

Coordination and nursing care of pediatric patients undergoing double balloon enteroscopy

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nursing care is essential to the successful execution of the procedure.

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Abstract

AIM: To review safety, efficacy, and proper nursing care of double-balloon enteroscopy (DBE) in pediatric patients with small intestinal disease.

METHODS: Our study included 37 patients with abdominal pain, diarrhea, passage of blood in the stools, and other symptoms, who underwent DBE from December 2006 to July 2010. DBE was retrograde in 36 procedures, antegrade in six, and from both ends in five. The diagnostic significance and salient points in nursing care are discussed in this article.

RESULTS: At least one lesion was discovered in 28 out of 37 patients, which yielded a positive diagnosis in 75.7% of cases. Good bowel preparation and skilled nursing care not only shortened the procedure time, but could also alleviate patient discomfort and enhance the quality of examination. No serious procedure-related complications were observed in any cases.

CONCLUSION: DBE is a new modality of endoscopic procedure that improves the standard of diagnosis and treatment of small bowel diseases in children. Good

INTRODUCTION

Small intestinal diseases are not rare in children, but limitations in investigative approaches affect our understanding of pediatric small bowel disorders. The small intestine is deep-seated, up to 6 m long in adults, and has many turns and convolutions, which makes direct visualization through the traditional means of upper and lower gastrointestinal endoscopic procedures difficult. Sonde or push enteroscopes can examine the small intestine only up to 80-100 cm beyond the ligament of Treitz, thus, a full endoscopic examination of the small bowel has always been difficult.

Double-balloon enteroscopy (DBE) provides a significant advance in diagnosis and management of small intestinal diseases^[1-5]. It also poses a challenge to the nursing profession. Nurses are responsible for assisting the endoscopist with completing the examination, minimizing the suffering of patients undergoing the procedure, and preventing the occurrence of complications during and after the examination. Our hospital acquired DBE equipment in 2006 and has achieved satisfactory results in its

application. Here, we report our experience using DBE in the management of small intestinal diseases, with an emphasis on indications and special aspects of nursing care.

MATERIALS AND METHODS

Ethics

This study was approved by the Institutional Ethics Committee of the Children's Hospital of Fudan University, Shanghai, China and informed consent was obtained from all patients and their parents.

Clinical data

During December 2006 to July 2010, we had 37 patients who underwent DBE, with 26 boys and 11 girls. Patient age ranged from 4 to 16 years, specifically: 4-8 years old, nine patients; 8-12 years old, nine patients; and 12-16 years old, 19 patients. Retrograde DBE was performed in 36 cases, antegrade DBE in six, and DBE from both ends in five. Demographic characteristics of the 37 children who underwent DBE examination are in Table 1. Procedures indicated included (Table 2): occult gastrointestinal bleeding, recurrent abdominal pain, chronic diarrhea, and hypoproteinemia. All patients underwent traditional investigations that included gastroscopy, colonoscopy, abdominal computer tomography (CT) or magnetic resonance imaging (MRI), and radioisotope scan for Meckel's diverticulum if symptom cause could not be identified.

Methods of examination

DBE can be administered through the mouth (antegrade), or through the anus (retrograde). The route of insertion is determined by the clinical features and results of other ancillary examinations including CT/MRI scans, angiography, barium examination of the small bowel, and radioisotope scanning. The procedure is usually conducted in a fully equipped operating room with full anesthetic capabilities, with the anesthesiologist administering general anesthesia *via* an endotracheal tube. The lower ileum can usually be reached in the transoral, antegrade approach, whereas the upper jejunum can be reached *via* the transanal, retrograde approach. Sequential application of the antegrade and retrograde examinations can achieve full examination of the small intestine.

Pre-procedure nursing care

Psychological care: Psychological preparation of an adult patient undergoing DBE is very important. If patients are poorly prepared, an unsuccessful examination may result. For the pediatric patient, psychological preparation is equally or more important. Most of our patients undergoing DBE suffered from illnesses of long duration and had received gastroscopy, colonoscopy, and many other investigations without a definitive diagnosis. Moreover, because DBE requires a long procedural time, and most patients and parents demonstrated anxiety, a preprocedural routine that carefully detailed the aspects of the examination to the parents as well as patients was impera-

Table 1 Demographic characteristics of 37 children who underwent double-balloon enteroscopy

Age group (yr)	<i>n</i>	Mean age (yr)	Male/female	Antegrade/retrograde/both
4.0-8.0	9	5.6	3/6	0/8/1
8.1-12.0	9	10.4	3/6	1/6/2
12.1-16.0	19	13.9	5/14	0/17/2

Table 2 Preliminary indication for double-balloon enteroscopy in 37 children

Preliminary indication	<i>n</i>
Occult gastrointestinal bleeding	12
Recurrent abdominal pain	10
Chronic diarrhea	13
Other	2

tive. The aim, method, significance, and other details of the procedure were carefully explained, to gain confidence and cooperation before the examination.

