Neonatal fluid requirement/therapy & special condition

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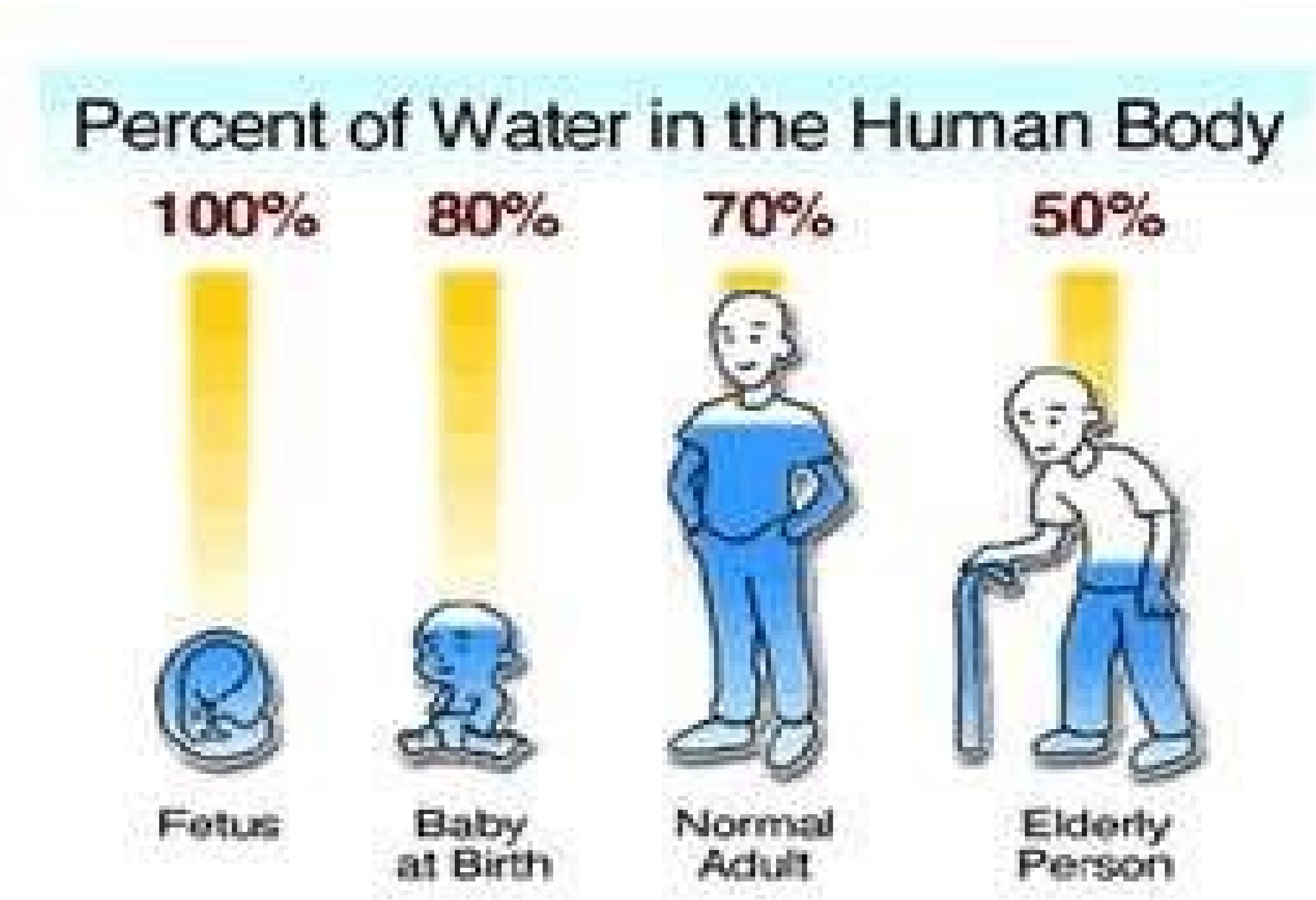
Life originates in water

OVERVIEW

- Introduction
- Developmental changes.
- Physiology of regulation.
- Maturation of organs regulating body composition
- Management of fluid & electrolyte requirement
- Monitoring of fluid & electrolyte status
- Special condition
- Key home message

INTRODUCTION

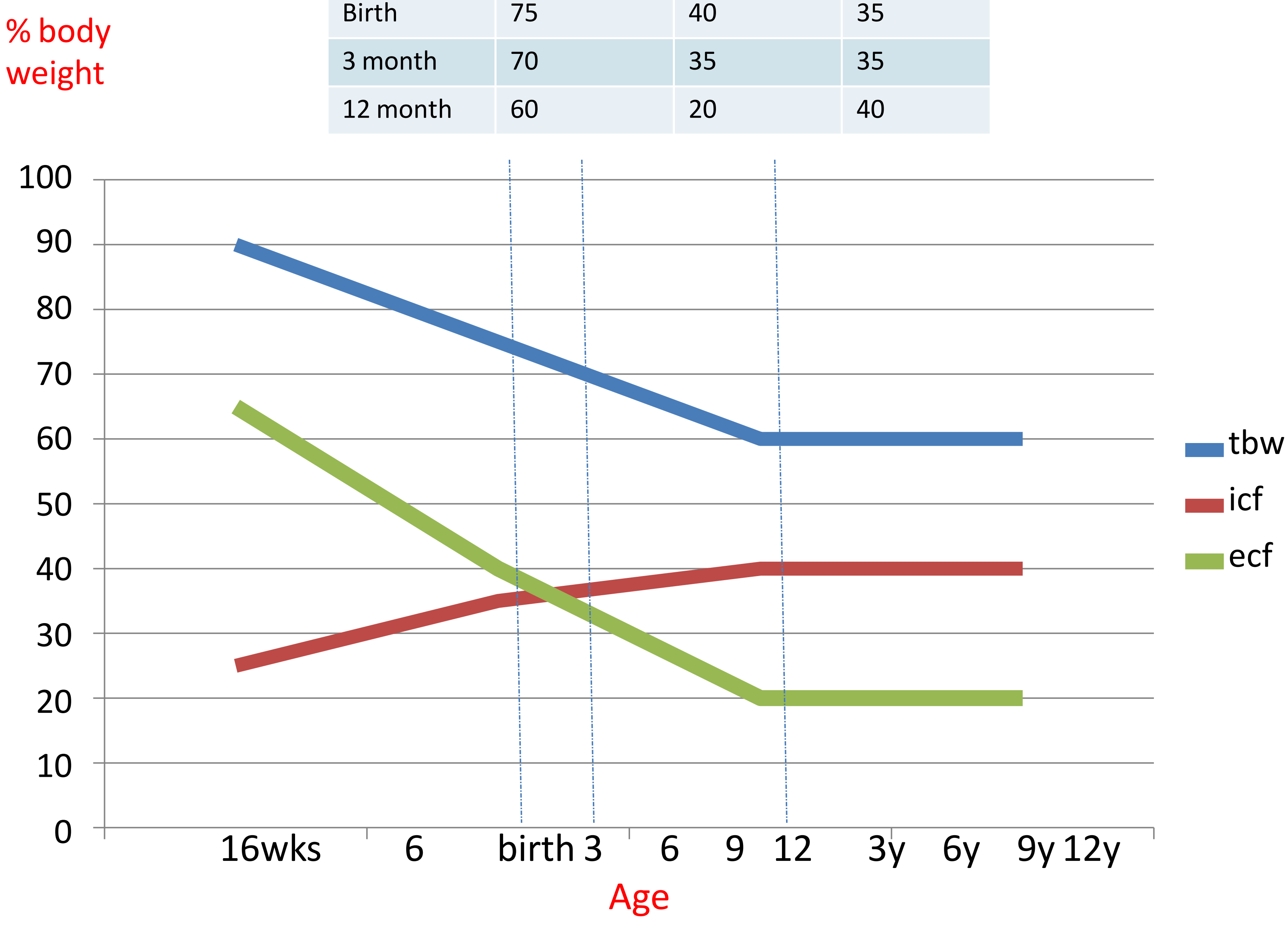
- Disorders of fluid and electrolyte are common in neonates.
- Proper understanding of physiological changes in fluid and electrolyte after birth is necessary to overcome the morbidities.


