Correlation between Duration of Postoperative Parenteral Nutrition and Incidence of Postoperative Complication in Gastroschisis Patients

Akkrapol Mungnirandr MD*,
Jiraporn Khorana MD*, Ravit Ruangtrakool MD*

** Division of Pediatric Surgery, Department of Surgery, Siriraj Hospital, Mahidol University, Bangkok, Thailand*

Background: *Gastroschisis is the most common neonatal anterior abdominal wall defect. Since all neonatal infants with gastroschisis require total parenteral nutrition (TPN), the authors retrospectively review was to find correlation between duration of TPN and postoperative complications including necrotizing enterocolitis (NEC) and poor feeding in gastroschisis patients. The secondary objective of the present study was to find correlation(s) among length of stay (LOS), gestational age (GA), birthweight(BW), type of operation and postoperative complications.*

Material and Method: *Forty-one gastroschisis patients were reviewed during 2001 to 2006. Postoperative complications were analysed among duration of TPN, LOS, GA,BW,and type of operation. Multiple parameters affecting gastroschisis patients with NEC were compared with those without NEC.*

Results: *There were 21 male and 20 female infants. Normal labour was the major route of delivery (31 in 39 infants). Complications from TPN usage included line infection 5/40, central line requirement 9/40, cutdown requirement 5/40, sepsis 7/40, and TPN leakage 1/40. NEC and poor feeding were 6/40 and 9/40 respectively. In the present study, the Incidence of NEC in gastroschisis was 15%. NEC and poor feeding were significantly correlated with longer TPN administration ($p = 0.0046$ & $p = 0.0042$). Lowest bodyweight of gastroschisis infants occured in the 5.39 ± 3.19 days after birth. Gastroschisis patients with NEC were frequently found with low birthweight and premature ($p = 0.007$ & 0.028). All gastroschisis infants with NEC were delivered vaginally. No correlation was shown between time to first oral feeding and development of NEC ($p = 0.964$).*

Conclusion: *Longer TPN administration time was found in gastroschisis patients with NEC and poor feeding. Duration of NPO after operation did not associate with NEC development. NEC was more likely to occur in gastroschisis patients with low birthweight and prematurity. All of the gastroschisis infants with NEC were born through the vaginal route. Like other newborn babies, gastroschisis patients lose their bodyweight during the first week of life and gradually gain bodyweight thereafter.*

Keywords: *Gastroschisis, Total parenteral nutrition, Necrotizing enterocolitis, Post operative complications*

J Med Assoc Thai 2010; 93 (4): 443-8
Full text. e-Journal: *http://www.mat.or.th/journal*

Gastroschisis is the most common type of neonatal anterior abdominal wall defect. The characteristic is a full-thickness cleft in the abdominal wall, usually to the right of the umbilical insertion. The precise etiology of gastroschisis is unknown. The association of maternal smoking and maternal cocaine use with an increased incidence of gastroschisis supports the theory of a vascular insult to the developing abdominal wall in early gestation. Other possible causes include vascular disruption of the right omphalomesenteric artery, premature atrophy or abnormal persistence of the right umbilical vein and in utero rupture of a hernia of the umbilical cord. Risk factors for gastroschisis include a young maternal age, primiparous, low socioeconomic, cigarette use, use of vasoactive drugs (*e.g.* decongestant pseudoephedrine) early in pregnancy and recreational drug use. Since all neonatal infants with gastroschisis require total parenteral nutrition (TPN), the authors retrospectively reviewed to find the correlation between duration of TPN and postoperative complications, including NEC and poor feeding in gastroschisis patients. The secondary objective of the present study was to find

Correspondence to: Mungnirandr A, Division of Pediatric Surgery, Department of Surgery, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand

correlations among length of stay (LOS), gestational age (GA), birthweight (BW), type of operation and post-operative complications.

