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Short Communication

What Is the Evidence on the Practice of Mucous Fistula Refeeding in Neonates With Short Bowel Syndrome?

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ABSTRACT
A systematic review of literature was performed on the practice of mucous fistula refeeding in neonates with short bowel syndrome. No randomised controlled studies were identified. Case series reports of 30 infants showed improved weight gain (from −2.36 ± 1.24 to 21.06 ± 3.02 g/d) and reduced need for total parenteral nutrition. Randomised controlled trials are required to establish the benefits of mucous fistula refeeding in this condition. ***JPGN 43:267–270, 2006.*** **Key Words:** Short bowel syndrome—Mucous fistula refeeding—Weight gain—Total parenteral nutrition. © 2006 Lippincott Williams & Wilkins

INTRODUCTION

Surgical resection of necrotic bowel segments in neonates is commonly performed for conditions such as necrotising enterocolitis, intestinal atresias, volvulus and sometimes in gastroschisis (1). Substantial resection is associated with a short residual length of bowel, often with a proximal stoma and a distal mucous fistula (2). Short bowel syndrome (SBS) is defined as a malabsorptive state resulting from a congenital malformation of the gut or occurring after an extensive resection of the small intestine for acquired lesions (3). High stomas located in the jejunum or proximal ileum can result in the production of large quantities of effluent containing unabsorbed nutrients resulting in poor growth and electrolyte imbalance (4). The neonate is usually dependant on total parenteral nutrition (TPN) until the intestinal adaptation takes place. Total parenteral nutrition is associated with significant risk of central line–related sepsis, thrombosis and neonatal cholestasis. Refeeding the proximal stoma effluent through the distal mucous fistula uses the absorptive surface of the distal bowel for nutrient absorption, stimulates mucosal growth and intestinal adaptation and prevents atrophy of the distal bowel. In theory, this practice should improve weight gain and reduce electrolyte imbalance and the days on TPN. The purpose of this review is to evaluate the evidence of the practice of mucous fistula refeeding on weight gain and TPN usage in neonates with SBS.

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MATERIALS AND METHODS

A systematic literature search was carried out using Dialog Data Star and MDCONSULT search engine accessing MEDLINE and EMBASE databases (1996 to date) using key words 'short bowel syndrome', 'enteral feeding' and 'mucous fistula refeeding', restricted to English language and infants younger than 1 year. Cross-references were manually examined to identify further studies. Studies were included if they used the technique of mucous fistula refeeding in infants younger than 1 year with short gut syndrome. Studies that did not meet the above criteria were excluded.

RESULTS

There was no randomised controlled study identified. The studies were restricted to small case series and isolated case reports. The characteristics of included studies are shown in Table 1 and the characteristics of excluded studies in Table 2. In total, there were 30 neonates included within the 5 included studies (4–8). The mean and standard deviation of birth weight and gestational ages of infants included in the studies are shown in Table 3. The residual bowel length ranging from 36 to 66.5 cm was recorded in only 2 studies (4,6). The technique of mucous fistula refeeding was established in all participants with no complications. The effluent was collected every 4 to 6 hours from the proximal stoma in all studies and refed into the distal intestine using a syringe pump. The skin around the mucous fistula was protected using