Dietary and bowel preparation: We recommended a restrictive diet for the patients prior to the procedure. Two days before the examination, they were instructed to consume a low-residue, semi-liquid diet. A light laxative such as senna or lactulose was administered with adequate fluid. On the day of examination we usually gave, in addition to the laxative, an enema of 500-1000 mL of warm saline until clear fluid passed.

Others: Six hours before the procedure we carefully enquired if the patient had any contraindications. Any serious cardiological or pulmonary disorder and significant gastrointestinal blood loss was noted and evaluated for suitability to undergo the procedure. We routinely checked the liver and renal function, electrocardiogram, complete blood count and clotting factors preoperatively. Venous access, cardiac monitoring, oxygen saturation monitoring, and other routine monitoring procedures were set up for the anesthesiologist. Other facilities such as suction tubes, suction pump, oxygen supply, Ambu bag, and instruments and medications for resuscitation were also routinely checked to ensure patient safety.

Nursing care during the procedure

The double balloon endoscope is different from regular gastroscopy or colonoscopy, and is much longer and softer. The small intestine is long and convoluted, and situated deeper in the abdomen; hence, manipulation of the endoscope is difficult. The assistance of nursing personnel during the procedure is very important. Before the procedure, a small amount of water was added into the space between the overtube and the endoscope, as a lubricant to facilitate the pushing and pulling of the scope. K-Y Jelly (Johnson and Johnson Co.) was routinely used as a lubricant to reduce the friction between the mucosa and the endoscope. For antegrade DBE, the initial part of

the insertion of the endoscope was similar to that for routine gastroscopy. The endoscope was first introduced into the duodenum as far as the third part of the duodenum. Then, the balloon tip was inflated to anchor the tip of the endoscope at this part of the intestine. The overtube was slid to the most anterior position and the balloon inflated, anchoring it firmly to this part of the duodenum. The balloon at the tip of the endoscope was deflated and gradually inserted further into the small intestine beyond the ligament of Treitz. The balloon tip was again inflated and the overtube balloon was deflated. The overtube was slid to the anterior position and the entire endoscope, together with the overtube, was pulled out to shorten the inserted length, and pleated the small intestine onto the shaft of the endoscope. The entire procedure was repeated several times to increase the depth of insertion. For retrograde insertion, the endoscope was inserted into the anus, rectum, and sigmoid colon as in a regular colonoscopy examination. The balloons were inflated and deflated as previously described to facilitate the advance of the endoscope to the cecum. The overtube balloon was inflated to anchor it securely at the cecum, and the tip of the endoscope with its deflated balloon was inserted into the ileocecal valve. The endoscope was manipulated to have a safe length inside the ileum, and the balloon tip inflated. The overtube balloon was deflated and the overtube was slid carefully to the anterior position through the ileocecal valve. The overtube balloon was inflated again to allow secure anchoring at the terminal ileum. The endoscope balloon was deflated and the tip of the endoscope gradually advanced deeper into the small intestine. The process of inflation and deflation of the balloons and advancing of the endoscope were repeated to achieve deeper insertion of the endoscope into the small intestine, until it could go no further or the suspected lesion was reached.

During the procedure, nursing assistance was needed for maintaining the endoscope and overtube at the proper position during various phases of the procedure, and for inserting the overtube to the 1.55-m mark on the surface of the endoscope. When a pathological lesion was detected during the procedure, the endoscopic nurse assisted in obtaining biopsies, injection of dye, removal of polyps *via* diathermy snare, and other tasks. The procedure usually took more time than regular gastroscopy or colonoscopy, hence, the period of anesthesia was also longer. Patient vital signs were carefully monitored, and the condition of the abdomen closely observed. Excessive inflation of air can cause gross distension of the abdomen; in this case, the operator must be alerted and air removed from the intestinal lumen. In this series, we did not encounter any perforation or major bleeding after the procedure.