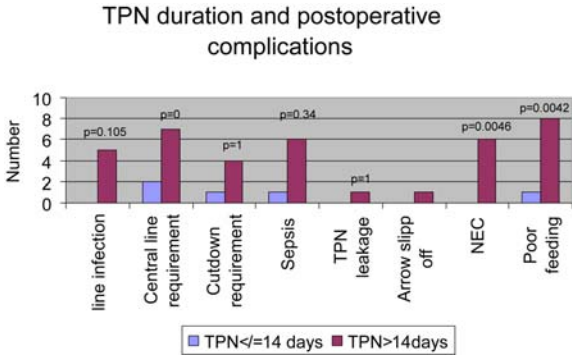
Material and Method

Retrospective review of gastroschisis infants admitted at the Division of Pediatric Surgery, Department of Surgery, Siriraj Hospital between June 2001 and February 2006. Inclusion criteria was all infants newly diagnosed of having gastroschisis admitted at the Division of Pediatric Surgery. Exclusion criteria was infants with previously diagnosed gastroschisis and admitted for reconstructive surgery (remove mesh graft, abdominal wall reconstruction). Parameters collected were length of hospital stay (LOS), birthweight, gestational age, type of operation, time to first oral feeding, time to first milk feeding, duration of TPN, preoperative bodyweight, lowest bodyweight, duration of lowest bodyweight from the first operation, bodyweight at discharge, postoperative complications (Central line requirement, line infection, cutdown requirement, TPN leakage, sepsis, arrow slipp off, necrotizing enterocolitis (NEC), poor feeding). The NEC group included infants who had both poor oral feeding and had abdominal distension, whereas the poor feeding group had no abdominal distension. Duration of TPN ($\leq$ 14 days, > 14 days), LOS (14-20 days, 21-164 days), gestational age (< 36 wk, $\geq$ 36 wk), birthweight ($\leq$ 2000 g, > 2000 g), type of delivery (normal labour and cesarean section) and type of operation(primary fascial closure and silocoverage) in both groups were compared concerning post-operative complications. Finally, gastroschisis patients who developed NEC were com-pared with the patients who did not have NEC in multiple parameters (birthweight, mode of delivery, type of operation, time to first oral feeding, time to first milk feeding, duration of TPN, preoperative body weight, lowest bodyweight after birth, day of the lowest bodyweight after the first operation, bodyweight at discharge and length of stay). Statistical analysis for Fig. 1, 2 and Table 1-3 was Chi-square test. Statistical analysis for Table 4 is independent t-test. P-value $\leq$ 0.05 was considered significant.

Results

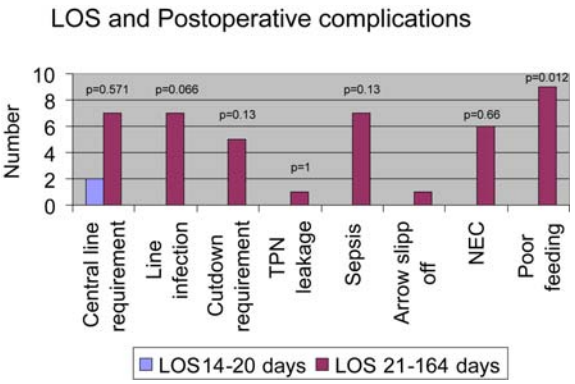
There were 21 male and 20 female infants. All of the infants were first operated on during the first 2 days of life. 21 infants (51.22%) were born in Siriraj Hospital whereas 20 infants (48.78%) were referred from outside the Hospital. Thirty one mothers received antenatal care (81.58%). Prenatal ultrasonography diagnosed 7 infants with gastroschisis, whereas other infants were diagnosed from bowel obstruction. Con-cerning route of delivery, normal labour was the major route (31 of 39 infants). Seven patients were prenatally diagnosed of having gastroschisis, Cesarrean section was the major route of delivery (4 of 7 infants). Mean birthweight of gastroschisis infants was 2308.90 $\pm$ 461.46 g. Mean gestational age was 35.08 $\pm$ 2.98 wk.

Primary fascial closure operations were performed in 24 infants. Silo sac coverage operations were accomplished in 13 infants. Silo sac coverage with ileostomy operation was performed in one case, while primary fascial closure with double end enterostomy operation was performed in another one.



