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Original Contribution

T-TUBE ENTEROSTOMY: TECHNICAL CONSIDERATIONS AND CLINICAL APPLICATIONS

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ABSTRACT

Introduction: T-tube enterostomy is a minimally invasive technique for temporary gastrointestinal decompression in pediatric patients, particularly neonates and infants. Traditional enterostomy methods often lead to complications and prolonged recovery, highlighting the need for alternative approaches.
Materials and methods: This study evaluates the outcomes of 33 patients under one year of age who underwent T-tube enterostomy at St. Anna Hospital, Varna (2008–2021). The cohort included neonates with low birth weight and gastrointestinal conditions, such as bowel obstruction, meconium ileus, and necrotizing enterocolitis.
Results: The procedure, performed via a supraumbilical transverse laparotomy, prioritized organ preservation and minimized trauma. The T-tube was placed using standardized techniques, with adjustments based on patient anatomy. Clinical outcomes confirmed its effectiveness in providing gastrointestinal decompression while enabling intraoperative and postoperative lavage. The mean T-tube retention was 14 days, with spontaneous fistula closure after removal, eliminating the need for additional surgery. No significant complications were observed. Compared to conventional enterostomy, the T-tube method offers reduced invasiveness, shorter operative time, spontaneous fistula closure, and improved postoperative management. Its multifunctionality also facilitates medication administration and contrast studies.
Conclusion: In conclusion, T-tube enterostomy is a safe and effective alternative for managing neonatal and infant gastrointestinal conditions, supporting its use as a preferred surgical technique.

Key words: T-tube enterostomy, neonates, bowel obstruction, meconium ileus, necrotizing enterocolitis, minimally invasive surgery, neonatalsurgery

INTRODUCTION

The term "stoma" originates from the Greek word *stomoun*, meaning the creation of an opening or mouth. In pediatric surgery, "stomia" refers to any surgically created opening between a hollow organ (e.g., stomach, small intestine, or colon) and the skin, either directly (stoma) or via a tube. The history of enterostomies is extensive, with the concept of treating bowel obstruction through colostomy dating back to the 18th century (1, 2). Among the first recorded survivors were children with anal atresia. For a long time, the creation of an intestinal stoma in pediatric patients was considered a drastic procedure due to the high incidence of complications and mortality (1, 3). Despite the successful implementation of colonic and later small bowel enterostomies, the development of this technique in pediatrics progressed relatively slowly (3). However, advances in modern surgical techniques, improved resuscitation, and postoperative care have significantly increased neonatal survival rates, consequently raising the demand for enterostomy. The emergence of minimally invasive techniques has opened new possibilities for stoma creation for feeding, decompression, and irrigation. An alternative to classical enterostomy is the use of a T-tube, introduced for the treatment of various neonatal conditions (4). This article aims to describe the

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application of the T-tube enterostomy technique. The method of externalizing an enterostomy with the aid of a T-tube has been established as a routine surgical intervention based on clearly defined indications. This technique is designed to provide temporary gastrointestinal decompression while minimizing complications associated with conventional approaches.

Aim

The aim of the present study is to evaluate the application of a surgical technique for enterostomy using a T-tube.

MATERIALS AND METHODS

Over the period from 2008 to 2021, a total of 33 patients under one year of age underwent enterostomy with a T-tube at the Department of Pediatric Surgery, St. Anna Hospital, Varna. This cohort included neonates with low and extremely low birth weight, as well as infants with congenital or acquired gastrointestinal conditions, such as bowel obstruction, meconiumileus, and necrotizing enterocolitis. The surgical approach was minimally invasive, prioritizing organ preservation and minimizing trauma to the small intestine. All procedures were conducted under general anesthesia, involving a supraumbilical transverse laparotomy and a systematic revision of the abdomina lcavity. T-tube placement was performed according to a standardized technique, with individualized adjustments to tube size based on the patient's anatomical and clinical characteristics.

RESULTS AND DISCUSSION

Enterostomies play a crucial role in the management of various gastrointestinal conditions in pediatric patients. The indications for stoma formation encompass a wide range of diseases and primarily aim to provide decompression in congenital or acquired bowel obstruction, divert intestinal passage in cases of neonatal bowel perforations, or allow access to the gastrointestinal tract for long-term enteral feeding or antegrade enemas (5, 6). Pediatric enterostomies differ significantly from those in adult patients in several aspects, including criteria for selecting the most appropriate type, the importance of technical precision during stoma formation, and the specialized care required to address age-related growth and psychological needs. The need for developing and implementing a novel method for temporary gastrointestinal decompression in pediatric patients arises from the fact that most techniques used in adults are either inapplicable or unsuitable for children (4, 7, 8). A rising incidence of cases requiring enterostomy formation has been observed, particularly in preterm neonates, which is associated with advancements and high-tech achievements in modern medicine (9). The increasing ability to successfully treat and care for preterm neonates with low and extremely low birth weight (10) has, in turn, led to the emergence of pathologies and complications characteristic of immature organ systems. To further substantiate the clinical relevance and practical applicability of the proposed technique, a structured summary of the procedural steps, patient outcomes, and observed advantages of the T-tube enterostomy method is presented below **(Table 1)** (11).

Table 1. *Clinical and Demographic Characteristics of Pediatric Patients Undergoing T-Tube Enterostomy*

Variable	Value
Number of patients	**33**
Sex (M/F)	**18/15**
Gestational age (mean, range)	**36.5 weeks (28-40)**
Birth weight	**2520 g (850-3600)**
Main diagnoses	**NEC, Meconium ileus, Anorectal malformation, Ileal atresia, Ileal perforation**
Indications for T-tube placement	**Prophylactic (e.g., ARM); Therapeutic (e.g., NEC, obstruction)**

Clinical Outcomes (Extended Quantitative Data)

The average length of hospital stay was significantly shorter in patients treated with the T-tube technique (26.45 ± 13.19 days) compared to those with conventional enterostomies (40.79 ± 19.57 days), with the

difference reaching statistical significance (t = 3.496; p = 0.001).