TABLE 1. *Characteristics of included studies*

Study	Methods	Participants	Interventions	Outcomes	Notes
Wong et al. (6)	Retrospective review: Review the records of 12 neonates between July 1999 and December 2002	12 premature neonates (5 boys, 7 girls): Mean gestational age: 31 wk Mean gestational weight: 1.59 kg Mean residual bowel length: 66.5 cm	Refeeding of enterostomy contents into the distal mucous fistula	Primary: Weight gain: 18.9 ± 2.9 g/d Secondary: Duration of refeeding: 63.5 d	Successful refeeding in 12 neonates
Al-Harbi et al. (5)	Retrospective review: From 1993 to 1997, review of neonates with stoma effluent refeeding	6 neonates (4 boys, 2 girls): Gestational age: 27–38 wk Mean gestational age: 31 wk Birth weight: 533–3400 g Mean birth weight: 1900 g	Ileostomy output collected every 4 to 6 h and refed into the distal mucous fistula.	Primary: Weight gain: 12.3–45 g/d Secondary: Duration of refeeding: 16–169 d	Successful refeeding in all participants
Gardner et al. (4)	Case study: A premature infant with SBS Bowel obstruction with jejunal atresia	1 premature infant (boy): Birth weight: 2460 g Gestation: 34 wk Residual bowel length: 36 cm + ileocaecal valve and colon	Losses form the jejunostomy were refed into the terminal ileum.	Primary: Weight gain: 22 g/d	Stomas reanastomosed 6 wk after the initial surgery
Puppala et al. (8)	Case study: 2 infants with distal jejunal atresia.	2 infants (girls): Gestational age: 36–38 wk Mean gestational age: 37 wk Birth weight: 2230–2807 g Mean birth weight: 2520 g	Continous drip of 5% glucose started through distal ileostomy. All secretions from the proximal ostomy collected and refed through the distal ileostomy drip.	Primary: Weight gain: 16–20 g/d Duration of refeeding: 16–18 d	
Schafer et al. (7)	Case study: Neonates underwent surgery due to meconium ileus or intrauterine perforation All neonates had a split ileo-or jejunostomy implanted.	9 infants Birth weight: 780–3600 g Mean birth weight: 2450 g Gestational age: 28–39 wk Mean gestational age: 32.7 wk	Deviated intestinal chyme from proximal to distal stoma, within a closed circuit. A pump connected the stomas and pumped effluent from proximal to distal stoma.	Primary: Weight gain: 6–31.4 g/d Duration of refeeding: 22–99 d	Reanastomosis of proximal and distal bowel successful in all neonates

TABLE 2. *Characteristics of excluded studies*

Study	Title	Methods	Reason for exclusion
Andorsky et al. (3)	Nutritional and other postoperative management of neonates with SBS correlates with clinical outcomes	Retrospective review	Focuses on enteral feeding only: using breast milk and an amino-acid–based formula
Lima-Rogel et al. (9)	Tolerance of an enterally administered simulated amniotic fluidlike solution by neonates recovering form surgery for congenital bowel abnormalities	Single-centred, Phase I pilot trial, testing the enteral administration of an experimental amniotic fluidlike solution to 10 neonates	Focuses on enterally administered feeds
Luton et al. (10)	Prenatal management of gastroschisis: the place of the amnioexchange procedure	Case report	Not a clinical study; it is a report on gastroschisis and the new exchange technique.
Rhoads et al. (11)	Serum citrulline levels correlate with enteral tolerance and bowel length in infants with SBS	Prospective study	No information regarding refeeding; focuses on enteral feeding only
Scolapio (12)	SBS	Review	Not a study, so no results
Sondheimer et al. (13)	Predicting the duration of dependence on parenteral nutrition after neonatal intestinal resection	Retrosepctive review	Focuses on TPN, with no inclusion of the refeeding technique

SBS, short bowel syndrome; TPN, total parenteral nutrition.

barrier creams. Only 1 study (8) collected the proximal stoma effluent and added this to pregestamil for fistula refeeding.

Weight gain was the primary outcome in all studies and ranged from 6 to 45 g/d after the initiation of fistula refeeding. The mean weight gain before and after the intervention is depicted in Figure 1. The neonates gained more weight whilst receiving mucous fistula refeeding compared with TPN alone. In all the included studies, the requirement for TPN decreased and this inherently reduced the associated complications such as cholestatic jaundice. In addition, the time to reanastomosis was shortened due to the exposure of the distal bowel to refed effluent, encouraging intestinal adaptation to occur. No major complications were seen in any of the studies.

DISCUSSION

The mortality and morbidity in neonates with SBS are significant and are primarily related to complications associated with the mandatory use of TPN to sustain growth. The aim of the refeeding technique in infants who have undergone bowel resection is to prime the distal bowel with luminal feeding promoting intestinal adaptation. The intestinal adaptation involves cell hyperplasia, bowel hypertrophy, lengthening and heightening of villi, improved peristalsis and mucosal growth. The distal bowel also stimulates enterohepatic circulation, therefore minimising the risk of cholestasis. The proximal bowel that has been brought out as a stoma benefits from refeeding because it can regain its tone due to the lack of resistance encountered. A further advantage of the refeeding technique is the simplification of the control of fluids and electrolyte balance in neonates with a high stoma that has a large output. Eventually, this should lead to reduction in TPN days and its inherent complications.