Percent of Water in the Human Body
100%
80%
70%
50%
Fetus
Baby at Birth
Normal Adult
Elderly Person

Developmental changes affecting fluid & electrolyte balance in fetus & neonates

- Changes during intrauterine period
- changes during labour & delivery
- Changes in postnatal period

Age	TBW %	ECF %	ICF %
16 wks	90	60	30
Birth	75	40	35
3 month	70	35	35
12 month	60	20	40

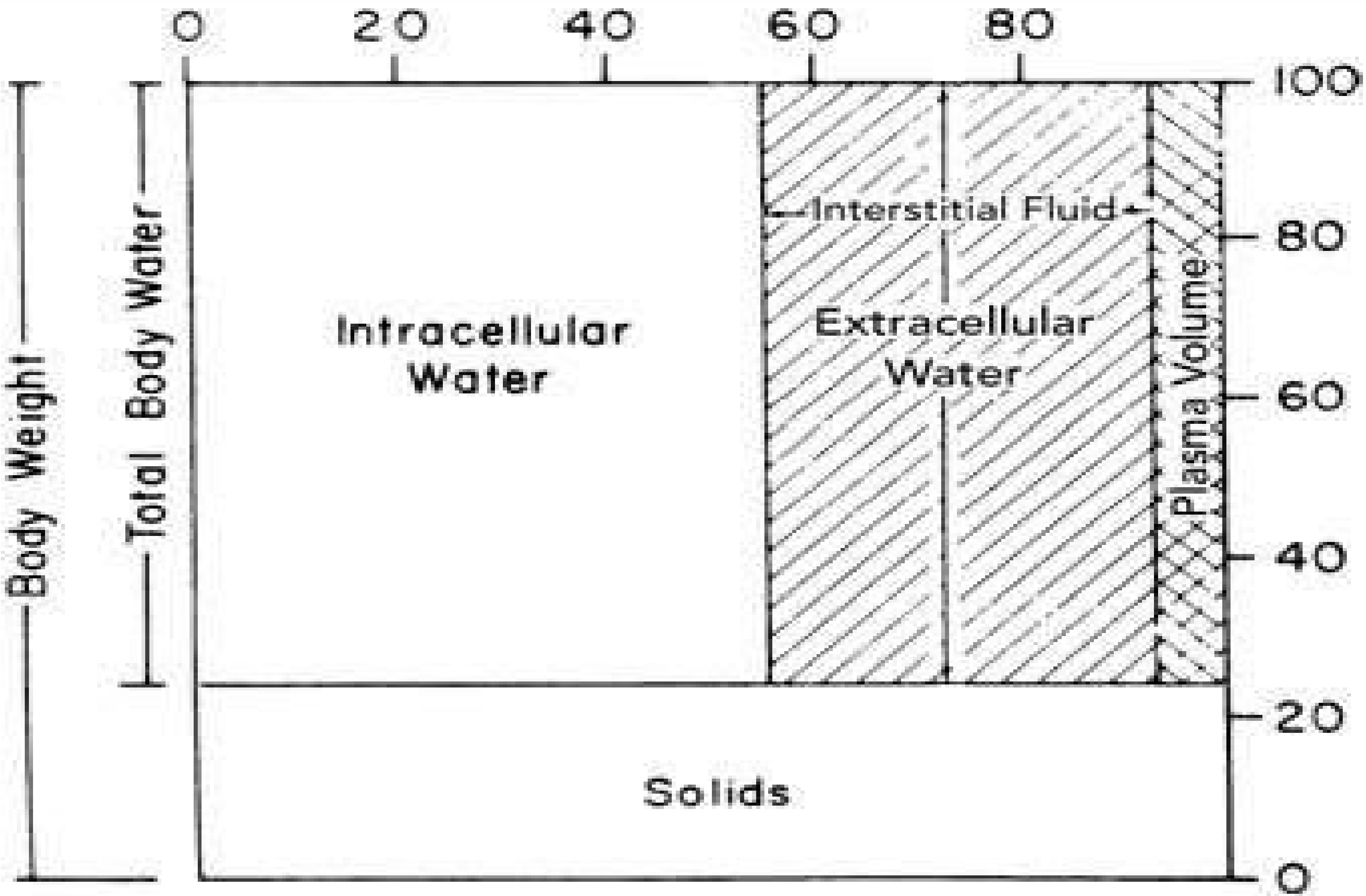


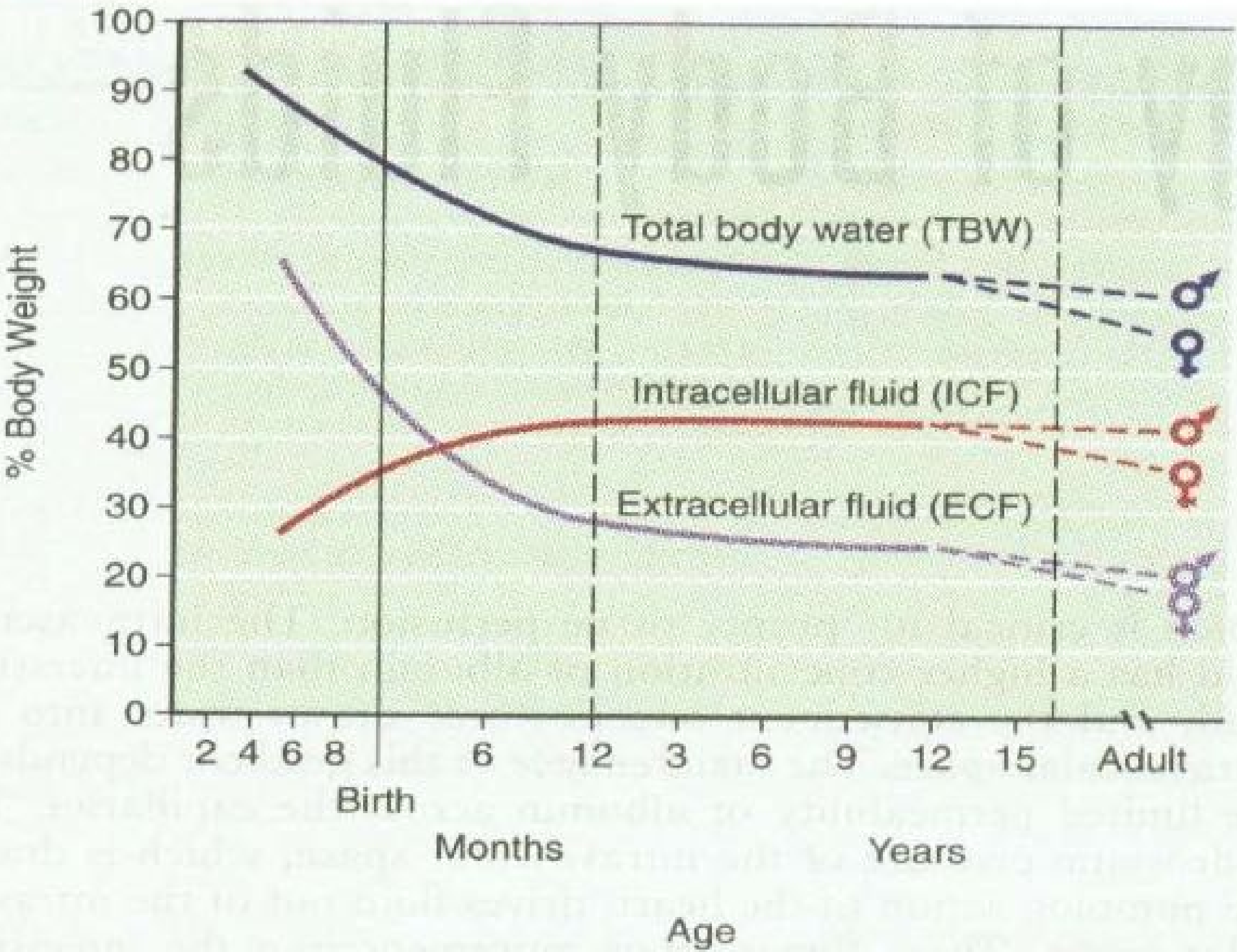
Age wise distribution of TBW

Age	TBW %	ECF %	ICF %
16 wks	90	60	30
Birth	75	40	35
3 month	70	35	35
12 month	60	20	40

- Therefore infants born <u>prematurely have TBW excess and extracellular volume expansion</u> compared with their term counterparts with majority of expanded ECF being distributed in the interstitium.

