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Original Article

Application of a modified reflux enema method with indwelled anal canal in infants with long-segment Hirschsprung's disease

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Abstract: Objective: To discuss the value and the influence on prognosis of the modified reflux enema method with indwelled anal canal in treating infants no more than 2 months old with long-segment Hirschsprung's disease. Methods: A total of 104 infants with long-segment Hirschsprung's disease no more than 2 months old received by Baoji Maternal and Child Health Care Hospital from January 2016 to August 2017 were chosen as the subject of research, and then divided into the treatment group (n=52) and the control group (n=52) as per the random number table method. The control group was treated with the traditional reflux enema method, while the treatment group was treated with the modified reflux enema method (MREM) with indwelled anal canal. Differences in respect of the coloclysis time, amount of liquid used, cleanliness of intestinal tract, time of infants clinical symptoms improvement, degree of comfort, state of perianal skin, and the complications incidence rate were compared every time. Results: Coloclysis time and amount of liquid used of the treatment group were obviously lower than those of the control group (both P<0.05). The total good rate of the intestinal tract cleanliness of the treatment group was 92.31%, obviously higher than that of the control group (76.92%, P<0.05). The time of relief of abdominal distension, vomiting disappearance, and restoration of appetite to normal of the infants in the treatment group infants was shorter than that of the infants of the control group (all P<0.05). The good rate of comfort for the infants in the treatment group was 42.31% higher than that of the control group (17.31%), with the difference being statistically significant (P<0.05). The perianal skin state of the infants in the treatment group was significantly superior to that of the control group (P<0.05). The difference of complications incidence rates between the two groups wasn't statistically significant (P>0.05). All infants of the treatment group were discharged with anal canals after (12.09±3.49) d, obviously shorter than that of the control group (17.13±5.22) d. As guided by the physician, all infants of the treatment group accepted coloclysis continually, and the radical macrosigmoid operation was performed at the age of 4 months. Such symptoms as constipation and abdominal distension reoccurred or aggravated among 36 infants in the control group within 2 weeks after discharge, and then they were admitted to accept the radical macrosigmoid operation. Sixteen patients with mild symptoms were admitted to accept the MREM with indwelled anal canal, and then underwent the radical macrosigmoid operation at the age of 4 months. Conclusion: Applying the MREM with indwelled anal canal to infants no more than 2 months old with long-segment Hirschsprung's disease had advantages like time saving, cleanliness, and comfort, thus providing improved condition following radical megacolon operation.

Keywords: Modified reflux enema method with indwelled anal canal, newborn, infants no more than 2 months old, long-segment, Hirschsprung's disease

Introduction

Hirschsprung's disease is a common congenital gastrointestinal tract disease among infants, mainly involving the deformity of gastrointestinal tract resulting from the absence or reduction of the ganglion cells in the submucosal and myenteric plexus under the end of intestinal tract. Long-segment megacolon is named in the case of such ganglion cell segment without extending to the sigmoid colon or descending colon [1, 2]. The intestinal canal without ganglions is subject to persistent spasm and peristalsis slowdown, so the infants have such

symptoms as difficult defecation, abdominal distension, constipation, vomiting and other low-position intestinal obstruction symptoms [3]. In particular, newborns and infants no more than 2 months old with intestinal distal obstruction may induce complete intestinal obstruction due to pressure increase in local colectasia, because of a thin colon wall and immature intestinal nerves [4]. If such phenomena aren't handled in a timely manner, the patients may go into megacolon crisis which includes dyspnea, cyanosis, shock, intestinal perforation, etc., and even death [5]. Long-term abdominal distension and constipation may lead to malnutrition and developmental retardation, seriously threatening the infants' physical and mental health [6]. Radical macrosigmoid operation is the major means used to treat the disease, but due to poor physical fitness, young age, and immature intestine nerve development of infants within 2 months, of which the risk is greater [7]. Coloclysis can clear foul gas and faeces in the colon, improve the micro-ecological environment of intestinal tract, and impede the persistent colectasia, preparing the gastrointestinal tract for the radical macrosigmoid operation [8]. However, it is difficult to carry out coloclysis, because the stenotic segment of long-segment megacolon is long and the position is high. So, it is of great significance for increasing the surgical success rate and improving the infants' prognosis to master the skills on long-segment megacolon lavage. In this research, the application and influence on prognosis of the modified reflux enema method (MREM) with indwelled anal canal in treating the infants no more than 2 months old with long-segment Hirschsprung's disease were observed. Relevant conclusions are described below.

