بسم الله الرحمن الرحيم

management in Neonates Protocol of fluid and electrolyte

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Fluid loss:

1. *Mandatory water loss (sensible water loss – SWL) by the;*
   - Kidneys
   - GIT
2. *Insensible water loss (IWL):*
   - Evaporation from the skin – 70%
   - Evaporation from the respiratory tract – 30%

Insensible water loss (IWL):

The emphasis in fluid and electrolyte therapy should be on prevention of excessive IWL rather than replacement of increased IWL.

Insensible water loss (IWL)

[in incubator during 1st week of life]

Birth weight (g)	*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 ➢ Increased body temperature: 30% increase in IWL per 1˚C rise in temperature ➢ High ambient temperature (above the thermo-neutral zone): 30% increase in IWL per 1˚ C rise in temperature ➢ Use of radiant warmer and phototherapy: 50% increase in IWL ➢ Decrease ambient humidity ➢ Increase motor activity, crying: 50 – 70% increase in IWL ➢ Conditions with skin injury (removal of adhesive tapes) ➢ Surgical malformations (gastroschisis, omphalocele, neural tube defects)
Decrease insensible water loss (IWL)
➢ Use of incubators ➢ Humidification of inspired gases in head box and ventilators ➢ Use of Plexiglas heat shields ➢ Increase ambient humidity ➢ Thin transparent plastic barriers

Fluid therapy

Daily fluid requirements during the first week of life (ml/kg/day)

Birth weight (g)	Dextrose %	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1000 >	5	80	100	120	130	140	150	160
- 1000 1500	10	80	95	110	120	130	140	150
1500 <	10	60	75	90	105	120	135	150

Fluid rate for ELBW- the 1st 2 days of life

(BW (g	*Fluid Rate ml/kg/day*
600 - 500	200 – 140
800 -601	130 – 120
801-1000	110 - 90

:*IV fluids should be increased in the presence of*

1. Increased weight loss (> 3% /day or a cumulative loss > 20%)
2. Increased serum sodium (Na > 145 mmol/l)
3. Increased urine Specific gravity (> 1.020) or urine osmolality > 400 mosm/l
4. Decreased urine output (< 1 ml/kg/hour)

IV fluids should be restricted in the presence of:

1. Decreased weight loss (< 1%/ day or a cumulative loss , 5%
2. Decreased serum sodium in the presence of weight gain (Na < 130 mmol/l)
3. Decreased urine specific gravity (< 1.005) or urine osmolality (< 100 mosm/l)
4. Increased urine output (> 3 ml/kg/hour)

Electrolytes therapy

All electrolytes should be added after 48hrs of age

Electrolyte	term	preterm
Sodium	mmol/kg/day 1-3	mmol /kg/day 2-4
Potassium	mmol /kg/day 1-2	mmol /kg/day 2-4
Calcium	kg/day/mmol 0.5 (ml/kg/day 2)	mmol/kg/day 1.0 – 0.5 (ml/kg/day 2-4)

Monitoring of fluid and electrolytes :

1. Body weight (12 hrly)
   - Term babies lose 1-2% of their BW daily: cumulative loss of 5 – 10% in the first week of life
   - Preterm neonates loose 2-3% of their BW daily: cumulative loss of 15 – 20% in the first week of life
2. Serum sodium (> 130 or < 145 mmol /l)
   - Hyponatraemia + weight loss = sodium depletion; Needs sodium replacement
   - Hyponatraemia + weight gain = Suggests water excess: Needs fluid restriction
   - Hypernatraemia + weight loss = dehydration: fluid correction over 48 hrs

- Hypernatraemia + weight gain = salt and water load: needs fluid & Na restriction

3. Urine specific gravity (> 1.005 or < 1.020)
4. Urine osmolality > 100 or < 400 mosm/l
5. Urine output – acceptable range 1 – 3.5 ml/kg/hr
6. Signs of shock (hypotension, tachycardia, capillary refilling > 3 sec)
7. Blood gas analysis: hypotension and shock are associated with metabolic acidosis
8. Serum urea and creatinine:
   - Serum creatinine is a useful indicator of renal function
   - Serum creatinine levels in the first week of life reflect maternal creatinine level. It falls gradually as maternally derived creatinine is excreted.
   - Failure to observe this normal decline in serial (not a single value) samples is a better indicator of renal failure

Fluid and Electrolytes in specific clinical conditions:

- Extreme prematurity (gestation < 28 weeks, Birth weight < 1000 grams):
  - Have large IWL (Thin, immature skin barrier)
  - Skin matures rapidly in 1-2 weeks and fluid requirements become comparable to larger infants by the end of the second week
  - Use of plastic transparent barriers, oil application or use of doubled walled incubators decrease substantially the IWL in the first week of life
  - Use 5% dextrose to avoid hyperglycaemia
  - Electrolytes should be added after 48 hours of age
- Respiratory Distress Syndrome (RDS):
  - Renal function may be compromised in the presence of hypoxia and acidosis
  - Positive pressure ventilation may lead to increase secretion of aldosterone and ADH leading to water retention
  - RDS may lead to symptomatic PDA
- Asphyxia:
  - May be associated with inappropriate ADH (SIADH)
  - May be associated with acute tubular necrosis (ATN)
    - Oliguria and anuria is commonly seen
    - Fluid should be restricted to replenishment of: IWL + Metabolic water requirement (= 400 ml/m2 or 40 ml/kg/day) + ongoing losses
- PDA: Avoid fluid overload. If indomethacin is used, monitor urine output.

Electrolyte therapy

Electrolyte disturbances:

Sodium:

Management of neonatal Hypernatraemia

- 100ml/kg of D10% + 2-3 mmol/l of sodium running over 24hrs
- Check serum Na every 4-6 hrs
- Serum sodium should be decrease by 0.5 mmol/hr (12 mmol/day)

Management of severe neonatal Hyponatraemia- (Serum sodium < 120 mmol /kg/day)

- Calculate sodium deficit as follows: 0.6 X body weight X (135- observed serum sodium)
- Fluid used 3% sodium chloride

- ❖ Restrict the fluid until sodium level exceeds 120 mmol/kg/day
- ❖ Monitor for the signs of cerebral oedema

Symptomatic hyponatremia: (*e.g.*, seizures or [Na] <120 mEq/L).

- Calculate Na deficit to raise [Na] to 125 mEq/L and give as 3% NaCl (0.5 mEq/mL) over 3-6h.
- Correct remaining deficit over next 24h.

Asymptomatic hyponatremia:

- Calculate total deficit of Na and give ½ over 6-8h
- Give the rest over the next 24h.

Potassium:

Normal Values: 3.5 – 6.0 mmol/l

Hyperkalaemia:

Definition of Hyperkalemia:

K of ≥ 6.5 mmol/l.. Hyperkalemia is an emergency the patient needs to be watchd constantly. Serial serum K levels and ECG strip need to be done.

Causes of Hyperkalaemia

• Oliguric Renal failure • Cephalhaematoma • Bleeding • Hypothermia	• Haemolysis • Asphyxia • IVH (intraventricular haemorrhage) • Traumatic delivery	• CAH (Congenital Adrenal Hyperplasia) • Blood Transfusion • Medication error

:Complications

(most common ventricular tachycardia & sinus Bradycardia) ,The main complication is arrhythmia

ECG: lead II strip; changes seen with progressive increase in the serum K levels:

- ➢ > 6.0 mEq/l: Tall peaked T wave
- ➢ > 7.5 mEq/l: Tall T wave
  Long PR interval
  Wide QRS duration (intra-ventricular block)
- ➢ > 9.0 mEq/l: Absent P wave
  Wide Bizarre diphasic QRS
  Asystole

1st 48 hours- ELBW

- ❑ Prone to high K level: range; 4-8 mmol/l
- ❑ *At the age of 3-6 days:* S. K level decreases to normal range

Treatment of Hyperkalaemia:

- ❑ Remember:
  - ➢ Omit K from IVF
  - ➢ hold gentamicin pending evaluation of renal status
  - ➢ high potassium (> 6.5 mmol) without ECG changes (although unlikely) still needs treatment
  - ➢ check for factitious causes first
  - ➢ hyperkalemia is worsened by hypocalcemia, hypomagnesemia
- ❑ K ≥ 7.0 without ECG changes:
  - ➢ Kayexalate Enema: (Na Polystyrene sulfonate resin).
  - ➢ This resin exchanges 1 mEq of K for 2-3 mEq of Na.

- ➢ Contraindicated in ELBW infants.
- ➢ Dose: 1 gm/kg/dose q 2 hr; will lower K by 1 mmol/l.
- ➢ Given per rectum mixed with sorbitol as follows:
  1 gm Kayexalate in 4 ml 10% sorbitol

❑ K ≥ 7 mEq: with only peaked T wave:

1. Kayexalate: - as above but not alone because it takes a few hours to work and start the following therapy
2. If patient is acidotic, give sodium bicarbonate:
   1 mmol/kg IV over 20 min, it will lower K by 1 mmol/1
   Note: alkali lowers serum Ca and hypocalcemia may worsen the effects of hyperkalemia
3. Glucose and Insulin:
   Intravenous administration of insulin (together with glucose) effectively manages Hyperkalaemia in neonates but:
   - The response is unpredictable, and
   - Carries the risk of hypoglycaemia, hyperosmolarity, and volume overload

   ➢ Bolus Dose:
   - o The ratio should be 1 Unit of soluble insulin to 4 gm glucose given as D10 (40 cc) at 0.5 gm/kg/dose (5 ml/kg/dose) IV push over 15 min.
   - o Blood sugar (by glucometer) needs to be monitored. K will start to decrease around 1 hour after dose and the effect will last ~ 4-5 hours.
   - o Note: This hypertonic solution will increase endogenous secretion of insulin; it is important not to stop abruptly because of risk of hypoglycemia.

   ➢ Drip: Mix 2.5 U of insulin in 100 cc of D10% to start (1 Unit insulin: 40 ml D10%). The dose of insulin may be increased if needed.

   ➢ If no response: ⟶ proceed to step 4
4. Salbutamol:
   - Intravenous salbutamol:
     Is rapidly effective and side effects, including elevated heart rate, mild vasomotor flushing and mild tremor are all short-lasting.
     Dose: Salbutamol: 4 micrograms/kg IV over 10 minutes. May be repeated after 2 hours.
   - Nebulised salbutamol: 400 mcg
   - Salbutamol MDI treatment
5. Consider exchange transfusion

❑ K ≥ 7 mmol/l: With Major ECG Changes

1. First give 100 mg/kg of 10% Calcium gluconate over 10 minutes under cardiac monitoring. This will help to prevent cardiac arrythmia and then after slowly flushing IV administer sodium bicarbonate, and insulin and glucose as described above.
2. Make arrangement for :
   - exchange transfusion or
   - peritoneal dialysis.

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MANAGEMENT OF NEONATAL HYPOGLYCAEMIA

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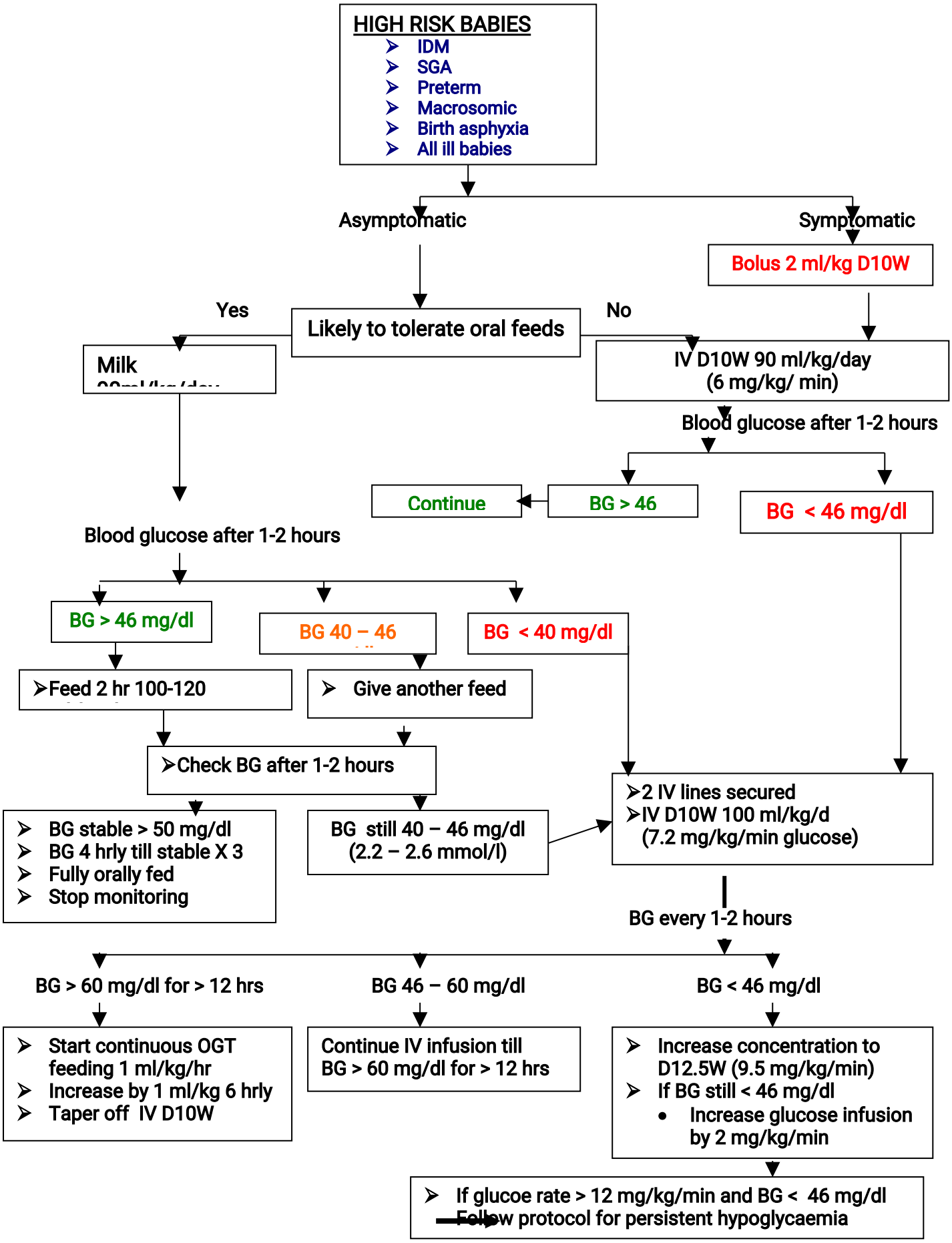
Definition: A blood glucose less than 2.6 mmol/l (46mg/dl)