Distribution of body water in a term newborn infant




100
90
80
70
60
50
40
30
20
10
0
% Body Weight
Total body water (TBW)
Intracellular fluid (ICF)
Extracellular fluid (ECF)
2 4 6 8
Birth
6
12
Months
3
6
9
12
15
Years
Adult
Age

Things to consider:

Normal changes in TBW, ECF

- All babies are born with an excess of TBW, mainly ECF, which needs to be removed
  - Adults are 60% water (*20% ECF*, 40% ICF)
  - Term neonates are 75% water (*40% ECF*, 35% ICF) : lose 5-10 % of weight in first week
  - Preterm neonates have more water (23 wks: 90%, *60% ECF*, 30% ICF): lose 5-15% of weight in first week

Things to consider:

Normal changes in Renal Function

- Adults can concentrate or dilute urine very well, depending on fluid status
- Neonates are not able to concentrate or dilute urine as well as adults - at risk for dehydration or fluid overload
- Renal function matures with increasing:
  - gestational age
  - postnatal age

Changes during labor & delivery

- Arterial blood pressure rises several days before delivery in response to increases in catecholamine, vasopressin, and cortisol plasma concentrations and translocation of blood from the placenta into the fetus.
- This rise in arterial blood pressure, along with changes in the fetal hormonal milieu and an intrapartum hypoxia-induced increase in capillary permeability, results in a shift of fluid from the intravascular to the interstitial compartment.

- This fluid shift results in an approximately 25% reduction in circulating plasma volume in the human fetus during labor and delivery

- Healthy term newborns lose an average of 5% to 10% of their birthweight during the first 4 to 7 days of life

- Because preterm infants have an increased TBW content and extracellular volume, they lose an average of 10% to15% of their birthweight during transition.

- Failure to loose this ECW may be associated with overhydration and problems of patent ductus arteriosus (PDA), necrotizing enterocolitis (NEC) and chronic lung disease (CLD) in preterm neonates.

Fluid compartment ,composition & their physiological regulation

- TBW = ECF + ICF
- (60%) (20%) (40%)

- ECF = Intravascular fluid + Interstitial Fluid

  (20%) (5%) (15%)

PLASMA (in meq/L)

Na+ 140	HCO_3^- 24
	Cl 105
	Protein 15
K+ 5	HPO_4^{2-} 5
Ca2+ 5	SO_4^{2-} 4
Mg2+ 3	R- 2

ISF

Na+ 144	HCO_3^- 24
	Cl- 118
K+ 5	$HPO_4$3 5
Ca2+ 5	SO_4^{2-} 4
Mg2+ 5	R- 2

INTRACELLULAR FLUID

Na+ 6	
K+ 154	
Mg2+ 40	

Osmolality

- Calculated osmolality

  2 [Na+] + [Glucose] /18 + [BUN]/2.8

- Effective osmolality /Tonicitiy

  2[Na+] + [Glucose]/18

- Measured Osmolality –measured by degree of freezing point depression

Maturation of Organs Regulating Body Composition and Fluid Compartments

- ***Maturation of the Cardiovascular System***

◉There is a direct relationship between gestational maturity and the ability of the neonatal heart to respond to acute volume loading .

◉ The blunted Starling response of the immature myocardium results from its lower content of contractile elements and incomplete sympathetic innervations.

- Because central vasoregulation and endothelial integrity are also developmentally regulated , an appropriate effective intravascular volume is seldom maintained in a critically ill preterm infant.

- During the first few weeks of life, hemodynamically stable but extremely immature infants produce dilute urine and may develop polyuria because of their renal tubular immaturity.
- As tubular functions mature, their concentrating capacity gradually improves from the 2nd to 4th week of life. However, it takes years for the developing kidney to reach the concentrating capacity of the adult kidney.

Skin changes

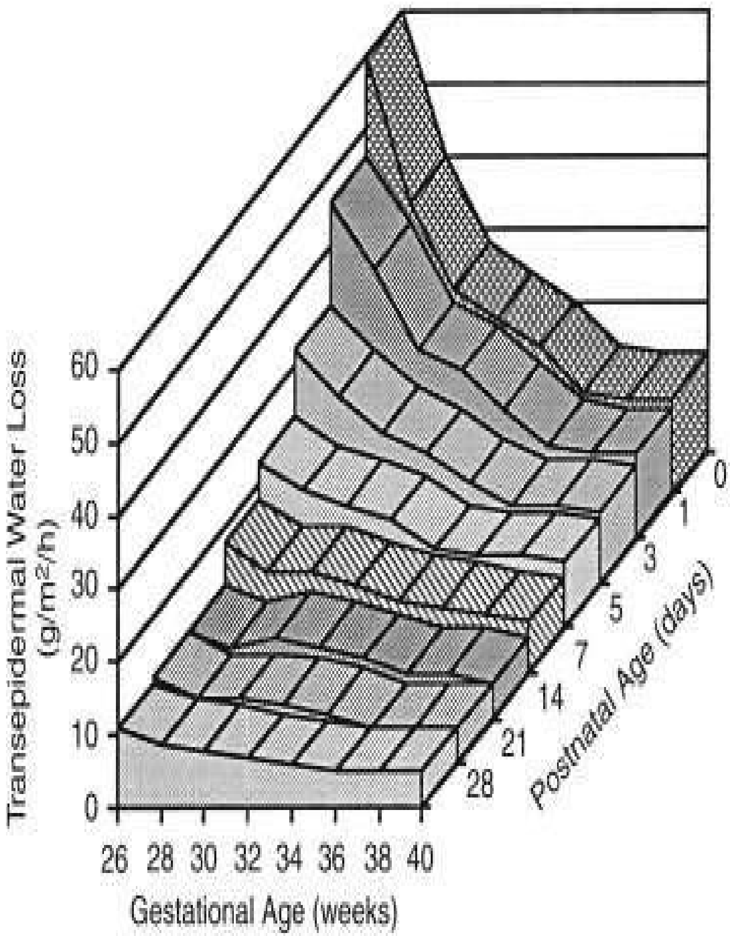
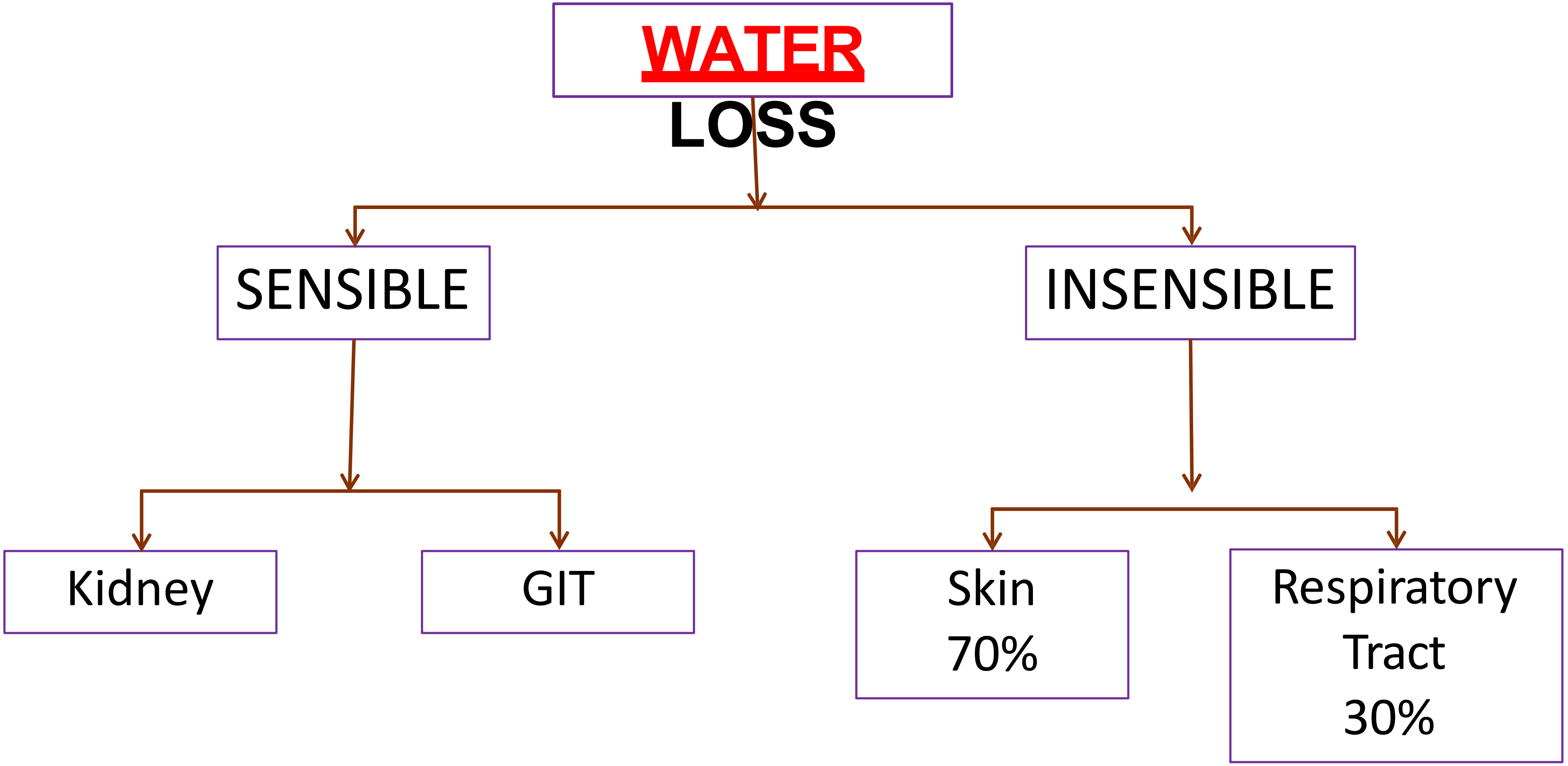


