HEALTH HOLDING

HAFER ALBATIN HEALTH CLUSTER
MATERNITY AND CHILDREN HOSPITAL

Department:	Neonatal Intensive Care Unit (NICU)		
Document:	Multidisciplinary Policy and Procedure		
Title:	Neonatal Total Parenteral Nutrition		
Applies To:	All NICU Staff and Pharmacists		
Preparation Date:	January 05, 2025	**Index No:**	NICU-MPP-018
Approval Date:	January 19, 2025	**Version :**	2
Effective Date:	February 19, 2025	**Replacement No.:**	NICU-DPP-018 (1)
Review Date:	February 19, 2028	**No. of Pages:**	05

1. PURPOSE:

1.1 Parenteral nutrition enables Physicians to provide adequate nutrition, calories for the proper growth and development of infants who clinical condition precludes full enteral feeding.
1.2 TPN helps to achieve our aim of postnatal growth that parallels in utero growth rates.
1.3 TPN can supplement the slowly increasing enteral feedings so that the total daily intake by both routes meet the infant's nutritional needs.
1.4 When necessary, TPN alone can meet most nutritional requirements for considerable periods.

2. DEFINITIONS:

2.1 **Total Parenteral nutrition** (TPN) is the intravenous infusion of all nutrients (carbohydrates, fats, proteins, minerals, vitamins and trace elements), necessary for metabolic requirements and growth. It should provide sufficient nutrients to prevent negative energy and nitrogen balance and essential fatty acid deficiency.

3. POLICY:

3.1 The Physician must order total Parenteral Nutrition daily.
3.2 Staff Nurse may administer TPN.
3.3 TPN solution, tubing & filter will be change every 24 hours.
3.4 TPN solutions are available as amino acid/ intralipid ready to use solutions.
3.5 TPN is administered to all preterm infants with birth weight < 1500 grams. Can be done in conjunction with slowly advancing enteral nutrition.
3.6 TPN is administered to Infants with birth weight of > 1500 grams for whom significant enteral feeding is not expected for more than 3 days, for any clinical condition that precludes full enteral feeding e.g. prematurity, respiratory distress, congenital malformations of the gastrointestinal tract, meconium or paralytic ileus, necrotizing enterocolitis, gastroschisis.

4. PROCEDURE:

4.1 The assigned Physician writes the order of the Total Parenteral Nutrition and enter it on the Physician order sheet.
4.2 **Constitution**
4.2.1 **Fluids:** Calculate the volume of parenteral nutrition (hyperalimentation + intralipids) by subtracting the volume of patient's other necessary fluids e.g. (for inotropes, sedation, etc.) from the total daily fluid requirements. If the patient has ongoing abnormal losses that can be changing over day, replace it separately. Consider 3 phases for the daily maintenance fluid management.
4.2.1.1 **Transition phase**: (the immediate postnatal phase; hours to days):
During which extracellular fluid (ECF) volume contraction occurs, relative oliguria followed by diuresis.

4.2.1.2 Allow weight loss of 1 -3% of birth weight (BW) for the first few days. The normal full term neonate loses 5-10% of their weight during the first 4-7 days of life, and then establishes steady weight gain. Preterm neonates lose 10-15% of their BW depending on degree of prematurity & associated pathology; they regain BW by 10-20 days of age.

4.2.1.3 Ends when maximal weight loss has occurred.

4.2.1.4 Starting fluid rate is: 80 ml/kg/day for neonates with birth weight of < 1.5 Kg. and 60 ml/kg/day for neonates weighing more than 1.5 kg. Then tailor intake to allow appropriate contraction of extracellular fluid (ECF) without compromising cardiovascular function.

4.2.1.5 Follow by weight loss, serum sodium and urine output and accordingly may increase intake by l0-20 ml/kg/day up to ~120-150 ml/kg/day.

4.2.1.6 If the baby gains weight or becomes edematous, do not increase the intake. Weight gain is anticipated when caloric intake is sufficient to permit growth i.e. (~ 80-120 kcal/kg/day).

4.2.1.7 Type of starting fluid.

4.2.1.7.1 Stable preterm < 1250 gm start within first few hours after birth by 2 grams/kg/day of protein. Use the "starter TPN fluid" available in pharmacy refrigerator 24 hours a day. It consists of 2.5 grams protein and calcium gluconate 1 mmol to each 100 ml of the electrolyte free 10% D/W.

4.2.1.7.2 Preterm 1251-1500 gm starts within the first 24 hours of life.

4.2.1.7.3 Preterm > 1501 gm start if significant enteral intake is not expected for > 3 days.

4.2.1.8 **Stabilization phase:** Ends when extracellular fluid contraction is complete (birth weight is regained). Duration~5-20 days.

