Intravenous fluid management for neonates

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INTRAVENOUS FLUID MANAGEMENT FOR NEONATES

FOCUS ON FLUIDS: SUPPORTING BEST PRACTICE NEONATAL AND PAEDIATRIC FLUID MANAGEMENT

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OUTLINE

- Neonatal fluid and electrolyte requirements are different:
  - Fluid shifts after birth
  - Insensible water loss
  - Reduced renal function
  - Low birth weight
- IV fluids
  - Requirements
  - Types
- Role of parenteral nutrition in SCN

FLUID SHIFTS AFTER BIRTH

- **WATER COMPARTMENTS**

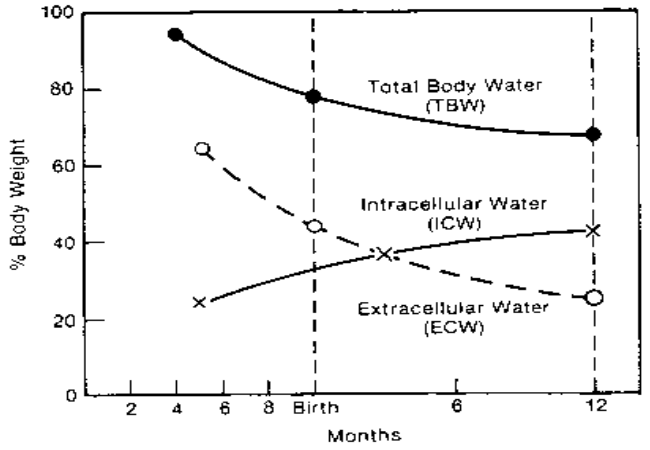
Total Body Water (TBW)

TBW = Intracellular water (ICW)
+ Extracellular water (ECW)

ECW = Interstitial fluid + plasma

FLUID SHIFTS AFTER BIRTH

- TBW ↓ with ↑ gestation, secondary to ↓ ↓ ECW and ↑ ICW
  - Early fetus: 95% TBW
  - 24W: 85% TBW (60% ECW)
  - Term: 75% TBW (45% ECW)
  - Adult: 70% TBW



FLUID SHIFTS AFTER BIRTH

- Excess of extracelluar water
- TBW ↓ secondary to ↓ ECW in **ALL** term and preterm infants
  - First 48-72 hours

INSENSIBLE WATER LOSS

- Evaporation from skin (~70%) & respiratory tract (~30%)
- Normal: ~40mL/kg/day
- Increased by:
  - Lower birth weight and gestation
  - ↑ minute ventilation (dry gas)
  - ↑ skin blood flow – phototherapy, radiant heater
  - Ambient temperature outside neutral thermal environment, hyperthermia
- Decreased by:
  - ↑ humidity: inspired gas and ambient humidity
  - Heat shields: double walled incubators, bubble wrap

RENAL FUNCTION

- Nephron numbers increase to 35 weeks
  - Fetal urine output increases with gestation
- GFR low in utero, increases from birth
  - Physiological diuresis
- Urine output 1 – 3 mL/kg/hour
- Preterms:
  - High urinary sodium loss
  - High urinary HCO_3^- loss

WEIGHT

- ***Weight loss of 10 – 15% is physiological and normal***
- ***Calculate fluids based on birth weight until regained***

SODIUM

- Normal: 135 – 145 mmol/L
- Requirement: 2 – 3 mmol/kg/day
  (after 48 – 72 hours)

- Low serum sodium (<130 mmol/L)
  First 72 hours = Requires less water
  Fluid restrict, don't add Na

- High serum sodium (>150 mmol/L)
  First 72 hours = Requires more water
  Increase TFI

POTASSIUM

- Normal: 3 – 6 mmol/L

  Falsely high if capillary specimen haemolysed

- Requirement: 2 – 3 mmol/kg/day

  After 72 hours & with reasonable urine output

- Hyperkalaemia:

  Treat when K^+:

  >7.0 mmol/L with VT

  >7.5 mmol/L with peaked t waves on ECG

  >8.0 mmol/L (insulin & 25% dextrose, never resonium)

GLUCOSE

- Requirement: 4 – 8 mg/kg/min

Intake ml/kg/day	5% glucose	10% glucose	12.5% glucose
	mg/kg/minute glucose		
60	2.1	4.2	5.2
90	3.1	6.3	7.8
105	3.7	7.3	9.1
120	4.2	8.3	10.4
150	5.2	10.4	13.0

GLUCOSE

- If hypo or hyperglycaemic, calculate GUR mg/kg/min
- >12.5% glucose: run through central catheter due to osmolarity and risk of extravasation injury

IV FLUIDS

INDICATIONS

- Resuscitation
- > 32 weeks' requiring short-term IV fluids and/or antibiotics
- Nil orally for any reason
- Parenteral nutrition
- Transfusion red cells, platelets, fresh frozen plasma, etc

FLUID BALANCE

- Calculate for all newborns on IV fluids (and nil orally)

IV FLUID REQUIREMENTS:

- **Resuscitation:**
  - ***10 - 20 mL/kg Sodium Chloride 0.9% administered rapidly***

- **Maintenance fluids**
  - Insensible water loss **+** urine output **+** abnormal losses ("skin", GIT)
  - NICU: aim to run 'dry' rather than 'wet'

    Over hydration associated with ↑ PDA, CLD
  - Monitor and adjust according to:

    Current weight

    Serum Sodium (and acid-base)

    Urine output (and urine pH & SG)
  - Standardised solutions

Age	Nil orally mL/kg/day
<24 hours	60
24-48 hours	60 – 80
48-72 hours	80 – 100
72-96 hours	100 – 120
96-120 hours	120 – 140
120-144 hours	140 – 150
Day 6	140 – 150
Days 7+	140 – 150

