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Prolonged feeding difficulties after surgical correction of intestinal atresia: a 13-year experience

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ABSTRACT

Background: Although surgical interventions for intestinal atresia are usually successful, oral feed intolerance could raise in certain cases. The aim of this study was to identify the factors that affect postoperative oral feed by retrospective analysis.
Methods: Neonates meeting the inclusion criteria, who were admitted at our center from 1 January 2000 to June 2013, were enrolled into this retrospective study. Time to establishment of full oral intake (TOI), length of hospital stay (LOS) were outcome measures. Univariate and multiple regression were used.
Results: Overall survival was 85.7%. Mean TOI was 20.4 ± 17.8 days, and mean LOS was 35.6 ± 44.8 days. Multivariate analysis confirmed a significant association with TOI for meconium peritonitis ($P = 0.024$), luminal discrepancy between proximal and distal intestine ($P = 0.038$), number of anastomoses ($P = 0.044$), reportage of immature ganglion in proximal and/or distal intestine ($P = 0.029$), and short bowel syndrome ($P < 0.001$). Prematurity ($P = 0.022$) increased the duration of hospitalization without affecting time to full oral intake.
Conclusions: Meconium peritonitis, luminal discrepancy, number of anastomoses, reportage of immature ganglion, and short bowel syndrome were factors related to prolonged feeding difficulties. We advocate alertness for patients with these factors to reduce postoperative morbidity and treatment costs.

Intestinal atresia is one of the most common causes of intestinal obstruction in neonates, with a reported incidence of approximately 1 in 500 newborns [1]. Although most of these patients do very well after initial surgical correction, some patients need prolonged time to full oral intake, suffer from progressive abdominal distension and require further surgery to treat bowel dilatation and short bowel syndrome [2,3]. In the clinical setting, some infants with adequate bowel length have prolonged parenteral nutritive needs and, contrarily, infants with marginal bowel length do reasonably well. Pediatric surgeons usually call these situations “oral feed intolerance” or “delayed recovery of bowel function”. Although a short gut after initial management is a noted cause of these situations, it is not clear whether other unknown variables have a significant influence on postoperative oral feeding. In the present study, we performed a retrospective review of patients with intestinal atresia treated in our center over the last 13 years, to identify factors associated with postoperative oral feeding intolerance.

1. Materials and methods

The Institutional Review Board of Xinhua Hospital affiliated to Shanghai Jiao Tong University School of Medicine approved this retrospective study. From January 2000 to June 2013, all patients with intestinal atresia who underwent surgical correction at Xinhua Hospital were included in this analysis. The literature indicated that duration of parenteral nutritive support was significantly prolonged in patients with intestinal atresia and gastroschisis or omphalocele [4,5]; therefore, these patients were excluded from the study population to eliminate the extrinsic effects of gastroschisis or omphalocele on postoperative recovery.

Intestinal atresia diagnosis was based on identification of polyhydramnios and/or dilated bowel on antenatal ultrasound, or on plain X-ray demonstration of extreme bowel obstruction and dilated bowel loop postnatally. At arrival, the patients were resuscitated with intravenous fluids, a nasogastric tube was placed to decompress the stomach, and intravenous antibiotics (cefotaxime) and metronidazole were given. After adequate evaluation of other associated congenital anomalies, surgical repair was planned. Atresias were classified on the basis of the Grosfeld modification of the intestinal atresia classification [6]. The management of duodenal atresia at our institution involved a duodeno-duodenostomy, a conservative web excision, and a duodenojejunostomy in the more

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distal types of duodenal atresias. For jejuno-ileal atresias, an end-to-end anastomosis was the most commonly performed procedure, with or without tapering of the dilated proximal bowel in the type I, II, and IIIa atresias. Bowel length conservation was more important in the more complicated type IIIb and type IV atresias. We anastomosed the dilated proximal bowel to the distal apple peel, based on the often tenuous ileo-colic branch, without bowel resection. To avoid development of short bowel syndrome, multiple anastomoses were performed in type IV intestinal atresia. A Bishop–Koop procedure or temporary enterostomy was performed in cases of bowel perforation with significant contamination or meconium peritonitis if there was question of bowel viability, if there was a large disparity in diameter between the proximal and distal bowel part, or in conditions where the intestinal length was short. For colonic atresia, a primary anastomosis was performed for right-sided lesions and a colostomy was performed for left-sided lesions (splenic flexure and beyond).

Oral intake was permitted once the nasogastric aspirate had decreased and bowel function had returned. All neonates were supported with parenteral nutrition until goal calories were achieved by oral intake. We started feeding slowly and increased the rate first and increased concentration of feeds only after goal rates had been achieved and tolerated. Most neonates were fed by gavage until they were mature enough to swallow.

