

# PAEDIATRIC PARENTERAL NUTRITION - INDIAN CONTEXT

**Dr. Sarath Gopalan**

**Senior Consultant in Pediatric  
Gastroenterology, Hepatology**

**Indraprastha Apollo Hospital, New Delhi**



## Neonates, 0 – 3kg bodyweight Regimens 1 – 4

Regimens 1 to 3 are used for the first three days of parenteral nutrition, regimen 4 is used for day 4 and beyond.

Regimen number:	/kg/day	1	2	3	4
Amino Acid	g	0.8	1.5	2.0	2.5
Carbohydrate	g	10	12	12	14
Fat	g	1	2	3	3.5
Sodium	mmol	3	3	3	3
Potassium	mmol	2.5	2.5	2.5	2.5
Calcium	mmol	1	1	1	1
Magnesium	mmol	0.2	0.2	0.2	0.2
Phosphate	mmol	0.4*	0.4*	0.4*	0.4*
Iron	µg	100	100	100	100
• Solivito <sup>®</sup> N ♦	ml	1	1	1	1
• Vitlipid <sup>®</sup> N Infant ♦	ml	1	1	1	1
Peditrace <sup>®</sup> ♦	ml	0.5	1	1	1
Per kg bodyweight / 24 hours					



## Patients over 1 month old but under 10kg bodyweight Regimens 5 to 8

Regimens 5 to 7 are used for the first three days of parenteral nutrition, regimen 8 is used for day 4 and beyond.

Regimen number:	/kg/day	5	6	7	8
Amino Acid	g	1	1.5	2.0	2.5
Carbohydrate	g	10	12	13	14
Fat	g	1	2	2	3
Sodium	mmol	3	3	3	3
Potassium	mmol	2.5	2.5	2.5	2.5
Calcium	mmol	0.6	0.6	0.6	0.6
Magnesium	mmol	0.1	0.1	0.1	0.1
Phosphate	mmol	0.4*	0.4*	0.4*	0.4*
Iron	µg	100	100	100	100
• Solivito <sup>®</sup> N ♦	ml	1	1	1	1
• Vitlipid <sup>®</sup> N Infant ♦	ml	1	1	1	1
Peditrace <sup>®</sup> ♦	ml	1	1	1	1
Per kg bodyweight / 24 hours					



## Patients over 10kg but under 15kg bodyweight Regimens 9-11

Regimens 9 and 10 are used for the first two days of parenteral nutrition, regimen 11 is used for day 3 and beyond.

Regimen number:	/kg/day	9	10	11
Amino Acid	g	1	1.5	2.0
Carbohydrate	g	5	8	10
Fat	g	1.5	2	2.5
Sodium	mmol	3	3	3
Potassium	mmol	2.5	2.5	2.5
Calcium	mmol	0.2	0.2	0.2
Magnesium	mmol	0.07	0.07	0.07
Phosphate	mmol	0.1*	0.1*	0.1*
Iron	µg	100	100	100
• Solivito <sup>®</sup> N ♦	ml	1	1	1
• Vitlipid <sup>®</sup> N Infant ♦	ml	1	1	1
Peditrace <sup>®</sup> ♦	ml	1	1	1
Per kg bodyweight / 24 hours				



## Patients over 15kg but under 20kg bodyweight Regimens 12 to 14

Regimens 12 and 13 are used for the first two days of parenteral nutrition, regimen 14 is used for day 3 and beyond.

Regimen number:	/kg/day	12	13	14
Amino Acid	g	1	1.5	2.0
Carbohydrate	g	4	6	8
Fat	g	1.5	2	2
Sodium	mmol	3	3	3
Potassium	mmol	2	2	2
Calcium	mmol	0.2	0.2	0.2
Magnesium	mmol	0.07	0.07	0.07
Phosphate	mmol	0.1*	0.1*	0.1*
Additrac <sup>®</sup> ♦	ml	0.1	0.1	0.1*
Per kg bodyweight / 24 hours				
• Solivito <sup>®</sup> N ♦	ml (total)	10	10	10
• Vitlipid <sup>®</sup> N Infant ♦	ml (total)	10	10	10



## Patients over 20kg but under 30kg bodyweight Regimens 15 to 16

Regimen 15 is used on day 1 of parenteral nutrition, regimen 16 is used for day 2 and beyond.