4.2.1.9 Urine output : 1-2 ml/kg/hour and decreased sodium excretion.

4.2.1.10 Average fluid intake:
- Infants < 1500 grams: 140- 180ml/kg/day.
- Infants > 1500 grams: 140-160ml/kg/day.

4.2.1.11 Stable growth phase: New tissue build up, expected weight gain is 10-20 gram/kg/day. Average fluid intake 140-160 ml/kg/day.

4.2.1.12 Fluid intake in all phases depends on clinical condition. Infants who have PDA: intake ≤130 ml/kg/day (provided that tissue perfusion and hydration state are satisfactory), infants with bronchopulmonary dysplasia: intake is ≤150 ml/kg/day.

4.2.1.13 When the total daily fluid requirements are increased, do not increase the rate of an already running parenteral nutrition solution. It is advisable to order a side drip until the new parenteral nutrition fluid is available.

4.2.2 **Carbohydrates**:

4.2.2.1 Glucose: Start at 4-6mg/kg/m, increase daily intake by 1 - 2 mg/kg/m as tolerated to a-maximum of 11-13 mg/kg/m. Excessive glucose intake causes increases fat tissue deposition, liver steatosis, increases very low density lipids, triglycerides and CO2 production and impaired protein metabolism.

4.2.2.2 Maintain serum glucose between 60-120 mg/dl. If hyperglycemia occurs (RBS > 180mg/dl) at glucose infusion rates < 3-4 mg/kg/minute; start insulin infusion 0.01-0.1 unit/kg/hour and adjust according to blood sugar maintaining it between 100-150mg/dl.

4.2.3 **Proteins:**

4.2.3.1 Early administration of amino acids prevents protein catabolism, stimulates insulin secretion and prevents hyperglycemia and hyperkalemia.

4.2.3.2 Start by 1.5 -2 gm/kg/day on the first day of life, increase daily by 0.5-1gm/kg/day to a target of 3-3.5 gm/kg/day for infants weighing < 1500 gm and 3gm/kg/day for infants weighing > 1500 gm.

4.2.4 **Intralipids** :

4.2.4.1 Essential fatty acid deficiency can be avoided by 0.5-1gm/kglday of lipids.

4.2.4.2 Start 20% lipid emulsion at 0.5-1 gm/kg/day on 2nd or 3rd day of life. increase by 0.5-1 gm/kg/day up to a maximum of 3gm/kg/day.

4.2.4.3 Give intralipids continuously over 24 hours at a rate that does not exceed 0.14 gm/kg/hour.

4.2.4.4 Aim to maintain serum triglyceride levels at < 150 - 200 mg/dl (1.69 -2.2 mmol/L)

4.2.5 **Electrolytes:**

4.2.5.1 Sodium: Add sodium after the first day of life, after postnatal ECF contraction has occurred, urine output > 1- 2 ml/kg/hour and serum Sodium is normal.
Daily requirement: 2- 4 mmol/kg/day. Preterm infants may require higher intake (up to 8mmol/kg/day).

4.2.5.2 Potassium: start potassium after urine output is established and serum K is < 5.5 mmol/L and not rising. Give 1-3 mmol/kg/day.

4.2.5.3 Chloride : Give 2-4 mEq /kg/day.

4.3 **Note :**

4.3.1 Calcium : 1 mmol = 40mg =2mEq

4.3.2 Phosphorus; 1 mmol =31 mg = 1.47mEq.

4.3.3 Elemental Magnesium: 1 mmol = 25 mg = 2 mEq

4.3.4 Na phosphate (PO4-) 1ml = 3 mmol Phosphorous + 4 mEq sodium

4.3.5 K phosphate (inorganic) 1ml = 3 mmol Phosphorous + 4.4 mEq K

4.3.6 Magnesium (Mg) Sulphate 10%=100 mg /ml= 10 mg elemental Mg/ml = 0.8 mEq Mg/ ml = 0.4 mmol Mg/ml.

4.4 **Discontinuing TPN**

4.4.1 Introduce feeding as early as possible and decrease TPN gradually according to feeding tolerance.

4.4.2 Consider discontinuation of TPN when feeding is ≥75% of total fluid intake.

4.4.3 When the decision has been made to discontinue TPN, give regular intravenous fluids to make up the remaining fluid until total enteral intake is achieved. Check for hypoglycemia.

4.4.4 Consider discontinuing lipids when infant reaches > 2.5 g/ kg per day of enteral fat intake (about 70 ml/kg/day of 20 calorieJ30 ml of milk formula) without tapering the rate.

4.5 **Clinical Monitoring of patients receiving TPN**

4.5.1 Daily weight and assessment of intake and output.

4.5.2 Complete physical examination looking for signs of possible complications e.g. hepatomegaly, dehydration, systemic sepsis or local signs of infection at the catheter site, thrombosis.