FIGURE 31-4 Transepidermal water loss in relation to gestational age during the first 28 postnatal days in infants who are appropriate for gestational age. There is an exponential relationship between transepidermal water loss and gestational age, the water loss being higher in preterm infants than in term infants. Transepidermal water loss is also significantly affected by postnatal age, especially in the immature preterm infant. The measurements were performed at an ambient air humidity of 50% and with the infants calm and quiet.

(From Hammarlund K, Sedin G, Stromberg B: Transepidermal water loss in newborn infants. VIII: Relation to gestational age and postnatal age in appropriate and small for gestational age infants. Acta Paediatr Scand 72:721-728, 1983.)


WATER LOSS
SENSIBLE
INSENSIBLE
Kidney
GIT
Skin 70%
Respiratory Tract 30%

Insensible Water Loss according to Birth Weight

BIRTH WEIGHT	IWL (ml/Kg/day)
<1000 gm	60-80
1000-1500 gm	40-60
>1500 gm	20

Management of fluid & electrolyte requirement

- Total fluid & electrolyte requirement =
  Resuscitation fluid + Maintenance fluid + Deficit
  fluid + ongoing losses

- Maintenance fluid = sensible water losses (urine + stool) + Insensible water loss (skin + lung)
  + Water for tissue growth

- IWL= Fluid intake-Urine output+wt loss or
  IWL=Fluid intake-Urine output – wt gain

- All, Resuscitation, maintenance, Deficit & ongoing fluid are different in volume,composition & rate of adminstration.

Sensible water loss

- Urine output is most important source of sensible water loss

- Extremely preterm infants without systemic hypotension or renal failure usually lose 30 to 40 mL/kg/day of water in the urine on the first postnatal day and approximately 120 mL/kg/day by the third day.

- In stable, more mature preterm infants born after the 28 weeks' gestation, urinary water loss is approximately 90 mL/kg/day on the first postnatal day and 150 mL/kg/day by the third day .
- Normal water losses in the stool are less significant, amounting to approximately 10 mL/kg/day in term infants and 7 mL/kg/day in preterm infants during the first postnatal week .

Insensible water losses

- Evaporation loss through skin usually contributes to 70% IWL ,rest 30% is contributed by respiratory tract.

- Gestational age, postnatal age, and environmental factors determine the amount of daily insensible water losses through the skin .

- During the first few postnatal days, transepidermal water losses may be 15-fold higher in extremely premature infants born at 23 to 26 weeks’ gestation than in term neonates

- Although the skin matures rapidly after birth, even in extremely immature infants, insensible losses are still somewhat higher at the end of the first month than in the term counterparts.

- Prenatal steroid exposure is associated with substantially less insensible water loss (IWL) in premature infants .

- Incubators, heat shields, transparent plastic barriers, coconut oil application, caps & shocks are effective in reducing insensible water loss.
- Thin transparent plastic barrier (e.g cling wrap) reduces IWL 50%-70% without interfering thermal regulation of warmer.
- The emphasis in fluid and electrolyte therapy should be on prevention of excessive IWL rather than replacement of increased IWL.

Mean IWL in incubators during first week of life

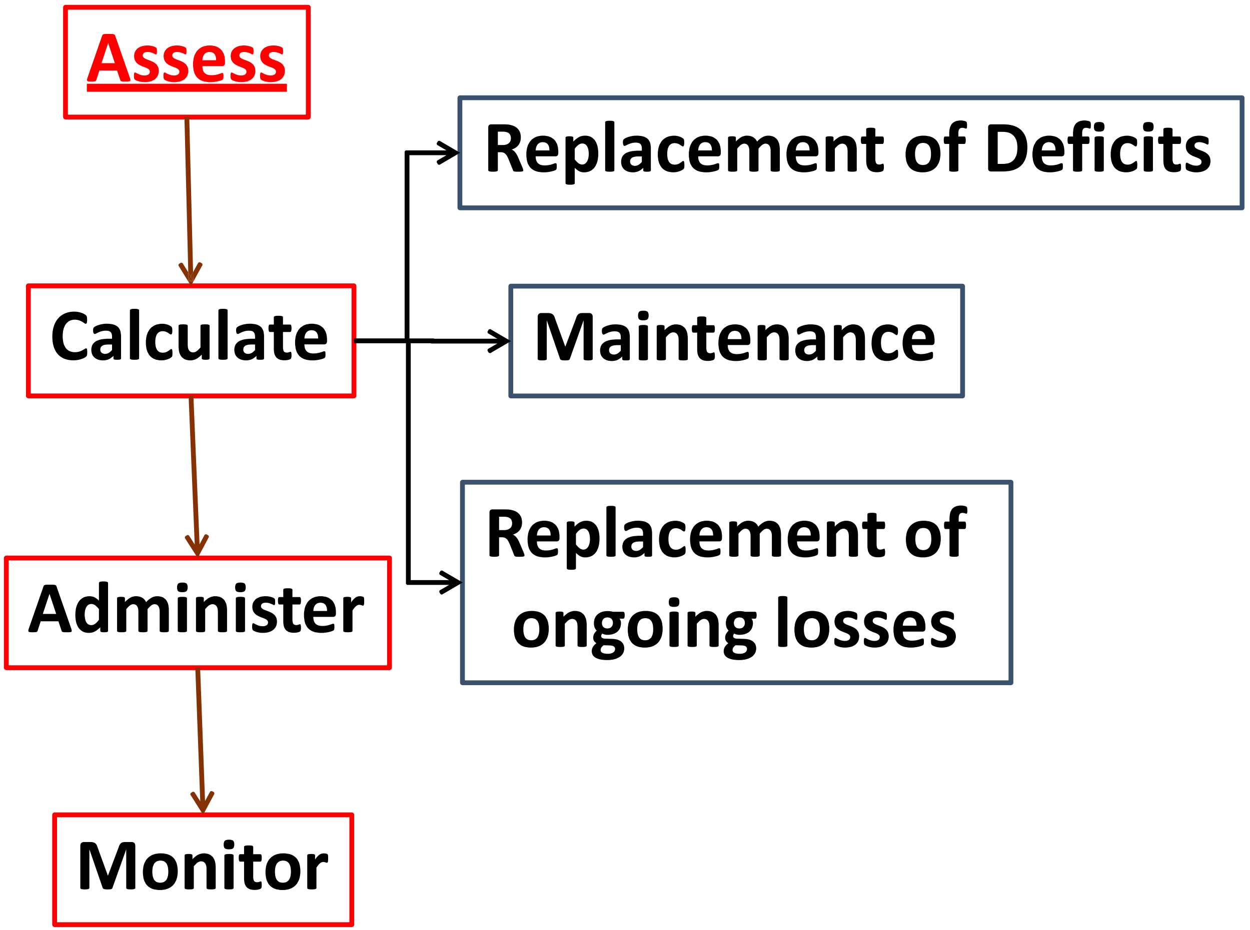
Birth weight (gm)	IWL(ml/kg/day)
750 -1000	82
1001 -1250	56
1251 -1500	46
>1501	26

