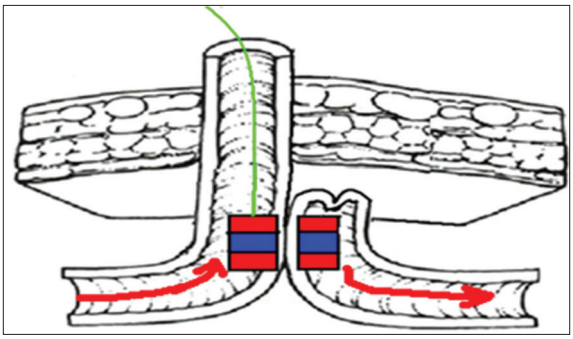

Figure 2: The technique for removing single-barreled enterostomy

We have to put intestine 10-15cm distance from the end of the stoma, when we do the technique of removing single-barreled enterostomy. Magnetic elements are removed by thread after 5–8 days after the formation of the anastomosis. We applied this technique in 20 children.

Disintoxication therapy was carried out according to the basic principles of pediatric surgery, taking into account the physiological need, degree of intoxication, pathological losses, enterally obtained fluid, diuresis, acid-baseline data, and electrolyte transfer. Antibacterial therapy was performed with broad-spectrum antibiotics (ampicillin and ampioks) or cephalosporins (cefamezin, cefazolin, ceftriaxone, and cefuroxime) with aminoglycosides (gentamicin), an antimicrobial agent (metronidazole) in age dosages. Antibiotic therapy after receiving the results of antibiotic sensitivity continued taking into account these data until the elimination of the inflammatory process, normalization of temperature, and laboratory parameters. Furthermore, in the complex of drug therapy included antihistamines, antispasmodics, heparin 100–150 U/kg of body weight per day, Vitamins B, C, ATP, potassium, and calcium preparations. We provided nutrition through the vascular system(veins), included fat emulsions (interlipid), protein hydrolazates, and aminoacids (aminos 600, 800). Below we showed the results of research. The general condition of children at admission was severe and extremely serious. The general condition for 29 (65.9%) children was severe, for 15 (34.1%) children extremely severe. Practical for all children against the background of surgical disease was bradypnea. On the part of the cardiovascular system, 85–89% of children had tachycardia. On 5–6 and 10–12 days after the operation, we took the following laboratory tests: Complete blood count and biochemical blood count. At 5–6 days between children with single-barreled and double-barreled enterostomy between children aged 3–7 years and 7–11 years, blood indices did not reveal a significant difference.

At 10–12 days for children who were superimposed with MCIA with a single-barreled enterostomy, laboratory parameters such as hemoglobin and red blood cells began to progress well in a positive direction, and these same figures were significantly higher than in children who were superimposed with MCIA with a double-barreled enterostomy. On days 5–6, the results of biochemical blood tests for children after surgery, the concentration of electrolytes remained low. It was noted hyponatremia, hypokalemia, and hypoproteinemia. The results of ALT and urea for children 3–7 years old and 7–11 years old were identical, and there was no significant difference between them. The results we obtained on days 10–12 for children using MCIA with a single-barreled enterostomy were significantly higher than with a double-barreled enterostomy. All these indicate a lesser loss of electrolyte balance elements with a single-barreled enterostomy. Below you can see the amount of exeration chyme from the stoma. Another of the main criteria for clinical evaluation is the determination of the amount of excretion from the stoma. On the 5–6th day, after the enterostoma was removed, the amount of excretion from the double-barreled enterostomy was on average 514.58 + 13.57 ml and the amount of excretion from the single-barrel stoma was 512.5 + 15.7 ml, and there was no significant difference between them. At 10–12 days,

the amount of excretion from the stoma from the single-barreled enterostomy was significantly lower than from the double-barreled enterostomy [Table 3].

In our study, maceration and skin hyperemia were observed with double-barreled enterostomy for 20 (83%) children and single-barreled enterostomy for 5 (25%) children. At the same time, maceration and hyperemia of the skin were observed significantly less frequently in children who had single-barred enterostomas with MCIA (χ^2 = 12.846; P < 0.05). Wound suppuration and seam divergence were found in 18 (75%) children with double-barreled stoma, and in 9 children (25%) with single-barreled stoma. At the same time, there was no significant difference between the compared groups (χ^2 = 2.972; P > 0.05). All the children were weighed on admission and 10–14 days after, the stoma was placed. Then, we evaluated their weight loss and compared between groups, with single-barreled and double-barreled enterostomy. And so, for children with a double-barreled enterostomy, the average weight loss from admission was 18.1%. With single-barrel enterostomy, the average weight loss was 9.9% [Figure 4]. At the same time, children with double-barreled enterostomy lost weight significantly more than children with single-barreled enterostomy (P < 0.05).

In our study, children with a double-barreled enterostomy were on average in hospital for 28.71 + 0.30 patient days. Children with single-barreled enterostomy stayed in the hospital for 18.55 + 0.32 bed-days. At the same time, children with single-barreled enterostomy stayed in the hospital significantly shorter than children with double-barreled enterostomy with MCIA [Table 4]. Here we found that the hospital stay time has reduced, and by it we reduced the material costs of treatment and drugs, infusion environment we use before.

Below we provided the time of closure of the stoma. Restoration of intestinal continuity was performed for 44 children with enterostomy. 24 of them were children with double-barreled enterostomy using MCIA and 20 children with single-barreled enterostomy with MCIA.

The timing of closure of the stomas largely depended on the type of stoma imposed. The closure of the stoma was preceded by an increase in activity, improvement, minimal manifestation of intoxication, stabilization of body weight, and normalization of laboratory parameters.

Taking into account all the above criteria, in children with which a single-barreled enterostomy was performed using MCIA, the stoma was eliminated on average at 5.1 + 0.22 weeks. In patients with a double-barreled enterostomy, an average of 9.44 + 0.36 weeks was eliminated by stomas, which, in turn, depended on the above criteria [Table 5]. At the same time, stoma elimination was performed in children with a single-barreled enterostomy significantly earlier than in children with a double-barreled enterostomy.

Table 3: The amount of exeration chyme from the stoma in 10-15 days

Type	Double-barreled enterostomy	Single-barreled enterostomy	*P*
Number	450.42±21.58	225±12.62 мл	*P*<0.05

Table 4: Hospital stay days

Stoma type	Single-barreled enterostomy	Double-barreled enterostomy	*P*
Hospital bed-days	28.71±0.30	18.55±0.32	*P*<0.05

Table 5: Elimination time of stoma

Time of eliminating	Stoma type		
	Single-barreled enterostomy	Double-barreled enterostomy	*P*
Elimination time Weeks	5.1±0.22	9.44±0.36	*P*<0.05

CONCLUSION

1. The results of the management of children with a single-barreled enterostomy with the formation of a magnetic compression interintestinal anastomosis indicate a decrease in the frequency of post-operative complications such as hyperemia and skin maceration from 83% to 25%, average weight loss from 18.1% to 9.9%, separation of sutures and wound suppuration from 75% to 45%, rapid restoration of laboratory parameters in children with single-barreled enterostomy, and earlier elimination of the stoma.
2. The use of the method of temporary restoration of the intestinal continuity through the formation of single-barreled enterostomy with MCIA contributes to a more rapid improvement in the condition of children as a result of the cessation of depleting losses of the intestinal contents, reducing the number of drugs used, reducing the length of hospital stay, and thereby significantly reducing material costs.

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Source of support: Nil; Conflict of interest: None Declared