Regimen number:	/kg/day	15	16
Amino Acid	g	1.5	2.0
Carbohydrate	g	4	8
Fat	g	1	2
Sodium	mmol	3	3
Potassium	mmol	2	2
Calcium	mmol	0.2	0.2
Magnesium	mmol	0.07	0.07
Phosphate	mmol	0.1*	0.1*
Additrac <sup>®</sup> ♦	ml	0.1	0.1*
Per kg bodyweight / 24 hours			
• Solivito <sup>®</sup> N ♦	ml (total)	10	10
• Vitlipid <sup>®</sup> N Infant ♦	ml (total)	10	10





## Patients over 30kg Regimens 17 to 18

Regimen 17 is used on day 1 of parenteral nutrition, regimen 18 is used for day 2 and beyond.

Regimen number:	/kg/day	17	18
Amino Acid	g	1	1.5
Carbohydrate	g	3	5
Fat	g	1	2
Sodium	mmol	3	3
Potassium	mmol	2	2
Calcium	mmol	0.2	0.2
Magnesium	mmol	0.07	0.07
Phosphate	mmol	0.1*	0.1*
Additrac <sup>®</sup> ♦	ml	0.1■	0.1■
Per kg bodyweight / 24 hours			
• Solivito <sup>®</sup> N ♦	ml (total)	10	10
• Vitlipid <sup>®</sup> N Adult ♦	ml (total)	10	10



