

# Small Steps, Big Leap: Physiological Feeding Regime Helps Infant with Ultra-short Bowel Syndrome to Achieve Full Enteral Autonomy Early

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## Abstract

Aggressive and continuous feeding regimes for children with short bowel syndrome (SBS) have been recommended in literatures for decades. Adequate bowel rest has not been addressed for bowel adaptation in literature previously. Our patient is a term infant girl with ultra short bowel after massive small bowel resection for volvulus on the third day of life. When on aggressive feeding regimen, she developed rectal bleeding and shock. After bowel rest, milk feeding was resumed at a volume corresponding to her remnant bowel length. She was on small bolus feeds via syringe every 2 hours. The advancement interval was according to the intestinal mucosal turnover time. The total nutrient given by oral and intra-venous routes were as for usual infant, about 100 kcal/kg/day. She achieved full enteral autonomy by 9.5-month-old with a body weight of 8.54 kg. She was discharged by 10.5-month-old. In our physiological feeding regime, tube feeding, prokinetics, anti-diarrheal agents, cyclic antibiotics, probiotics, hormonal therapy, or repeated bowel operations were not needed. Different from the usual recommendations for infants with SBS, excessive milk feeding was not needed all along and even beyond enteral autonomy.

## Key words

Children; Enteral nutrition; Feeding methods; Parenteral nutrition; Short bowel syndrome

## Introduction

In the management of short bowel syndrome (SBS) in children, it remains a matter of debate on how to feed these

children. Intermittent feeding is more physiological but continuous feeding had the advantage of providing more energy and better weight gain in an old reference.<sup>1</sup> Whether adequate bowel rest is necessary has not been thoroughly studied. There are literatures suggesting aggressive feeding regimes with continuous enteral tube feeding, different sorts of medications and bowel operations to manage these children.<sup>2</sup> Though there was reported improvement in survival on these feeding regimes, the patients would have to take many different medications and underwent repeated surgical operations. This may impair the development of these children, and likely will put stress on the children and their family members not only physically, but also psychologically, socially and financially. Rest is important for child growth. Our patient with ultra-short bowel syndrome initially received aggressive feeding regimes after bowel resection, but she developed rectal bleeding and shock afterwards. Enteral feeding was stopped. With parents' consent, we re-fed her physiologically, starting with an amount of milk based on her remnant bowel length,<sup>3</sup> and by small bolus via syringe every 2 hours. We stepped up her feeds slowly, according to the intestinal mucosal

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turnover rate,<sup>4</sup> and in small amount. The total nutrient, enteral and parenteral, given to her was the same as normal infants.<sup>5</sup> Different from the usual recommendation for patients with SBS, no excessive nutrient was given to our patient.<sup>4,5</sup>

## Case Report

Our index patient is a Pakistan girl born by spontaneous vaginal delivery at gestational age of 39 weeks and 6 days with a birth weight of 3.8 kg. She presented at the 24th hour of life with massive fresh rectal bleeding. Gastric aspiration yielded bile stained fluid. Abdominal X-ray showed absence of bowel gas. She was transferred to a paediatric surgical centre for laparotomy. She had midgut malrotation and volvulus of the small bowel, causing massive infarction of the small bowel extending from the distal duodenum to the terminal ileum. Massive small bowel resection was performed. The third part of the duodenum was directly anastomosed to the remaining 12 cm of terminal ileum. The ileocaecal valve and colon were preserved.

In the post-operative period, she was put on protein hydrolysed formula and conventional feeding regime with rapid advancement. Total parenteral nutrition was also given. On day 24 of life when she was referred back to our hospital, she was on oral feeding 15 ml of milk every 2 hours. By day 27 of life, when she took 22.5 ml of milk every 2 hours, she developed watery diarrhoea, which did not respond to reduction of feeds back to 15 ml every 2 hours. On day 40 of life, she developed Hickman catheter related *Klebsiella pneumoniae* bacteraemia, shock, and rectal bleeding. Antibiotics were started and enteral feeding was stopped.