PROTOCOL FOR PERSISTENT HYPOGLYCAEMIA

BG < 46 mg/dl (< 2.6 mmol/l) on glucose infusion rate > 12 mg/kg/min
Or lasting for > 1 week

- Discuss with the pathologist (Lab)
- Take blood during hypoglycaemia
- Discuss with the consultant neonatologist on

BLOOD

- S. Insulin
- S. GH
- Cortisol
- U&Es
- ABG
- B. Ammonia
- Amino acids
- B. Lactate
- Tandam Mass Spectrometry
- Ketone bodies
- Free Fatty Acids

URINE

- Ketone bodies
- Reducing substances

- Give glucagon 100 ug/kg bolus SC or IM (Max 300 ug/kg)
- Glucagon infusion 1mg/day
- Hydrocortisone 10 mg/kg/day (divided 6 hrly)

BG after 30 min

Good response

Keep monitoring BG hourly

Poor response

Increase glucose infusion rate by increasing the volume or concentration

Poor response

Increase glucagon infusion to 2.0 mg/day in D10W

Poor response

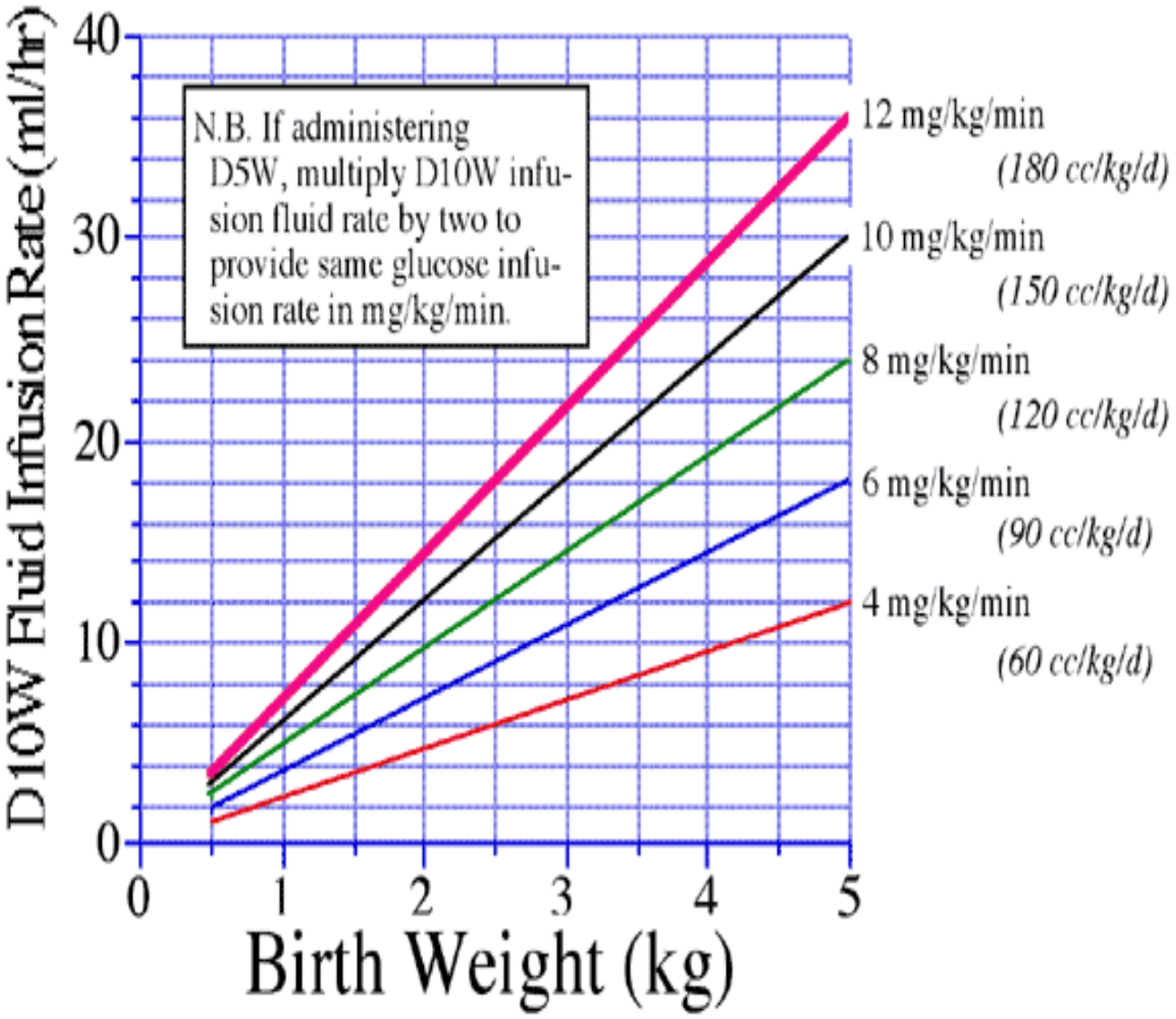
Refractory hypoglycaemia

Consider hyperinsulinism

Add

- Diazoxide 10 - 25 mg/kg/day PO (8 hrly)
- Chlorothiazide 10 mg/kg bid
- Octreotide (somatostatin): 5-20micrograms/kg/day by intravenous or continuous subcutaneous infusion

i.v. Glucose Infusion Rates



Glucose Intake

Glucose intake (mg/kg/min) = $\frac{\text{\% Dextrose x Volume (ml/kg/day)}}{144}$

or

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

To get glucose concentrated solutions

Intake (ml/kg/day)	5% Dextrose	10% Dextrose	12.5% Dextrose
	mg/kg/min of Dextrose		
60	2.1	4.2	5.2
75	2.6	5.2	6.5
90	3.1	6.3	7.8
105	3.7	7.3	9.1
120	4.2	8.3	10.4

Solution	10% Dextrose	50% Dextrose
12.5%	450 ml	30 ml
15 %	420 ml	60 ml

Solution	5% Dextrose	50% Dextrose
7.5%	450ml	30ml

NEONATAL HYPOCALCAEMIA

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- 1.Early onset neonatal hypocalcaemi
- 2. Late onset neonatal hpocalcaemia

CAUSES OF EARLY ONSET NEONATAL HYPOCALCAEMIA

NEONATAL HYPOCALCEMIA

Definition:

- Prematurity (< 32 weeks)
- Birth asphyxia:
- Diabetes mellitus in the mother:
- Intrauterine growth retardation (IUGR)
- Maternal hyperparathyroidism:
- Maternal intake of anticonvulsants

CAUSES OF LATE ONSET NEONATAL HYPOCALCAEMIA

- Increased phosphate load:
  - Exogenous phosphate load (fresh cow's milk)
  - Advanced renal failure
- Hypomagnesaemia
- Transient hypoparathyroidism of newborn
- Hypoparathyroidism:
  - Primary
  - Secondary
- Metabolic syndromes
- Iatrogenic
- Maternal Vitamin D deficiency

DIAGNOSIS OF EARLY ONSET NEONATAL HYPOCALCAEMIA

Laboratory:

- Total or ionized calcium
- Serum albumin level

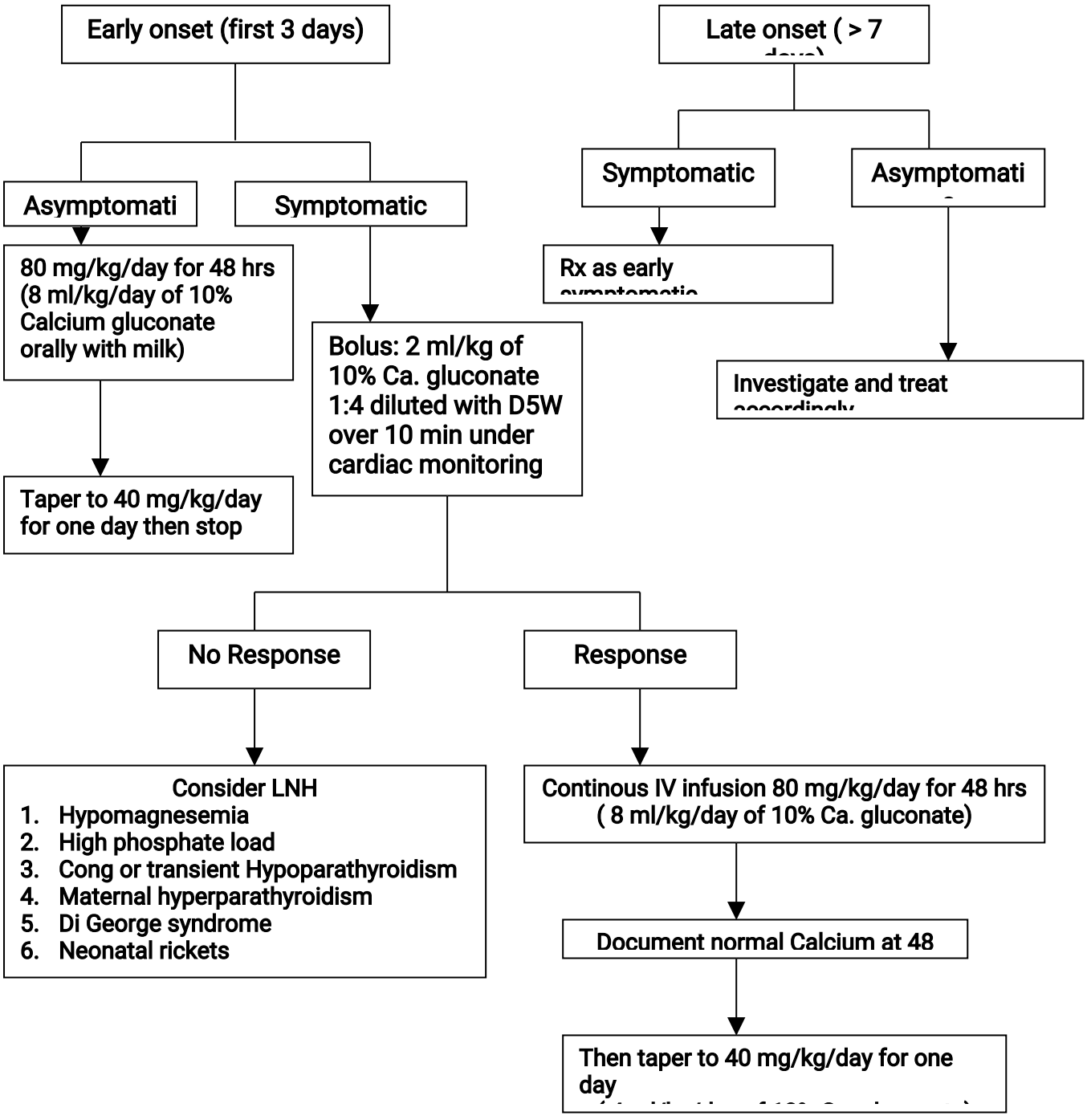
ECG:

QoTc > 0.2 seconds OR QTc > 0.45 seconds.

DIAGNOSIS OF LATE ONSET NEONATAL HYPOCALCAEMIA

- Serum magnesium: Mg level < 1.2 mg/dl should be treated
- Phosphate level: increased in Top-up feeding with cow's milk, renal failure and hypoparathyroidism
- Alkaline phosphatase (ALP): Increased in hypovitaminosis D
- PTH levels: Decreased in hypoparathyroidism
- Urine calcium/ creatinine ratio: Ratio > 0.20 is suggestive of hypoparathyroidism
- Chest X-ray: Absent thymus is suggestive of Di George syndrome
- Maternal calcium, phosphate and alkaline phosphatase levels: helpful in detection of maternal vitamin D deficiency
- Brain CT scan: Basal ganglion calcifications
- ECHO: if Di George syndrome is suspected
- Ophthalmologic evaluation: for cataract
- Hearing test

- Term neonate: Total Serum Calcium level < 8 mg/ dl (< 2.0 mmol/L) or ionized Ca < 4 mg/dl (1 mmol/l)
- Preterm neonate: 7 mg/dl (1.75 mmol/L)
- S. albumin > 3.5 g/dl for both term & preterm



Neonatal Hypomagnesaemia

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Definition:

Hypomagnesaemia is defined as magnesium concentration less than 1.5 mg/dl (< 0.6 mmol/l)

[Normal plasma magnesium concentration is 1.5 – 2.3 mg/dl (1.2 – 1.9 mEq/l; 0.62 – 0.94 mmol/l)]

Causes of Hypomagnesaemia:

In neonates, hypomagnesaemia is associated with:

- Prematurity
- Intrauterine growth retardation
- Di George syndrome
- Familial hypoparathyroidism
- Exchange transfusions.
- Infants of diabetic mothers
- Mothers with hyperparathyroidism
- Mothers with magnesium deficiency
- Primary intestinal hypomagnesaemia (present between 2 – 8 weeks)
- Medications: loop diuretics, aminoglycosides
- Genetics: Gitelman syndrome, Bartter syndrome,

Clinical presentation:

Hypomagnesaemia causes secondary hypocalcaemia by impairing the release of PTH by the parathyroid gland and through blunting the tissue response to PTH. Symptoms of hypomagnesaemia include:

- irritability
- vomiting
- lethargy
- weakness
- Tetany
- tremor
- muscle fasciculation
- Seizures