Factors affecting insensible water loss in neonates

- ***Increased insensible water loss (IWL)***
- Increased respiratory rate, increase tidal volume,
- Conditions with skin injury (removal of adhesive tapes)
- Surgical malformations (gastroschisis, omphalocele, neural tube defects)
- Increased body temperature: 30% increase in IWL per oC rise in temperature
- High ambient temperature: 30% increase in IWL per oC rise in temperature
- Use of radiant warmer (50%) and phototherapy: (40%) increase in IWL
- Decreased ambient humidity.
- Increased motor activity, crying: 50-70% increase in IWL
- Increase surface area to body wt ratio

- ***Decreased insensible water loss (IWL)***
- Use of incubators
- Humidification & Temp of inspired gases in head box and ventilators
- Dead space ventilation
- Use of plexiglas heat shields
- Increased ambient humidity
- Thin transparent plastic barrier

PRINCIPLES OF THERAPY:



Assessment of fluid and electrolyte status

Maternal history

- excessive administration of hypotonic intravenous fluid.
- Placental dysfunction.
- Poorly controlled maternal diabetes.
- Maternal use of ACE inhibitors during pregnancy. (indomethacin, furosemide, and aminoglycoside).
- Antenatal steroids.

Newborn history

- The presence of polyhydramnios or oligohydramnios.
- Severe in utero hypoxemia or birth asphyxia.
- The environment in which an infant is cared. high ambient humidity decreases IWL, while the use of a radiant warmer or phototherapy may significantly increase an infant's IWL.

Clinical evaluation

Weight factors

- Sudden change in an infant's weight is important but not necessarily correlate with change in intravascular volume.
- long-term use of paralytic agents and septic shock or peritonitis--lead to increased interstitial fluid volume and increased body weight but decreased intravascular volume.

Skin and mucosa manifestations:

- Altered skin turgor, a sunken AF, and dry m.m are not sensitive indicators of dehydration in babies.

Cardiovascular signs

- Tachycardia (too much ECF or too little ECF).
- Delayed capillary refill (low cardiac output).
- Hepatomegaly can occur in neonates with ECF excess, (CHF).
- Blood pressure (BP) readings usually are normal, with mild or moderate hypovolemia. With severe hypovolemia, hypotension is almost present.

Laboratory evaluation

- Serum electrolyte, urea, creatinine, and plasma osmolarity levels (first 12-24 hours, may still reflect maternal values).
- Accurate total urine output and total fluid intake
- Blood gas analysis: Metabolic acidosis ---inadequate tissue perfusion.

Monitoring

1. weight : Term → 1-3% per Day / 5-10% first week

Preterm→2-3% per Day / 10-15% first week

Increased loss → fluid correction

Decreased loss → fluid restriction

2.Clinical Examination : signs unreliable

10% dehydration-signs of dehydration

15% dehydration-shock

3.Serum Biochemistry : Sr Na^+ & plasma osmolarity

Normal 135-145mmol/L

Monitor:

4. Urine Parameters :

Acceptable Range:

- **Output → 1-3ml/Kg/hr(oligurea UOP<1ml/kg/h)**
- **Specific Gravity → 1.005-1.012 (by Dipstick or Refractometer)**
- **Osmolarity → 100-400 mOsm/L (Freezing point osmometer)**

5. Blood Gas : Poor perfusion and Shock ➔ Metabolic Acidosis

Effect of pH on potassium — Potassium is primarily an intracellular cation. On average, the serum potassium concentration will rise by 0.6 mEq/L for every 0.1 unit reduction in extracellular pH.

6. Serum Creatinine, BUN : assess Renal Function

exponential fall in Serum Creat (excretion of Maternal)

serial samples – better indicator ➔ Renal failure

GUIDELINE FOR FLUID REQUIRMENT

Day 1 Term babies and babies with birth weight > 1500gms

- A **f**ull term infant on intravenous fluids would need to excrete a solute load of about 15 mosm/kg/day in the urine.
- The infant would have to pass a minimum of 50 ml/kg/day.
- Allowing for an additional IWL of 20 ml/kg, the initial fluids should be 60-70 ml/kg/day.
- The initial fluids should be 10% dextrose with no electrolytes to maintain GFR 4-6 mg/kg/min.
- Hence total fluid therapy on day 1 would be 60 ml/kg/day.

Day 1: Preterm baby with birth weight 1000-1500 grams

- ✓ Urine output similar to term baby however fluid requirement is more in preterm because of inreased IWL and increased weight loss(ECF loss).
- ✓ To reduce the IWL under warmer,there should be liberal use of socks,cap,plastic barriers.
- ✓ 80ml/kg/day of 10%dextrose is adequate on day 1.

Day 2 - Day 7: Term babies and babies with birth weight >1500gm

- ✓ As infant grows and receives enteral milk feeds, the solute load presented to the kidneys increases and the infant requires more fluid to excrete the solute load.
- ✓ Water is also required for fecal losses and for growth purposes.
- ✓ The fluid requirements increase by 15-20 ml/kg/day until a maximum of 150 ml/kg/day.
- ✓ Sodium and potassium should be added after 48 h of age and glucose infusion should be maintained at 4-6mg/kg/min

Day 2 – Day 7: Preterm babies with birth weight 1000-1500 grams

- ✓ As the skin matures in a preterm baby, the IWL progressively decreases and becomes similar to a term baby by the end of the first week. Hence,the fluid requirement would become similar to a term baby by the end of first week.
- ✓ Plastic barriers, caps and socks are used throughout the first week in order to reduce IWL from the immature skin.
- ✓ Fluids need to be increased at 10-15 ml/kg/day until a maximum of 150 ml/kg/day.

>Day 7: Term babies and babies with birth weight >1500 grams

Fluid should be given at 150-160 ml/kg/day.

>Day 7: Preterm babies with birth weight 1000-1500 grams

Fluids should be given at 150-160 ml/kg/day and sodium supplementation at 3-5 mEq/kg should continue till 32-34 weeks corrected gestational age.

Fluid Requirment

Birth wt (gm)	Day 1	Day 2	Day 3-6	Day >7
<750gm	100-140	120-160	140-200	140-160
750-100gm	100-120	100-140	130-180	140-160
1000-1500gm	80-100	100-120	120-160	150
>1500gm	60-80	80-120	120-160	150

Additional allowances

- These are applicable more for very preterm baby due to increased IWL
- Radiant warmer -20 ml/kg/day
- Phototherapy -20 ml/kg/day
- Increased body temperature -10-20 ml/kg/day

GUIDELINES FOR ELECTROLYTE REQUIRMENT

- SODIUM

  Do not add on day 1.

  Start after ensuring initial diuresis(U.O. > 1ml/kg/hr), a decrease in serum sodium (<130meq/L) or at least 5-6% wt loss.

- Term - 2 meq/kg/day
- Preterm- 2-3 meq/kg/day to begin with & 3-5 meq/kg/day after 1st week

- Potasssium
- Add from day 3rd after make sure baby has UOP of > 1ml/kg/hr & k+ <5.5meq/L. caution must be taken for ELBW who develop severe hyperkalemia in initial few days of life.

- Both term & preterm – 2 meq/kg/day

Calcium

- Add from day 1st to all sick babies & babies
  <1500 gm

- 36-72 mg/kg/day of elemental calcium
  i.e 4-8 ml/kg/day of 10% calcium gluconate

Choice of fluid

- Give 10% Dextrose (wt>1250gm) or 5% Dextrose(wt<1250gm) for the initial 48 hours of life.

- After the age of 48 hrs if the baby is passing urine 5 – 6 times a day, use commercially available IV fluid, such as Isolyte P.

- If the **premixed solution is not available or baby requires higher GIR (Glucose infusion rate),**

- Add normal saline (NS) 20 ml/kg body weight (which contains 3meq of Na /kg) to the required volume of 10% Dextrose. Add 1ml KCl/100ml of prepared fluid.

- To calculate the necessary fluid volume, determine the volume of fluid required for day of life . Provide this as 20 ml/kg of NS and the remaining as 10% Dextrose.

