Extremely Premature, Extremely Low Birthweight Nutritional Recommendations

Fluid and Nutritional Management

Parenteral Nutrition: Initial Orders

- Initial fluid rate = 80mL/kg/day (briefly 60mL/kg/day via PIV until central access obtained)
- Order TPN on the day of admission if possible (check with Pharmacist even if after 1200)
- Infuse isotonic amino acids 3.6% with 1 unit heparin/mL via UAC at 0.3-0.5mL/hr
- If able to obtain UAC should remain in place for first 72 hours generally with isotonic AA solution during this time
- Infuse D10W with 2.5% AA & 0.5 unit heparin/mL via UVC (PIV if unable to obtain UVC)
- Order IL at 0.5g/kg/day on admission (to infuse with D10W AA & Isotonic AA)
- Use D5W for flush solution and as base solution for medications initially
    - (CANNOT be used to heplock a PIV)

Parenteral Nutrition: Fluid & Electrolyte Management

- Use birth weight to calculate fluids until birth weight is regained
- Anticipate and facilitate 10-15% loss from birthweight
- Do not fluid overload. Avoid exceeding birthweight in the first 14 days
- Incremental increases in TF ***are*** indicated; particularly in the following situations:
    - Weight loss approaching 10% of birthweight
    - To keep up with diuresis (as UOP increases >3mL/kg/hr)
    - To avoid serum sodium >155
- Consider increasing by no more than 10mL/kg/day Q12 hours
- Be cognizant of how much total fluid is comprised of enteral volume; there is ***less*** need to be restrictive with fluids when the percentage of enteral intake increases

Sodium

- Avoid the use of ***additional*** sodium during the first 72 hours
    - Avoid infusing NaAcetate or NaCl via arterial line during the first 72 hours
    - Consider ***single*** bolus of LR rather than NaCl for hypotension (see Hypotension Management)
- Begin adding ***maintenance*** sodium at 1mEq/kg/day ~day 2 based on overall fluid status, and advancing daily to maintenance
- Maintenance sodium in this population is 2-5mEq/kg/day

Magnesium

- Magnesium supports normal function of the muscles of the GI tract, is essential for bone health, and plays a role in neurodevelopmental outcomes
- Magnesium should be maintained between 2 - 2.5mg/dL and should not be omitted from

PN unless the serum Mg level is >3.9mg/dL

- Avoiding hypomagnesemia is necessary to maintain appropriate calcium & phosphorus levels

Calcium & Phosphorus

- When TPN is initiated, provide both calcium and phosphorus
- Usual recommendation is 2:1 (calcium:phosphorus) ratio in parenteral nutrition, however, a more gradual initiation and progression of both calcium and phosphorus should be considered in this population
- Phosphorus should be added to PN within 24 hours of life; consider 0.25 mmol/kg/day of Kphos on admission
- Avoid allowing phosphorus to drop below 5mg/dL
- Do NOT increase protein above 3g/kg/day until phosphorus is >4.5mg/dL
- Of note, hypophosphatemia may also precede glucose intolerance
- In the presence of hypophosphatemia avoid continuing to increase calcium provision in order to maintain 2:1 (calcium:phos)
- Consider obtaining ionized calcium to fully appreciate calcium levels and inform decision making
- Trend ionized calcium levels at least daily for infants on TPN that are also require routine blood gases

Refeeding-like syndrome (RS) in ELBW infants

- SGA infants are at highest risk for refeeding like syndrome, however, ELBW infants who are AGA may also develop RS
- Characterized by electrolyte abnormalities which may be related to increased supply of glucose and protein following a period of compromised nutrition in utero
- Increased energy stimulates endogenous insulin secretion and the transfer of phosphate from bones into cells from energy and protein production
- Insufficient provision of electrolytes: phosphorus, potassium, magnesium, sodium may promote RS which can be seen within 2 - 5 days
- Insufficient addition of phosphorus to early IV nutrition may lead to phosphorus and calcium being released from bone

Meet resting energy needs ASAP

- Achieve 45-50 kcal/kg/day
- *Projected* initial substrates: 0.5 g/kg/day lipid (5 kcal/kg), GIR 4.5-5 mg/kg/min (23-25 kcal/kg), AA 2.5-3 g/kg (~11 kcal/kg), unfortified MBM/DBM at 10mL/kg/d (7 kcal/kg) Total = 47 kcal/kg/day
- Recommend achieving 90 kcal/kg/day by DOL #7

- Be cognizant of the ratio of caloric constituents of TPN (provide proportionally appropriate calories when possible; ~ 55% **carbohydrates** (dextrose), 15% **protein** (amino acids), and 30% **fat** (lipid emulsion); consider enteral sources as well
- DO NOT titrate Isotonic AA to adjust for changes in total fluids (there are risks to providing too much protein)

Parenteral (nutritional management)