TPN = total parenteral nutrition

Fig. 1 Comparision of postoperative complications in infant received TPN $\leq$ 14 days and > 14 days



LOS = length of stay

Fig. 2 Complications of TPN in infants with length of stay (LOS) $\leq$ 20 days and > 20 days

Table 1. Birthweight and postoperative complications

	BW ≤ 2000 g Number of patients/ Total number of patients	BW > 2000 g Number of patients/ Total number of patients	p-value
Line infection	1/11	4/24	1.000
Cutdown requirement	2/10	3/25	0.627
Poor feeding	3/9	6/22	1.000
Septicemia	1/11	5/23	0.648
TPN leakage	0/12	1/27	1.000
Central line requirement	1/11	4/22	0.530

* Number of patients not equal to 41 due to missing data
TPN = total parenteral nutriton, BW = bodyweight in gram (g)

Table 2. Gestational age and postoperative complications

	GA < 36 wk Number of patients/ Total number of patients	GA ≥ 36 wk Number of patients/ Total number of patients	p-value
Line infection	2/16	1/17	1.000
Cutdown requirement	4/14	0/18	0.104
Poor feeding	6/12	3/15	0.443
Septicemia	3/15	1/17	0.603
Central line requirement	2/16	3/13	0.285

* Number of patients not equal to 41 due to missing data
GA = gestational age in week (wk)

Table 3. Type of operation and postoperative complications

	Primary fascial closure Number of patients/ Total number of patients	Silo coverage Number of patients/ Total number of patients	p-value
Line infection	1/22	4/10	0.057
Cutdown requirement	1/22	2/12	0.544
Poor feeding	3/20	3/11	0.653
Septicemia	2/21	2/12	0.625
Central line requirement	2/21	3/9	0.078
TPN leakage	0/23	1/13	0.378

* Number of patients not equal to 41 due to missing data
TPN = total parenteral nutriton, BW = bodyweight in gram (g)

Average intubation time from the first operation was 3.89 ± 3 days. Average intubation time from the second operation was 3.125 ± 2.3 days. Average time from the first to the second operation was 6.36 ± 2.54 days. Average duration of NPO was 7.92 ± 4.14 days for first oral feeding and 9.95 ± 5.94 days for the first milk feedings. Average duration of TPN was 16.61 ± 7.82 days. Average length of stay was 32.88 ± 28.87 days.

Mean preoperative bodyweight was 2,327.58 ± 473.46 g, mean postoperative bodyweight was 2,568.13 ± 547.02 g. Average lowest bodyweight

Table 4. Comparision of multiple parameters between NEC and non-NEC gastroschisis infants

	NEC (mean ± SD)	No. NEC (mean ± SD)	p-value
Body weight (g)	1,861.67 ± 306.23	2,399.85 ± 440.4	0.007
Gestational age (wk)	31.00 ± 4.00	35.97 ± 1.956	0.028
Normal labour	6/6	24/32	0.03
Type of operation	Primary fascial closure 3 Silosac coverage 2 Primary fascial closure with small bowel resection with double end enterostomy 1	Primary fascial closure 20 Silosac coverage 10 Abdominal wall closure (Dacron patch) 1 Primary fascial closure with double barrel colostomy 1	
Time to first oral feeding (day)	8.00 ± 4.90	7.91 ± 4.10	0.964
Time to first milk feeding (day)	11.00 ± 8.22	9.79 ± 5.67	0.676
Duration of TPN (day)	25.80 ± 6.98	15.21 ± 7.03	0.03
Preoperative bodyweight (g)	1,909.17 ± 292.51	2,401.41 ± 292.51	0.017
Lowest bodyweight (g)	1,778.33 ± 360.98	2,236.72 ± 360.98	0.029
Date of the lowest bodyweight (from the first operation)	7.00 ± 4.62	5.10 ± 2.86	0.253
Bodyweight at discharge (g)	2,167.50 ± 383.79	2,638.82 ± 544.96	0.05
Length of stay (day)	46.17 ± 20.49	30.53 ± 29.72	0.211

* NEC = necrotising enterocolitis, TPN = total parenteral nutrition

was 2,166.21 ± 456.91 g. at 5.39 +/- 3.19 days from first operation.

Complications from TPN usage included line infection (5/40), central line requirement (9/40), cutdown requirement (5/40), sepsis (7/40), and TPN leakage (1/40). NEC and poor feeding were 6/40 and 9/40, respectively.

The results of postoperative complication including NEC and poor feeding receiving TPN less than 14 days and more than 14 days are shown in Fig. 1.

Discussion

This retrospective study was primarily aimed to determine the relationship between duration of TPN and complications of TPN administration. From Fig. 1, except for NEC and poor feeding, there was no statistical difference between duration of TPN and postoperative complications. Normally NEC and poor feeding lead to prolonged TPN usage. Longer TPN administration time and longer LOS shoud be expected (Fig. 1, 2).