LABORATORY GUIDELINE FOR FLUID AND ELECTROLYTE THERAPY:

- Intravenous fluids should be increased in the presence of
  - (a) Increased weight loss(>3%/day or a cumulative loss >20%)
  - (b) Increased serum sodium (Na>145 mEq/L)
  - (c)Increased urine specific gravity (>1.020) or urine osmolality (>400mosm/L)
  - (d)Decreased urine output (<1 ml/kg/hr)

- Fluids should be restricted in the presence of
  - (a) Decreased weight loss (<1%/day or a cumulative loss <5%)
  - (b) Decreased serum sodium in the presence of weight gain (Na<130mEq/L)
  - (c) Decreased urine specific gravity (<1.005) or urine osmolality (<100mosm/L)
  - (d) Increased urine output (>3 ml/kg/hr)

Monitoring of babies receiving IV fluid

- Inspect the infusion site every hour.
- Look for redness and swelling around the insertion site of the cannula, which indicates that the cannula is not in the vein and fluid is leaking into the subcutaneous tissues.
- If redness or swelling is seen at any time, stop the infusion, remove the cannula, and establish a new IV line in a different vein.
- Check the volume of fluid infused and compare to the prescribed volume, record all findings.
- Measure blood glucose every nursing shift i.e. 6 – 8 hours.
- If the **blood glucose is less than 45 mg/dl, treat for low blood glucose**
- If the **blood glucose is more than 150 mg/dl on two consecutive readings: - Change**to a 5% Dextrose solution and measure blood glucose again in three hours

Management of F&E

Amount of fluid required in 1st few days of life :

Start fluid volume according to gestational age or BW

- **Preterm infant or BW <1500 gm ……….. start with 80ml/kg/day**
- **Term infant or BW >1500 gm …………. start with 60ml/kg/day**

Rate of increment is 20ml/kg/day till reaching 150- 160ml/kg/day or according to the infant needs.

*** Total fluids are calculated based on birth weight till baby become heavier than birth weight**

Electrolyte requirements

- For the first 24-48 hours, sodium, potassium, and chloride usually are not required.
- Later in the first week, needs are 1-2 mEq/kg/d for potassium and 2-4 mEq/kg/d for sodium and chloride.
- During the active growth period after the first week, needs for potassium increase to 2 mEq/kg/d, and for sodium and chloride to 3-5 mEq/kg/d.
- Some of the smallest preterm infants have sodium requirements as high as 6-8 mEq/kg/d because of the decreased capacity of the kidneys to retain sodium.

Glucose Intake

- The neonatal liver normally puts out 6 - 8 mg/kg/min of glucose.
- This is approximately the basal requirement of a newborn infant.
- Hypoglycaemia is severe if it persists despite an intake of >10 mg/kg/min.

Calculate the glucose intake :

- **Glucose intake (mg/kg/min)**

$$\text{Glucose intake (mg/kg/min)} = \frac{\textbf{Dextrose conc x Hourly Rate}}{\textbf{Weight (Kg) x 6}}$$

F&E in common neonatal conditions (no cook book)

RDS

- Adequate but not too much fluid.
- Excess leads to hyponatremia, risk of BPD.
- Too little leads to hypernatremia, dehydration.

BPD

- Need more calories but restricted fluids
- hence the need for fortification.
- If diuretics are used, w/f 'lyte.

PDA

- Avoid fluid overload. Fluid restriction.
- If indomethacin or Ibuprofen is used, monitor UOP.

Asphyxia

- May have renal injury or SIADH.
- Restrict fluids initially, avoid potassium.
- May need fluid challenge if cause of oliguria is.

GI obstruction

- If there are significant gastric aspirates(>10ml/kg/d), replace these ml for ml with 0.9% NaCl.

Chest/peritoneal drain

- If there are significant fluid losses, measure the volume and replace with 4% albumin.
- Monitor serum albumin concentrations.

Renal Impairment

- Restrict intake to insensible water loss + urine output.
- Monitor fluid balance, serum electrolytes and weight carefully.
- To differentiate between early Acute Tubular Necrosis, & a pre-renal cause. *Fractional Excretion of Sodium* will help sort it out.

$$FE\ Na^{+} = \frac{\text{Urine [Na]} \times \text{Serum Creatinine}}{\text{Serum [Na}^{+}\text{]} \times \text{Urine Creatinine}} \times 100\%$$

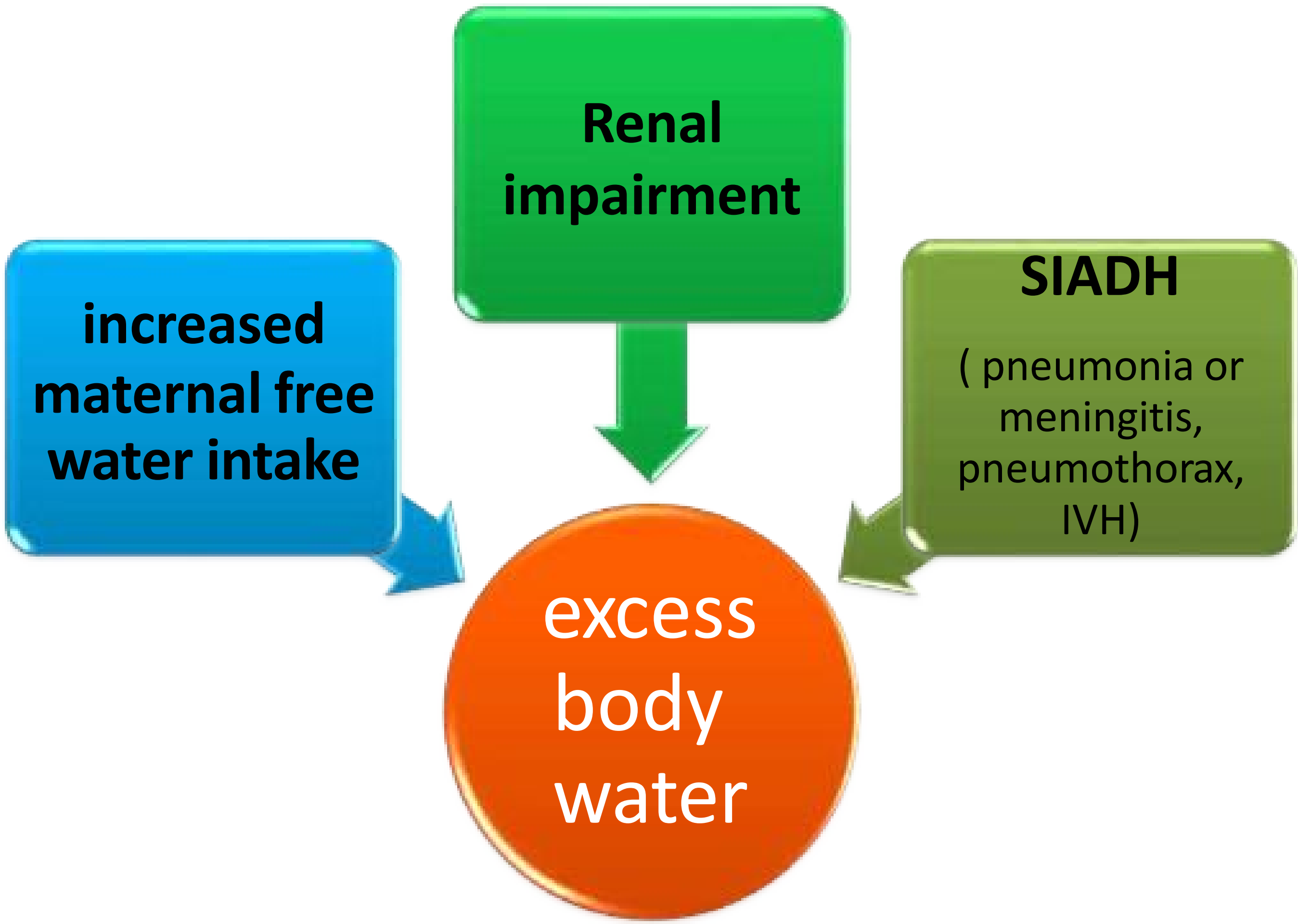
FE $Na^{+} \geq 2\%$ in term infants suggests renal failure.

FE $Na^{+} < 1\%$ in term infants suggests pre-renal failure.