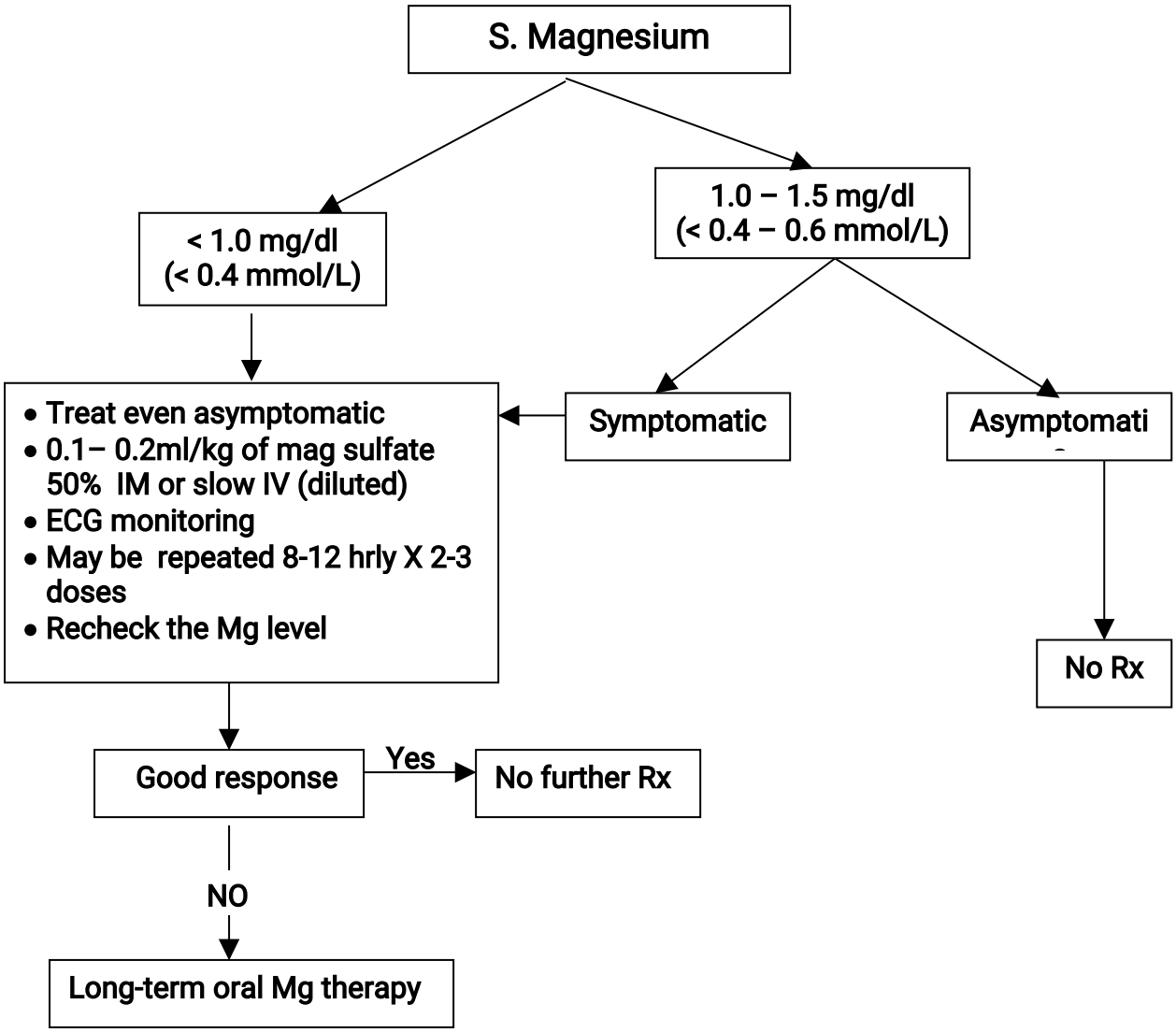
Evaluation:

- Serum magnesium level
- Serum calcium, phosphate
- PTH level
- Electrolytes (hypokalaemia in Bartter and Gitelman syndromes)
- ABGs (alkalosis in Bartter and Gitelman syndromes)
- 24 urinary magnesium and the ratio of urine magnesium to urine creatinine
- Electrocardiogram (ECG) changes, including widening of the QRS wave complex and peaking of T waves, may be seen.

HYPOMAGNESAEMIA

Serum magnesium <1.5 mg/dl (0.6 mmol/L)

Consider hypomagnesaemia if hypocalcaemia persists despite conventional treatment



NEONATAL SEPSIS

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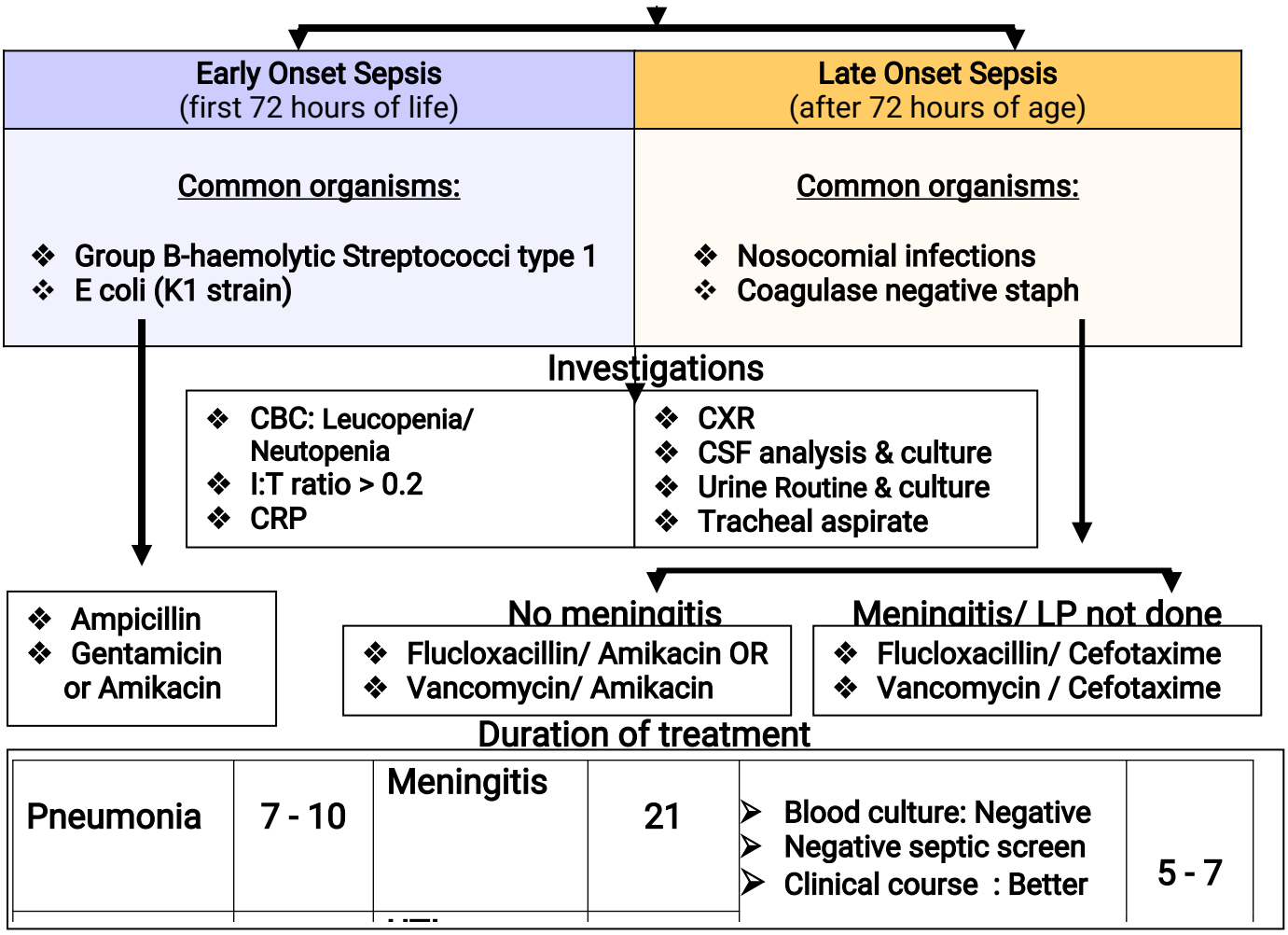
Maternal risk factors
- PROM
- Chorioamniotis
  - Maternal fever
  - Uterine tenderness
  - Purulent/ foul-smelling amniotic fluid
  - malodorous baby

Infant risk factors
- Prematurity
- Birth asphyxia
- Indewelling catheters
- Male gender

Symptoms & signs [subtle and non-specific]



Components of septic screen

Component	Abnormal value
Total leucocyte count	< 5000/ mm^3
Absolute neutrophil count	< 1800/ mm^3
Immature / total neutrophil	> 0.20
Micro-ESR	> 15 mm in 1^{st} hour
CRP	> 1 mg/ dl

Normal CSF examination in neonates

CSF Components	Normal range
Cells/ mm^3	8 (0-30 cells

PMN (%)	60%
CSF proteins (mg/dl)	90 (20 - 170)
CSF glucose (mg/dl)	52 (34 – 119)
CSF/ Blood glucose (%)	51% (44 – 248%)

Drugs, route of adminstration and doses of common antibiotics used in NICU

Drug	Route	BW < 2000 g		BW > 2000 g	
		0 – 7 days	> 7 days	0 – 7 days	> 7 days
Amikacin	IV/ IM	7.5 mg q 12 hrs	7.5 mg q 8 hrs	10 mg q 12 hrs	10 mg q 8 hrs
Ampicillin *Meningitis* *Others*	 IV IV/IM	 100 mg/kg q 12 hrs 25 mg/kg q 12 hrs	 100 mg/kg q 8 hrs 25 mg/kg q 8 hrs	 100 mg/kg q 8 hrs 25 mg/kg q 8 hrs	 100 mg/kg q 6 hrs 25 mg/kg q 6 hrs
Cefotaxime *Meningitis* *Others*	 IV IV/IM	 50 mg/kg q 6 hrs 50 mg/kg q 12 hrs	 50 mg/kg q 6 hrs 50 mg/kg q 8 hrs	 50 mg/kg q 6 hrs 50 mg/kg q 12 hrs	 50 mg/kg q 6 hrs 50 mg/kg q 8 hrs
Piperacillin + Tazbactam	IV	50 –100 mg/kg q 12 h	50 – 100 mg q 8 hrs	50 –100 mg/kg q 12 hrs	50 – 100 mg q 12 hrs
Ceftriaxone	IV/IM	50 mg/kg q 24 hrs	50 mg/kg q 24 hrs	50 mg/kg q 24 hrs	75 mg/kg q 24 hrs
Ciprofloxacin	IV/ PO	10-20 mg/kg q 24 h	10-20 mg/kg q 24 h	10-20 mg/kg q 12 hrs	10-20 mg/kg q 12 h
Cloxacillin *Meningitis* *Others*	 IV IV	 50 mg/kg q 12 hrs 25 mg/kg q12 hrs	 50 mg/kg q 8 hrs 25 mg/kg q 8 hrs	 50 mg/kg q 8 hrs 25 mg/kg q 8 hrs	 50 mg/kg q 6 hrs 25 mg/kg q 6 hrs
Gentamicin *Conventional* *Single dose*	 IV IV/IM	 2.5 mg/kg q 12 hrs 4 mg/kg q 24 hrs	 2.5 mg/kg q 8 hrs 4 mg/kg q 24 hrs	 2.5 mg/kg q 12 hrs 5 mg/kg q 24 hrs	 2.5 mg/kg q 8 hrs 5 mg/kg q 24 hrs
Netlmicin	IV/IM	2.5 mg/kg q 12 hrs	2.5 mg/kg q 8 hrs	2.5 mg/kg q 12 hrs	2.5 mg/kg q 8 hrs
Penicillin G *Meningitis* *Others*	 IV IV/IM	 75000 -100000 U/kg q 12h 25000 units/kg q 12 hrs	 75000-100000 U/kg 12h 25000U/kg q 8 hrs	 75000 -100000/kg q 8 h 25000 units/kg q 8 hrs	 75000-100000 U/kg q 6 h 25000U/kg q 6 hrs
Vancomycin	IV	15 mg/kg q 12 hrs	15 mg/kg q 8 hrs	15 mg/kg q 12 hrs	15 mg/kg q 8 hrs

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Neonatal jaundice

- Jaundice is an extremely common problem occurring during the newborn period.
- The etiology of the jaundice is quite varied; although most causes are benign
- Criteria of non-physiologic jaundice are:
  - Visible jaundice on the first day of life,
  - A total serum bilirubin level increasing by more than 5 mg/dl per day,
  - A direct serum bilirubin level exceeding 1.5 mg/dl, and
  - Clinical jaundice persisting for more than 2 weeks in term babies and 3 weeks in a preterm

- Following the identification of an icteric infant;
  - The maternal and preceding neonatal histories are reviewed.
  - Complete physical examination.
  - The following is the minimal work up necessary in each infant:
    - Serum bilirubin level (both direct and indirect)
    - CBC with smear,
    - Infant's blood type and Coombs' tests;
    - Mother blood group and Coombs' tests
  - A urinalysis, culture and urine testing for reducing substances should be done only if sepsis, urinary tract infection, or galactosemia is suspected.

- Infants with ABO incompatibility may have extremely rapid increases in their serum bilirubin values, so their bilirubin levels may need to be done more frequent
- Guide to dermal staining with level of bilirubin

Area of body	Level of bilirubin
Face	4-6 mg/ dl
Chest, upper abdomen	8-10 mg/dl
Lower abdomen, thighs	12-14 mg/dl
Arms, lower legs	15-18 mg/dl
Palms, soles	15-20 mg/dl

Suggested guidelines for frequency of monitoring serum bilirubin in healthy term infants are as follows:

Serum Bilirubin mg/dl [If Direct Bilirubin < 1.5 mg/dl, use the total level]	Days of Age		
	1	2	3
5-10	repeat in 3-5 hr	repeat x 1 in 8-12 hr	Repeat x1 in 24 hr
10-15	repeat in 3-4hr;	repeat in 4-6 hr	repeat in 6-8 hr
15-20	repeat in 2-3 hr	repeat in 2-4 hr;	repeat in 4-6 hr
>20	discuss exchange transfusion with senior staff	repeat in 2-3 hr;	repeat in 3-4 hr;

Shaded area = consider institution of phototherapy

Management of Hyperbilirubinemia in the Healthy Term Newborn

Total Serum Bilirubin (TSB) Level, mg/dL (µmol/L)

Age, hours	Phototherapy	Exchange Transfusion if Intensive Phototherapy Fails †	Exchange Transfusion and Intensive Phototherapy
≤ 24 ‡	*Pathological and requires further evaluation*		
25-48	≥ 15 (260)	≥ 20 (340)	≥ 25 (430)
49-72	≥ 18 (310)	≥25 (430)	≥ 30 (510)
>72	≥ 20 (340)	≥ 25 (430)	≥ 30 (510)

† Intensive phototherapy should produce a decline of TSB of 1-2 mg/dL within 4-6 hours and the TSB level should continue to fall and remain below the threshold for exchange transfusion. If this does not occur, it is considered a failure of phototherapy.