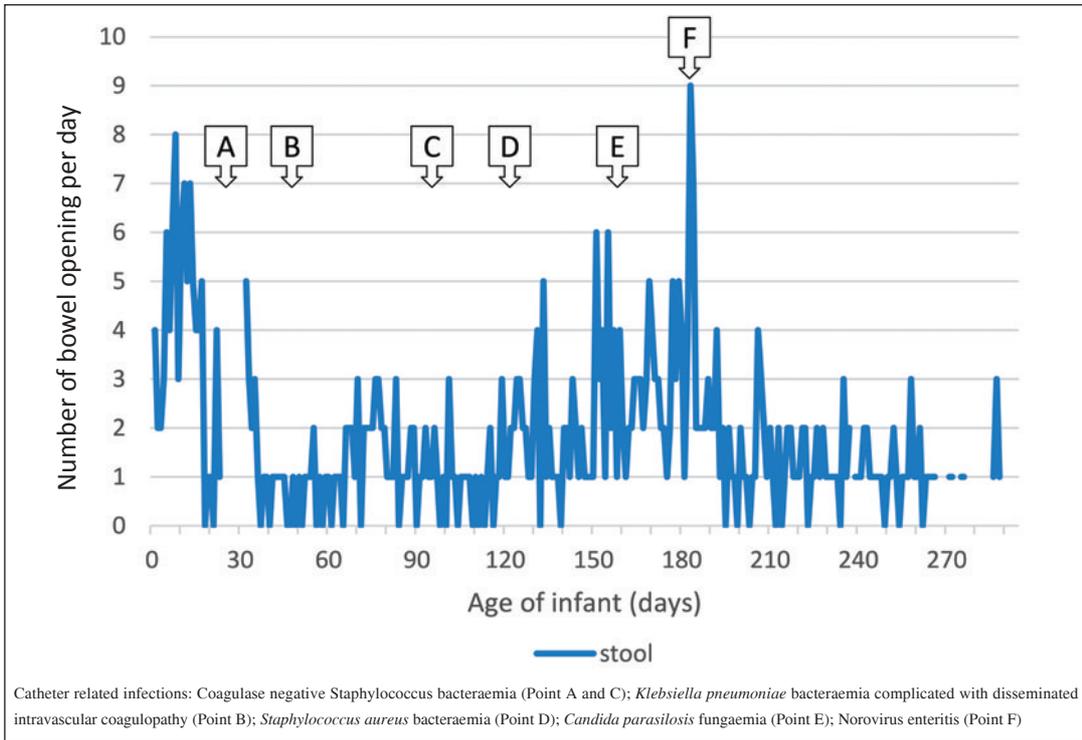
A new physiological feeding regime was discussed with the parents. On day 50 of life, enteral feeding was resumed with amino acid based formula [Neocate, Nutricia]. Milk was resumed at a volume corresponding to her remnant small bowel length. The small bowel length of a normal full term newborn was 250 cm,<sup>3</sup> and our patient's small bowel was 12 cm long, i.e., about 5% remained after the operation. Her body weight was 4.37 kg. We assumed that her normal milk intake was 150 ml/kg/day, i.e. about 655 ml per day; or, 55 ml milk per meal, 12 meals per day. As she had only 5% of small bowel remaining inside her body, we gave her 3 ml milk per meal, i.e. about 5% of her daily requirement orally. The milk was given via syringe at 8am, 10am, noon, 2pm, 4pm, 6pm, 8pm, 10pm, mid-