In this 10-year review of reported studies, it seems that enteral refeeding technique is safe, improves weight gain and potentially reduces TPN-related complications in infants with SBS. However, the studies identified in this review were uncontrolled case series with its obvious limitations. A greater number of studies need to be carried out on a larger number of neonates to elicit patterns of success and failure. The technique is labour intensive and requires input from a coordinated multidisciplinary team that includes neonatologist, paediatric surgeon, gastroenterologist, dietician and stoma therapist and the neonatal nurse. There is a need for randomised controlled trials on this subject to establish reliable evidence before

TABLE 3. *Patient characteristics*

Characteristics	Mean (SD)
Birth weight, g	2184 (416.33)
Gestational age, wk	33 (2.55)
Weight gain, g/d	21.06 (3.02)
Duration of refeeding, d	55.6 (30.27)
Weight gain before refeeding, g/d	−2.36 (1.24)
Weight gain after refeeding, g/d	21.06 (3.03)

Wk, weeks; d, days.

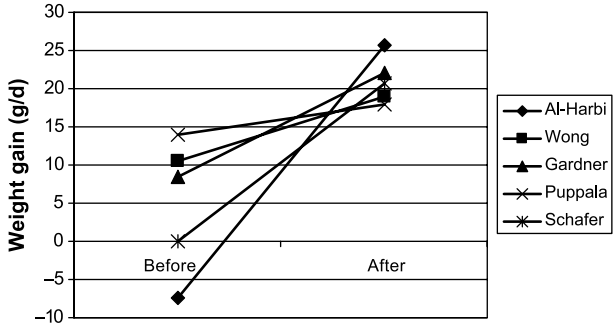

FIG. 1. Effects of fistula refeeding on the mean weight gain of infants in the included studies.

recommending this technique on a routine basis in neonates with SBS. It would also be a helpful guide to follow-up the effect of the refeeding technique on the child's survival, growth and clinical outcome.

CONCLUSION

The results from uncontrolled case studies suggest clinical benefits such as improved weight gain and reduced use of TPN in infants with SBS. However, randomised controlled trials needed to confirm these findings.

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REFERENCES

1. Grosfeld JL. Pediatric surgery. In: Sabiston DC, Lyerly HK, eds. *Textbook of Surgery: The Biological Basis of Modern Surgical Practice*, 15th ed. London: WB Saunders, 2000:1234–74.
2. Collin J. Small intestine-short bowel syndrome. In: Morris PJ, Malt RA, eds. *Oxford Textbook of Surgery*. Oxford: Oxford University Press, 2002:994–6.
3. Andorsky DJ, Lund DP, Lillehei CW, et al. Nutritional and other postoperative management of neonates with short bowel syndrome correlates with clinical outcomes. *J Pediatr* 2001;139:260–70.
4. Gardner VA, Walton JM, Chessell L, et al. A case study utilising an enteral refeeding technique in a premature infant with short bowel syndrome. *Adv Neonatal Care* 2003;3:258–71.
5. Al-Harbi K, Walton JM, Gardner VA, et al. Mucous fistula refeeding in neonates with short bowel syndrome. *J Pediatr Surg* 1999;34:1100–3.
6. Wong KKY, Lan LCL, Lin SCL, et al. Mucous fistula refeeding in premature neonates with enterostomies. *J Pediatr Gastroenterol Nutr* 2004;39:43–5.
7. Schafer K, Zachariou Z, Loffler W, et al. Continuous extra-corporeal stool-transport system: a new and economical procedure for transitory short-bowel syndrome in prematures and newborns. *Pediatr Surg Int* 1997;2:73–5.
8. Puppala BL, Mangurten HH, Kraut JR, et al. Distal ileostomy drip feedings in neonates with short bowel syndrome. *J Pediatr Gastroenterol Nutr* 1985;4:489–94.
9. Lima-Rogel, Ojeda MA, Villegas C, et al. Tolerance of an enterally administered simulated amniotic fluid-like solution by neonates recovering from surgery for congenital bowel abnormalities. *J Perinatol* 2004;24:295–8.
10. Luton D, Guibourdenche J, Vuillard E, et al. Prenatal management of gastroschisis: the place of the amnioexchange procedure. *Clin Perinatol* 2003;30:551–72.
11. Rhoads JM, Plunkett E, Galanko J, et al. Serum citrulline levels correlate with enteral tolerance and bowel length in infants with short bowel syndrome. *J Pediatr* 2005;146:542–7.
12. Scolapio JS. Short bowel syndrome. *J Parenter Enteral Nutr* 2002;26:11–6.
13. Sondheimer JM, Cadnapahornchai M, Sontag M, et al. Predicting the duration of dependance on parenteral nutrition after neonatal intestinal resection. *J Pediatr* 1998;132:37–47.