Phototherapy

- Infant receiving phototherapy should be left unclothed except for eye and genital protection
- The insensible water loss is increased with the use of overhead phototherapy, so monitor the weight, fluid intake and urine output on daily basis.
- 10-20% increase in fluids can be considered if the baby is dehydrated.
- The phototherapy unit should be placed 30 – 50 cm above the infant and have a Plexiglas shield between the light bulbs and the infant.
- Phototherapy should be given continuously although the baby may come out for breastfeeds if the bilirubin levels are not very high.
- Phototherapy has its greatest effect in the first 24-48 hours of treatment. If bilirubin levels have not dropped by 25-50% by then, think about compliance, haemolysis, sepsis or conjugated hyperbilirubinaemia
- Babies must have 2 bilirubin measurements 'below the line' *prior to stopping phototherapy* and 2 'rebound' readings still below the line *prior to sending home.*

Exchange transfusion

Indications for exchange transfusion:

- When phototherapy fails to prevent the rise in bilirubin to a toxic level
- To correct anaemia & improve heart failure in hydropic infant
- Stop haemolysis & bilirubin production by removing antibodies
- In haemolytic disease , immediate exchange is indicated in:
    - The cord bilirubin level is over 5 mg/dL & the cord haemoglobin level is under 10 gm/dL
    - The bilirubin level is rising over 1 mg/dL per hour despite phototherapy
    - The haemoglobin level is between 11 & 13 gm/dL & the bilirubin level is rising over 0.5 mg/dL per hour despite phototherapy
    - The bilirubin level is 20 mg/dL, or it appears that it will reach 20 mg/dL at the rate it is rising
    - There is progression of anaemia in the face of adequate control of bilirubin by other methods (e.g., phototherapy)
- Subsequent exchange transfusions are indicated if:
    - Bilirubin >10 mg/dl within 24 hours of age
    - Bilirubin>15 mg/dl between 25-48 hours of age
    - Bilirubin >20 mg/dl after 48 hours of age.
    - Rate of rise of bilirubin is >0.5 mg/dl/hr.

Blood for exchange transfusion:

1. *Red Blood Cells for Exchange Transfusion*
2. This red cell product has the following specifications:
    - Group O
        - CMV Negative
        - If available, Fresh (≤ 5 days)
        - Known haematocrit (<0.6)
        - RhD negative
        - Kell negative

      Commence transfusion within 30 minutes of product receipt and complete transfusion within 4 hours of spiking pack.
    - In nonimmune hyperbilirubinemia, the blood is typed and cross-matched against the plasma & red cells of the infant.
    - Exchange transfusion usually involves double the volume of the infant's blood & is known as a two-volume exchange (160 mL/kg)

Techniques of exchange transfusion:

- Exchange is done with the infant under a radiant warmer.
- Vital signs recorded
- Equipment & personnel for resuscitation must be readily available
- IV line should be in place for the administration of glucose & medication.
- The infant's legs should be properly restrained.
- An assistant should be assigned to the infant to record volumes of blood, observe the infant, & check vital signs.
- The blood should be warmed to 37˚c.

- Sterile techniques should be used.
- Old, dried umbilical cords can be softened with saline-soaked gauze
- If a dirty cord was entered or there was a break in sterile technique, treat with cloxacillin & gentamycin for 2-3days.
- Do most exchanges by the push-pull technique:
  - Two Catheter Push-pull Technique
    Blood is removed from the artery while infusing fresh blood through a vein at the same rate.

	In	Out
	Umbilical vein	Peripheral artery
or	Umbilical vein	Umbilical artery [2]
or	Peripheral vein	Peripheral artery [1]
or	Peripheral vein	Umbilical artery

  - *One Catheter Push-pull Technique*

1. This can be done through an umbilical venous catheter. [3] Exceptionally, an umbilical artery catheter can be used.
2. Ideally, the tip of the UVC should be in the IVC/right atrium (at or just above the diaphragm) but can be used if it is in the portal sinus. For 'high' UVC placement, position should be checked by an X-ray. This is not always necessary for a low position. A low positioned catheter is usually removed after each exchange.
3. Withdraw blood over 2 minutes, infuse slightly faster.

- If it is not possible to insert a catheter in the umbilical vein, exchange transfusion can be accomplished through a central venous line placed through the antecubital fossa or into the femoral vein via the saphenous vein.
- Volume: Usually use two blood volumes (160 ml/kg).
  1. One blood volume removes 65% of baby's red cells.
  2. Two blood volumes remove 88%.
  3. Thereafter the gain is small. [3]

<1500 gms	Use 5ml aliquots
1500-2500 gm	10ml
2500-3500 gm [3]	15ml
>3500 gm	20 ml

- The recommended time for the exchange transfusion is 1 hour.
- After exchange transfusion, phototherapy is continued & bilirubin levels are measured every 4 hrs.

Conjugated hyperbilirubinaemia:

This becomes significant if the direct bilirubin is >25 micromol/L in the first few days of life or ≥ 20% of the total bilirubin.

First Line investigations:

• Pre-feed blood glucose • Hb, Reticulocytes count • ALT, AST, Gamma GT, ALP, Albumin, Total bilirubin, Direct bilirubin, INR • Urea, Na+, K+, Creatinine, Ca++, PO4	• One EDTA saved • One clotted saved • Blood culture, Urine culture • Urine for reducing substances • Group and save

Second Line investigations:

• Liver ultrasound	• Urinary succinyl acetone (tyrosinaemia)

• Examine stools for pigmentation • Chromosomes for karyotype • Cortisol • GAL-1- PUT (galactosaemia) • Alpha-1 antitrypsin phenotype • TSH, T4 • Sweat test • Cystic fibrosis genotype • Cholesterol, triglycerides (abnormal in Alagille's)	• Serum amino acids • Urinary organic acids • Hep A IgM, Hep B surface antigen, Hep C antibody • EBV, Parvovirus, Throat swab and stool for adenovirus • Urine for CMV • Herpes, Toxoplasmosis, Rubella, Syphilis • Liver biopsy

Third Line investigations:

• Lactate • Pyruvate • Ammonia (urea cycle defects) • White cell enzymes • Very long chain fatty acids (peroxisomal disorders) • Alpha-fetoprotein • Mitochondrial deletions	• Acyl carnitine • Free carnitine • Total bile acids • X-ray spine • Posterior embryotoxon (Alagille's) • MRI head • Muscle biopsy (mitochondrial and respiratory chain disorders)

Prolonged jaundice:

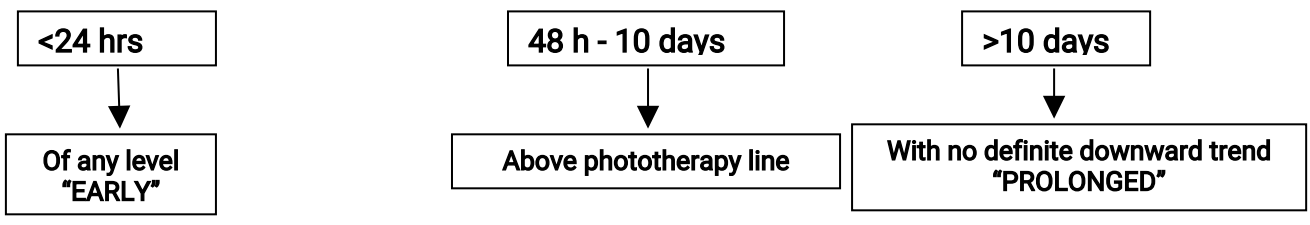
Definition: Significant Jaundice at 2 weeks of age in full term babies, and at 3 weeks for preterm babies. The following screen should be performed:

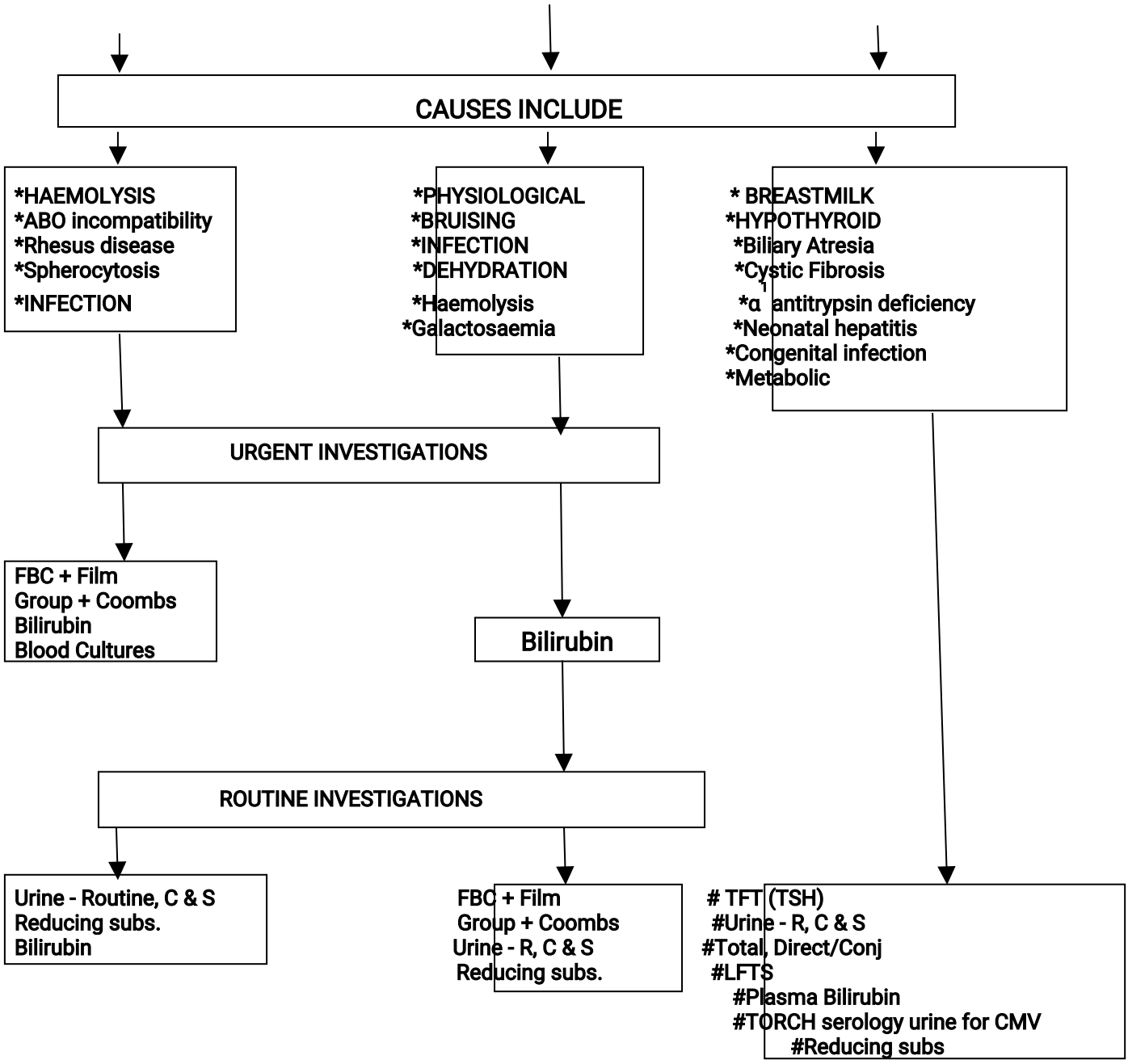
- Serum Bilirubin total and direct (if the direct bilirubin >= 20% of the total bilirubin then please see conjugated hyperbilirubinaemia)
- TSH, T4,
- FBC, reticulocytes, Blood film
- Group, DCT
- Urine routine, culture and reducing substances
- G6PD

Attachment:

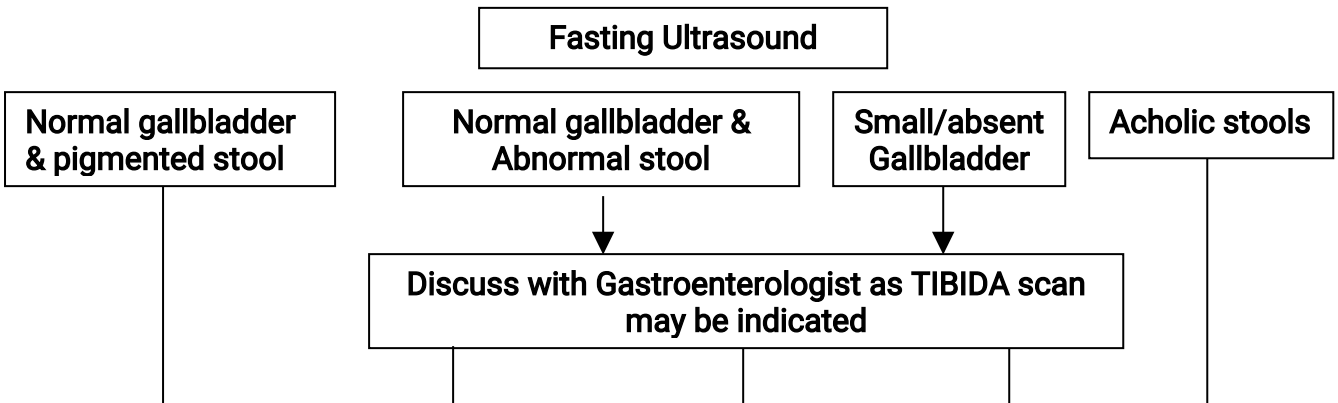
Bilirubin Charts

Flow Chart for Clinically Jaundiced, Well, Term Baby





Conjugated hyperbilirubinaemia



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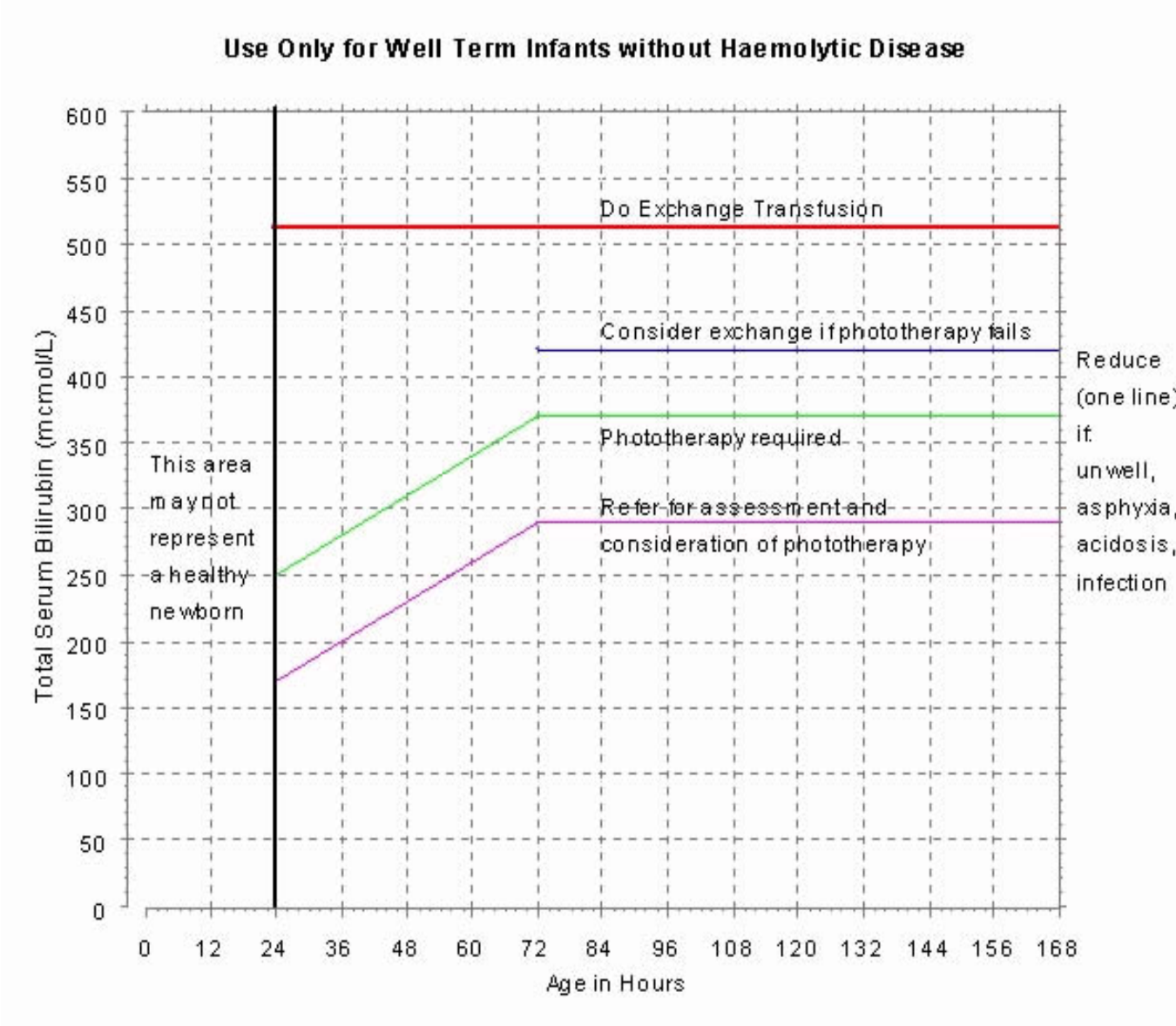
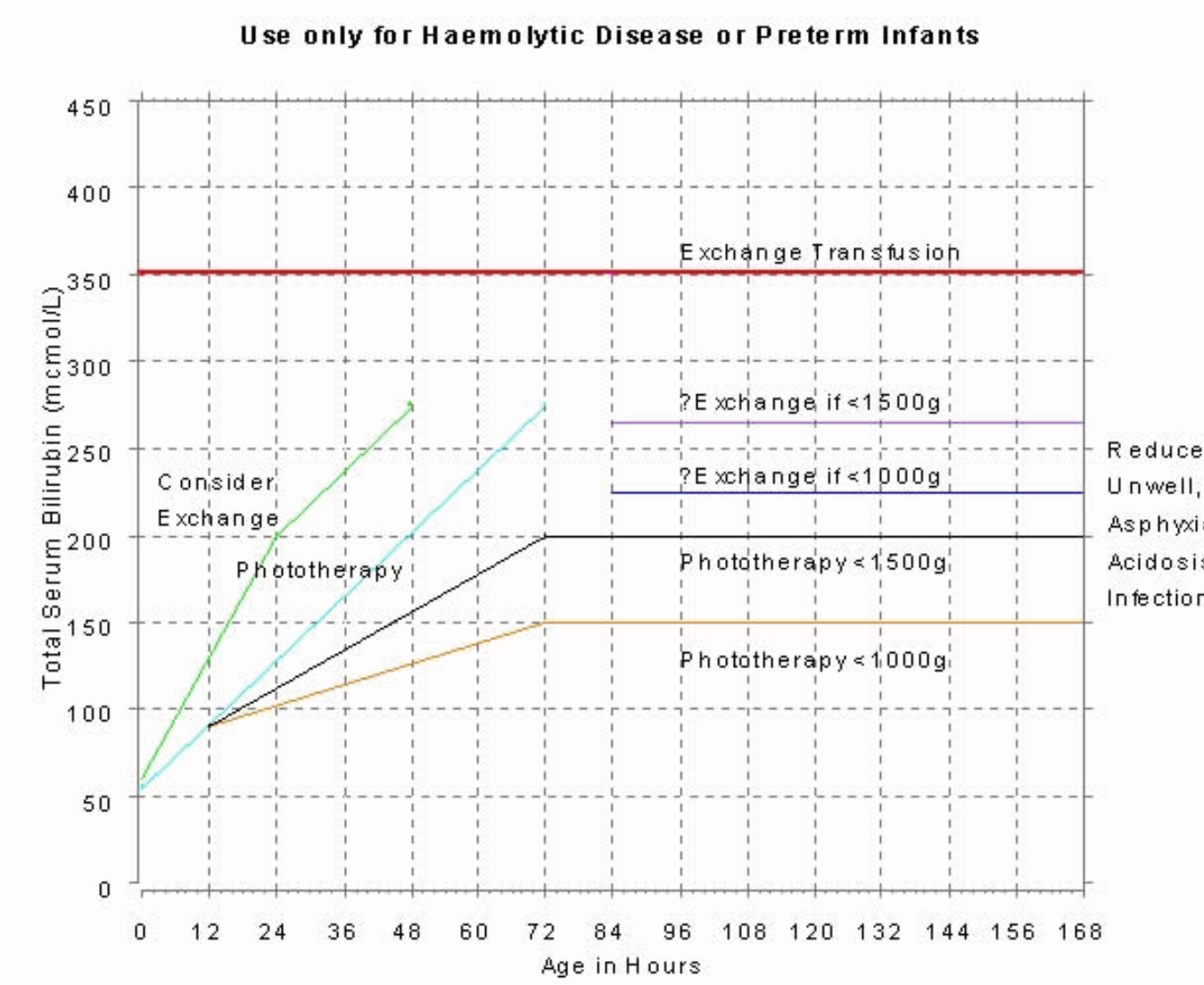

Use Only for Well Term Infants without Haemolytic Disease
Total Serum Bilirubin (mcmol/L)
600
550
500
450
400
350
300
250
200
150
100
50
0
0
12
24
36
48
60
72
84
96
108
120
132
144
156
168
Age in Hours
Do Exchange Transfusion
Consider exchange if phototherapy fails
Phototherapy required
Refer for assessment and consideration of phototherapy
This area may not represent a healthy newborn
Reduce (one line) if unwell, asphyxia, acidosis, infection


Use only for Haemolytic Disease or Preterm Infants
Total Serum Bilirubin (mcmol/L)
450
400
350
300
250
200
150
100
50
0
0
12
24
36
48
60
72
84
96
108
120
132
144
156
168
Age in Hours
Exchange Transfusion
?Exchange if <1500g
?Exchange if <1000g
Consider Exchange
Phototherapy
Phototherapy <1500g
Phototherapy <1000g
Reduce
Unwell,
Asphyxi
Acidosis
Infection

NEONATAL SEIZURES

Dr. Mohamed Khalil Ali, Associate professor, consultant neonatologist, Gaafar Ibn Nauf Hospital

DEFINITION:

Paroxysmal alteration in neurologic function (i.e. behavioral, motor, autonomic function)

Background:

It is important to recognize the presence of seizures in the neonatal period since they are often related to a significant underlying illness. In addition, seizures may be sustained for considerable periods of time, interfering with essential supportive care.

CAUSES OF NEONATAL SEIZURES:

1. Perinatal asphyxia;
   There is usually an interval of time between the event and the onset of seizures, but this interval is quite variable (1-36 hr).
2. Intracranial haemorrhage:
   - Subarachnoid haemorrhage
   - Periventricular or intraventricular haemorrhage
   - Subdural haemorrhage
3. Metabolic disturbances:
   - Hypoglycaemia
   - Hypocalcaemia
   - Hyponatraemia
   - Hypernatraemia
   - Pyridoxine dependency
   - Amino Acid disorders
   - Disorders of subcellular Organelles
4. Infection: Acquired either in utero, during delivery or in the immediate Perinatal period
   - Bacterial infection
   - Non bacterial infection:
5. Drug withdrawal: Heroin, methadone
6. Structural defects of the central nervous system.

TYPES OF SEIZURES: There are 4 major types of seizures in neonates:

1. Subtle seizures:
   - More common in preterm than full term infants
   - More commonly associated with EEG activities in preterm than term infants

- Such seizures include oral-buccal-lingual movements (smacking), certain ocular phenomena, peculiar limb movements (cycling), autonomic alterations and apnea.

Manifestations:

- Tonic horizontal deviation of the eyes, with or without jerking
- Eyelid blinking or fluttering
- Sucking, smacking or drooling
- Swimming, rowing or pedaling movements
- Apnoeic spells (convulsive apnoea)

2. Clonic Seizures:
   - More common in full term
   - Commonly associated with EEG activities

   Types:

   o Focal:
   - Well localized, rhythmic, slow, jerking movements
   - Involving the face, upper and lower extremities, neck or trunk on one side of the body
   - Usually not unconscious during or after the seizures

   o Multifocal:
   Several body parts seize in a sequential non jacksonian fashion e.g. left arm jerking followed by right leg jerking
3. Tonic: Mainly in premature infants

   Types:
   - Focal: Commonly associated with EEG activities
     - Sustained posturing of a limb
     - Asymmetric posturing of the trunk or neck or both
   - Generalized:
     - EEG changes are uncommon
     - Decerebrate posturing: Tonic extension of both upper and lower extremities
     - Decorticate posturing: Tonic flexion of the upper extremities with extension of the lower extremities
4. Myoclonic seizures:
   - Occurs in both premature and full term infants
   - Characterized by single or multiple synchronous jerks

   Types;
   - Focal:
     - Involve flexor muscles of the upper limbs
     - Not commonly associated with EEG changes
   - Multifocal;
     - A synchronous twitching of several parts of the body
     - Not commonly associated with EEG seizure activities
   - Generalized:
     - Bilateral jerks of flexors of the upper and sometimes the lower extremities
     - Commonly associated with EEG activities

DD: Jitteriness: Myoclonic seizures must be differentiated from jitteriness;

- Jitteriness is not associated with abnormal eye movements
- Movements in jitteriness cease on application of passive flexion
- Movements in jitteriness are stimulus sensitive
- Movements are not jerky

DIGNOSIS:

- **HISTORY:**
  - i. Family History of previous neonatal seizures
  - ii. Maternal History:
    - ➢ Diabetes
    - ➢ Hyperparathyroidism
    - ➢ Drugs during pregnancy
    - ➢ Infection during pregnancy
  - iii. Delivery:
    - ➢ Maternal analgesics
    - ➢ Mode and nature of delivery
    - ➢ Fetal intrapartum status
    - ➢ Resuscitative measures used
- **PHYSICAL EXAMINATION:**
  - i. A thorough general physical examination including:
    - ➢ Gestational age
    - ➢ Blood pressure
    - ➢ Presence of skin lesions
    - ➢ Presence of hepatosplenomegaly
  - ii. Neurologic evaluation:
    - ➢ level of alertness
    - ➢ Cranial nerves
    - ➢ Motor function
    - ➢ Primary neonatal reflexes
    - ➢ Sensory function
    - ➢ Anterior Fontanel; size and "feel"
    - ➢ Tone
    - ➢ Eyes: Retinal haemorrhage, Chorioretinitis, Pupilary size, Reaction to light, Extraocular movements, cataract
  - iii. Notation of seizures:
    - ➢ Site of onset
    - ➢ Spread
    - ➢ Nature
    - ➢ Duration
    - ➢ Level of consciousness
- **LABORATORY STUDIES:**

Guided by the information obtained from the history and examination

1. Serum chemistry: Glucose, Calcium, Sodium, Urea, magnesium, phosphate and blood gases
2. Full septic screen, including LP (CSF examination includes checking for xanthochromia, lactic acid & pyruvate –for evidence of mitochondrial cytopathies -, PCR, glucose concentration- persistently low in the absence of bacterial meningitis may suggest a glucose transport defect)
3. TORCH screen
4. Metabolic screen: In the present of FH of neonatal convulsion, peculiar odor about the infant, milk intolerance, acidosis, alkalosis, or seizures not responding to anticonvulsant:
   - Blood ammonia level
   - Urine for reducing substances
   - Urine and plasma amino acids
   - Urine for 2,4-dinitrophenylhydrazine (2,4-DNPH); Fluffy yellow precipitate will be seen in cases of maple syrup urine disease