Data were obtained by retrospective review of medical and surgical records. The patient demographics collected included birth weight, gestational age, mode of delivery, sex, maternal age and associated abnormalities. Duration between presentation and surgery, location of atresia, type of atresia, surgical intervention, luminal discrepancy between proximal and distal intestine, number of anastomoses, presence of immature ganglion in proximal and/or distal intestine, occurrence of short bowel syndrome, episodes of sepsis, meconium peritonitis, intestinal necrosis, and surgical re-intervention were recorded. The outcome variables used were time to establishment of full oral intake (TOI) and length of hospital stay (LOS). For the purposes of this study, we defined sepsis as any positive culture that required antibiotic treatment; short bowel syndrome was defined as a small bowel length less than 75 cm for term neonates or less than 50 cm for premature neonates. [7]

1.1. Statistical analysis

The Statistical Package for the Social Sciences (SPSS) 20.0 was used for statistical analysis. A P value less than 0.05 in the analyses was considered statistically significant. Fisher's exact test was used to test the significance of differences in categorical data, while Student's t test and analysis of variance (ANOVA) were used to analyze the significance of differences between continuous variables. TOI and LOS were analyzed using time-to-event analyses, where the event was defined as goal calories achieved by oral intake or discharge from the hospital. Patients who died before the event were censored at the time of death. The analyses of the separate end points were performed in two steps. In the first step, selected independent factors were evaluated using univariate Cox proportional hazards models. In the second step, factors with $P < 0.1$ from the first step were entered into a multivariate Cox proportional hazard model, where the final multivariate model was selected using a backward stepwise approach, consecutively removing the factor with the highest P value at each step until all of the remaining P values in the model were below 0.05.

2. Results

One hundred and thirty five patients were initially identified for review. Four patients were excluded because of gastroschisis (three) or omphalocele (one), and seven patients were excluded because they were not treated for economic reasons. Another five patients were excluded because of incomplete clinical data. In our series, no patients had cystic fibrosis. Overall mortality for the remaining 119 patients was 14.3%, including two patients with duodenal atresia and 15 patients with jejuno-ileal atresia. Of the 17 deaths, most patients had type IIIb/IV atresias or associated anomalies. Eight patients died because of intestinal failure associated with liver disease and uncontrollable sepsis from prolonged total parenteral nutrition dependency; five died from severe associated congenital anomalies, most often of cardiopulmonary origin; two patients died from persistent abdominal distension because of intestinal neuronal dysplasia; 1 death was caused by uncontrollable sepsis after intra-abdominal abscess formation from an anastomotic leak; and one infant had an unexpected death from intraventricular hemorrhage after surgery unrelated to the atresia. Table 1 illustrates the clinical features of the study cohort, grouped according to the location of the bowel obstruction. There were no significant differences among groups with regard to birth weight, gestational age, mode of delivery, sex ratio, maternal age, duration between presentation and surgery, time to initial postoperative oral feeding, TOI and LOS. Infants with duodenal obstruction were most likely to have associated congenital anomalies compared with infants with either jejuno-ileal or colonic obstruction ($P = 0.026$). In comparison, infants with jejuno-ileal obstruction were most likely to have immature ganglion ($P = 0.034$), episodes of meconium peritonitis ($P = 0.012$) and short bowel syndrome ($P < 0.01$) compared with infants with either a duodenal or colonic obstruction.

In neonates with duodenal atresia, duodeno-duodenostomy was the most frequently performed procedure (19 patients). Duodenojejunostomy was performed in five patients and a web excision alone was performed in seven patients. The median length of the remaining small intestine was 146 cm (range, 112–202 cm). In the group of neonates with jejuno-ileal atresia, 59% (48/81) of atresia was noted in the jejunum, 25% (20/81) in the ileum, and 16% (13/81) in both the jejunum and the ileum. Among these patients, 48 underwent resection and end-to-end anastomosis, of which 11 underwent a tapering enteroplasty. Twenty-five patients underwent a Bishop–

Table 1
Clinical characteristics based on location of obstruction.

Clinical feature	Duodenal ($n = 31$)	Jejunal/ileal ($n = 81$)	Colonic ($n = 7$)
Birth weight (g)	2859.94 ± 711.54	3002.92 ± 678.42	3153.48 ± 527
Gestational age (weeks)	36.3 ± 3.1	37.2 ± 3.4	36.9 ± 3.1
Mode of delivery (vaginal/cesarean)	12/19	30/51	2/5
Sex (male/female)	15/16	44/37	3/4
Maternal age (years)	26.8 ± 4.7	27.4 ± 3.3	26.5 ± 3.6
Associated anomalies (n, %)*	24 (77.4%)	29 (35.8%)	2 (28.6%)
Duration between presentation and surgery (hours)	23.6 ± 12.7	25.4 ± 23.5	29.6 ± 25.2
Meconium peritonitis (n, %)*	1 (5.3%)	26 (32.1%)	0
Sepsis (n, %)	5 (16.1%)	24 (29.6%)	1 (14.3%)
Reportage of immature ganglion (n, %)*	0	23 (28.4%)	1 (14.3%)
Short bowel syndrome (n, %)*	0	19 (23.5%)	0
Time to initial postoperative oral feeding (days)	5.8 ± 4.3	6.4 ± 2.9	5.6 ± 2.2
Time to full caloric enteral intake (days)	15.7 ± 9.8	21.63 ± 24.3	13.5 ± 8.6
Duration of hospital stay (days)	32.6 ± 34.8	41.4 ± 48.6	30.5 ± 15.6
Mortality (n, %)	2 (6.5%)	15 (18.5%)	0

Data are presented as mean ± standard deviation.
* Statistically significant difference in P values.