

Enteral Nutrition for Neonatal Intestinal Failure East Bay Newborn Specialists Guideline

by

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Intestinal failure in the newborn period is typically due to conditions leading to short bowel syndrome, bowel dysmotility and malabsorption. This feeding guideline is intended for, but not exclusive to, the following diagnoses:

Necrotizing enterocolitis (Bell stage IIIA)

Malrotation with volvulus

Gastroschisis

Small bowel ostomy

Bowel atresias

Bowel perforation

Dysmotility with malabsorption

What to Feed

Background:

After surgical resection of the bowel, the intestinal adaptive process begins almost immediately, but full absorptive capacity may take up to years. There is no consensus about which type of feeding best promotes intestinal adaptation; however luminal nutrient delivery is the best method to stimulate mucosal hyperplasia, villus lengthening, increased crypt depth, and bowel dilatation.

Human milk is thought to be the optimal feeding as it contains growth hormone and trophic factors. When human milk is not available, protein hydrolysate formula or elemental formula is considered. Protein hydrolysate formulas (Pregestimil) containing hydrolyzed protein and medium chain triglycerides (MCT) are widely used and generally well tolerated. Amino acid-based formulas (Elecare Infant/Neocate Infant) are also well tolerated and have been associated with a shorter duration of parenteral nutrition. Studies have shown that disaccharides and long chain triglycerides (LCT) exert trophic effects on the intestine. GI functional workload should be considered when feeding a short gut infant. Elemental formulas have the least functional workload and complex formulas the greatest.

The length of the intestine doubles between 27 weeks to 35 weeks gestations; therefore providing adequate nutrition and promoting optimal growth are paramount in infants with short bowel.

Recommended caloric, protein and fat intake:

	Kcal/kg/day	protein (g/kg/day)	fat (gm/kg/day)
Parenteral nutrition	100-110	3- 4	2-3
Enteral nutrition	120- 130	3.5- 4.5	
Parenteral + Enteral nutrition	110- 130	3- 4	

Policy:

When mother's own breast milk is available, it is the feeding of choice. If it is not, donor breast milk is preferred for infants less than or equal to 1500 grams (see donor milk policy).

Patients at lower risk for malabsorption (mid-low ileostomy with presence of ileocecal valve, functioning colon) should receive an initial trial of protein hydrolysate (e.g. Pregestimil®) formula, if breast milk is poorly tolerated or unavailable. If unable to tolerate a protein hydrolysate formula, the trial of an amino acid based formula (e.g. Elecare Infant®) should then be used.

Patients at significant risk for malabsorption (high ileostomy, jejunostomy, absent ileocecal valve) should receive an initial trial of amino acid- based formula (e.g. Elecare Infant®), if breast milk is poorly tolerated.

Once patients reach full feeds and are stable, they should be transitioned gradually to mother's own breastmilk or an age- appropriate standard polymeric formula which facilitates greatest intestinal adaptation and a more optimal nutrient profile.

Premature infants receiving mother's own breast milk may need fortification to meet their increased nutrient needs. In addition, a premature infant who is receiving donor breast milk may be transitioned to an age appropriate formula at 34 weeks post conceptional age as medically indicated.

Continuous vs Bolus Enteral Feedings

Background:

Enteral nutrition should be started as soon as possible following bowel resection to promote intestinal adaptation. Continuous enteral infusion of feedings promotes adaptation and optimizes absorption by permitting continuous total saturation of gut protein transporters. It has been demonstrated in small studies that drip feedings promote nutrient and mineral retention and increase weight gain. Gastric distension from bolus feeds may promote the gastrocolic reflex and increase the risk of osmotic diarrhea.

Policy:

Enteral feedings for newborns with short bowel syndrome will be started by continuous drip. Advancement of feeds is described below.

Guidelines for feeding advancement

General Guidelines:

Quantify feeding intolerance primarily by number of stools or ostomy output (ml/kg/d).

Advance once every other 24h period.

Goals: 150-200 ml/kg/day
 100-140 kcal/kg/day

As feeds are advanced, PN should be reduced such that weight gain velocity meets goal weight gain for age.

If there is difficulty advancing feeds for 7 days due to vomiting, increase caloric density and decrease feeding volume.

Do not check stool reducing substances or pH. They do not provide useful clinical information.