The mean duration until restoration of bowel continuity, measured as the time to stoma closure, varied depending on the underlying condition. Overall, the average closure time was 64.72 ± 78.16 days (range: 6 to 365 days), with the shortest intervals observed in cases of meconium ileus (mean: 45.7 days) and the longest in patients with extensive small bowel necrosis (mean: 168 days).

Although the exact time to achieve full enteral feeding is not explicitly quantified, clinical observations indicate a favorable trend in the T-tube group. In particular, rapid resolution of bowel stasis following meconium evacuation facilitated earlier initiation of enteral nutrition.
Regarding the need for reoperation, 2 patients (6.9%) in the conventional enterostomy group required repeat surgical intervention due to complications. In contrast, no patients in the T-tube group underwent reoperation, indicating a lower complication rate and improved surgical outcomes associated with the technique (11).

Diagnosis-Specific Outcomes and Postoperative Course

Among the 33 patients included in the study, the most common indications for T-tube enterostomy were necrotizing enterocolitis (NEC) and meconium ileus. In cases of NEC (n = 9), the technique was applied in the presence of intestinal perforation, with favorable outcomes in terms of peritoneal sanitation and bowel decompression. In patients with meconium ileus (n = 7), the T-tube facilitated effective evacuation of inspissated meconium and allowed for the local application of mucolytic agents such as N-acetylcysteine, resulting in early restoration of bowel passage.
Additional indications included intestinal atresia (n = 5), where the technique proved especially useful in preserving bowel length and reducing surgical trauma, and focal spontaneous intestinal perforation in extremely low birth weight neonates (n = 4), for whom minimal invasiveness was a key advantage. Other cases involved Hirschsprung's disease and small bowel volvulus.

No early postoperative complications were observed. The team actively monitored for wound infections, peristomal necrosis, and septic episodes, but none were recorded. Similarly, long-term complications, such as persistent enterocutaneous fistula, bowel stenosis, or symptomatic adhesions did not occur during follow-up.

Compared to classical enterostomy, the T-tube technique offers several potential advantages: shorter duration of tube retention, spontaneous closure without reoperation, and avoidance of a second anesthetic procedure. Literature data support the reduced morbidity associated with this approach, particularly in fragile neonatal populations, where operative time and surgical trauma must be minimized (11).

Enterostomy Formation Using a T-Tube

Under general anesthesia, a supraumbilical transverse laparotomy is performed, followed by a systematic exploration of the abdominal cavity. The underlying pathology is confirmed intraoperatively. In cases of spontaneous bowel perforation, commonly associated with necrotizing enterocolitis or other conditions, the peritoneal cavity is irrigated with normal saline and antiseptic solutions to prevent the spread of inflammation. The edges of the perforated intestinal segment are refreshed, and a Kerh T-tube, adapted to the bowel size and perforation site, is inserted. The tube is secured with purse-string sutures, with the suture ends used to fix the bowel loop to the peritoneum. The longer limb of the T-tube is exteriorized through a separate incision in the anterior abdominal wall and secured to the skin. In cases of intestinal atresia, resection of the dilated segment is performed, and the T-tube is placed to facilitate decompression and protect the anastomosis. Gastrointestinal tract patency is verified by instillation of normal saline through the tube.

Enterostomy Closure Technique

Following the patient's clinical improvement and restoration of normal bowel function, the T-tube is gently removed by traction. No additional surgical intervention is required, as the fistula closes spontaneously within a short period. Minimal leakage of intestinal contents may occur post-extraction but ceases spontaneously without further intervention.

Clinical Outcomes

In all patients, enterostomy with a T-tube ensured effective gastrointestinal decompression. Free passage of bowel contents was achieved, allowing for both intraoperative and postoperative lavage. The mean duration of T-tube retention was 14 days, after which it was removed without the need for additional

surgery. Minimal leakage of intestinal contents was observed following tube removal, which resolved spontaneously without long-term complications.

Advantages of the Method

The T-tube enterostomy technique demonstrated high effectiveness compared to conventional enterostomy. The following advantages were identified:

Less invasive approach: The procedure allows for minimally invasive exploration and sanitation of the abdominal cavity, avoiding extensive small bowel resection.

Shorter enterostomy closure time: The T-tube enables natural and rapid spontaneous fistula closure after removal, eliminating the need for additional surgery.

Reduced operative duration: The technique shortens surgical time, consequently lowering the risk of complications associated with prolonged anesthesia.

Absence of complications: No early postoperative or post-extraction complications were recorded in the studied patient cohort.

Multifunctionality: The T-tube permits the administration of medications and contrast agents for gastrointestinal tract patency assessment.

A comparative analysis confirmed that the method is reliable and safe, particularly for neonates and infants with extremely low birth weight, where conventional techniques are often ineffective or associated with high risks. In patients with meconium ileus, the T-tube facilitated effective meconium evacuation and medication administration, including N-acetylcysteine. The technique demonstrated particularly favorable outcomes in cases of intestinal atresia, where preserving the maximum intestinal length was crucial in preventing postoperative complications.

CONCLUSION

Enterostomy using a T-tube represents an innovative and effective surgical technique for temporary gastrointestinal decompression in neonates and infants. This approach combines minimal invasiveness, safety, and functionality while reducing complications and accelerating patient recovery. The findings of this study support the adoption of this technique as a preferred option in the management of complex pediatric gastrointestinal conditions.

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