4.6 **Laboratory monitoring of patients receiving TPN**

4.6.1 Daily electrolytes, gases, glucose, calcium, phosphorous, urea/creatinine, for the first week or until the baby is stable and tolerating full parental nutrition, then once to twice weekly and as needed.

4.6.2 Check liver function tests, albumin, alkaline phosphatase, magnesium and hemoglobin weekly.

4.6.3 Check triglycerides following each increase in dose then weekly.

4.6.4 Elevated serum urea may be due to excess protein intake, inadequate provision of energy with subsequent endogenous protein breakdown, or adequate energy accompanied by dehydration or renal impairment.

4.7 **The assigned nursing staff will:**

4.7.1 Inspect the TPN bag for patient name, correct formula expiration date and leaks and the solution for cloudiness, discoloration, sediment, particles and/or brown oily streaks (lipid solutions).

4.7.2 Report to the assigned Physician any noticed precipitate (the solution should be clear), change in color etc. or reactions.

4.7.3 Use aseptic technique for priming and handling of TPN solution when connecting it to the IV pump and to central or peripheral lines. Wear mask and sterile gloves and create a sterile surface. The assistant, if needed, wears a mask and clean gloves.

4.7.4 Run the TPN through an infusion pump over 24 hours.

Replace the intravenous set after 24 hours following administration of TPN.
Notice that TPN infusates may enhance microbial growth.
Do not access the line during TPN infusion. Run other infusions in separate IV peripheral line.
If no other line can be inserted: Note that some medication may be incompatible with the TPN.
May give certain medications through a Y connection (3way connection) only after checking with the pharmacy for drug compatibility.

4.8 **Role of pharmacist in TPN preparation**

4.8.1 The pharmacist reviews and verifies the composition of the ordered TPN to ensure it is correct and complete.
4.8.2 He/she communicates with ordering Physician in case there are any questions or suggestions.
4.8.3 Make sure there is no precipitation of ingredients e.g. of calcium and phosphorous.
4.8.4 Prepare the TPN solution under laminar flow hood and aseptic precautions.
4.8.5 Label the TPN bag with proper patient identification and detailed contents of the solution.
4.8.6 Check stability, compatibility and medications interactions with TPN mixture if medications have to be administered with the TPN through a Y connection.

5. MATERIAL AND EQUIPMENT:

5.1 TPN solution.
5.2 Infusion pump, tubing volumetric chamber.
5.3 Twin site infusion adaptor, if infant is IV medications.
5.4 IV Burette Set
5.6 PPE
5.7 Amber tubing
5.8 TPN filter

6. RESPONSIBILITIES:

6.1 Physician
6.2 Neonatology Nursing Staff
6.3 Pharmacy Staff

7. APPENDICES:

N/A

8. REFERENCES:

8.1 CBAHI Resources
8.2 American Society for Parenteral and Enteral Nutrition (S.P.E.N). Clinical Guidelines: Nutrition Support of Neonatal Patients at Risk for Metabolic Bone Disease. Journal of Parenteral and Enteral nutrition. 20131'37;' 570-59E
8.3 American Academy of pediatrics. Clinical Report. Calcium and Vitamin D Requirements of Enterally Fed Preterm Infants. Pediatrics, 20 I 3; I3I, (5), I6E6-16E3
8.4 European Society for Pediatric Gastrointestinal, Hepatolory and nutrition (ESPGHAN); Fluid and Electrolytes (NA, Cl and K). Joumal of Pediatric Gastroenterology and Nutrition. 2005; 41:S33-S38.
8.5 American Academy of Pediatrics: Nutritional Needs of the Preterm Infant. Pediatric Nutrition Handbook. Fifth Edition; 2004; 23-54

9. APPROVALS:

	Name	Title	Signature	Date
Prepared by:	Ms. Afrah Saud Al Shammari	NICU Head Nurse		January 05, 2025
Prepared by:	Dr. Falah Nabhan Al Shammari	NICU Quality Coordinator		January 05, 2025
Reviewed by:	Mr. Sabah Turayhib Al - Harbi	Director of Nursing		January 07, 2025
Reviewed by:	Dr. Sarhan Hamdan Al Shammari	NICU Head of the Department		January 08, 2025
Reviewed by:	Ph. Mutlaq Al Dhafeeri	Pharmaceutical Care Director		January 08, 2025
Reviewed by:	Mr. Abdulellah Ayed Al Mutairi	QM&PS Director		January 09, 2025
Reviewed by:	Dr. Tamer Mohamed Naguib	Medical Director		January 12, 2025
Approved by:	Mr. Fahad Hazam Al - Shammari	Hospital Director		January 19, 2025