# PN DELIVERY

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graph TD; A[PN DELIVERY] --> B[CENTRAL]; A --> C[PERIPHERAL]; A --> D[ALL-IN-ONE INFUSION]; A --> E[INFUSING FROM SEPARATE BAGS];
```

**CENTRAL**

**PERIPHERAL**

**ALL-IN-ONE  
INFUSION**

**INFUSING  
FROM  
SEPARATE  
BAGS**



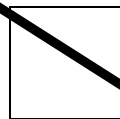


**AMINO ACIDS**

**DEXTROSE**

**LIPID**

**FILTER**



**ALL-IN-ONE**



**AMINO ACIDS**

**LIPID**

**DEXTROSE  
WITH MEDICATIONS**

**FILTER**

**CENTRAL LINE**

**PERIPHERAL LONG LINE**



# PN products available in Indian market

## A) AMINO ACID INFUSIONS

### 1. Standard infusions

Strength

a. 6%

Volume

100ml

Protein content

6g

b. 10%

100ml

10g



**B) LIPID INFUSIONS  
MCT/LCT SOLUTION**

**20%**

**250ml**

**450cal**

**LCT SOLUTION ONLY**

**10%**

**100ml**

**90cal**

**10%**

**50ml**

**45cal**

**SMOF LIPID**



## **C) DEXTROSE**

<b>5%</b>	<b>500ml</b>
<b>10%</b>	<b>500ml</b>
<b>20%</b>	<b>500ml</b>
<b>25%</b>	<b>As ampoules</b>
<b>50%</b>	<b>50ml ampoule &amp; 100ml bottle</b>



# Pediatric PN - fluid and energy requirements

- **Fluid requirement = maintenance +deficit correction +replacement of ongoing losses.**
- **PN should be used for maintenance needs .**
- **Total daily energy requirement (kcal/d)=REE+REE X (total factors)**

**Factors=Maintenance +Activity + Fever+ Simple Trauma +Multiple Injuries +Burns +Growth**



# Practical approach to pediatric PN administration

SUBSTRATE	INITIATE	ADVANCE MENT	GOALS
DEXTROSE	10%	2-5%/d	25%
AMINO ACIDS	1 g/kg/d	0.5-1g/kg/d	2-3 g/kg/d
LIPIDS	1 g/kg/d	0.5-1 g/kg/d	2-3 g/kg/d





# PN Indications

Patients who cannot be completely fed orally or enterally

- Measure the cost-benefit relationship
- Evaluate the possibility of accomplishing an adequate enteral intake in a short time
- For patients with chronic intestinal failure, consider home-based PN

*Not indicated* in terminal patients whose therapeutic support is being removed



# Vein Access & Catheter Complications

- Polyurethane & silicon catheters: less thrombogenic, traumatic
- Subclavian CVA is preferable to femoral CVA
- Children have the same incidence of mechanical and infectious complications with femoral catheters in comparison to jugular or subclavian ones
- The choice of the insertion site depends on the team's experience
- Security is greater with catheters placed with ultrasounds
- The position of the tip of the catheter must be confirmed= Outside the pericardic sac

## Infectious

- Catheter-related sepsis
- Cultures
- Wide spectrum antibiotics depending on local patterns

## Mechanical

- Occlusion
- Thrombosis
- Catheter migration
- Accidental removal or damage



# Liquids

## Preliminary fluid volume calculation

Weight	Volume
First 10 kg	100 ml/kg
11-20 kg	1000 ml + 50 ml/kg for every kilo over 11
> 20 kg	1500 ml + 20 ml/kg for every kilo over 21



# Equations for estimating energy expenditure (REE)

Group Age	WHO	Harris-Benedict
0-3 years	<p><u>Male:</u>  <math>REE = 60.9 \times Wt - 54</math></p> <p><u>Females:</u>  <math>REE = 61 \times Wt - 51</math></p>	<p><u>Male:</u>  <math>REE = 66.47 + 13.75 \times Wt + 5.0 \times Ht - 6.76 \times age</math></p> <p><u>Female:</u>  <math>REE = 655.10 + 9.56 \times Wt + 1.85 \times Ht - 4.68 \times age</math></p>
3-10 years	<p><u>Male:</u>  <math>REE = 22.7 \times Wt + 495</math></p> <p><u>Female:</u>  <math>REE = 22.4 \times Wt + 499</math></p>	<p><u>Male:</u>  <math>REE = 66.47 + 13.75 \times Wt + 5.0 \times Ht - 6.76 \times age</math></p> <p><u>Female:</u>  <math>REE = 655.10 + 9.56 \times Wt + 1.85 \times Ht - 4.68 \times age</math></p>