Advancing feeds:

Stool output

If <8 stools/d-----Advance rate by 10-20 ml/kg/d

If 8-10 stools/d-----No change

If >10 stools-----Reduce to previously tolerated rate. Adjust PN rate to meet fluid/nutrition requirement. If not on PN, IV fluids may be needed.

Ostomy output

≤ 20 ml/kg/d-----Advance feeds by 20 ml/kg/d every other day

20-30 ml/kg/d-----Advance feeds by 10 ml/kg/d every other day

≥ 30 ml/kg/d -----Hold feeds or return to previously tolerated feeds volume

Other Considerations for Evaluating Ostomy Output

Use baseline ostomy output as a factor

Beginning Oral Feeds: When infant is developmentally able to nipple, one hour's worth of continuous feeds may be offered by nipple BID or TID after five days of continuous feeds.

During this time, tube feeds should be held.

More than 1 hour's worth of continuous feeds may be offered by nipple once the infant has reached full volume of feeds by continuous drip and is demonstrating weight gain after 7 days of feeding advancement

Advantages of Oral Enteral Feeding

Background:

In patients with SBS, continuous tube feeding (either exclusively or in conjunction with oral feeding) following the postoperative period significantly increased net absorption of lipids, proteins, and carbohydrates compared with oral feeding. While continuous drip feedings are preferable for these reasons, offering a small amount of oral feeding is developmentally appropriate for neonates and may provide a source of comfort to the patient and family. Oral or bolus feedings stimulate more physiologic release of gastrointestinal secretions and normal motility in the term or older infant. There may be a physiologic advantage of oral feeding related to the presence of growth factors in the saliva.

Saliva has been shown to play a significant role in maintaining oral mucosal homeostasis.

Numerous growth factors are secreted in high concentrations in the saliva which include epidermal growth factor (EGF), vascular endothelial growth factor (VEGF), nerve growth factor, transforming growth factor α and β , acidic and basic fibroblast growth factors, and insulin-like growth factors. These factors are thought to play a restorative role to the tissues following injury. Animal models demonstrate a critical role of salivary derived EGF to the adaptive

response following a massive small bowel resection, while VEGF is felt to play an important role through its angiogenic effects on the submucosa.

Policy:

While the majority of nutrition will be provided by continuous drip, infants with short bowel syndrome shall be offered small amounts of feeding by nipple. Once feedings are established, a combination of bolus feeds (either oral or via a tube) during the daytime and continuous feeds at night allows for achieving a more normal, physiologic pattern of feedings as well as time off from the feeding pump during the day for motor development.

Other Strategies for Management of Short Bowel Syndrome

Acid Blockade

Recommended in the post- op and with initiation of enteral feeds because of gastric hypersecretion.

No data on duration of treatment.

Avoid over suppression of acid secretion due to risk for bacterial overgrowth.

Zinc

Supplement if low alkaline phosphatase and zinc level. Recheck level in 3- 6 months.

Sodium chloride

Patients with jejunostomy and severe SBS are more prone to increased sodium (and electrolyte) losses

Decreased urine Na (< 20 mEq/L) is a more reliable indicator for Na depletion than serum sodium. Consider checking urine sodium routinely on patients with SBS.

If patient is on enteral feeds, may start 2 meq/kg/d NaCl supplementation. Repeat a random urine Na after 1-2 weeks of supplementation. Please consult dietitian.

Loperamide

Loperamide can slow down GI motility, which may facilitate more absorption of nutrients.

Higher doses often needed because entero- hepatic circulation altered in short bowel.

Recommended doses 0.08- 0.24mg/kg/dose PO q8- 12h; max dose 2mg (0.8mg/kg/d)

Do not use in patients with refractory small bowel bacterial overgrowth.

Liquid formulation not recommended due to its sorbitol and alcohol content.

Pectin/Benefiber

Soluble fiber provides SCFAs as an energy source for the colon

Can decrease stool output

May not work in patients w/o a colon or short colon and no ICV

Discontinue if abdominal distention + emesis

1-3% of total feeds

Ursodiol

May improve bile flow and reduce gall bladder stasis; little data suggesting that prophylactic use reduces Parenteral Nutrition Associated Liver Disease (PNALD).

Cholestyramine

Binds bile acids. May be indicated for treatment of choleric diarrhea, in patients lacking the terminal ileum but with some portion of the colon in continuity.

Antibiotic therapy

For small intestinal bowel overgrowth (SIBO), especially when recurrent episodes of sepsis or clinical symptoms are consistent with SIBO.

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