- Initiate total parenteral nutrition (TPN)
- Quick calculations: GIR x 5 = kcal/kg/day carbohydrate; AA g/kg x 4 = kcal/kg protein; lipids g/kg x 10 = kcal/kg fat; add together to obtain kcal/kg/day
- Calculation of calories per substrate will allow for quick caloric contribution (%) from each substrate
- Carbohydrate (CHO)
    - CHO should provide the majority of caloric intake
    - Providing excessive lipid or protein calories may lead to acidosis
    - Limiting GIR without presence of hyperglycemia could lead to "disorganized" caloric contributions from substrates
- Lipid (IL)
    - Providing 0.5 g/kg/day of *intralipid* prevents Essential Fatty Acid deficiency
    - ELBW infants can develop EFA deficiency within 1-2 days especially those infants 22-23 weeks
    - ***Attempt to ensure a minimum of 0.5 g/kg/day of IL for at least 12hrs per day for infants receiving exclusive parenteral nutrition***
- Amino Acid (AA)
    - Recommend initiating AA intake at 2.5-3 g/kg/day (including isotonic AA)
    - Goal protein intake 3.5 g/kg/day by DOL #5
    - Aggressive initial amino acid provision (3.5 g/kg/day) may lead to electrolyte abnormalities (although this may be alleviated with adequate electrolyte supplementation)

Parenteral (glucose & triglyceride management)

- ELBW infants are at high risk for hyperglycemia
- Some ELBW infants may only tolerate 3.5-4.5 mg glucose/kg/min in the first days of life
- Generally, advance GIR by 1-2 mg glucose/kg/min if blood glucose <130-150mg/dL
- ***Glucoses and Triglyceride levels must be obtained via heelstick for infants receiving parenteral nutrition via UAC***
- Obtain a triglyceride level in the case of hyperglycemia >250mg/dL
- Consider use of 1:1 heparin in TPN and other fluids in the case of hypertriglyceridemia
- If glucose level is persistently >300mg/dL, reduce GIR to 3.5mg glucose/kg/min prior to initiating insulin
- Consider multiple insulin doses prior to initiation of continuous infusion as the small

volume and low rate of the infusion results in a long delay in reaching steady state (see Hyperglycemia and the Use of Insulin guideline).

ELBW < 28 weeks Intralipid Emulsion (ILE) initiation and advancement rates by birthweight

Birthweight	Initiation on Admission	First TPN	Advancement	Triglyceride Monitoring
<750 grams	0.5 gram/kg/day	1 gram/kg/day	0.5-1 gram/kg/day	• Morning after admission labs • Morning labs with each advancement
750-1000 grams	0.5 gram/kg/day	1 gram/kg/day	1 gram/kg/day	• Morning after admission labs • Morning labs with each advancement
>1000 grams	0.5 gram/kg/day	1 gram/kg/day	1 gram/kg/day	• Once at goal of 3 grams/kg/day

Consider advancement by 0.5 g/kg/d for infants < 24 weeks
Advance as tolerated if triglyceride (TG) level is < 250 mg/dL
Obtain a triglyceride level in the case of hyperglycemia >200mg/dL
If TG level >250mg/dL reduce ILE by 0.5-1g/kg/day and repeat TG the next morning
For TG level 251-450mg/dL ILE at 0.5g/kg/day is recommended to prevent essential fatty acid deficiency
For TG level >450mg/dL discontinue ILE; repeat TG level within 6-12hrs (attempt to coordinate with next lab draw)
If TG level < 450mg/dL, restart ILE at 0.5g/kg/day immediately (goal of no more than 12hrs without ILE)
If ILE cannot be resumed/tolerated at min 0.5g/kg/day within 24 hours or TG level remains >450mg/dL consult Nutrition Team
Consider use of 1:1 heparin in TPN and other fluids in the case of hypertriglyceridemia

Adapted from Carnielle et al., 2021 & Baylor Nutrition Guidelines, 2024

Laboratory Evaluation Schedule for ELBW Infants (for the first 72 hours of life)		
Admission (STAT)	**Daily 0800 (for 3 days)**	**Daily 2000 (for 3 days)**
CBC and differential **		
	Neonatal Bilirubin	Neonatal Bilirubin (if risk factors)
	Chem 10	Sodium
	Triglyceride level (wt based)	
	iCa (only if obtaining blood gas)	
Blood gas (POC) Glucose (POC) Blood culture ** Type and screen ABO/Rh *(for type check)* **		

*** CBC, blood culture and ABO/Rh should be obtained from cord blood whenever possible*

Enteral

- Mother's own milk provides unique benefits to the infant. The pasteurization of donor human milk negatively impacts some of the bioactive components that influence digestion and absorption, development of the intestinal microbiome, and immunity. Establishing and protecting maternal milk supply should be a priority
- ***Verbal assent should be obtained and documented in the electronic medical record at admission for feeding donor human milk.***
- Formula should not be provided as a backup feeding in this population.
- Provide Oral Immune Therapy with maternal colostrum Q6 hours at "touch times" as soon as it is available (regardless of NPO status)
- After verbal consent for human donor milk obtained, begin feedings per protocol with first 6 hour "touch time" unless contraindicated

See also:

(Standard) Nutrition Guidelines (Parenteral and Enteral) & Feeding Guidelines and Pathways