Post-procedural nursing care

After the examination, vital signs were closely monitored in the recovery room until the patient was fully conscious. For patients undergoing antegrade examination, the head was turned towards one side, and any secretion or vomit

Table 3 Endoscopic findings and diagnoses from double-balloon enteroscopy in 37 patients

Endoscopic findings or diagnoses	Cases (%)
Inflammatory bowel disease	13 (35.1)
Meckel's diverticulum	5 (13.5)
Ulcerations or erosions	4 (10.8)
Non-specific ileitis	2 (5.4)
Jejunal polyp	1 (2.7)
Amebiasis	1 (2.7)
Anaphylactoid purpura	1 (2.7)
Congenital small intestinal lymphangiectasia	1 (2.7)
Overall positive rate	28/37 (75.5)

was cleared from the oral cavity and pharynx to prevent aspiration. When fully conscious, patients may complain of a slight headache or sore throat. This was thoroughly explained to patients and parents. The long procedure time and repeated insertion and withdrawal of the overtube can result in frictional injury to the pharynx that usually does not require special treatment. Management was usually supportive, including rinsing the mouth with chilled saline, which can be effective in soothing the oral and pharyngeal mucosa and reducing discomfort. For patients who underwent retrograde DBE, rectal bleeding can be a complication and was watched for; nursing care to the anus was also performed. The patients were usually kept nil by mouth for 6 h after the procedures until they were fully conscious. Feeding was initiated with a fluid diet, and after eating, patients were monitored for nausea, vomiting, and abdominal pain. Changes in level of consciousness, stool characteristics, and other symptoms were closely observed. Any deterioration was reported to the doctors responsible for the patient. The small intestine is very long, so after the procedure, gas tends to be retained in the intestine, which results in distension. Patients were encouraged to pass gas through the anus or by burping, and early ambulation also enhanced the passage of gas from the system.

Equipment cleansing and sterilizing after use

After the procedure, the enteroscope was immediately cleaned as a preliminary procedure, and then fully treated in the endoscope treatment room with water, enzyme, antiseptic and finally rinsing with 75% ethyl alcohol and water. The enteroscope was dried with air current and hung in the endoscope cabinet for future use.

RESULTS

Among the 37 cases, lesions were detected in 28 (75.5%) (Table 3). Lesions were mainly inflammatory bowel disease, Meckel's diverticulum, jejunal polyp, anaphylactoid purpura, and congenital small intestinal lymphangiectasia. Of 10 cases that were investigated for abdominal pain, no mucosal abnormality in the small intestine was detected in seven (positive rate of 30%), and these were probably cases of functional disorders that resulted in abdominal pain. In 10 of 12 patients with occult gastro-

intestinal bleeding, the bleeding source was found (positive rate of 83.3%). The positive rate for patients with suspected intestinal bleeding was higher than for patients with abdominal pain.

In all procedures, patients who underwent examinations had no complications during or after DBE, and the average procedure time was 101 ± 53.0 min (antegrade: 91 min; retrograde: 104 min).

DISCUSSION

Yamamoto *et al.*^[1], and May have been pioneers in applying DBE for clinical use. They generally regard DBE as a safe procedure and the appearance of bleeding or perforation are rare complications. Recent reports have confirmed the safety of DBE in pediatric patients^[6,7]. A majority of patients may develop abdominal distension, mild abdominal pain or sore throat, but these symptoms are mostly self-limiting and resolve spontaneously without any specific treatment. In this study, no major complication resulted after the procedure, which confirmed that DBE is a relatively safe procedure in the pediatric age group.

In our series of 37 patients who underwent a total of 42 DBE procedures, the positive rate was 75.5%, and the preliminary indication for DBE examination was occult gastrointestinal bleeding. In 12 patients with intestinal hemorrhage, five were diagnosed with Meckel's diverticulum, and in these, conventional diagnostic methods including ^{99m}Tc scanning, did not yield a definitive diagnosis. Meckel's diverticulum is usually located 50-100 cm from the ileocecal valve, therefore, it is out of the range of conventional endoscopic procedures. If Meckel's diverticulum is highly suspected, but ^{99m}Tc scanning is negative, DBE examination may be considered. In the present study, the positive rate for patients with suspected intestinal bleeding was higher than for patients with abdominal pain.

In our study, 15 patients underwent DBE examination for suspected Crohn's disease, and diagnosis was confirmed in 13. Characteristic changes were found in all 13 patients, such as aphthous ulcers, intestine stenosis and discontinuity inflammatory lesions. Lesions of Crohn's disease are beyond the reach of traditional colonoscopy, therefore, DBE examination may be a good choice for patients with suspected Crohn's disease. Our research demonstrated that DBE has high diagnostic value for Crohn's disease.