Materials and methods

General data

A total of 104 long-segment Hirschsprung's disease infants no more than 2 months old who had been admitted into the Pediatric Department of Baoji Maternal and Child Health Care Hospital from January 2016 to August 2017 were taken as the subjects of research.

Inclusion criteria: (1) All infants visited Baoji Maternal and Child Health Care Hospital with these major symptoms: abdominal distension, constipation or alternation of diarrhea and constipation. Barium enema indicated congenital megacolon, with the manifestation of sigmoid colon or descending colon stenosis, obvious transverse colectasia and about 10-15 cm spasm segment of intestinal canal. The disease was then definitely diagnosed as long-segment Hirschsprung's disease; (2) All the patients were no more than 2 months old and visited Baoji Maternal and Child Health Care Hospital for the first time; (3) With symptoms like hyperpyrexia, vomiting and serious dehydration; (4) Regular laboratory examination: the total number of leukocytes had increased dramatically, and there were also such symptoms as disturbance of the water-electrolyte balance and acidosis.

Exclusion criteria: (1) Infants with short-segment Hirschsprung's disease; (2) Infants that ever received the radical macrosigmoid operation, and had been suffering from postoperative colitis; (3) The idiopathic megacolon and false intestinal obstruction caused by chronic constipation, etc. were excluded; (4) Infants no less than 2 months old; (5) Infants and family members unable to cooperate in treatment.

The infants selected were divided into the treatment group (n=52) and the control group (n=52) as per the random number table method. There were 28 boys and 24 girls in the treatment group; they were aged 0-56 d, (15.23±4.20) d on average. There were 25 boys and 27 girls in the control group; they were aged 1-53 d, (17.64±5.18) d on average. The difference between the general data of the infants in the two groups wasn't statistically significant (all $P>0.05$), thus they were comparable. This research was approved by the Ethics Committee of Baoji Maternal and Child Health Care Hospital, and the family members of all infants signed the informed consent.

Methods

The control group was treated with the traditional reflux enema method: with the child lying laterally and its anus exposed, an anal canal of proper size lubricated with paraffin oil was slowly inserted into anus until lots of foul gas and trapped feces erupted. One person connected a 50 mL glycerinum injector with normal saline to the anal canal to directly inject normal saline into the anal canal, while another person

massaged the child's abdomen to promote the full dissolution and excretion of feces. This process was repeated till the aspirated liquid was clear.

The treatment group was treated with the MREM with indwelled anal canal: 30 min before coloclysis, a 1:2:3 solution was prepared with 50% magnesium sulfate, glycerinum and warm boiled water, with the temperature kept at 38-41°C. About 5 mL was injected into the dilated intestinal segment every time, with about 10 min reserved. Later, the family member held the child for defecation. After defecation was completed, cleaning was carried out with normal saline; the child was helped to take a lateral lying or lithotomy position, with the anus fully exposed. A preheated normal saline bottle was hung on an infusion support 30 to 60cm higher than the position of anus, and a No.12 to 14 disposable gastric tube was chosen as the material of indwelled anal canal. With the head cut off, the indwelled anal canal was lubricated and then lightly inserted into the anus and then the rectum under the guidance of an X-ray apparatus. During insertion, rotation was also conducted, and all movements were slow and gentle. When the X-ray apparatus indicated that the catheter entered the dilated segment from the stenotic segment, the infusion apparatus was connected to the catheter, and warm normal saline was injected from the catheter. When lots of foul gas and trapped feces erupted, it indicated that the continual insertion of the intestinal canal for dilation could be stopped. Then the catheter was fixed on both sides of the child's hip with adhesive tapes, while 0.10-0.15 L/kg warm normal saline was injected. After injection was completed, the infusion apparatus was closed. After saline and feces were fully dissolved, the catheter and infusion tube were separated to let the lavage liquid flow out. Additionally, at the same time, the child's abdomen was lightly rubbed, and the catheter was moved towards all directions, so that feces could be fully excreted. After coloclysis, the gastric tube was continually indwelled in the colon, the disposable drainage bag was connected, properly fixed for continual drainage, and intermittent coloclysis was conducted twice a day. This process was repeated till the drained liquid was clear.