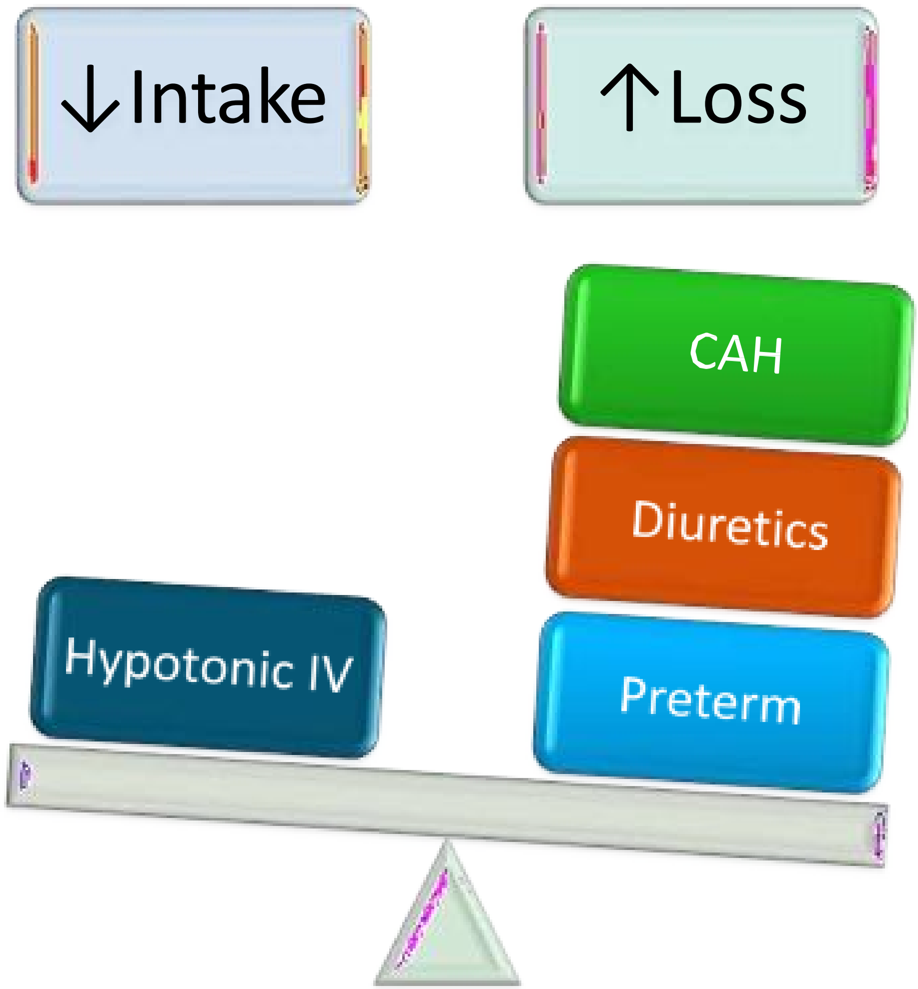
Electrolytes abnormality

Na	K	Ca
Hypo<130 (critical<125)	Hypo<3.5 (critical<3)	Hypo↓Total<7 (Ion<4)
Hyper>150	Hyper>6	Hyper↑Total>11 (Ion>5)

Hyponatremia Early(1st week)



Late hyponatremia(-ve Na balance)

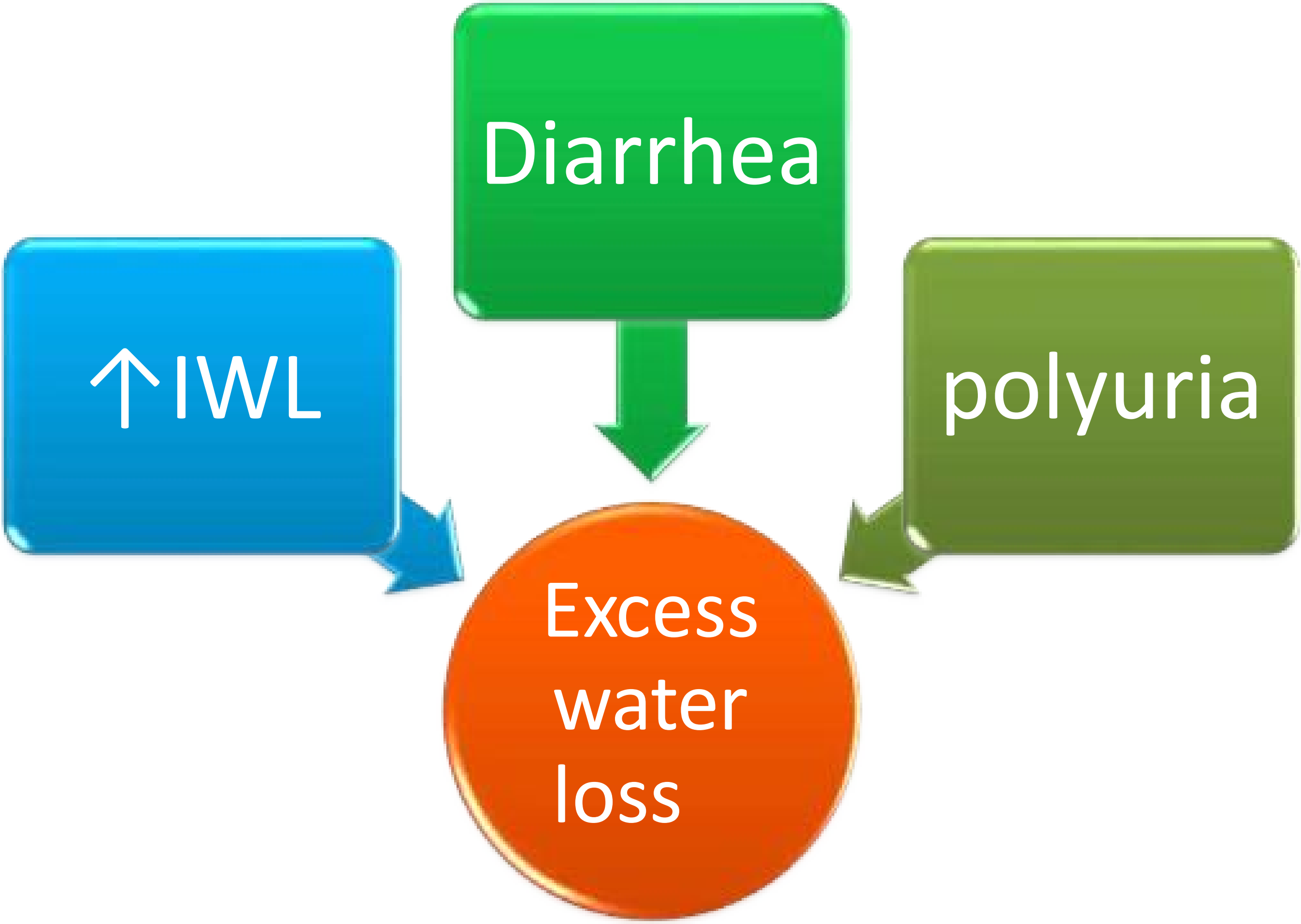


management

- Acute symptomatic hyponatremia(seizures, lethargy, or if the serum sodium concentration is extremely low (<120 mEq/L)…>urgent correction
- Hypertonic saline 3 %(6 mL/kg), infused over one hour, should be given to increase the serum sodium concentration to 125 mEq/L and eliminate seizures.

- Further correction of hyponatremia should be accomplished slowly, over one to two days
- Treat the cause……fluid restriction, increase Na intake

Hypernatremia



NaHco3 intake

Medications &infusions with ↑Na(in arterial line

Na level interpritation….in clinical context

- Is the baby dehydrated?
- Is there ongoing losses?
- How much UOP?
- Any medication containing Na?

