Neonatology: a branch of medicine concerned with the care, development & diseases of newborn infants

Term baby **infant born at a gestational age between 37 and 42/52**

Post-term delivered after 42/52 gestation

Preterm 37/52 less

LBW <2.500 normal BW 2.500-4.200kg

VLBW <1.500

ELBW <1.000

SGA 10^{th} centile

LGA 95th centile

IUGR :is when a fetus in the uterus does not grow as expected. Symmetric &asymmetric

Depressed , Lethargic Neonate, Birth injuries

Learning Objectives :

Concept ;

-Define birth asphyxia,

-Define APGAR score

-Explain the importance of APGAR score in the Mx of neonate with birth asphyxia;

-Determine the factors associated with birth asphyxia.

-Explain the Neonatal resuscitation and its associated problems

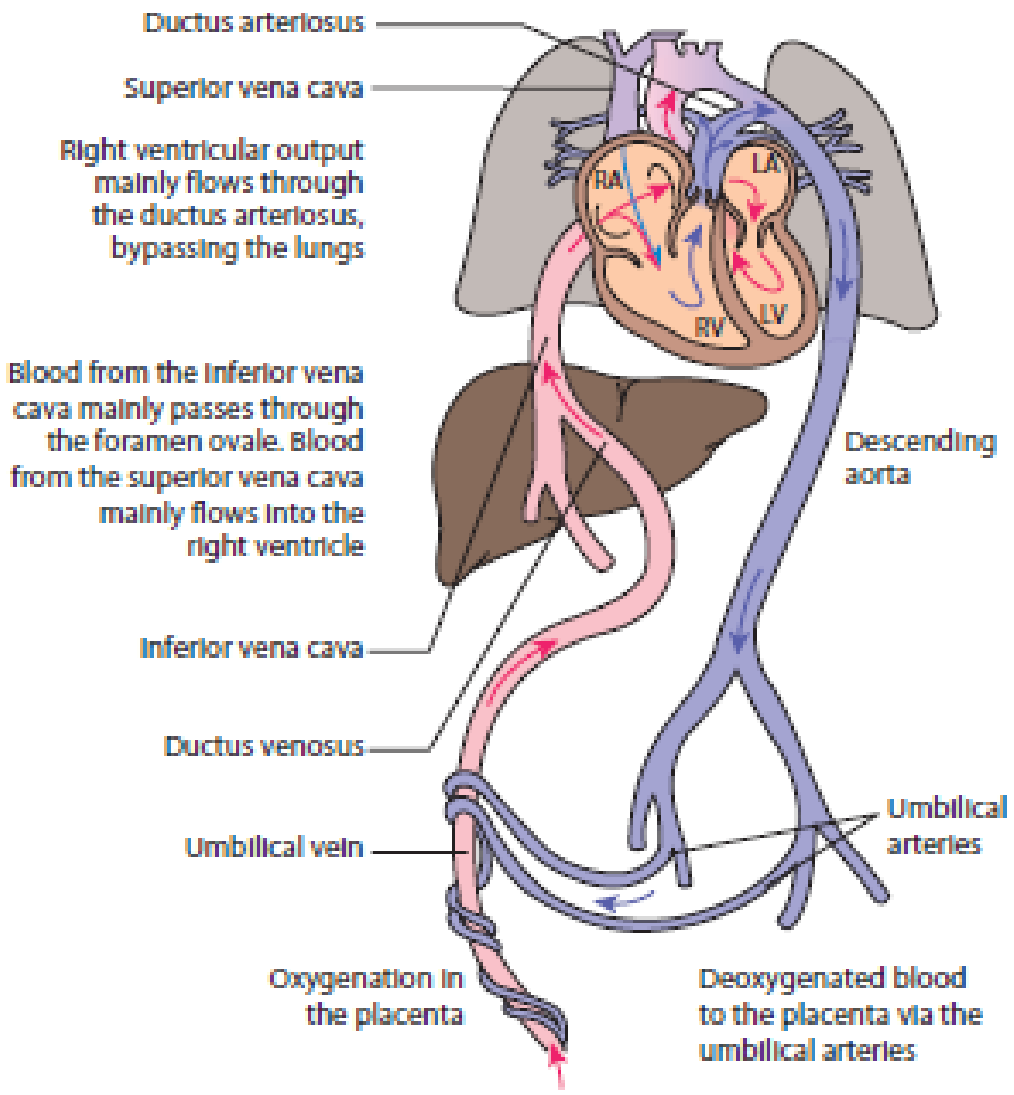
-Outline the management of a Baby sustained asphyxia.