- **RADIOLOGIC STUDIES:**
  1. Cranial ultrasound

2. CT scan of the head
3. MRI

- EEG

MANAGEMENT:

1. HYPOGLYCAEMIA:
   See hypoglycaemia protocol
2. HYPOCALCAEMIA:
   See hypocalcaemia protocol
3. HYPOMAGNESAEMIA OR REFRACTORY HYPOCALCAEMIA:
   See hypomagnesaemia protocol
4. ANTICONVULSANTS:
   [If facilities available, drug levels should be monitored]

® *Phenobarbitone*: 77% of cases are controlled by Phenobarbitone

DOSE:

- *loading dose:* 20 – 30 mg/kg IV or IM over 15 – 30 min
- *Maintenance dose*: 2.5 – 4 mg/kg/day od or in 2 divided doses [for neonates < 30 weeks 1 – 3 mg/kg/day]

® *Phenytoin*: Fosphenytoin is preferred – available only as IV/IM

DOSE:

- Intravenous:
  Loading dose: 15 – 20 mg/kg at a rate not >0.5 mg/kg/min
  Maintenance dose: 5 – 8 mg/kg/day divided q 12-24 h
- PO: highly variable; 5-8 mg/kg/day to 8 mg/kg q 12h
  [NB: 75 mg Fosphenytoin is equivalent to 50 mg phenytoin. The dose of Fosphenytoin is expressed as phenytoin equivalent (PE) e.g. the loading dose from the fosphenytoin is 15 – 20 mg PE]

® *Lorazepam (Ativan):*

- Initial dose; 0.05 mg/kg/dose. If no response after 15 minutes repeat the dose.
- Dilute with equal volume of sterile water, normal saline, D10 and infuse over 2-3 min

® *Midazolam:*

- Dose; 0.05 – 0.2 mg/kg/dose IV 2-4 hourly PRN
- Continuous infusion:
  - Loading dose; 0.2 mg/kg
  - Maintenance; 0.4 – 0.6 mcg/kg/min (max 6 mcg/kg/min

® *Paraldehyde:* PO, PR

- Dosage: 0.3 ml/kg/dose Q 4-6hif needed
- For rectal use dilute in an equal volume of olive or mineral oil. For oral use, dilute in infant formula

® *Pyridoxine:*

- Dose: 100 – 200 mg IV under EEG control. The seizure will abruptly stop and the EEG will normalize within few hours
- Maintenance; 50 – 100 mg PO daily
- If a trial of withdrawal at the age of 6 months fails, treatment should be continued for life

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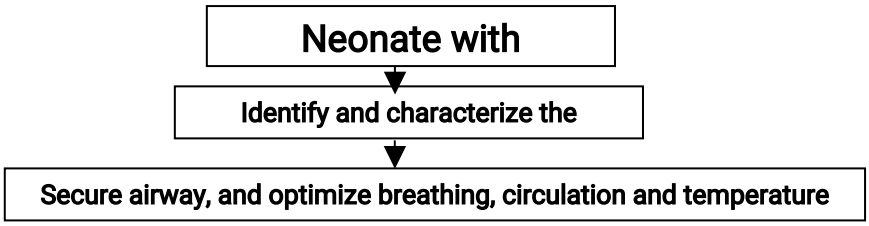
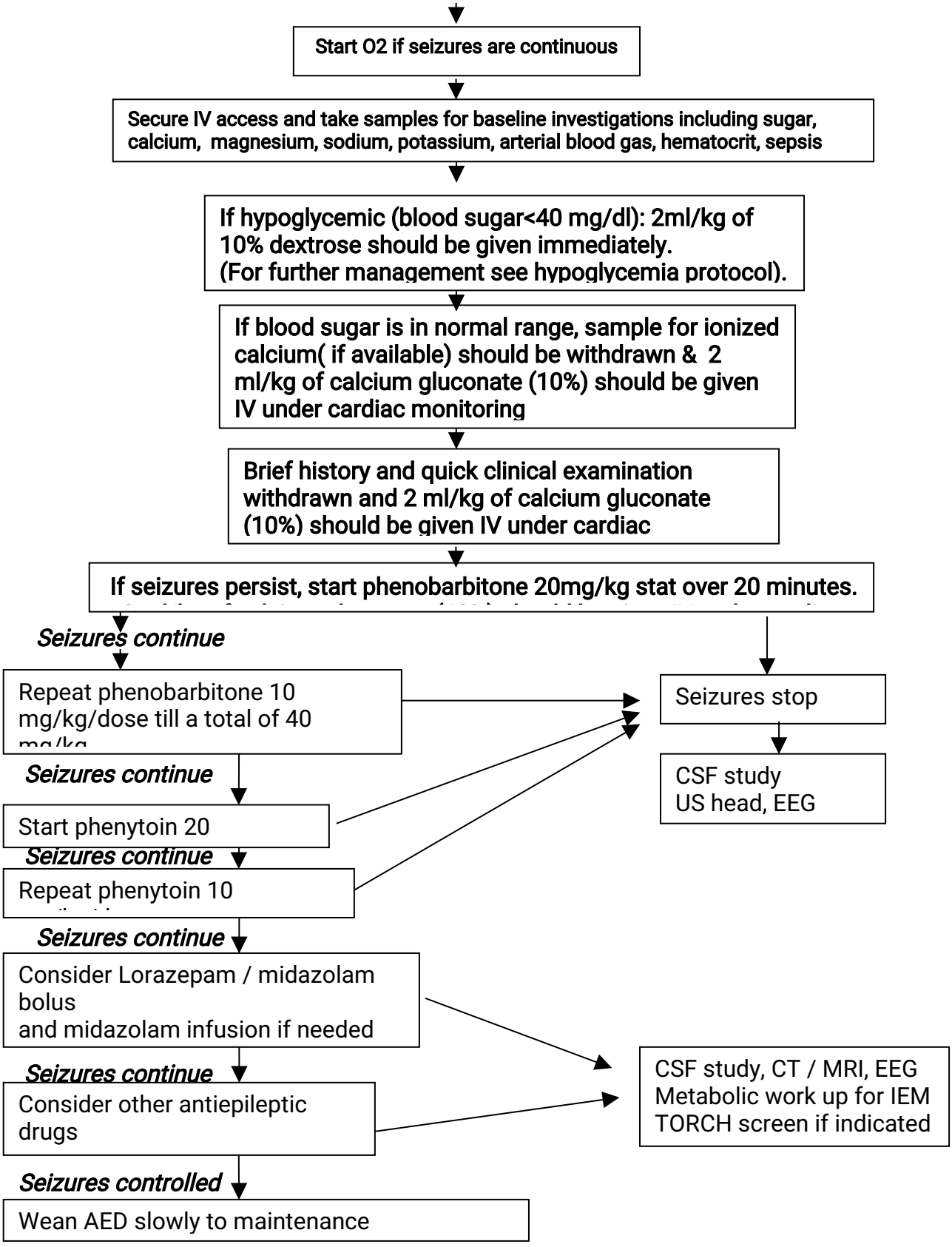
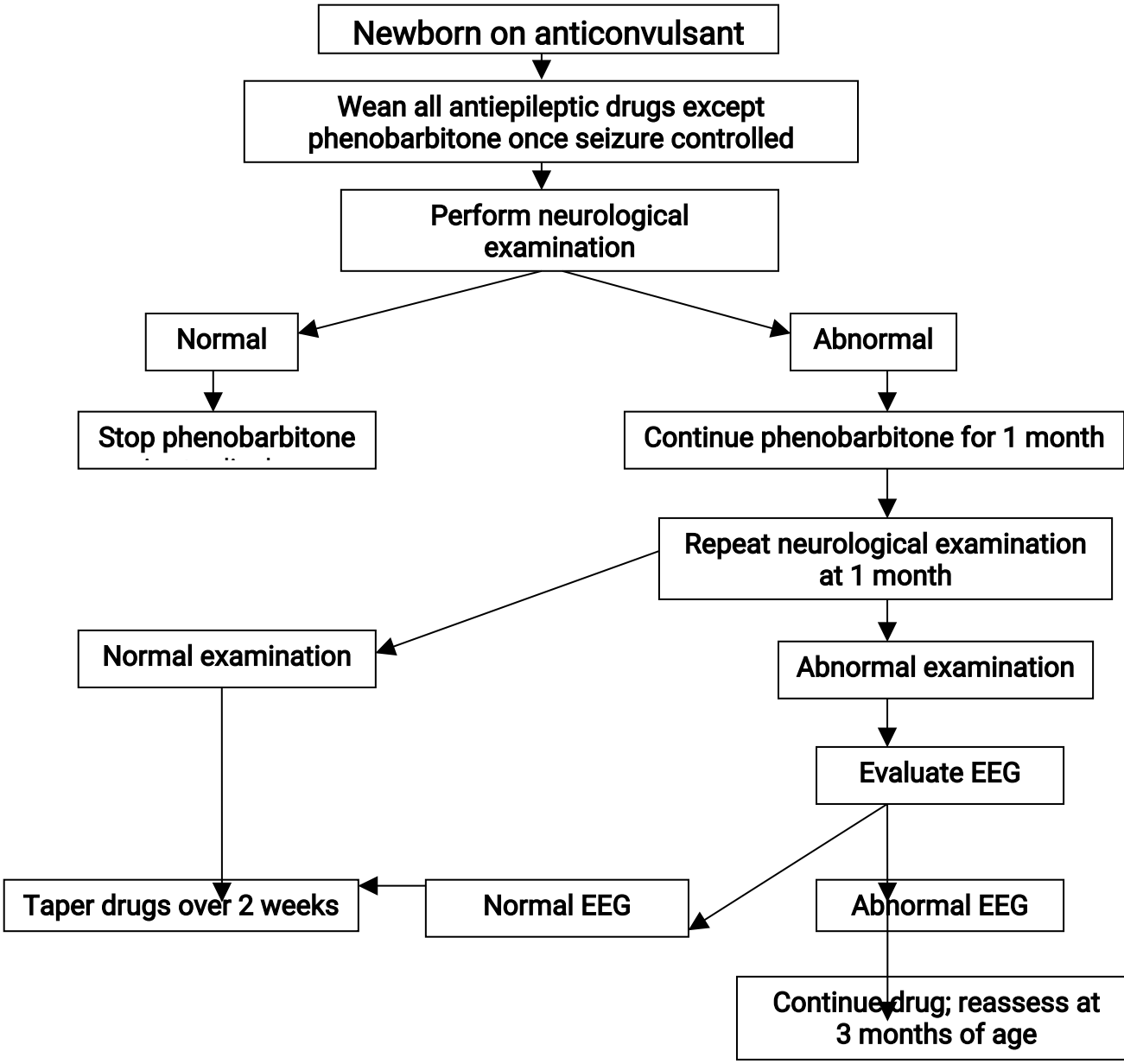
Flow diagram on management of neonatal seizures




Start O2 if seizures are continuous
Secure IV access and take samples for baseline investigations including sugar, calcium, magnesium, sodium, potassium, arterial blood gas, hematocrit, sepsis
If hypoglycemic (blood sugar<40 mg/dl): 2ml/kg of 10% dextrose should be given immediately.
(For further management see hypoglycemia protocol).
If blood sugar is in normal range, sample for ionized calcium(if available) should be withdrawn & 2 ml/kg of calcium gluconate (10%) should be given IV under cardiac monitoring
Brief history and quick clinical examination withdrawn and 2 ml/kg of calcium gluconate (10%) should be given IV under cardiac
If seizures persist, start phenobarbitone 20mg/kg stat over 20 minutes.
Seizures continue
Repeat phenobarbitone 10 mg/kg/dose till a total of 40
Seizures stop
CSF study
US head, EEG
Seizures continue
Start phenytoin 20
Seizures continue
Repeat phenytoin 10
Seizures continue
Consider Lorazepam / midazolam bolus
and midazolam infusion if needed
Seizures continue
Consider other antiepileptic drugs
CSF study, CT / MRI, EEG
Metabolic work up for IEM
TORCH screen if indicated
Seizures controlled
Wean AED slowly to maintenance

Flow diagram on weaning and duration of anticonvulsant therapy



CYANOSIS

Neonatal Bleeding

Dr. Mohamed Khalil Ali, Associate professor, consultant neonatologist, Gaafar Ibn Nauf Hospital

INTRODUCTION:

Neonatal bleeding results from:

- Disorders of platelets
- Coagulation proteins
- Disorders of vascular integrity.

CAUSES OF NEONATAL BLEEDING:

1. Platelet Disorders:

A. Thrombocytopenia (platelet count <150 x 10^9/L) occurs in: 1-4% of term newborns, 40-72% of sick. Causes include:

Decreased platelet production:	Increased platelet consumption
Congenital infection:(*e.g.*, CMV, Rubella,HIV),	Maternal auto-immune disease (*e.g.*, ITP, SLE)
Certain syndromes :e.g. Fanconi	Asphyxia/Shock
Sepsis	IUGR with toxemia of pregnancy
Hemolytic Disease of Newborn.	Sepsis
	Exchange transfusion
	Polycythemia/Hyperviscosity
	Hemolytic disease of the newborn
	Maternal thiazide intake
	Necrotizing enterocolitis

B. Impaired platelet function:

- Decreased platelet adhesivenesss associated with indomethacin therapy
- Von Willebrand's Disease

2. Coagulation Protein Disorders:

A. Congenital factor deficiencies:

•X-linked recessive: Hemophilia A (Factor VIII) and Hemophilia B (Factor IX)
•Autosomal recessive (rare): Factors V, VII, X, XI, XII, XIII, afibrinogenemia

B. Acquired deficiencies: Most common is Vitamin K deficiency.

3. Combined Platelet and Coagulation Factor Disorders:

A. Disseminated Intravascular Coagulation (DIC):
Infants have low platelet counts and fibrinogen levels, prolonged PT and PTT, and elevated Fibrin Degradation Products.