Observational index

Major observational indices: (1) Time and amount of liquid used for each coloclysis: the time and amount of liquid used for each coloclysis of the infants of the two groups were carefully recorded. (2) Intestinal tract cleanliness: an experienced surgeon assessed the coloclysis effect [9]. Three grades (excellent, good and poor) were set. It was rated as excellent if the intestinal canal had obviously shrunk, and the mucous membrane of intestinal tract was clear and there was no liquid dung; it was rated as good if there was a small amount of unshaped egg drop-like liquid dung in the mucous membrane of intestinal tract; it was rated as poor if the mucous membrane of intestinal tract contained shaped faeces. The two groups' total good rates were compared. (3) Clinical symptoms improvement: The time for the restoration of child's feces color and smell to normal, abdominal distension relief, disappearance of vomiting, and restoration of appetite to normal was observed and recorded.

Secondary observational indices: (1) The child's degree of comfort: during coloclysis, the degrees of comfort of the infants of the two groups were assessed. Three grades (good, intermediate and poor) were set. It was rated as good if the child didn't cry and at the same time, the anal canal hadn't prolapsed and enema liquid hadn't flowed to the clothes and bed sheet; it was rated as intermediate if the child cried and at the same time, the anal canal had prolapsed for less than three times and a small amount of enema liquid had flowed to the clothes and bed sheet; it was rated as poor that the child cried and at the same time, the anal canal had prolapsed for more than 3 times and lots of enema liquid had flowed to the clothes and bed sheet. The good rates of the degrees of comfort of the two groups were compared. (2) State of perianal skin: It was observed whether the child's perianal skin had redness, and the redness cases of the perianal skin of the two groups were counted and compared. (3) Complications incidence rate: The water intoxication, intestinal rupture, intestinal perforation, and intestinal hemorrhage of the two groups were compared. (4) Follow-up: After the child was discharged, follow-up was conducted by outpatient service once a week, with the

Table 1. Comparison of coloclysis of the infants between the two groups ($\bar{x}$ ± sd)

Group	The time for each coloclysis (min)	The amount of liquid for each coloclysis (L)
Control group (n=52)	48.78±11.25	2.47±0.58
Treatment group (n=52)	31.20±7.38	1.65±0.52
t	9.422	7.591
P	<0.001	<0.001

Table 2. Comparison of the post-coloclysis intestinal tract cleanliness of the infants between the two groups (n, %)

Group	Excellent	Good	Poor	Total of excellent and good
Control group (n=52)	17 (32.69)	23 (44.23)	12 (23.08)	40 (76.92)
Treatment group (n=52)	41 (78.85)	7 (13.46)	4 (7.69)	48 (92.31)
χ^2				4.727
P				0.030

state of anal canal (drop, and blockage cases) and autonomous coloclysis recorded and the surgery situation conducted after four months.

Statistical analysis

Data were handled with SPSS 18.0 software, and the time and amount of liquid used for each coloclysis and other measurements according with normal distribution were indicated with ($\bar{x}$ ± sd) and underwent the t test. Counting data such as the intestinal tract cleanliness, degree of comfort, and complications incidence rate are indicated with percentages and tested with χ^2; the rank sum test was adopted for comparing grade data. P<0.05 means that the difference is statistically significant.

Results

Time and amount of liquid used for each coloclysis

The time and amount of liquid used for each coloclysis of the treatment group were lower than those of the control group, with the difference statistically significant (both P<0.05) as shown in **Table 1**.

Intestinal tract cleanliness

The good rate of the intestinal tract cleanliness of the treatment group was obviously higher than that of the control group, with the difference statistically significant (P<0.05) as shown in **Table 2**.

Time of clinical symptoms improvement

Since infants no more than 2 months old cannot describe clinical symptoms, improvement of the said clinical symptoms were counted and assessed by attending physicians. The time of relief of abdominal distension, disappearance of vomiting, and restoration of normal appetite in the treatment group infants were obviously shorter than that of the infants of the control group, with the difference statistically significant (all P<0.05) as shown in **Table 3**.

Degree of comfort

The good rate of the degree of comfort of the infants of the treatment group was obviously higher than that of the control group, with the difference statistically significant (P<0.05) as shown in **Table 4**.

