ISSN 1009 – 3095 *Journal of Zhejiang University*(*SCIENCE*) V.2, No.3, P.329 – 332, July – Sep., 2001
http://www.chinainfo.gov.cn/periodical; http://www.zju.edu.cn;
http://lib.zju.edu.cn/English; http://www.zjupress.com

SEVERE SHORT-BOWEL SYNDROME AFTER TOTAL SMALL BOWEL RESECTION

CHEN Li(陈　力)[1], WANG Bin(王　彬)[1], LIU Jian(刘　坚)[2], DAI Ning(戴　宁)[3]

([1] *The Second Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou 310009, China*)

([2] *Hangzhou first People's Hospital, Hangzhou 310006, China*)

([3] *Sir Run Run Shaw Hospital, College of Medicine, Zhejiang University, Hangzhou 310016, China*)

Received Dec.6, 2000; revision accepted Feb.28, 2001

Abstract: Extensive intestine resection may result in short bowel syndrome (SBS) which is difficult to manage. This study reports a rare SBS case in a 6-year-old boy following resection of total jujunoileum and right colon. Our experience in 4-years follow-up and literature reports on SBS is discussed. The purpose of this study was also to evaluate the nutritional absorptive capacity and intestinal adaptation. In the 15th postoperative month, barium x-ray study showed a significantly extended and enlarged duodenum and colon. The intestinal transit time was prolonged to 22 hours. The absorption rate of palmic acid, glycine and D-xylose had increased from 57%, 50% and 4% respectively in the 15th postoperative month, to 75%, 65% and 6% in the 2nd postoperative year. His absorptive capacity allowed him normal oral feeding and normal school life. Our data confirmed the reports of the colon as an energy-salvage organ, and suggested that it may have some capacity to absorb long-chain fatty acids and amino acids.

Key words: short bowel syndrome(SBS), postoperative complications, intestine
Document code: A **CLC number:** R544.1

INTRODUCTION

Short bowel syndrome leads to significant morbidity and is potentially lethal, especially when intestinal loss is extensive and when the patient is very young (Kurkchubasche et al., 1993; Weber et al., 1991; Vanderhoof et al., 1997). Despite the advances in medical and surgical technique and the development of home parenteral nutrition, the mortality continues to be high in infants and children. For pediatric patients, with less than 10 cm small intestine beyond the duodenum was not compatible with long survival and intestinal adaptation (Kurkchubasche et al., 1993). Furthermore, little information is available on the long-term outcome of survivors. In China, only 1 case of adult patient who underwent total small bowel resection was reported to be successful (Jin et al., 1993). We describe the successful survival of a child for 4 years after resection of total jujunoileum and right colon. This paper also presents a review of the literature on the outcome of SBS in children over the last 15 years.

PATIENT AND METHODS

A 6-years-old child with intestinal obstruction was admitted to hospital in July 1996. He underwent a laparotomy and was found to have a tight volvulus and extensive bowel gangrene. The fourth part of the duodenum, the jejunum, ileum and right colon were resected. A duodenal transverse colonstomy was performed, leaving about 15 cm remnant duodenum.

After the operation, the patient was supported initially with total parenteral nutrition. Oral feeding was started after one month. He suffered however from severe short bowel syndrome with weight loss of 2 kg and 6 – 8 watery faeceses per day.

He was referred to our university hospital. On physical examination on admission, he weighed 22 kg and lacked subcutaneous tissue. A parenteral nutrition solution consisting of 7% amino acid, 10% to 50% dextrose, 20% emulsified fat, vitamins and electrolytes was administered, providing 1.5 to 1.7 g/kg per day of crystalline animo acids and 146 to 208 kJ/kg per day of calories. Meanwhile he took a normal soft diet

including rice, wheat flour, flesh, egg, etc. After 2 months in the hospital, he was discharged. Home-based parenteral nutrition 5 times a week was continued to make up for the deficit of enteral nutrition. The patient was regularly followed up for 4 years, and hospitalized at 6 months interval for optimization of nutritional support. He was given two 2-week courses of growth hormone and glutamine. The suggestion of intestinal transplantation was refused by his family.

During the hospitalization and follow-up, clinical data on weight, height, defecation, blood routine and biochemistry, etc. were collected. The intestinal function was assessed in the 15th and 24th postoperative month by nonradioactive ^{13}C-palmic acid breath test with measurement of expired $^{13}CO_2$ and nonradioactive ^{15}N-glycine absorption test followed by measurement of enrichment of blood ^{15}N-glycine. In addition, D-xylose absorption test was conducted every time he was hospitalized. A barium G.I. series was taken 2 and 15 months after the operation.

