T-tube enterostomy in surgical management of emergency cases in neonate

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Abstract
Exteriorization of intestine may be required in established peritonitis and if questionable distal parts of alimentary tract are found during laparotomy. In these life-threatening situations everting the damaged intestine by stoma formation results in improvement of survival. Another indications for enterostomy are cases of intestinal occlusion caused by inspissated meconium in which the attempts to completely remove it during surgery may be dangerous to intestine. The interesting type of enterostomy is T-tube enterostomy (TTES). Used in selected indications it offers to patients the possibility to avoid the need of further operation for its closure. In this paper we present the application of temporary TTES in different indications in neonates surgically treated for acute abdomen.

Key words: neonate, surgery, acute abdomen, T-tube, enterostomy

Introduction
Enterostomy – ileostomy and colostomy have been used in surgical practice since many years for emergency management. Exteriorization of intestine may be required in established peritonitis and if questionable distal parts of alimentary tract are found during laparotomy. In these life-threatening situations everting the damaged intestine by stoma formation results in improvement of survival [1]. Otherwise there are cases of intestinal occlusion caused by inspissated meconium usually blocking the distal half of gastrointestinal tube and making intraoperative efforts to remove it dangerous [2]. Enterostomy formation in such situations permits cleaning off the abnormal meconium by repeated washouts and enemas and eventually the relief of intestinal obstruction. The exteriorization of intestine performed for acute or chronic intestinal conditions can be lifesaving. But its main disadvantage is the need of staged procedures for closure with prolonged hospitalization or repeated admissions. Another serious inconveniences are stoma associated complications [3]. The use of T-tube installed inside intestine during operation and led out through abdominal wall forms a kind of enterostomy [4]. This T-tube enterostomy (TTES) gives to neonates such advantages as functioning low output stoma concurrently offering the opportunity of avoiding the next operation to stoma closure. Its removal is made by simple maneuver.

In our institution TTES was primarily used in nineties of last century in neonates for surgical treatment of meconium ileus resistant to conservative therapy. The use of TTES has been extended further because of its simplicity and effectiveness in selected cases of necrotizing enterocolitis (NEC), spontaneous intestinal perforation (SIP), inspissated meconium of prematurity (IMP) and recently in intestinal occlusion in middle celosomy (MC): gastroschisis and omphalocele [5-7]. This paper is a preliminary report.

Aim
Presentation of the use of temporary decompressing T-tube enterostomy in different indications in surgically treated neonates for acute abdomen.

Material and methods
A review of authors experience using T-tube enterostomy to treat 75 neonates for abdominal emergency between 2002 and 2010 in Departments of Pediatric Surgery, Traumatology and Urology and Department of Neonatology was performed. Demographic data obtained included age at operation, final diagnosis and type of operation performed. Postoperative outcome, hospital stay and follow-up information were obtained. Database included also any modifications made to the technique of TTES.

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Decision of TTES usage was made during operation. In all cases T-tube enterostomy was performed installing the perpendicular part of T-shaped tube inside intestinal lumen in both afferent and efferent intestinal limbs. Sizes of T-tubes were Ch 8 or Ch 10, depending on size of intestine. Before introduction both fragments of this part of T-tube were trimmed accordingly to bowel dimensions and 2-3 hollows were made on both fragments of this part of tube. The long part of tube was brought out in anastomotic line or through site of perforation or through incision of intestinal wall accordingly to intraoperative situation (Fig. 1).

Fig. 1. T-tube enterostomy. Each limb of intestine is cannulated with perpendicular part of T-tube. Proximal limb is cannulated with longer segment. Intestinal wall is closely secured to abdominal wall.

Fig. 2. Patient in 10th day of life after SILO staged operations for exomphalos. TTES of small intestine performed during second surgery because of insufficient abdominal compartment.

In cases when intestinal resection was performed the mesenteric defect was closed with absorbable sutures. At the end of operation the long part of tube was led out by small stab incision of abdominal wall distally to laparotomy wound and intestine with T-tube inside was brought close to abdominal wall by gentle tube traction and secured with single stitch suture (Fig. 2).

Oro- or nasogastric tube was placed during surgery and served to control gastric residuals. In postoperative course the total parenteral nutrition was started and continued until alimentary tract recovery. Oral intake was started after defecation under control of gastric residuals.

Results

From 2002 to 2010, 56 neonates (median age, 17 days, range from first to 54 days of life) underwent 63 TTES procedures at two university-based pediatric surgery and neonatology departments. Numbers of patients operated on using TTES accordingly to their primary diagnosis were presented in Table 1.

Table 1. Numbers of patients operated on using TTES according to primary diagnosis (NEC – necrotizing enterocolitis, SIP – spontaneous intestinal perforation, MI – meconium ileus, IMP – inspissated meconium of prematurity, MC – middle celosomy: gastroschisis 5 and omphalocele 1 neonates)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Patients</th>
<th>Operations</th>
<th>TTES</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC</td>
<td>28</td>
<td>45</td>
<td>32</td>
<td>71%</td>
</tr>
<tr>
<td>SIP</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>83%</td>
</tr>
<tr>
<td>MI</td>
<td>9</td>
<td>12</td>
<td>10</td>
<td>100%</td>
</tr>
<tr>
<td>IMP</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>71%</td>
</tr>
<tr>
<td>MC</td>
<td>6</td>
<td>18</td>
<td>7</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>90</td>
<td>63</td>
<td>80%</td>
</tr>
</tbody>
</table>