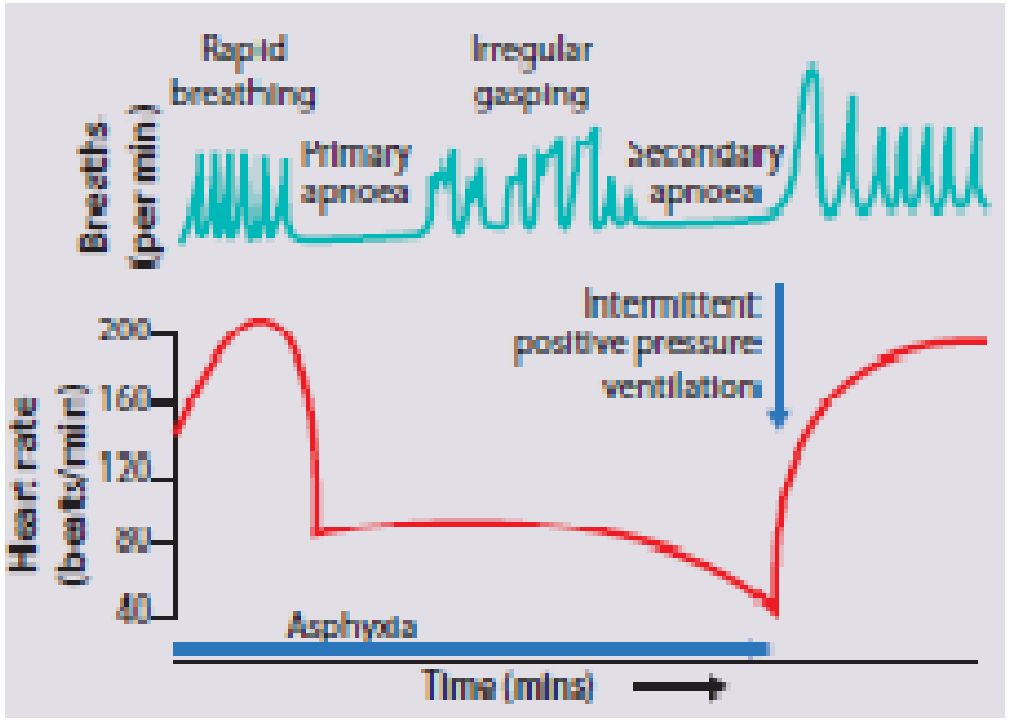
-Define types birth injuries sustained by NN

-How to deal with NN sustained birth trauma.

The APGAR Score

- Standard scoring system used to assess the status of a newborn
- Assigns a number value to five areas:
  - Appearance
  - Pulse
  - Grimace or irritability
  - Activity or muscle tone
  - Respirations





Changes in respiration & HR with continuous asphyxia. Once the infant has stopped gasping in 2ndary apnea, resuscitation with lung expansion is required to establish regular respiration & restore the circulation.

Apgar score assessment

7-10 – No or mild depression

4-6 – Moderate depression

0-3 – Severe asphyxia

If Apgar score is 0-3 at the first minute – neonatal mortality is 5,6 %. ***Nelson & Ellenberg*** examined Apgar scores in 49 000 infants. Of infants with an Apgar score 0 - 3 at 20 minutes, 59% of survivors died before 1 year, & 57% of the survivors had cerebral palsy. If Apgar score is 0-3 at the first min. & becomes 4 & more in the 5th min. – possibility of cerebral palsy is 1 %.