night, 2am, 4am, and 6am. We stepped up the amount of milk feeding every 5 days, according to intestinal mucosal turnover time,<sup>4</sup> and in an amount less than the initial feeding amount per meal, i.e., advanced her feeding by 2 ml of milk per feed every 5 days. The amount of milk feeding was stepped up slowly according to this pattern. Feeding would be stepped up only if her stool not watery, bowel opening less than 6 times per day and no rectal bleeding (Figure 1). Parenteral nutrition was used to support the rest of her nutrition. The total energy given to her was 100 kcal/kg/day. Thiamine 1 mg/kg/day was given as prophylaxis for D-lactic acidosis during hospitalisation.<sup>6</sup> Fish oil based lipid emulsion was used to treat her parenteral nutrition associated cholestasis.<sup>7</sup> By 3 months of age, we omitted her 2am and 6am feeds, but stepped up her feeds by 3-4 ml per meal, and advanced the amount of feed every 4 days. During the period of hospitalisation, she had repeated episodes of catheter related infections and one attack of norovirus gastroenteritis. Milk feeds were stepped back during infections. By 7 months old, her clinical condition became stable and we stepped up her milk feeds every 4 days by 2 ml per feed, 10 feeds per day till enteral autonomy was achieved.

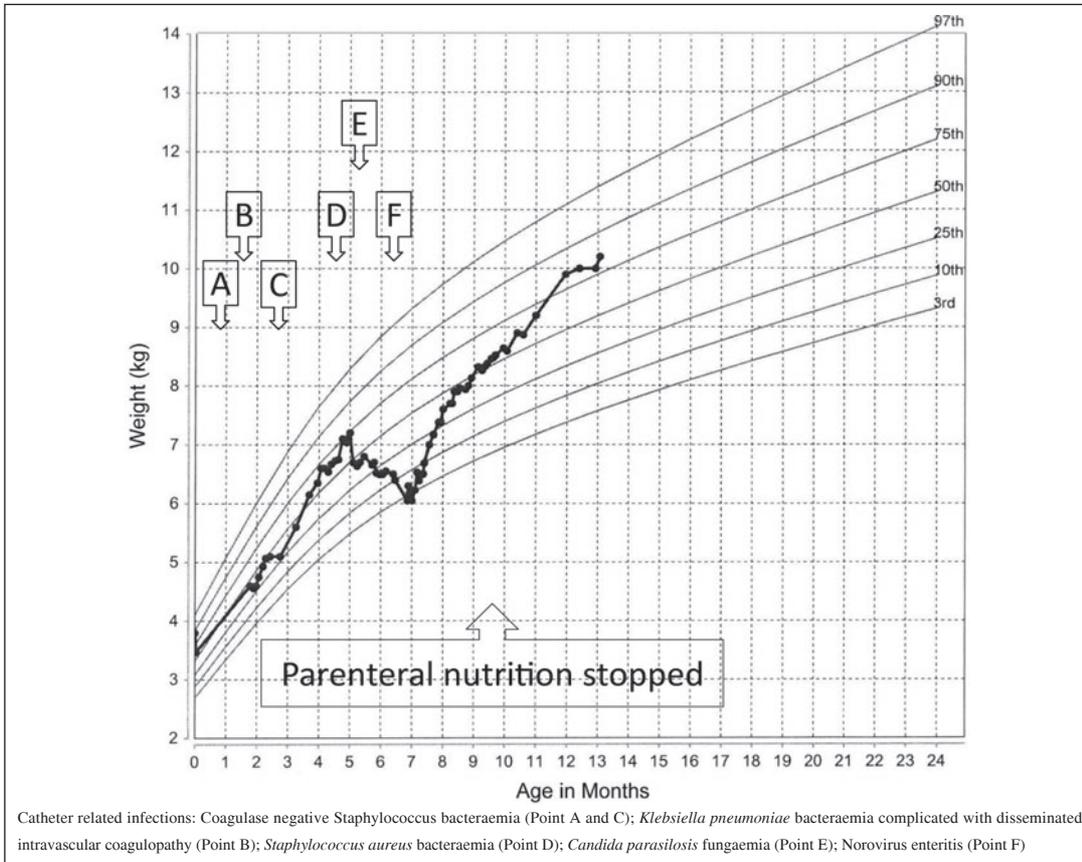
Finally, she achieved enteral autonomy by taking 1,000 ml milk per day at the age of 9.5-month-old, with a body weight 8.54 kg. By the time of discharge from hospital at 10.5-month-old, she was fed 8 times a day, without nocturnal feeds. On follow up at 13-month-old, she took 1200 ml milk per day at home, and her growth and development was normal (Figure 2). Because of severe food allergy which is common in patients with short bowel syndrome, she was on Neocate [Nutricia] all along.<sup>8</sup>