State of perianal skin

The incidence rate of the perianal skin redness of four infants of the treatment group was 7.69%. The incidence rate of the perianal skin redness of 18 infants of the control group was 34.62%. The state of perianal skin of the infants of the treatment group was superior to that of the control group, with the difference statistically significant (χ^2=11.299, P<0.05).

Complications

The difference between the complications incidence rates of the two groups was not statistically significant (P>0.05) as shown in **Table 5**.

Follow-up

The liquid drained from all infants during coloclysis was clear, and they were discharged

Table 3. Comparison of the time of clinical symptoms improvement of the infants between the two groups ($\bar{x} \pm sd$)

Group	The restoration of child's faeces color and smell to normal (d)	The relief of abdominal distension and vomiting disappearance (d)	The restoration of appetite to normal (d)
Control group (n=52)	3.42±0.82	4.09±0.83	6.71±1.29
Treatment group (n=52)	1.81±0.67	2.36±0.47	4.55±0.82
t	9.422	7.591	10.190
P	<0.001	<0.001	<0.001

Table 4. Comparison of the subjective feeling of the infants after coloclysis between the two groups (n, %)

Group	Excellent	Good	Poor
Control group (n=52)	9 (17.31)	29 (55.77)	14 (26.92)
Treatment group (n=52)	22 (42.31)	27 (51.92)	3 (5.77)
χ^2	7.767	0.155	8.509
P	0.005	0.694	0.004

after the appetite restored to normal. The discharge time of the infants of the treatment group was obviously earlier than that of the infants of the control group, with the difference statistically significant (P<0.05) as shown in **Table 6**. As guided by the physician, all infants of the treatment group were discharged with anal canals and accepted coloclysis continually at home. Specifically, the catheter came off autonomously from 2 patients on day 17 and day 20 respectively, and the catheter reinsertion conducted at Baoji Maternal and Child Health Care Hospital was successful. The shortest, longest and average indwelling time of catheter was 29 d, 69 d and 38.6 d respectively. No enterocolitis occurred during catheter indwelling, and the radical macrosigmoid operation was executed for all infants at the age of 4 months. Outpatient follow-up was conducted for the infants of the control group, such symptoms as constipation and abdominal distension reoccurred or aggravated among 36 infants in the control group within 2 weeks after their discharge. Some newborns were admitted to accept the radical macrosigmoid operation. Sixteen of them with mild symptoms were admitted to accept the MREM with indwelled anal canal, and then underwent the radical macrosigmoid operation at the age of 4 months.

Discussion

Due to immature ganglion cells of colon, poor physique, and serious obstructive symptoms, malabsorption of nutrients infants of Hirschsprung's disease no more than 2 months old may be subject to growth retardation, anemia, hypoalbuminemia, edema etc. Moreover, because of the thin colon walls, complete intestinal obstruction may occur under the effect of colonic pressure, resulting in severe megacolon crisis, even threating the infants' life. In this case, the child's physical condition generally can't withstand the radical macrosigmoid operation [10, 11]. If the operation is carried out despite the danger, it may do more harm than good [12, 13]. The content of colon can be effectively cleared through coloclysis to promote the restoration of the micro-ecological environment of the intestinal tract, effectively alleviating the megacolon edema as well as clinical symptoms like abdominal distension, vomiting, etc., is beneficial for absorption of nutrients and improving the child's nutrition [14]. Meanwhile, coloclysis can help the dilated intestinal canal to restore as quickly as possible and determine the excision scope of intestinal segment for the surgery, and not only increases the surgical success rate, but plays a positive role in improving the child's prognosis [15]. Coloclysis was conducted with the traditional reflux enema method that had been previously used before an operation, but the lavage difficulty was high, because the stenotic segment of long-segment megacolon was long and the position was high [16]. The traditional reflux enema method isn't adaptable to the treatment of long-segment Hirschsprung's disease. This is because traditional coloclysis requires much time, cooperation among more than 2 people, and complicated operation due to the prolonged surgical time. The amounts of force imposed for every liquid injection are also nonuniform and the infants cannot well cooperate, as the anal canal is mostly made of rubber

Table 5. Comparison of the complications incidence rates of the infants after coloclysis between the two groups (n, %)

Group	Water intoxication	Intestinal rupture	Intestinal perforation	Intestinal hemorrhage	Total
Control group (n=52)	0	0	1 (1.92)	0	1 (1.92)
Treatment group (n=52)	0	0	0	0	0
P					1.000
χ^2					1.010

Table 6. Comparison of the discharge time of the infants between the two groups

Group	Discharge time (d)
Control group (n=52)	17.13±5.22
Treatment group (n=52)	12.09±3.49
t	5.788
P	<0.001

and feels hard, which is highly irritating to the intestinal canal and can easily hurt the mucous membrane of intestinal tract.