Per the guidelines of the (AAP) & (ACOG), all of the following must be present for the designation of asphyxia (1992):

- Profound metabolic or mixed acidemia (pH <7.00) in an umbilical artery blood sample, if obtained
- Persistence of an Apgar score of 0-3 for >5 min.
- Neonatal neurologic sequelae (eg, seizures, coma, hypotonia)
- Multiple organ involvement (eg, of the kidney, lungs, liver, heart, intestines)

SIGN	SCORE		
	0	1	2
Heart rate	Absent	Less than 100/min	Over 100/min
Respiratory effort	Absent	Weak/irregular	Strong/re-gular
Muscle tone	Atony	Some flexion	Active movement
Reflex irritability	No response	Grimace	Cough or sneeze
Color	Universal cyanosis or pallor	Pink body, acrocyanosis	Completely pink

The APGAR Score

- *Appearance*
  - If the skin of the newborn's entire body is blue (cyanotic) or pale, award 0 points.
  - If the newborn has blue hands and feet with pink skin at the core of the body, award 1 point
  - If the skin of the extremities as well as the trunk is pink, award 2 points.

The APGAR Score

- *Pulse*
- Heart rate is one of the most important signs of whether oxygen is reaching the newborn's tissues following birth.
  - Count the HR for at least 30 sec., preferably with a stethoscope. If you do not have a stethoscope, feel the pulse of the umbilical cord where it joins the abdomen or at the brachial artery.
- If no pulse is present, award 0 points.
- If the heart rate is < 100 (also a serious finding), award 1 point.
- If the heart rate is > 100, award 2 points.

The APGAR Score

- *Grimace* (reflex irritability)
  - Gently flick the soles of the newborn's feet, or observe the facial expressions during suctioning.
- If the newborn displays no reflexive activity to your stimulation, award 0 points.
- If the newborn displays *only some facial grimace*, award 1 point
- If your stimulation causes the newborn to grimace & cough, sneeze, or cry, award 2 points.

The APGAR Score

- *Activity*
  - This score refers to extremity reflexes/movement, or the degree of flexion of the arms and legs and the resistance to straightening them. The normal newborn's elbows, knees, and hips are flexed, and you should encounter some degree of resistance when you try to extend them.
- If during your assessment, the newborn is limp and displays no extremity movement, award 0 points.
- If the newborn only displays some flexion without active movement, award 1 point.
- If the newborn is actively moving around, award 2 points.

The APGAR Score

- *Respiration*
  - Another important assessment sign is the newborn's breathing effort. The newborn should have regular respirations & a vigorous cry. Distress is indicated by irregular, shallow, gasping, or absent respirations.
- If the newborn displays no respiratory effort, award 0 points
- If the newborn displays only a slow or irregular breathing effort with a weak cry, award 1 point
- If the newborn displays good respirations and a strong cry, award 2 points.

The APGAR Score

- The total of the five numbers is the Apgar score.
  - A perfect score is 10.
  - Calculate the Apgar score at 1 minute & 5 minutes after birth.

The APGAR Score

- *7–10 points*—The newborn should be active and vigorous. Provide routine care.
- *4–6 points*—The newborn is moderately depressed. Provide stimulation & oxygen.
- *0–3 points*—The newborn is severely depressed. You will probably need to provide extensive care including oxygen with bag-valve-mask ventilations & CPR.

The high risk factors of fetal (antenatal) hypoxia development:

1.Maternal age of less than 16 years old or > 40 years old.

2. Postmaturity.

3.Prolonged (> 4 weeks) gestosis of pregnancy.

4. Multiple pregnancy.

5. Threatened preterm labor.

6. Diabetes mellitus in pregnant women.

7. Bleedings and infectious diseases in II-III trimester of pregnancy.

8. Severe somatic diseases in pregnant women.

9. Smoking or drug addiction in pregnant women.

10. Intrauterine growth restriction or another diseases revealed in fetus in ultrasound examination.

The high risk factors of acute (intranatal) asphyxia development:

1. C/S (planned or urgent).
2. Malpresentation (breech, pelvic presentation).
3. Premature or retarded birth.
4. Waterless period > 24 or < 6 hrs, accelerated labor - < 4 hrs in primipara or < 2 hrs in secundipara.
5. Placental abruption.
6. Obstetrical forceps or vacuum-extractor use.
7. Birth trauma.
8. Congenital malformations of fetus.
9. Acute labor hypoxia in mother (shock, amniotic fluid embolism, poisonings, decompensated diseases).
10. Maternal anaesthesia (both the i.v drugs &the anaesthetic gases cross the placenta & may sedate the fetus).