In most of cases T-tube was installed in small intestine. Only in 4 patients operated for NEC or SIP TTES was placed in colon. Duration of TTES depended on recovery of alimentary tract function and ranged from 10 to 39 postoperative days. The output by T-tube was rather small; there were the gases mainly. The amounts of fluent intestinal contents evacuated by T-tube did not exceed 10 ml per 24 hours. Normal stooling was noted late during TTES treatment. In 12 cases patients did not passed the stools. In such situation the x-ray studies with contrast material injected by T-tube were performed. This study permitted to confirm the patency, anatomy and function of intestines. Sometimes it had facilitated stooling. In two patients distal parts of alimentary tract could not be visualized by contrast study. It resulted in diagnosing intestinal occlusion, indicating the need of
surgical revision. These two neonates were operated on: in one of them generalized intestinal adhesions were found during relaparotomy. After release of adhesions the postoperative course was uneventful. The second one developed intestinal stricture after NEC in sigmoid colon and he was treated with resection and end-to-end anastomosis. In all patients no TTES related complications were noted. T-tube removal was done by simple maneuver performed under pharmacologic sedation. Minimal leakage of intestinal contents or stool followed the removal and stopped in several hours. 45 (80%) patients treated with TTES were discharged home, 11 patients died in postoperative course: 8 with NEC, 1 SIP and 2 treated with IMP diagnosis. Median birth weight of deceased neonates was 825 g (range from 530 g to 1060 g), median day of life when surgery was performed was 16th (from 1 to 29) and median postoperative day when they deceased was 2nd (1 to 17). Detailed data of survivors completed with follow-up results will be published later.

**Discussion**

The idea of decompressing the alimentary tract and at same time controlling the recovery of intestinal function is known for many decades. There were many methods and surgical techniques used to obtain this goal. The most frequently one used is definitive enterostomy [1]. In this case the everted intestine is pulled through abdominal wall and secured with stitches in place. Some modifications were used with enterostomy formation: double barreled Mikulicz type, Hartmann diversion, Santulli’s or Bishop-Koop’s chimney ileostomy with intestines anastomosed in pro- or antiperistaltic fashion. These temporary solutions necessitate the next operation needed to enterostomy closure. Apart of that there are many local and general inconveniences and complications related with stoma. Looking for better solution for intestinal decompressing stoma formation the description of T-tube ileostomy in 1981 was found. Harberg et al. used it in the treatment of uncomplicated meconium ileus [4]. In 2000 Mak, Harberg et al. presented their experience in four decades of TTES in surgical treatment of meconium ileus [8]. Its simplicity of performance and advantages made its application in selected indications possible. First: because it is not a time consuming procedure. TTES is performed during laparotomy, intestinal resection and anastomosis or intestinal incision for decompression. The intestinal loop with perpendicular part of T-tube inside is attached to abdominal wall by the use of external stitch so there is no need to oversew it forming the stoma. And second and more important advantage – because there is no need for further operation to its closure. The simple pull-out maneuver is sufficient to its removal.

The initial indication to TTES using was intestinal occlusion due to inspissated, putty-like meconium in cystic fibrosis. There were some published series documenting the use of TTES in other situations than uncomplicated meconium ileus. The authors published their results in the treatment of NEC [5, 6], IMP [7] and NEC and SIP [9]. The use of TTES in abdominal emergency cases in neonates resulted in statistically significant improvement of survival, especially in low- and extremely low birth weight patients. Also Rygl et al. published in 2007 their results with use of TTES in intestinal perforations in 5 extremely low birth weight neonates (body weight ranged from 600 to 900 g, gestational age 25-27 weeks) resulted with survival and no serious surgery related complications.

Emphasizing the advantages of TTES we have to keep in mind its limitations of use. In our opinion it is contraindicated in primary surgical treatment of intestinal atresia, anorectal anomalies or in Hirschsprung’s disease. In surgery of intestinal atresia the primary anastomosis is the recommended technique [11]. In patients with staged treatment of anorectal anomalies and Hirschsprung’s disease the high-grade output stoma is mandatory. In surgical abdominal emergencies of neonate there are also other measures in use. The progress in neonatology, anesthesiology and in pediatric surgery has broadened the use of primary intestinal anastomosis, eliminating indications to exteriorize intestines. At the other end of spectrum of surgical emergencies, TTES seems to be especially inutile in cases of intestinal pannecrosis.

The novel application of TTES presented in this paper was its use in surgical treatment of neonates with giant gastrochisis and omphalocele. In these cases the staged treatment of abdominal wall defects resulted only with moderated augmentation of abdominal compartment incompatible with amounts of eventrated viscera. Another common problem in neonates born with gastrochisis is altered gastrointestinal function manifesting as prolonged inability to oral intake [12]. Its intensity is probably correlated with inflammatory changes of intestines exposed to amniotic fluid in fetal life. The use of TTES in final operations of staged treatment of 5 neonates with gastrochisis and 1 with omphalocele resulted in good outcome.

In conclusion, the current paper provides additional evidence to the available literature that T-tube enterostomy in surgical management of emergency cases in neonate...
Entero-

References


stomy is a safe alternative to other types of entero-
stomies in newborns. This technique is easily applied to
neonatal patient operated on selected emergent abdomi-
nal indications. The important advantage of its use is
avoiding the need of further operation.