RESULTS

After the treatment, the patient's condition became stable. He gradually ingested from 30% to 60% of his total calorie requirement and received the remainder intravenously. His subjective and objective wellbeing was good. Although the child was thin, the nutritional parameters were kept relatively normal. The defecation was reduced to 1 – 2 times per day. He began to gain weight 4 months after the operation. In the last 4 years he gained 9 kg in body weight and 14 cm in height (Table 1), and was above the 50th percentile for the developmental and intellectual level for his age. He attended a regular school as well. Fifteen months after the operation, barium x-ray study showed a significantly extended and enlarged duodenum and colon (Figs. 1 – 3). The intestinal transit time was prolonged to 22 hours. Three episodes of catheter sepsis occurred in the last 4 years. He was then successfully treated with antibiotics and vein catheter change. Transient liver dysfunction and hyperbilirubinemia for 2 weeks was observed 18 months after the operation. There were no other long-term complications related to parenteral nutrition.

Fig. 1 Duodenal right transverse colonstomy
Barium x-ray study 2 months after the operation showed the lack of jujunoileum and right colon

Table 1 Nutritional status of the patient after the operation (months)

Time	0	Mon4	Mon6	Mon12	Mon18	Mon24	Mon36	Mon48
Weight(kg)	20	22	24.5	22.5	25	24	26.5	29
Height(cm)	122	124.5	125	125.5	126	129	130	136
Hb(g/L)	101	105	114	111	115	111	112	115
Albumin(g/L)	45.0	37.4	32.4	35.0	38.6	30.3		

The absorption rate of palmic acid and glycine was 57% and 50% respectively in the 15th postoperative month, then 75% and 65% respectively in the 2nd postoperative year. The peak $^{13}CO_2$ excretion and enrichment of blood ^{15}N-glycine occurred 3 hours after oral administration of the traces when the G.I. series showed the ingested barium passed the duodenum and stayed in the colon. D-xylose absorption test showed an increasing but low rate for intestinal

D-xylose absorption. The absorption rate was from 4% to 12% in the first 2 years.

Fig.2 The adaptation in duodenum
Barium x-ray study 15 months after the operation showed a significantly distended duodenum

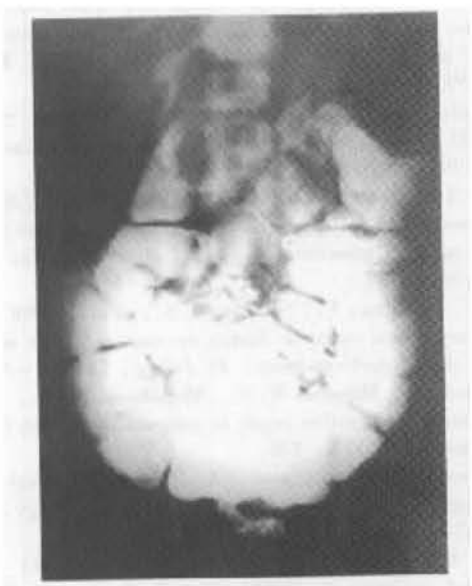

Fig.3 The adaptation in colon
Barium x-ray study 15 months after the operation showed a significantly extended colon

DISCUSSION

Shortbowel syndrome (SBS) is a complex condition resulting from massive surgical resection of the intestinal tract. The morbidity and mortality in SBS are directly related to the length, site, function and adaptive capacity of the remaining small bowel (Kurkchubasche et al., 1993). Nutritional and hydration status are difficult to maintain without the provision of specialized nutrition support when more than 75% of the small intestine has been resected although some therapeutic advances have improved survival in patients with short-bowel syndrome (Kurkchubasche et al., 1993; Weber et al., 1991; Vanderhoof et al., 1997). Morbidity and mortality are also significantly increased in pediatric patients (Weber et al., 1991; Vanderhoof et al., 1997; Grosfeld et al., 1986). Several nontransplantation surgical procedures have a role in improving intestinal function in short-bowel syndrome, either to decelerate intestinal transit or to increase the area of intestinal absorption (Grosfeld et al., 1986). However these procedures usually result in clinical improvement usually in properly selected patients. Due to inconsistent results so far these surgical therapies of the short bowel syndrome cannot be recommended for routine use (Georges et al., 1994; Huskisson et al., 1993). Smallbowel transplantation is a clinical possibility for short bowel syndrome, but there is still a high-risk proportion (Vanderhoof et al., 1997; Deltz-E, 1993; Kocoshis et al., 1993). Also for tranplantation, maintaining optimal nutritional and metabolic support until maximum bowel adaptation can occur is the top priority of therapy. Long-term survival after massive intestinal resection is now possible with parenteral nutritional support. The combined administration of growth hormone, glutamine, and a modified diet can enhance nutrient absorption from the remnant bowel after massive intestinal resection. This therapy may offer an alternative to long-term dependence on total parenteral nutrition for patients with severe short bowel syndrome (Booth, 1994; Byrne et al., 1995).