Neonatal Assessment & Resuscitation

- Follow standard precautions.
- Always put on gloves before handling a newborn.
- Protecting the newborn against heat loss is critical!
- Also assure that the airway is clear of all secretion or birth fluids. Perform additional suctioning as needed.

Neonatal Assessment and Resuscitation

- Newborn should begin breathing spontaneously within 15 - 30 sec. after birth
- HR should be 100 beats/min or higher
- If you do not observe these responses:
  - Gently tap or flick the soles of the feet or rub the back.
  - Begin resuscitation efforts.

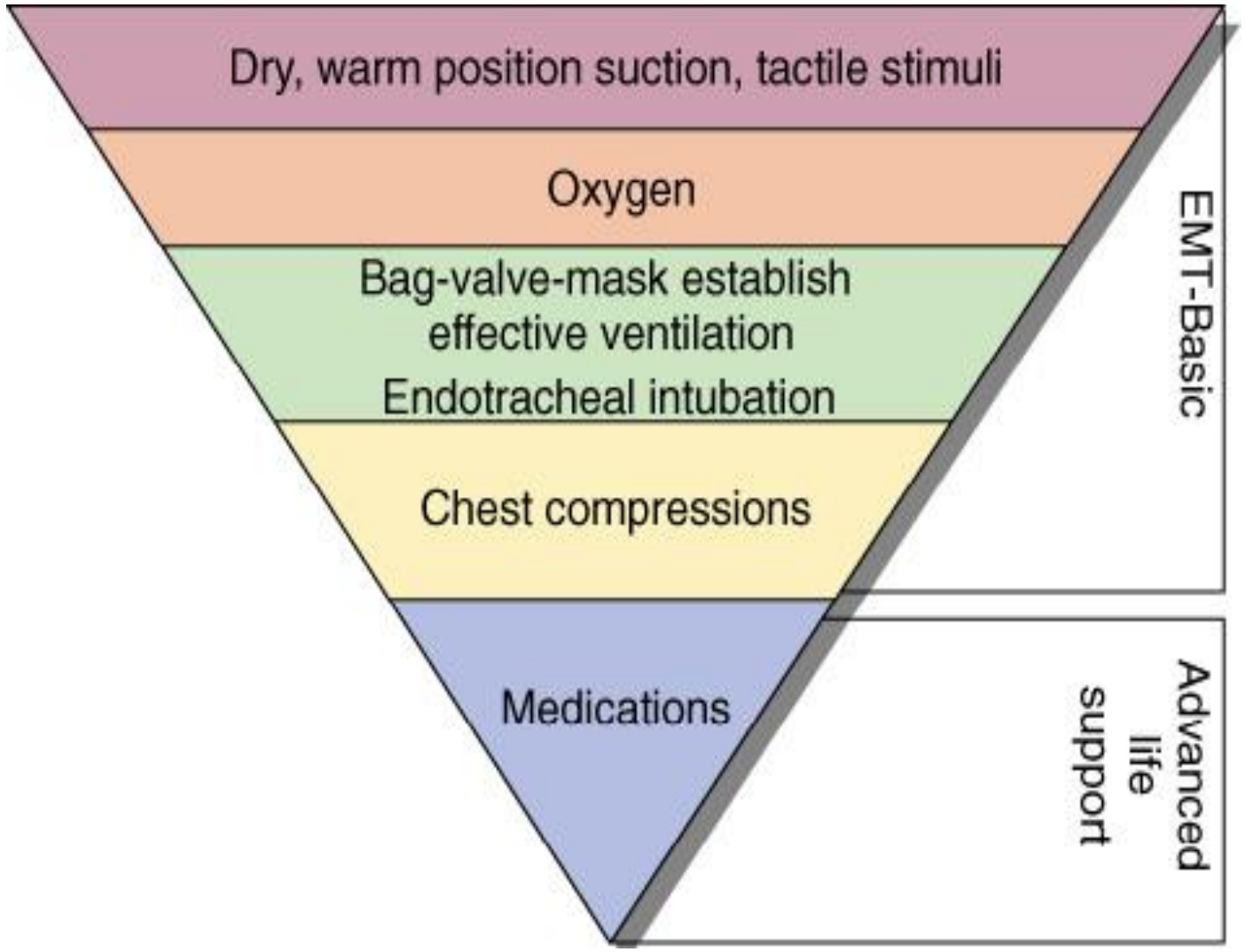
Neonatal Assessment and Resuscitation

- Most NN require no resuscitation beyond temperature maintenance, mild stimulation, & suctioning.
- A minority of the newborns will be so depressed that they also will need chest compressions or resuscitative medications.