B. Hepatic Dysfunction:
due to several causes (*e.g.*, shock, infection, inherited conditions); most have prolonged PT and decreased factor and fibrinogen levels.

4. Disorders of Vascular Integrity:

Such as haemangiomas or vascular malformations,

SIGNS AND SYMPTOMS:

Signs of abnormal bleeding tendency include:

- **petechiae,**
- **excessive bruising,**
- **prolonged bleeding from puncture sites,**
- **umbilical oozing,**
- **gastrointestinal bleeding,**
- **hematuria,**
- **pulmonary hemorrhage,**
- **subgaleal hemorrhage**
- **Signs of hypovolemia (pallor, weak pulses, tachycardia, hypotension, metabolic acidosis).**

DIAGNOSTIC EVALUATION OF ABNORMAL BLEEDING:

1. **History:**
   - **Family history** of bleeding disorders or neonatal deaths
   - **Maternal history** of bleeding disorders, medication intake, previous neonatal deaths, auto-immune disease
   - **Perinatal:** Toxemia of pregnancy, IUGR, infections, antepartum bleeding
   - **Neonatal:** History of asphyxia, birth trauma, administration of Vitamin K, gender (X-linked disorders)
2. **Neonatal physical examination:**
   - Signs of bleeding
   - Signs of infection (hepatosplenomegaly)
   - Signs of hypovolemia
   - Hemangiomas, vascular malformations
   - Other malformations
   - Other illness (*e.g.*, NEC, hemolytic disease)
3. **Laboratory investigation:**
   - A. **Initial screen**
     - CBC, peripheral blood picture
     - Prothrombin time (PT)
     - Partial Thromboplastin Time (PTT)
     - Fibrinogen
   - B. **Other investigations:**
     - **LFTs**
     - **Septic screen (partial or full septic screen)**
     -
   - C. **Imaging Studies:**
     - **Cranial US**
     - **MRI brain**

MANAGEMENT:

- For secondary bleeding disorders, treat underlying disease.

- Replacement of clotting factors is often necessary

1. **Severe, life threatening bleeding:**
   - Maintain adequate circulating blood volume
   - Send blood for clotting studies
   - If clotting defect is not known, consider giving all of the following:
     - Vitamin K 1 mg IV **slowly over 1 min** (Rapid infusion of Vitamin K can cause cardiac dysrhythmias).
     - Fresh Frozen Plasma 10 mL/kg over 5-10 min.
     - Platelets 1 unit
     - Cryopreciptate 1 unit
     - Repeat clotting studies in 4-6h
2. **Bleeding with known abnormal clotting screening tests**

A. Prolonged prothrombin time (PT), normal PTT, platelets and fibrinogen:
- Give Vitamin K 1 mg IV **slowly over 1 min**
- Repeat PT in 4h. If not improved, consider Haematology Consultion to R/O specific factor deficiency.

B. Prolonged PT and PTT:
- Give Fresh Frozen Plasma 10 mL/kg and Vitamin K 1mg.
- Repeat clotting studies in 2h.

C. Low fibrinogen:

- Give cryoprecipitate 1 unit.

D. Thrombocytopenia:
- Serious bleeding usually does not occur unless there is severe thrombocytopenia (*i.e.*, <20 x 10^9/L). With "sick" infants, bleeding may occur at higher levels.
- Platelet transfusions to maintain platelets >50 x 10^9/L.
- Platelets should be type and Rh specific

Products for Treatment of Coagulopathies

Product	Factor Content	Usual Dose	Indications
Fresh frozen plasma	All factors	10-20 mL/kg	➢ Disseminated intravascular coagulation (DIC); ➢ liver disease; ➢ protein C deficiency
Exchange transfusion	All factors platelets	Double volume	Severe DIC; liver disease
Factor VIII concentrate	Factor VIII	25-50 U/kg	Factor VIII deficiency (Hemophilia A)
Factor IX concentrate	Factor IX	50-100 U/kg	Factor IX deficiency
Vitamin K		1-2 mg	Vitamin K deficiency
Platelet concentrate	Platelets	1-2 units/5 kg	Severe thrombocytopenia
Intravenous gamma globulin	IgG	1-2 g/kg	Severe sepsis; thrombocytopenia due to transplacental antibodies

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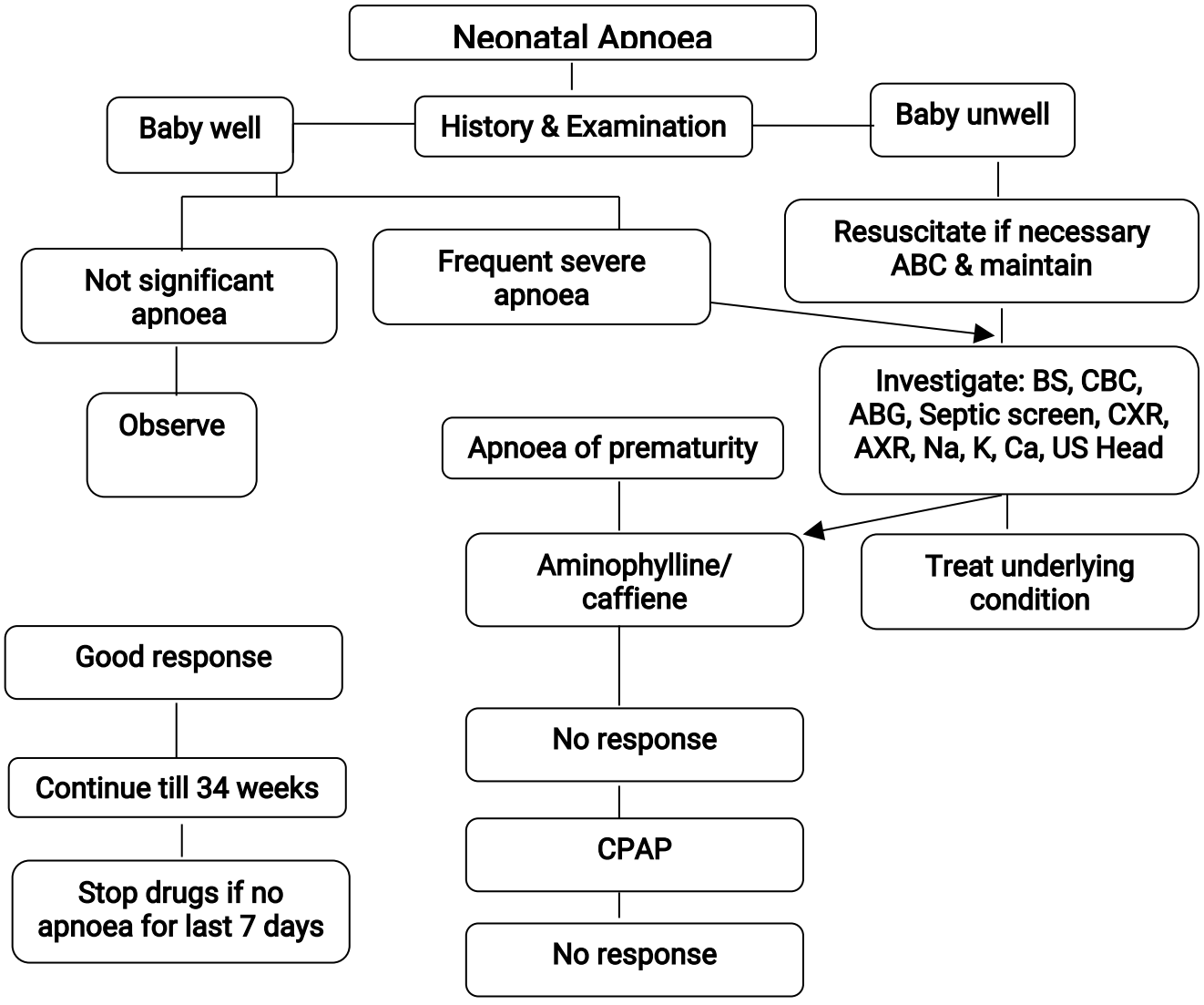
Flow diagram for treatment of apnoea



Ventilation

Protocol of management of respiratory distress syndrome- RDS

Aetiology:

- Prematurity
- Perinatal asphyxia
- Caesarean section
- Maternal diabetes

Clinical Signs:

RDS presents within four hours of birth:

- Sternal retraction, intercostal &sub costal recessions.
- An expiratory grunt.
- Tachypnoea above 60/min.

So common to all definitions of the disease is that the signs should present before four hours of age, should still be there at four hours of age, should still be there at four hours of age, and should persist for some period beyond tour hours of age.

Diagnosis:

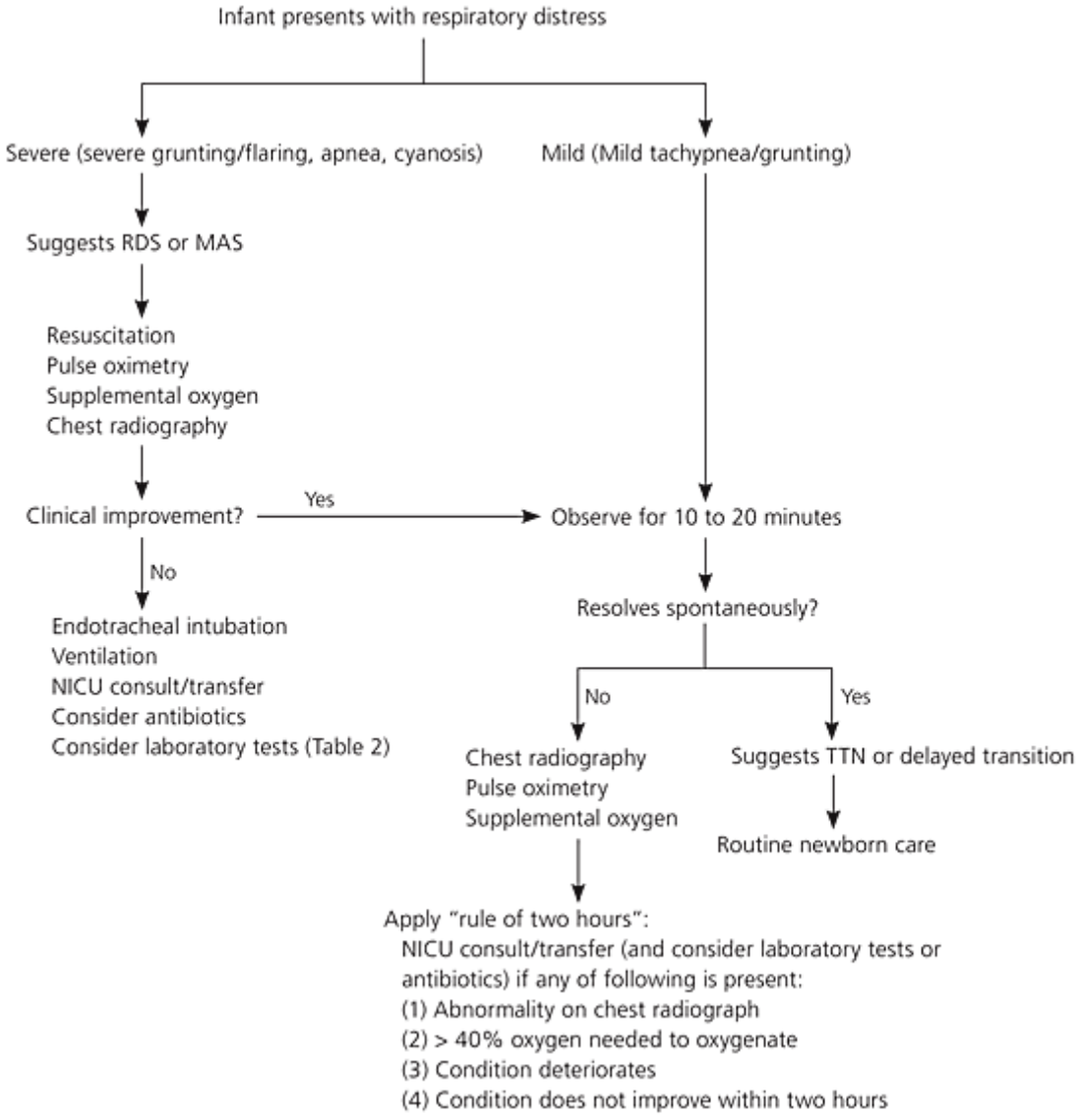
1. History
2. Clinical signs
3. Investigations:
    a. Radiology:
        - Atelectasis: documented by the ground-glass pattern.
        - Air bronchogram
        - In severe causes the lungs cannot be separated from the cardiac border.
    b. Hb%, packed cell volume (PCV), WBC &PLATELETS COUNT.
    c. Electrolytes, Creatinine, calcium (establishing base line).
    d. Blood gases (initiating treatment).
    e. Blood group and cross-match.
    f. Serum albumin.

Treatment:

The aim of treatment is to keep the alive and in good condition until he starts to synthesize his own surfactant 36-48 hours after birth. This means avoiding:

- Hypoxia.
- Acidemia.
- Hypothermia, which inhibits surfactant synthesis

Management of Neonatal Respiratory Distress



Distinguishing Features of TTN, RDS, and MAS

Cause	*Etiology*	*Timing of delivery*	*Risk factors*	*Clinicalfeatures*	*Chest radiography findings*	*Treatment*	*Prevention*
TTN	Persistent lung fluid	Any	Cesareandelivery4 Macrosomia Male sex Maternal asthma2 Maternal diabetes3	Tachypnea Often no hypoxia or cyanosis	Parenchymal infiltrates5“ Wet silhouette” around the heart5 Intralobar fluid accumulation	Supportive, oxygen if hypoxic	Prenatal corticosteroids before cesarean delivery if 37 to 39 weeks' estimated gestation (not accepted U.S. practice)19
RDS	Surfactant deficiency Lung under-development	Preterm	Male sex7 Maternal diabetes8 Preterm delivery6	TachypneaHypoxiaCyanosis	Homogenous infiltrates5Air bronchograms5Decreased lung volumes	Resuscitation, oxygen, ventilation, surfactant	Prenatal corticosteroids if risk of preterm delivery (24 to 34 weeks' estimated gestation)20 (accepted U.S. practice)
MAS	Lung irritation and obstruction	Term or post-term	Meconium-stained amniotic fluid Post-term delivery	TachypneaHypoxia	Patchy atelectasis5 Consolidation5	Resuscitation, oxygen, ventilation, surfactant	Do not impede delivery for suctioning23; amnioinfusion of no benefit27

TTN = transient tachypnea of the newborn; RDS = respiratory distress syndrome; MAS = meconium aspiration syndrome.