For secondary objectives, the authors tried to determine the relationship between gestational age, birthweight, type of operation and postoperative complications. However, the authors could not find any relation among them (Fig. 2, Table 1-3). Concerning type of operation and postoperative complication (Table 3), although there was no statistical significance, there was some difference in line infection and central line requirements between the two groups (p = 0.057 & p = 0.078 respectively). Line infection in the LOS 14-20 days group was somewhat different from that of the LOS 22-164 days group, although the difference did not reach the level of statistical significance (Fig. 2). The results may imply that the greater duration of hospital stay, the more chance of line infection and central line requirement or vice versa.

The incidence of NEC after repair of abdominal wall defect was previously reported between 9-18.5%[1,2]. The present study showed prevalence of NEC in 6 of 40 patients(15%) and the authors also found that low birthweight correlated with NEC (Table 4). The results corresponded with one other study[3]. From the previous study, there was no significant correlation between prematurity or low Apgar score and NEC[1]. However, from the present study, the authors found significant correlation between gestational age and NEC development. Gastroschisis patients with NEC had lower birthweight and were more premature than gastroschisis patients without NEC (p = 0.007 & p = 0.028, respectively). The bodyweight of gastroschisis infants reached minimal level between day 5-6 after

operation. It is the same duration as normal newborn babies that lose their bodyweight within the first week of life. Bodyweight of gastroschisis patients with NEC could not catch up with the other group at discharge ($p = 0.05$).

Concerning type of delivery, no previous study showed about correlation between NEC and type of delivery. The authors, surprisingly, found that all of the gastroschisis patients with NEC were born vaginally ($p = 0.03$). Because both low birthweight and prematurity were found in the NEC group, premature labour may be an explanation of this result. No bowel injury or mortality after vaginal delivery was found in gastroschisis patients in the present study.

Early enteral feeding in gastroschisis patients was encouraged in many studies[4-6]. There was no statical difference between time to first oral and milk feeding and NEC development in our gastroschisis patients (Table 4). This result may imply that early enteral feeding does not increase the risk of NEC in gastroschisis infants.

In summary, the authors retrospective review showed that gastroschisis infants with NEC and poor feeding had longer TPN administration time. There was some correlation between some postoperative complications (line infection and central line requirement) and LOS, but the difference did not reach statistically significant level. Duration of NPO after operation did not associate with NEC development. NEC was more likely to develop in gastroschisis patients with prematurity and low birthweight. All of the gastroschisis infants with NEC were born vaginally. Like other newborn babies, gastroschisis patients lost their bodyweight during the first week of life and gained bodyweight thereafter. Bodyweight at discharge in the gastroschisis patients with NEC group could not catch up with that of the other group without NEC.

Acknowledgements

The authors wish to thank Mr. Nattwut Ekapirat and Ms.Patcharaporn Krinara (Statisticians) for data analysis of this work.

References

1. Oldham KT, Coran AG, Drongowski RA, Baker PJ, Wesley JR, Polley TZ Jr. The development of necrotizing enterocolitis following repair of gastroschisis: a surprisingly high incidence. J Pediatr Surg 1988; 23: 945-9.
2. Eggink BH, Richardson CJ, Malloy MH, Angel CA. Outcome of gastroschisis: a 20-year case review of infants with gastroschisis born in Galveston, Texas. J Pediatr Surg 2006; 41: 1103-8.
3. Charlesworth P, Njere I, Allotey J, Dimitrou G, Ade-Ajayi N, Devane S, et al. Postnatal outcome in gastroschisis: effect of birth weight and gestational age. J Pediatr Surg 2007; 42: 815-8.
4. Sharp M, Bulsara M, Gollow I, Pemberton P. Gastroschisis: early enteral feeds may improve outcome. J Paediatr Child Health 2000; 36: 472-6.
5. Quirk JG Jr, Fortney J, Collins HB II, West J, Hassad SJ, Wagner C. Outcomes of newborns with gastroschisis: the effects of mode of delivery, site of delivery, and interval from birth to surgery. Am J Obstet Gynecol 1996; 174: 1134-8.
6. Singh SJ, Fraser A, Leditschke JF, Spence K, Kimble R, Dalby-Payne J, et al. Gastroschisis: determinants of neonatal outcome. Pediatr Surg Int 2003; 19: 260-5.