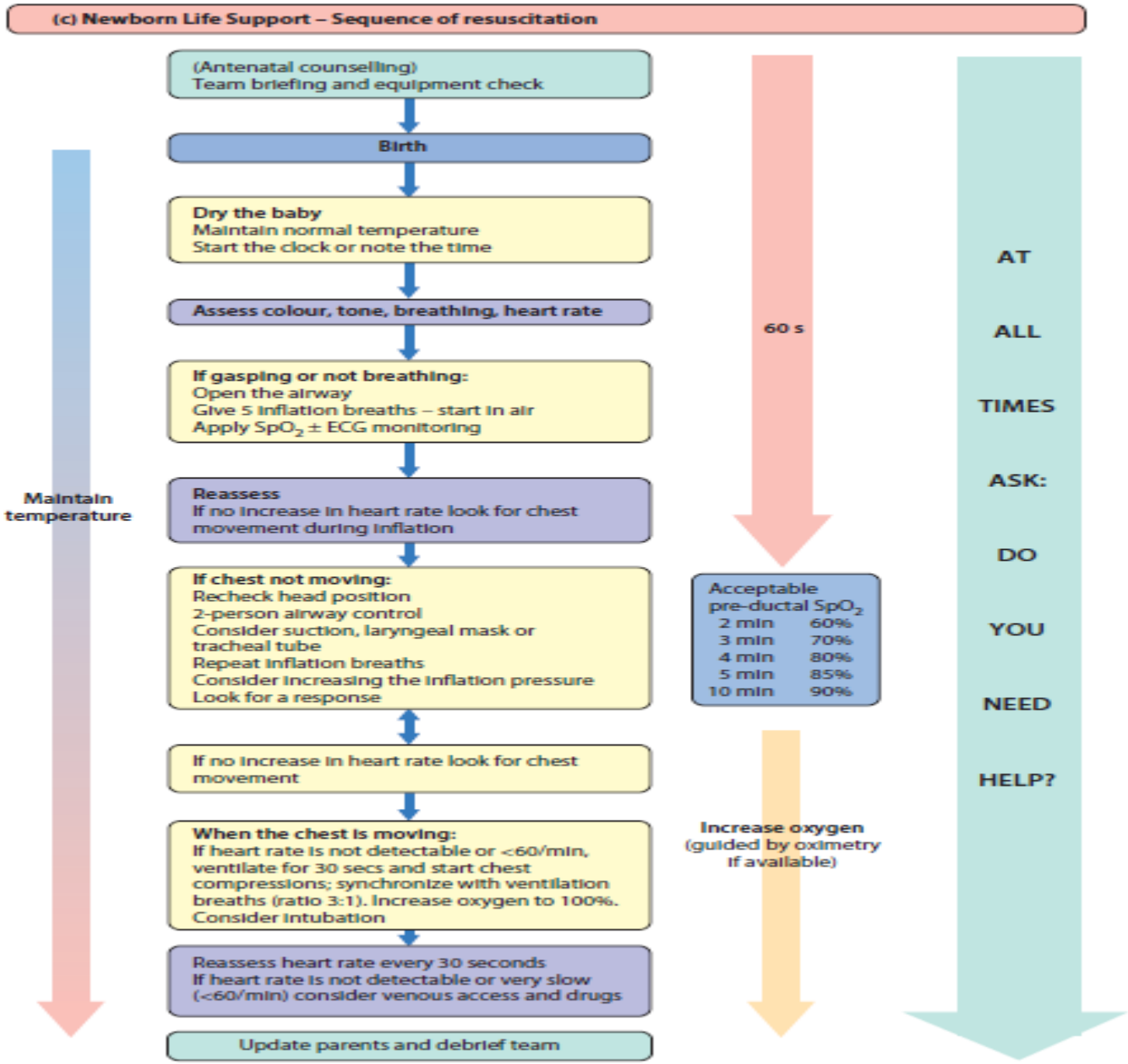
Signs of Severely Depressed Newborn

- Respiratory rate > 60 / min.
- ↓ breath sounds
- HR > 180 / min. or under 100 / minute
- Obvious signs of trauma from the delivery process
- Poor or absent skeletal M. tone
- Respiratory arrest, or severe distress
- Heavy meconium staining of amniotic fluid
- Weak pulses
- Cyanotic body (core &extremities)
- Poor peripheral perfusion
- Lack of or poor response to stimulation
- APGAR score < 4

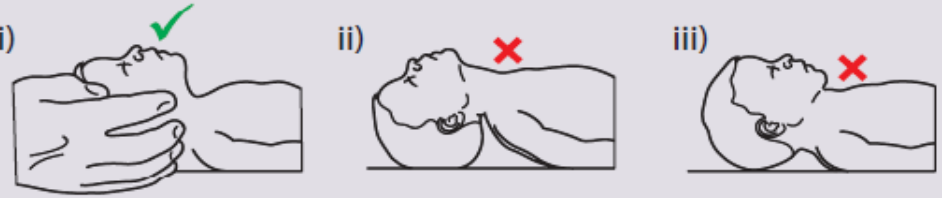
The Inverted Pyramid



Maintain normal body temperature (36.5° C–37.5° C). Hypothermia ↑ morbidity & mortality – every 1° C below this on NN unit admission in very preterm infants ↑mortality by 28%.

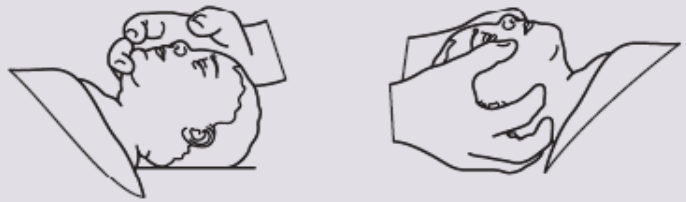

(c) Newborn Life Support – Sequence of resuscitation
(Antenatal counselling)
Team briefing and equipment check
Birth
Dry the baby
Maintain normal temperature
Start the clock or note the time
Assess colour, tone, breathing, heart rate
If gasping or not breathing:
Open the airway
Give 5 inflation breaths – start in air
Apply SpO2 ± ECG monitoring
Reassess
If no increase in heart rate look for chest movement during inflation
If chest not moving:
Recheck head position
2-person airway control
Consider suction, laryngeal mask or tracheal tube
Repeat inflation breaths
Consider increasing the inflation pressure
Look for a response
If no increase in heart rate look for chest movement
When the chest is moving:
If heart rate is not detectable or <60/min, ventilate for 30 secs and start chest compressions; synchronize with ventilation breaths (ratio 3:1). Increase oxygen to 100%.
Consider intubation
Reassess heart rate every 30 seconds
If heart rate is not detectable or very slow (<60/min) consider venous access and drugs
Update parents and debrief team
Maintain temperature
60 s
Acceptable pre-ductal SpO2
2 min 60%
3 min 70%
4 min 80%
5 min 85%
10 min 90%
Increase oxygen (guided by oximetry if available)
AT ALL TIMES ASK: DO YOU NEED HELP?