Currently, the lower limit of the jujunoileum length for survival and intestinal adaptation can be expected to be 10 – 25 cm (Kurkchubasche et al., 1993). This is still rare report of a child, in our case, who sustained long-term survival after resection of the total jejunuoileum and left colon. Our case also represented an unusually rapid adaptation response of the duodenum and colon both in morphology and function, which de-

serves to be further studied.

For patients with short bowel syndrome, the remaining gut has large capacity for adaptation that has been documented to occur from months to more than 2 years following resection (Weber et al., 1991; Booth, 1994), depending on whether the ileocaecal valve is present (Booth, 1994). This adaptation is achieved by the interaction of various factors. Oral feeding is perhaps the most important means for promoting intestinal adaptation (Georgeson, 1994). After initial total parenteral nutrition, enteral feeding should be instituted as soon as the patient stabilizes, usually after 2 to 4 weeks (Levy et al., 1988). In rats with massive intestinal resection, a polymeric diet can contribute to a better intestinal mucosa regeneration than a monomeric diet (Lai, 1989). Our patient took normal soft food that covered more than 60% of the daily requirements. The major adaptive change in this patient was the extended remnant intestine and the decreased intestinal flow rate, related to delayed gastroduodenal emptying. He had maintained his body development while the quantity of perenteral nutrition had not been increased, a sign that the intestinal adaptation had continued in the last 4 years. Colonic digestion has been reported to salvage up to 3 – 4 MJ/day, approximately 50% of the daily requirements, in short-bowel patients (Jeppeson et al., 1998). The digestive processes are completed by the bacterial fermentation of malabsorbed carbohydrates and protein to short-chain fatty acids, which are absorbed and supply energy. Therefore a high-carbohydrate diet can result in increased absorption of energy (Nordgaard et al., 1994). Our case confirmed the reports of the colon as an energy-salvage organ, and showed that the colon may also have some capacity to absorb long-chain fatty acids amino acids. It still must be determined what is the exact mechanism of absorption in the duodenum and colon after total resection of the jujunoileum, and how long the adaptation process will last.

References

Booth, I.W., 1994. Enteral nutrition as primary therapy in short bowel syndrome. *Gut supplement (Suppl.)*, **1**: 69 – 72.

Byrne, T. A., Persinger R. L., Young, LS. et al., 1995. A new Treatment for patients with short-bowel syndrome: Growth hormone, glutamine, and a modified diet. *Ann Surg*, **222**: 243 – 255.

Deltz, E., 1993. Development and perspectives of small intestine transplantation. *Langenbecks Arch Chir*, **378**: 262 – 264.

Georgeson, K., Halpin, D., Figueroa, R., et al., 1994. Sequential intestinal lengthening procedures for refractory short bowel syndrome. *J Pediatr Surg*, **29**: 316 – 320.

Grosfeld, J. L., Rescoria, F. J., West, K. W., 1986. Short bowel syndrome in infancy and children. *Am J Surg*, **151**: 41 – 46.

Huskisson, L. J., Brereton, R. J., Kiely, E. M., 1993. Spitz-L: Problems with intestinal lengthening. *J Pediatr Surg*, **28**: 720 – 732.

Jeppesen, P. B., Mortensen, P. B., 1998. Significance of a preserved colon for parenteral energy requirements in patients receiving home parenteral nutrition. *Scand J Gastroenterol*, **33**: 1175 – 1179.

Jin, D. Y., W, Z. H., Huang, D. N., et al. 1993. Protein metabolism after total small bowel resection. *Chin J Surg*, **31**: 49 (in Chinese, with English abstract).

Kocoshis, S. A., Tzakis, A., Todo, S., et al. 1993. Pediatric liver transplantation. History, recent innovations, and outlook for the future. *Clin Pediatr Phila*, **32**: 386 – 392.

Kurkchubasche, A. G., Rowe, M. I., Smith, S. D., 1993. Adaptation in short- bowel sytndrome: reassessing old limits. *J Pediatr Surg*, **28**: 1069 – 1071.

Lai, H. S., Chen, W. J., Chen, K. M., 1989. Effects of monomeric and polymeric diets on small intestine following massive resection. *Taiwan I Hsueh Hui Tsa Chih*, **88**: 982 – 988.

Levy, E., Frileux, P., Sandrucci, S., et al., 1988. Continous enteral nutrition during the early adaptive stage of the short bowel syndrome. *Br J Surg*, **75**: 549 – 553.

Nordgaard, I., Hansen, B. S., Mortensen, P. B., 1994. Colon as a digestive organ in patients with short bowel. *Lancet*, **343**: 373 – 376.

Vanderhoof, J. A., Langnas, A. N., 1997. Short-bowel syndrome in children and adults. *Gastroenterology*, **113**: 1167 – 1778.

Weber, T. R., Tracy, T., Connors, R. H., 1991. Short bowel syndrome in children. *Arch Surg*, **126**: 841 – 846.