ความสัมพันธ์ระหว่างระยะเวลาการให้สารอาหารทางหลอดเลือดดำ และอุบัติการณ์ของการเกิดภาวะแทรกซ้อนในผู้ป่วยโรค gastroschisis

อัครพล มุ่งนิรันดร์, จิราภรณ์ โกรานะ, รวิศ เรืองตระกูล

วัตถุประสงค์: *เพื่อศึกษาความสัมพันธ์ระหว่างระยะเวลาการให้สารอาหารทางหลอดเลือดดำ กับภาวะแทรกซ้อนหลังผ่าตัดรวมถึงอุบัติการณ์ของการเกิดโรคลำไส้ตาย (necrotizing enterocolitis) เพื่อหาความสัมพันธ์ภาวะแทรกซ้อนหลังผ่าตัดกับระยะเวลาการอยู่โรงพยาบาล, อายุครรภ์, น้ำหนักตัวของผู้ป่วย และประเภทของการผ่าตัด*

วัสดุและวิธีการ: *เก็บข้อมูลย้อนหลังในผู้ป่วย gastroschisis ตั้งแต่ปี พ.ศ. 2544-2549 โดยเปรียบเทียบภาวะแทรกซ้อนหลังผ่าตัดกับระยะเวลาการให้สารอาหารทางหลอดเลือดดำ, ระยะเวลาการอยู่โรงพยาบาล, อายุครรภ์, น้ำหนักตัวของผู้ป่วย และประเภทของการผ่าตัดในการนี้ได้ทำการวิเคราะห์เปรียบเทียบตัวแปรเหล่านี้ในกลุ่มผู้ป่วย gastroschisis ที่มีและไม่มีโรคลำไส้ตายร่วมด้วย*

ผลการศึกษา: *มีทารกเพศชาย 21 คน และทารกเพศหญิง 20 คน ภาวะแทรกซ้อนจากการให้สารอาหารทางหลอดเลือดดำประกอบด้วยการติดเชื้อทางหลอดเลือดดำ (5/40), ความจำเป็นต้องให้สารอาหารทางหลอดเลือดดำใหญ่ (9/40), ติดเชื้อในกระแสเลือด (7/40), สายให้อาหารทางหลอดเลือดดำรั่ว (1/40), และลำไส้ตาย (6/40) ไม่พบความแตกต่างที่มีนัยสำคัญทางสถิติระหว่างระยะเวลาการให้สารอาหาร ทางหลอดเลือดดำกับภาวะแทรกซ้อนหลังจากการผ่าตัดส่วนใหญ่ อย่างไรก็ตามพบว่าโรคลำไส้ตายมีความสัมพันธ์กับ ระยะเวลาที่นานของการให้อาหารทางหลอดเลือดดำ โดยผู้ป่วยที่เป็นโรคดังกล่าวจะมีน้ำหนักตัวที่น้อยกว่า และมักจะคลอดก่อนกำหนด ผู้ป่วย gastroschisis ที่เป็นโรคลำไส้ตายทั้งหมดคลอดวิธีปกติไม่พบมีความสัมพันธ์ระหว่างระยะเวลาการเริ่มให้อาหารทางปากหลังผ่าตัดกับการเป็นโรคลำไส้ตายในผู้ป่วย gastroschisis*

สรุป: *พบว่าการให้อาหารทางหลอดเลือดดำในผู้ป่วย gastroschisis มีภาวะแทรกซ้อนรวมถึงโรคลำไส้ตายร่วมด้วยได้ ไม่พบความแตกต่างที่มีนัยสำคัญทางสถิติระหว่างระยะเวลาการให้สารอาหารทางหลอดเลือดดำ(TPN $\leq$ 14 วัน: TPN > 14วัน) กับภาวะแทรกซ้อนหลังจากการผ่าตัดยกเว้นการเกิดโรคลำไส้ตาย ระยะเวลาการเริ่มให้อาหารทางปากหลังผ่าตัดไม่มีความสัมพันธ์กับการเกิดโรคลำไส้ตาย ผู้ป่วยที่เป็นโรคลำไส้ตายมักจะเป็นกลุ่มที่น้ำหนักตัวน้อยและคลอดก่อนกำหนดผู้ป่วย gastroschisis ทุกคนที่เป็นโรคลำไส้ตายคลอดโดยวิธีปกติ*