(e) **Head position, vital for airway management**



i) Head in correct, neutral airway position – incorrect iii) Head flexed – incorrect ii) Head over-extended

(f)



Chin lift Jaw thrust

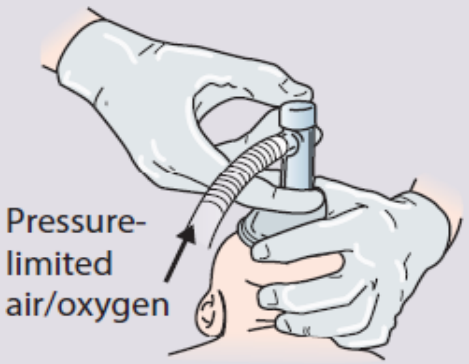
(g) **Correct size and position of the face mask. It should cover the mouth, nose, and chin**

Correct
Covers mouth, nose, and chin but not eyes

Incorrect
Too large – covers eyes and extends over chin

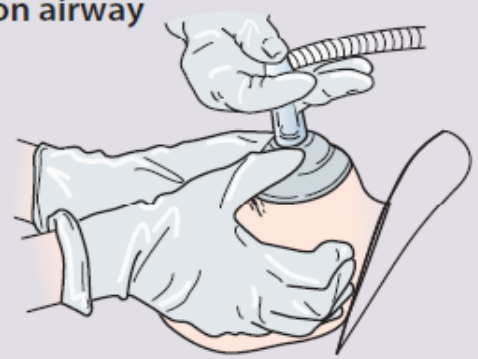
Incorrect
Too small – does not cover nose and mouth completely

(h) **Mask ventilation**



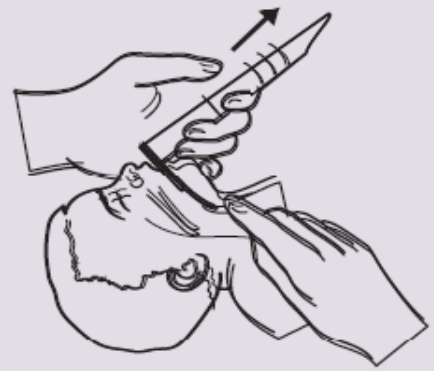
Mask ventilation delivered with pressure-limited circuit via T-piece (as shown), Neopuff or self-inflating bag.