DBE is a reliable procedure for the investigation of small intestinal pathology, and its safety and reliability have been reported in various clinical studies^[8-11]. In the present study, a significant 75.5% of patients had a positive diagnosis after examination, which was comparable to other centers, both in China and internationally^[12-14]. Videoendoscopy is superior to other modalities of investigation for the diagnosis and management of gastrointestinal disorders. DBE, as a successor to traditional gastroscopy and colonoscopy, is a major advance in gastrointestinal endoscopy^[15-18]. Through cycles of insertion, anchoring and pulling, the small intestine can be shortened by telescoping it onto the shaft of the endoscope, which enables ex-

amination of regions beyond the reach of the endoscope length. Compared to the maximum depth of insertion of a traditional enteroscope, which is 80-100 cm from the ligament of Treitz, DBE can be inserted much farther. Normally, the mid-ileum can be reached, and the terminal ileum can be reached in some patients. The double balloon endoscope provides a wide visual field and images of high clarity and definition. Moreover, similar to a regular gastroscope or colonoscope, with DBE, it is possible to insufflate air, aspirate, and perform biopsies and therapeutic procedures when necessary. It is now considered a gold standard for the diagnosis and management of small intestinal diseases that cannot be replaced with other means.

After 42 DBE procedures, we made the following observations from a nursing perspective. To assist endoscopists with performing DBE and to minimize the suffering of sick children, the endoscopic nurse should: (1) meticulously examine the instrument before the procedure, paying special attention to the installation of the endoscope balloon to ensure that it is functioning properly and free from leakage; (2) provide psychological support and intestinal preparation; (3) closely monitor the vital signs, and fully cooperate with the endoscopist during the procedure, to control the insertion and withdrawal of the endoscope and overtube, and occasionally introduce water or lubricant to the space between the endoscope shaft and overtube, to reduce friction; (4) be aware of markings on the endoscopic shaft to prevent damage to the endoscopic balloon; and (5) ensure that after the procedure, the child fasts for 6 h before a fluid diet is introduced. The child can usually be fed normally on the second day.

In conclusion, in adults, DBE is a well-established procedure that is used in many countries. Its application in the pediatric age group is relatively recent; hence, few reports are available on this topic. This study investigated the nursing perspective in cases conducted in our hospital under intravenous or general anesthesia. We conclude that DBE is a safe and reliable procedure in the pediatric age group, with few complications and little suffering. High quality nursing care and good coordination with the endoscopists are essential to the successful conduction and completion of the procedure. We look forward to conducting a prospective study on patients undergoing DBE, preferably with a large sample size. We hope that, as nurses, we can better collaborate with physicians, so that procedure time can be shortened and patient suffering can be minimized.

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COMMENTS

Background

Technical challenges have obstructed the diagnosis and treatment of small intestinal disease. The small intestine is long, tortuous, far from both ends of

the digestive tract, and unfixed in position. An innovative form of enteroscopy, double-balloon enteroscopy (DBE), allows full-length visualization, biopsy, and endoscopic treatment of previously inaccessible lesions. The diagnostic and therapeutic benefits of DBE have been well documented in the adult population. To date, little has been published to evaluate the safety and efficacy of DBE in pediatric patients and the impact of nursing on this procedure, which has its own unique set of indications, limitations, and potential complications.

Research frontiers

DBE constitutes a new procedure for digestive endoscopy that makes direct visualization of the entire small bowel possible, with the simultaneous ability to take biopsy specimens and carry out endoscopic interventions. However, more studies are needed to evaluate the diagnostic value of DBE in children with suspected small intestinal disease, and determine the role of appropriate nursing care in reducing the incidence of complications, shortening the examination, and improving the lesion-detection rate.

Innovations and breakthroughs

Publications on pediatric DBE operation and nursing care are limited. In this report, a descriptive, qualitative study was conducted on 37 pediatric patients who underwent 42 DBE examinations for suspected small intestinal diseases. The clinical significance and salient points for nursing are summarized.

Applications

In this study, the pre-procedural, intra-procedural, and post-procedural nursing care were described in detail. In addition, the points of nursing care for pediatric patients undergoing DBE are summarized, which may offer a reference strategy for future DBE operations.

Terminology

Antegrade DBE is administered through the mouth, whereas retrograde DBE is inserted through the anus. The route of insertion is determined by the clinical features and results of other ancillary examinations. If the suspected lesion is low in the intestinal, retrograde DBE should be chosen.

Peer review

In this paper, the authors review the safety, clinical efficacy and nursing care of DBE in children. This topic is interesting in the pediatric age group but before publication, the authors should discuss the indications for pediatric DBE in more detail.

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