In this research, the MREM was adopted for treatment, and the result indicated that the time and amount of liquid used for each coloclysis in the treatment group were obviously lower than those of the control group [17]. The total good rate of intestinal tract cleanliness of the treatment group was obviously higher than that of the control group. The modified enema method was to inject the magnesium sulfate-bearing solution into the intestinal tract. It could not be easily absorbed by the intestinal mucosa, and might become hypertonic saline in the enteric cavity, impeding water absorption by the intestinal tract and increasing the intestinal capacity; at the same time, it stimulated peristalsis to promote smooth excretion of feces. Moreover, the hypertonic dilated colon could absorb liquid among tissues to soften and excrete feces, further facilitating thorough feces excretion and improving intestinal tract cleanliness. At the same time, it could prevent the solution injected later on from being absorbed by the intestinal mucosa, effectively lowering the amount of enema liquid used [18]. In addition, the degree of comfort and the complications incidence rate of the infants in the treatment group were obviously higher and slightly lower than those of the control group respectively. This was possibly because catheterizing was implemented during coloclysis under the guidance of X-ray apparatus to realize accurate positioning, effectively avoiding the damage of blind catheterizing to the intestinal canal, making it easier for the catheter to pass the spasm segment and then enter the dilated intestinal canal to conduct persistent drainage. In the past, porous silicone suction tubes were adopted, since the regular anal canal was too short to reach the required insertion depth, resulting in a nonideal coloclysis effect [19]. The gastric tube chosen for this research was made of silicone, featured by soft quality and good tenacity, and could rapidly restore after being bent during operation. Moreover, the head of gastric tube had been handled, with multiple openings and less irritation to the intestinal mucosa. In this way, liquid could rapidly flow, reducing the tube blockage and further effectively avoiding the intestinal mucosa harm or edema and other complications caused by multiple catheterizing [20]. Furthermore, the degree of comfort of the infants and the coloclysis effect could be improved.

The research results indicate that the time of abdominal distension relief, vomiting disappearance and restoration of appetite to normal of the infants of the treatment group were obviously shorter than those of the control group. The modified enema method could accelerate the patient's recovering from such symptoms as abdominal distension, since it could more thoroughly clear the content of intestinal tract. Compared with the traditional reflux enema, the MREM with indwelled anal canal had several advantages: the enema liquid was hung on infusion support, and then the amount of liquid infused was rationally adjusted based on the child's age, so that the liquid was infused at a uniform speed without impact, and the child's degree of comfort was high. The porous silicone suction tube took the place of the traditional anal canal, decreasing the damage to intestinal mucosa and with the closed infusion system used, it wasn't required to repeatedly pour out liquid, reducing the workload. The coloclysis time was short, reducing the psychological and physiological pains of the infants,

and thus further improving the degree of comfort [21].

Throughout follow-up, it was seen that all infants of the treatment group were discharged with anal canals, and accepted coloclysis at home continually as guided by the physician. The average catheterizing time was 38.6 d, and no infant had enterocolitis during catheterizing, signaling that the MREM with indwelled anal canal applied to infants no more than 2 months old was featured by easy operation and high safety, could spare more time for the infants' neurodevelopment of intestinal canal to get mature and was more advantageous for the child's surgical success.

In summary, the MREM with indwelled anal canal applied to infants no more than 2 months old has advantages such as time savings, cleanliness, comfort, as well as good prognosis. This approach thus deserves promotion. Yet this research was preliminary, and long-term efficacy comparison between infants no more than 2 months old undergoing radical macrosigmoid operation and the procedure in infants undergoing coloclysis followed by radical macrosigmoid operation at the age of four months, haven't yet been conducted. They will be emphatically discussed in the further research.

Disclosure of conflict of interest

None.

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