Practical points:

1- Monitoring of Temperature, Pulse& Respiratory rate.

2- Control baby body temperature: incubator, heat radiator.

3- Stop enteral feeding for the first 2-3 days of life.

4- Give glucose 10% I.V.

5- Oxygen :head box, face mask .nasal Cannula

6- Continuous Positive Airway Pressure (CPAP).

7- Intubation.

8- Surfactant.

9- Broad spectrum antibiotics.

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Inborn Error of Metabolism

Etiology:
Gene mutations that affect specific proteins

Result:
Alteration of primary protein structure or the amount of protein synthesized

Screening:
Most of the IEM can be screened (by tandem mass specroscopy) in the first few days before they manifest themselves clinically

Clinical features:

- Most of IEM manifest itself in the neonatal period or shortly thereafter
- Clinical findings are usually nonspecific and similar to sepsis

NEONATAL PERIOD:

May present with one or more the flowing symptoms or signs:

- Metabolic acidosis (high or normal anion gap) [Anion gap = Na −(Cl +HCO3)]
- Persistent vomiting
- Failure to thrive
- Altered Consciousness
- Seizures
- Myopathy
- Devlopmental delay
- Hypoglycaemia
- Peculiar odor
- Dysmorphism
- Cardiomegaly
- Rashes
- Cataract
- Retinitis
- Optic atrophy
- Cornial opacity
- Skeletal dysplasias
- Macrocephaly
- Hepatomegaly
- Jaundice
- Elevated blood or urinary level of a particular metabolite(amino acid, organic acid or ammonia) at birth

History:

- Normal at birth
- Few hours or days later: deterioration with lethargy, poor feeding, convulsions and vomiting

Physical examination:

- Lethargy, hypotonia, abnormal movements
- Hypatomegaly
- Tachypnoea
- Unusual odor

Investigations:

Initial Laboratory investigations:

- Serum glucose
- Serum ammonia
- high ammonia usually caused by defects in urea cycle enzymes and usually have *normal pH and bicarbonate levels*.

- Organic acidaemias may be associated with elevated ammonia level but these infants are severely acidotic because of organic acid accumulation
- When blood ammonia, pH, and bicarbonate are normal other aminoacidopathies (e.g. hyperglycinaemia) or galactosaemia
- pH and bicarbonate
- Serum electrolytes

Specific investigations:

- Direct Biochemical assays of metabolites or their metabolic by-products
- Enzyme's function
- DNA analysis of the gene
- Functional tests
- Neuroradiology
- Biopsies
- Postmortem

POST-NEONATAL PERIOD:

- Mental retardation
- Motor deficits
- Developmental regression
- Convulsions
- Myopathy
- Recurrent emesis with coma and hepatic dysfunction
- Cardiomyopathy

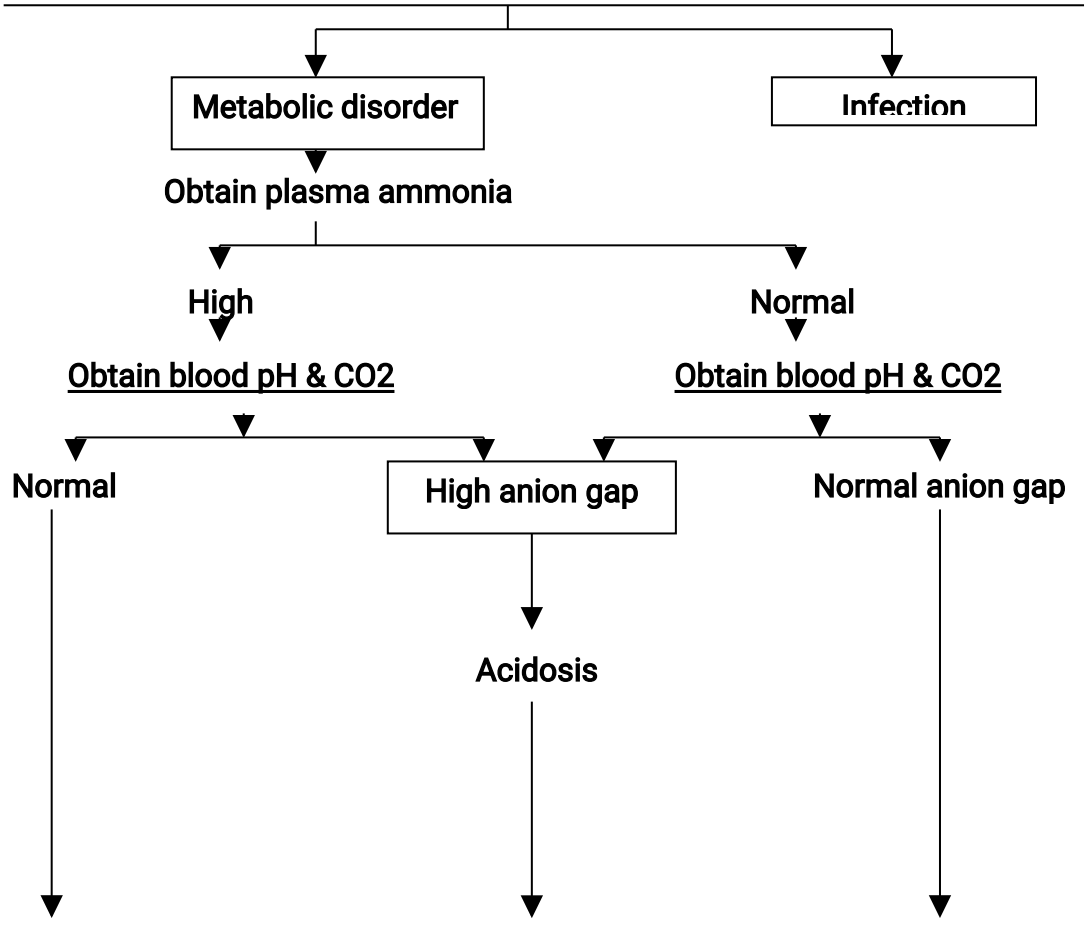
IEM are suspected in any child with one or more of the following manifestations:

- Unexplained mental retardation, developmental delay or regression, motor deficits or convulsions
- Unusual odor particularly during an acute illness
- Intermittent episodes of unexplained vomiting, acidosis, mental deterioration, or coma
- Hepatomegaly
- Renal stones
- Muscle weakness or cardiomyopathy

Clinical approach to patients with suspected IEM

Presentation includes one or more of the following:

- Poor feeding
- Vomiting
- Lethargy
- Convulsion not responsive to IV glucose or calcium
- Coma



Urea cycle defects	Organic acidaemias	Aminoacidopathies Or galactosaemia
These drugs are unsuitable for administration to breast-feeding mothers because;	These drugs can be administered to breast-feeding mothers only where the mother and infant can be monitored.	These drugs may be administered to breast-feeding mothers.

● Serious adverse effects have been described. ▲ Serious adverse effects may be anticipated on theoretical grounds.	○ Minor adverse effects have been described. ? Insufficient information relating to breast-feeding available to allow classification as a safe drug. △ Minor adverse effects may be anticipated on theoretical grounds. 🡻 May suppress lactation.	✓ They either: Are not excreted in breast milk. Are not absorbed by the infant. Give very low levels in infant with no apparent effects. ✱ Adverse effect (minor, reversible or of doubtful association) reported in a single case and therefore probably clinically insignificant.

Analgesics

Drug				Information
Analgesics				normal doses, short-term use.
Codeine			✓	
Dextropropoxyphene			✓	incl co-proxamol
Morphine			✓	
Paracetamol			✓	
Pethidine			✓	single-dose only
Salicylates (low dose or short-course use only)		?		Risk of Reye's Syndrome unknown
Antacids			✓	
Anthelmintics				
Mebendazole			✓	
Piperazine		?		7-day course
Piperazine and senna			✓	2-day course. Delay breast feeding for 8 hours after each dose
Anti-arrhythmics		?		
Amiodarone	▲			
Antibacterials				see also antituberculars
Aminoglycosides		△		avoid in neonates

Cephalosporins			✓	
Chloramphenicol IV/oral	●			
Chloramphenicol Ophthalmic			✓	
Clarithromycin		?		
Erythromycin			✓	
Metronidazole				
(high dose)		?		(eg IV or rectal)
(low dose)			✓	(eg oral 200-400mg tds)
				single course only
Penicillins			✓	
Quinolones		△		
Ciprofloxacin	●			
Sulphonamides		?		except avoid with G6PD deficiency and in neonates
Tetracyclines				
(short course)		△		ie up to 1 week
(long term)	▲			eg for acne
Trimethoprim			✓	
Anticoagulants				
Heparin			✓	including low molecular weight heparins
Nicoumalone			✓	
Phenindione	●			single report of adverse effect
Warfarin			✓	
Anticonvulsants				caution with multiple therapy
Carbamazepine			*	
Ethosuximide			✓	
Phenobarbitone		○		
Phenytoin		○		
Valproate				
(low dose)			✓	
(high dose)		?		
Antidepressants				
Fluoxetine and other SSRIs		?		
Lofepramine		?		
Tricyclics			✓	short-term use in normal doses, eg for PND
Doxepin	●			single report of adverse effect
Antidiarrhoeals				

Aminosalicylates				
Mesalazine		○		
Olsalazine		?		
Sulphasalazine		○		
Kaolin compounds			✓	also avoid with G6PD deficiency
Loperamide			✓	
Anti-D(rh$_o$) Immunoglobulin			✓	
Anti-emetics			✓	excluding high dose and ondansetron group
Antifungals				
Oral and topical			✓	but avoid ketoconazole
Parenteral		?		
Antihistamines				
Antihistamines		△		avoid long-acting formulations
Clemastine		○		single report of adverse effect
Terfenadine			✓	
Cromoglycate			✓	
Loratadine			✓	
Nedocromil			✓	
Antihypertensives				see also diuretics
ACE inhibitors		?		eg captopril, enalapril
Beta blockers			✓	incl labetolol
Atenolol		○		Propranolol, metoprolol or labetolol preferred
Sotolol		△		Propranolol, metoprolol or labetolol preferred
Calcium blockers		?		
Nifedipine			✓	
Verapamil			✓	
Hydralazine			✓	
Methyldopa			✓	
Anti-inflammatories				
NSAID's				
Diclofenac			✓	
Ibuprofen			✓	
Indomethacin			✓	
Ketoprofen			✓	

Mefenamic Acid			✓	
Naproxen		?		
Gold Salts	▲			
Salicylates (high dose or long-term only)		?		risk of Reye's Syndrome unknown
Antimalarials				
treatment	▲			eg quinine, chloroquine, primaquine
prophylaxis			✓	eg proguanil, chloroquine
Mefloquine		?		
Dapsone preps	●			eg maloprim
Antimigraine drugs				
Clonidine		?		
Ergotamine	●			
Pizotifen		?		
Sumatriptan		?		
Antineoplastics	▲			
Cyclophosphamide	●			
Antituberculars				
Ethambutol		?		
Isoniazid		△		
Pyrazinamide		?		
Rifampicin			✓	
Anti-ulcer drugs				
H_2antagonists		△		
Omeprazole		?		
Sucralfate			✓	
Antivirals		?		
Acyclovir				
standard oral / topical			✓	ie oral, 5 day short course
IV / High dose / long-term		?		
Benzodiazepines				
(high dose)		○		eg equiv to > 10 mg diazepam daily
(low dose)			✓	eg equiv to < 10 mg diazepam daily or short-acting hypnotics
Bronchodilators				

Aminophylline		△		
Theophylline		○		single report of adverse effect
Beta agonists				
Inhalers			✓	including all inhaled devices (disks, rotacaps etc)
Salbutamol (oral)		?		
Terbutaline (oral)			✓	
Corticosteriods				eg equiv to prednisolone
(high-dose)		?		>50mg daily
(inhaled and low-dose)			✓	<50mg daily
Cough and Cold Remedies				
Cough medicines			✓	except avoid iodide-containing preparations
Pseudoephedrine			✓	occasional use
Diuretics		↓		smaller effect with thiazides
Ergometrine			✓	short course (3-5 days) only
Herbal Medicines		○		
Ginseng	●			high-dose may cause androgenisation in neonate
Homeopathic Medicines			✓	
Hypoglycaemics				
Oral eg glibenclamide		?		
Insulins			✓	
Iron			✓	
Laxatives				
Bisacodyl			✓	
Bulk laxatives			✓	
Senna standardised			✓	
Oestrogens (high-dose)	●			see also Oral Contraceptives
Oral Contraceptives				
Oestrogen + Progestogen		↓ ○		
Progestogen only			✓	preferable to combined preps

Progestogens			✓	incl. medroxyprogesterone
Psycholeptics				
Haloperidol		△		
Lithium	●			
Phenothiazines		○		eg chlorpromazine, fluphenazine
Thioxanthines		△		eg flupenthixol, zuclopenthixol
Sulpiride		△		
Topical Medications				if applied to breast remove carefully by washing before feeding and reapply afterwards
Thyroid Drugs				
Carbimazole		△		
Propylthiouracil		△		preferable to carbimazole
Thyroxine			✓	
Vaccines				
Killed eg Typhoid			✓	
Live attenuated (eg Rubella)			✓	
Vitamins				
Folic Acid			✓	
Vitamin A (high-dose)		?		treatment of deficiency
Vitamin A (low-dose)			✓	prophylaxis
Vitamin B + C			✓	
Vitamin D (high-dose)	▲			treatment of deficiency
Vitamin D (low-dose)			✓	prophylaxis
Vitamin E			✓	
Vitamin K		?		