* Dependent on birth weight and sodium

Age	Nil orally mL/kg/day	SCN (IV ± oral) mL/kg/day
<24 hours	60	60
24-48 hours	60 – 80	60
48-72 hours	80 – 100	80
72-96 hours	100 – 120	100
96-120 hours	120 – 140	120
120-144 hours	140 – 150	140
Day 6	140 – 150	160
Days 7+	140 -150	180

* Dependent on birth weight and sodium

Age	Nil orally mL/kg/day	SCN (IV ± oral) mL/kg/day	'Term' oral mL/kg/day
<24 hours	60	60	30-40
24-48 hours	60 – 80	60	30-40
48-72 hours	80 – 100	80	60
72-96 hours	100 – 120	100	80
96-120 hours	120 – 140	120	100
120-144 hours	140 – 150	140	120
Day 6	140 – 150	160	140
Days 7+	140 -150	180	150

* Dependent on birth weight and sodium

Age	Nil orally mL/kg/day	SCN (IV ± oral) mL/kg/day	'Term' oral mL/kg/day
<24 hours	60	60	30-40
24-48 hours	60 – 80	60	30-40
48-72 hours	80 – 100	80	60
72-96 hours	100 – 120	100	80
96-120 hours	120 – 140	120	100
120-144 hours	140 – 150	140	120
Day 6	140 – 150	160	140
Days 7+	140 -150	180	150

* Dependent on birth weight and sodium

IV FLUID TYPE

- Standardised fluids (maintenance and parenteral nutrition)

	500 mLs
First 48 hours	Glucose 10%
After 48 hours	Sodium Chloride 22mmol Potassium Chloride 10 mmol

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IV ACCESS

- Consider Umbilical lines (UVC & UAC) if:
  - Starting PN on day of birth
  - < 800 – 1000 grams birth weight
  - "Unwell"
  - Hypotension requiring inotropes
- Otherwise:
  - ***Peripheral venous catheter***
  - Long Line (Percutaneous CVC)

PARENTERAL NUTRITION

- Purpose:
  - Prevent catabolism
  - Promote positive nitrogen balance
  - Improve growth
  - Prevent essential fatty acid deficiency
- Indications:
  - Birth weight <1000g
  - VLBW preterm infants in whom enteral nutrition is unlikely to be achieved within the first 3-5 days
  - "Nil orally for >3 days for "feed intolerance" or necrotizing enterocolits
- Administered via:
  - UVC, Peripheral IV, Percutaneous CVC (long line)

STANDARDISED PN SOLUTIONS

- Australian consensus PN formulations
  - Glucose 10%
  - Starter PN solutions – minimal electrolytes
    - 3.3% and 5.0% (concentrated) amino acids
  - Standard/Maintenance PN solutions
    - 3.0% and 4.0% (concentrated) amino acids
  - Also:
    - Term PN (2.3% amino acids)
    - High sodium preterm
    - Glucose 7.5% preterm
  - Lipid:
    - Clinoleic – 80% olive oil/ 20% soybean oil
    - SMOF – fish oil emulsion

CONCENTRATED IVN SOLUTIONS - RWH

Conc/Litre	IVN Starter	IVN Maintenance
Amino Acids, g	50 (5%)	40 (4%)
Glucose, g	125 (12.5%)	100 (10%)
Energy, Kcal	480	380
Sodium, mmol	10	50
Potassium, mmol	0	40
Calcium, mmol	16	12
Phosphate, mmol	0	12
Acetate, mmol	10	43
Osmolarity, mOsmol	1152	1165

PN ADMINISTRATION - RWH

	IVN			Lipid 17%	
	Type	maximum g/kg/day	maximum mL/kg/day	maximum g/kg/day	maximum mL/kg/day
BW <1000g#					
Day 0	IVN Starter*	2	40	1**	6
Day 1	IVN Starter	2	40	1	6
Day 2	IVN Starter	3	60	2	12
	or IVN Maintenance	3	75	2	12
Day 3	IVN Maintenance	3	75	2	12
Day 4	IVN Maintenance	4	100	3	18
Day 5+	IVN Maintenance	4	100	3.5**	21
BW 1000-1500g					
Day 0	Nil	0	0	0	0
Day 1	IVN Starter*	2	40	1	6
Day 2	IVN Starter	3	60	2	12
	or IVN Maintenance	3	75	2	12
Day 3	IVN Maintenance	3	75	2	12
Day 4	IVN Maintenance	3	75	3	18
Day 5+	IVN Maintenance	3.5	87.5	3	18
BW >1500g#					
Day 0	Nil	0	0	0	0
Day 1	Nil	0	0	0	0
Day 2	IVN Maintenance	2	50	1	6
Day 3	IVN Maintenance	2	50	2	12
Day 4+	IVN Maintenance	3	75	3	18

*Consider in 1000-1250g on respiratory support.

*Must be given via central catheter (UVC, PICC or CVL); if no central access, consider using IVN Maintenance solution.

**If TFI allows.

**Can be increased to 4g/kg/day after discussion with consultant.

#only use IVN if baby is not expected to reach full enteral feeds (120mL/kg/day) within 7 days.

SUMMARY

- Neonatal fluid and electrolyte requirements are unique:
  - Fluid shifts after birth
  - Insensible water loss
  - Reduced renal function
  - Low birth weight
- Use weight (birth then current) and serum sodium to determine IV fluid orders
- Standardise IV and PN solutions
- Prioritise enteral feed establishment (breast milk)