## Discussion

Despite aggressive feeding regimes and different types of bowel operations, bowel adaptation for patients with ultra short small bowel usually takes more than one year.<sup>1</sup> Adequate bowel rest has never been recommended for bowel adaptation. So far, feeding regimes for children with short bowel syndrome has never been studied systematically. Many authors recommended continuous feeding regime based on one old crossover study which involved only 2 patients with short bowel syndrome.<sup>9</sup> Though there were better weight gains for patients on the continuous regime during the study period, it did not imply better bowel adaptation in the long run. There is incomplete agreement on the ways of enteral feeding.<sup>1,8</sup>



**Figure 1** Number of bowel opening per day against age of the infant in days.



**Figure 2** Weight of the infant against her age in months.

Our feeding regime was designed corresponding to the remnant bowel length.<sup>3</sup> Therefore the volume of milk at initiation was much smaller than the usual recommendation for patients with ultra-short bowel syndrome.<sup>2</sup> The interval for feeding advancement was adjusted according to the intestinal mucosal turnover time for epithelial cell growth.<sup>4</sup> The advancement in volume was small. We increased the advancement volume slightly when the child reached 3-month-old, but we withheld the advancement or even reduced enteral intake when diarrhoea or rectal bleeding occurred. We believed that this physiological feeding regime may help to prevent stasis of milk and bacterial overgrowth in the bowel and its related complications. The total nutrient (parenteral and enteral) given should be based on the age specific recommendation of the patient. The rest of nutrient intake is supplemented by parenteral nutrition.<sup>4</sup> Despite some infection complications, our patient grew well and achieved enteral autonomy early (Figure 2). Excessive feeding was not needed for our patient.

Concerning our report, some points are worth considering. Our patient did not have a stoma. Management of patients with stoma could be different. Moreover, she had repeated catheter related infections and history of norovirus infection. Without these infections, she could have achieved enteral autonomy even earlier. We never know whether our patient could achieve enteral autonomy early if she was continued with the usual aggressive feeding regimes, together with cyclic antibiotics, probiotic and anti-diarrhoeal, and undergo repeated surgical procedures. Furthermore, the fish oil based lipid emulsion infusion used might have contributed to our baby's early bowel adaptation.<sup>7</sup> The amino acid based formula, as the management of severe food allergy, also contributed to the early enteral autonomy.<sup>8</sup>

In past studies, poor growths were commonly observed after weaning off parenteral nutrition.<sup>8,10</sup> Our patient had good weight gain after weaning off parenteral nutrition and on the initial follow-ups.

## Conclusion

There are case series or single case reports on early weaning off parenteral nutrition in infants with short bowel syndrome available.<sup>8,11,12</sup> However the study populations were small and no long term data were available. Furthermore, these results were not reproducible in large studies. We reported a patient of ultra short small bowel syndrome, who was successfully managed with a

physiological feeding regime, obviating the need for tube feeding, prokinetics, anti-diarrhoeal agents, cyclic antibiotics, probiotics, hormonal therapy, and repeated bowel operations. We advocate further studies in short bowel syndrome be focused on the physiological feeding regime. On managing patients with short bowel syndrome, we target at good bowel function – normal growth on usual amount of nutrient intake, no diarrhoea, and no nocturnal or continuous feeding on discharge, rather than just early weaning off parenteral nutrition. If our result can be reproduced in future studies, potentially thousands of patients with short bowel syndrome may benefit and huge economical savings will result as complications from the medications and surgeries used in the conventional management of short bowel syndrome can be avoided.<sup>2</sup>

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## Declaration of Interest

None

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