Potassium

- Potassium is mostly intracellular: blood levels do not usually indicate total-body potassium.
- pH affects K^+: 0.1 pH change=0.6 K^+ change (More acid, more K; less acid, less K).

chronic diuretic use

renal tubular defects

significant output from a nasogastric tube or ileostomy

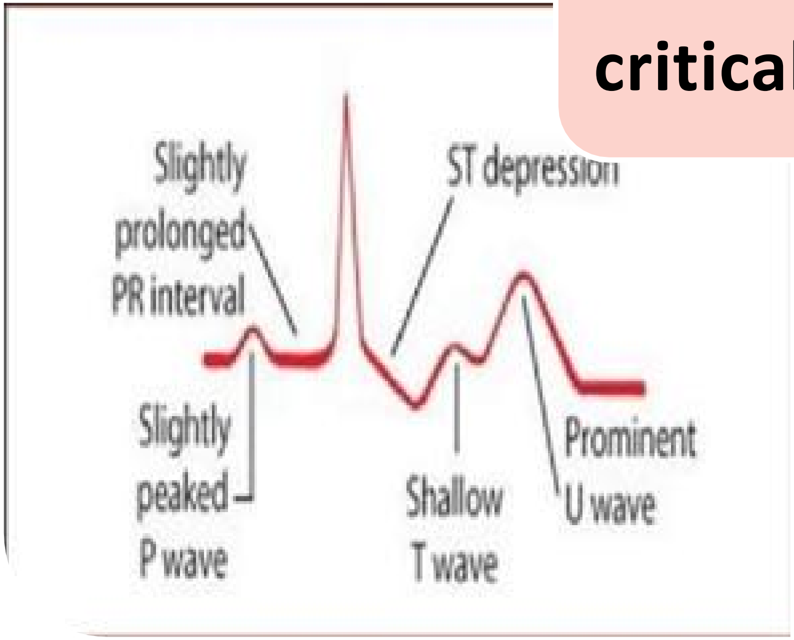
arrhythmias

Ileus

lethargy

Hypo K(3.5)

critical<3meq/L



increasing the daily potassium intake by 1 to 2 mEq/kg.

In severe or symptomatic hypokalemia, KCl (0.5 to 1 mEq/kg) is infused intravenously over one hour with continuous ECG monitoring to detect arrhythmias

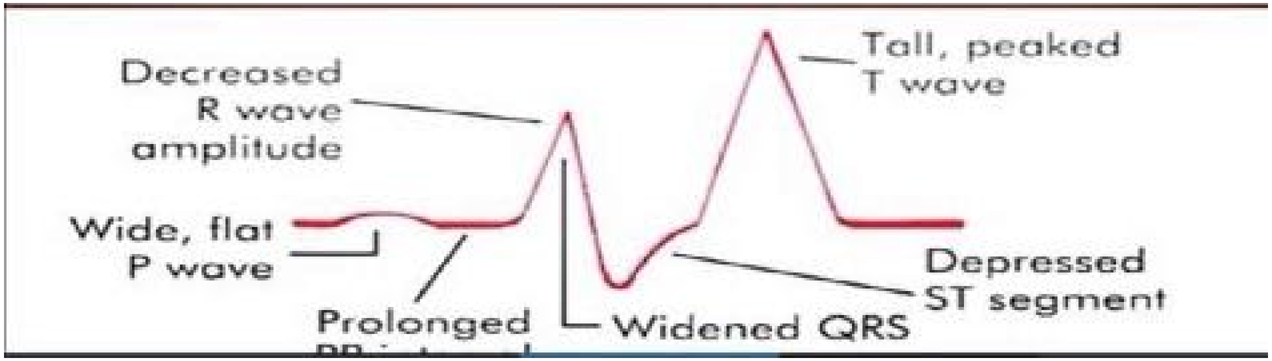
Increased K release from cells

(IVH, asphyxia, trauma, hemolysis)

Decreased K excretion with renal failure

Medication error very common, excessive administration of potassium

Hyper K(>6meq/L)



Management of Hyperkalemia

- Stop all fluids with potassium
- Calcium gluconate 1-2 cc/kg (10%) IV
- Sodium bicarbonate 1-2 mEq/kg IV
- Glucose-insulin combination((0.05 units/kg human regular insulin with 2 mL/kg 10 percent dextrose), followed by a continuous infusion of insulin (0.1 units/kg/ hour with 2 to 4 mL/kg/ hour glucose 10%)
- beta agonists, such as salbutamol 2.5mg, via nebulization
- Lasix 1 mg/kg per dose (increases excretion over hours)
- Dialysis/ Exchange transfusion be considered in infants with oliguria or anuria.

Calcium

- At birth, levels are 10-11 mg/dL. Drop normally over 1-2 days to 7.5-8.5 in term babies.

- **Hypocalcemia:**
  - Early onset (first 3 days):Premies, IDM, Asphyxia If asymptomatic, >6.5 Wait . Supplement calcium if <6.5
  - Late onset (usually end of first week)"High Phosphate" type: Hypoparathyroidism, maternal anticonvulsants, vit. D deficiency etc.

Adjusting IV fluid with enteral feeding

- Allow the baby to begin breastfeeding as soon as the baby's condition improves.

- If the **baby cannot be breastfed, give expressed breast milk using an alternative** feeding method .

- If the **baby tolerates the feed and there are no problems, continue to increase the** volume of feeds by 20-30mL/kg/day, while decreasing the volume of IV fluid to maintain the total daily fluid volume according to the baby's daily requirement.
- Feed the baby every two hours, adjusting the volume at each feeding accordingly.

- Discontinue the infusion of IV fluid when the baby is receiving more than two-third of the daily fluid volume by mouth and has no abdominal distension or vomiting.

- Encourage the mother to initiate breastfeeding as soon as possible

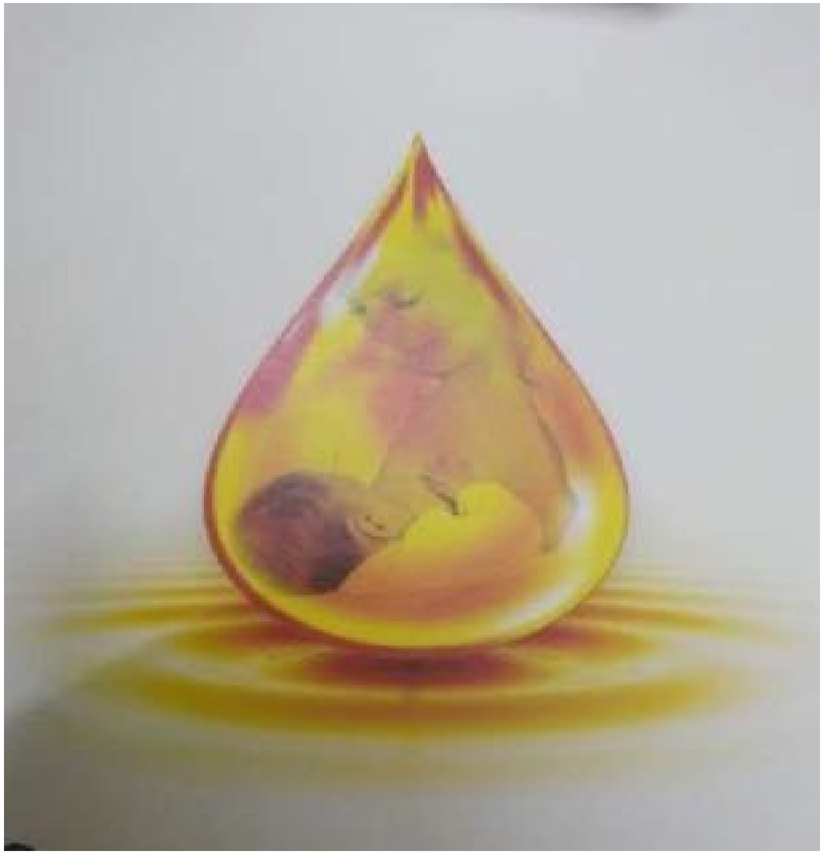
References

- Avery's Disease of The Newborn,9th edition
- Manual of neonatal care (Cloherty) seventh ed
- Care of Newborn seventh ed (Meharban singh)
- NELSON textbook of pediatrics,19th edition
- GHAI essential pediatrics,eighth edition
- AIIMS Nicu protocols 2014
- PGI Nicu protocols 2012
- NRHM SNCU Guidelines

Take home message

- ✓ Maintenance fluid in 1st day 60-80ml/kg
- ✓ Increase by 10-20ml/kg every day till reaching 150-160 ml/kg/day
- ✓ Electrolytes… 48h and K after adequate UOP
- ✓ Frequent clinical and lab monitoring is essential
- ✓ No **cook book** approach

Breast milk is a best fluid made by God




Thank You!