# Electrolytes

Electrolyte	Under 1 year	Over 1 year
Sodium	3-4 mEq/ kg	2-4 mEq / kg.
Potassium	2-3 mEq/ kg	2 -3 mEq / kg
Calcium	40-60 mg/kg Max 700mg/L	10-50 mg / kg Max 700mg/L
Phosphorus	20-45 mg /kg 0,5 – 1,5 mmol/kg Max 20mMol/L	15-40 mg/Kg 0,5- 1,5 mMol/ kg Max 20mMol/L
Magnesium	25-50 mg /kg 0.25-1 mEq/Kg	25-50 mg/ kg 0.25-1 mEq/Kg



# Aminoacids

Essential	Non Essential	Conditionally Essential
Histidine	Alanine	Arginine
Isoleucine	Aspartic Acid	Cysteine
Leucine	Asparagine	Glycine
Lysine	Glutamic Acid	Proline
Methionine	Serin	Thyrosine
Phenylalanine		Glutamin
Treonine		
Tryptofane		
Valine		



# Carbohydrates

Weight	Day 1	Day 2	Day 3	Day 4
3- 10 kgs	5 mg/kg/min Start D10%	8 mgs /kg/ min	10 mg/kg/min	11-15 mg/kg/min
10- 15 kg	4 mg/kg/min Start D10%	5 mg/kg/min	7 mg/kg/min	8,5-15 mg/kg /min
15-20 kg	2,5mg/kg/mi Start D10%	4 mg/kg/min D15%	5 mg/kg/min	8- 15 mg /kg/ min
20- 30 kg	2,5 mg/kg/min Start D10%	4 mg/kg/min	5 mg/kg/min	10 <15 mg/kg/min
➤30 kgs ➤Adolescents	2 mg/kg/min	4 mg/kg/min	5 mg /kg/min	8-10 mg /kg/min





# Lipids

- **Source of energy and essential fatty acids**
  - **25-40% of the non-proteic caloric intake in lipids is recommended**
  - **Linoleic acid intake of 0,1 g/kg. the minimum amount of alpha linolenic acid is not clear.**
  - **The lipid intake must be limited to a maximum of 3-4g/kg/day. Ideally, not use >1g/Kg to decrease tendency of cholestasis parenteral nutrition related**
  - **Monitor triglycerides with each increase of 1g/kg and after the maximum intake, monitor once a week**
  - **Maximum allowed limit of triglycerides max 200mg/dL**
- **Lipid emulsions contain**
    - Soy oil, egg yolk phospholipids and glycerin as the emulsifier
    - Soy oil/ olive oil, phospholipids and glycerol.
    - Emulsions that contain LCT/MCT
    - In the U.S. other emulsions containing fish oil like Omegaven® (omega 3 fatty acid) and Smof® (30% soy bean; 30%MCT; 15% Fish oil; and 25% Olive oil) have been tested in Peds and are safe.
  - **Pediatric patients: 20% emulsions in pediatrics**



# Vitamins

Vitamin	Babies ( dose /kg/day)	Children
Vitamin A (µg)	150-300	150
Vitamin D (µg)	0,8( 32UI)	10( 400 UI)
Vitamin E (µg)	2,8-3,5	7
Vitamin K (µg)	10 (no posible)	200
Vitamin C(mg)	15-25	80
Thiamine ( mg)	0,35-0,50	1,2
Riboflavin ( mg)	0,15-0,2	1,4
Pyridoxine (mg)	0,15-0,2	1
Niacin (mg)	4,0-6,8	17
B12 (µg)	0,3	1
Pantothenic Acid (mg)	1-2	5
Biotin (µg)	5-8	20
Folic Acid (µg)	56	140



# Trace Elements

Element	Recommendation
Copper	20 µg/kg
Manganese	1µg ( 0.018 µmol)/ kg. Maximo 50 µg / day
Molybdenum	0,25µg/kg/dia hasta un maximo 5 µg/ dia
Selenium	2-3 µg/ kg max Neonates 136mcg/day >1y-12 =176 >12Y max 264 mcg/day
Zinc	Preterm 400 µg/kg 250µg/kg/day < 3 meses 100 µg/kg/day > 3 m 100 µg / kg/ day; max 4 µg /day >7 years



# Monitoring

## Initial monitoring

Weigh twice a day

Balance of administered and eliminated fluids

Daily osmolarity, glucose, protein and urinary pH

Twice a week serum and urinary electrolytes, hematocrit, liver function tests.

Serum proteins



# Pediatric PN - monitoring

	<b>WEIGHT</b>	<b>URINE DRIP FOR GLUCOSE</b>	<b>BEDSIDE GLUCOSE</b>	<b>LABS</b>
FIRST WEEK	DAILY	Q SHIFT	Q SHIFT	DAILY SMA-7, Ca, Mg, Phos, triglycerides Q OD LFTs
SUBSEQUENTLY	DAILY	Q SHIFT	Q SHIFT	SMA-7, Ca, Mg, Phos. twice weekly CBC, LFTs weekly triglycerides twice weekly



# Complications

**Infections**

**Instability of mixtures**

**Incompatibility with medications**

**Hydroelectrolytic imbalance**

**Hyper- or hypoglycemia**

**Proteic excess**

**Bone disease**

**Hepatobiliary complications**

**Refeeding syndrome**

**Growth deficiencies**