(i) **Two-person airway control**

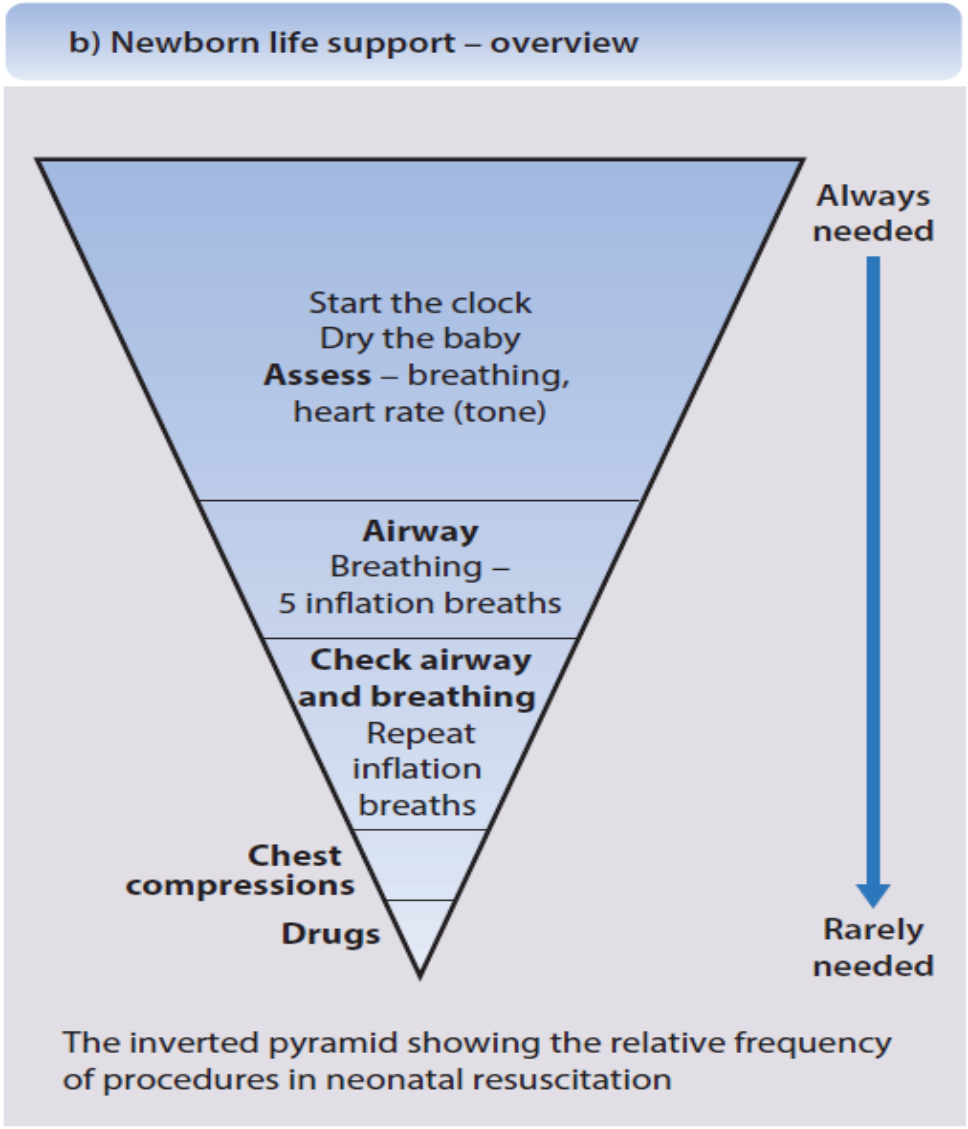


Consider if mask inflation ineffective. One person holds the head in the correct position, applies jaw thrust and holds the mask in place. The assistant operates the T-piece to provide lung inflation.

(j) **Tracheal intubation**



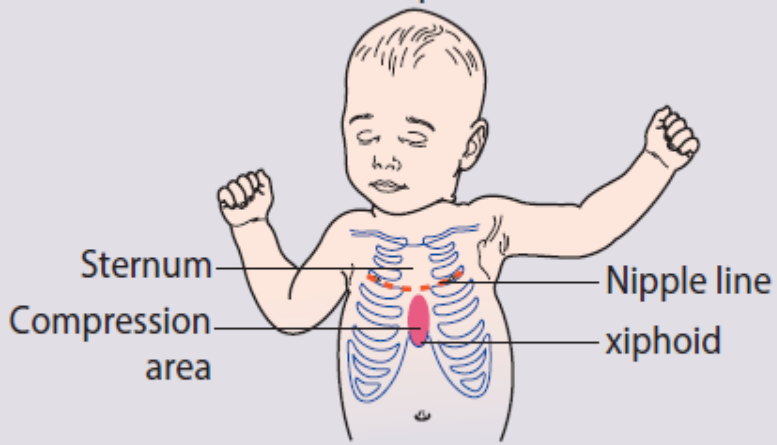
The laryngoscope blade is lifted upwards. Gentle pressure on the trachea helps bring the vocal cords into view



Neonatal resuscitation. *(From Newborn Life Support, 2015, Resuscitation Council (UK) with permission)*

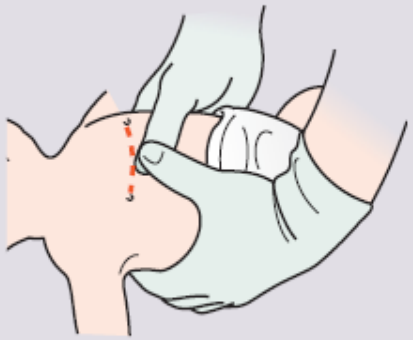
(l) Chest compression

Landmarks for chest compression



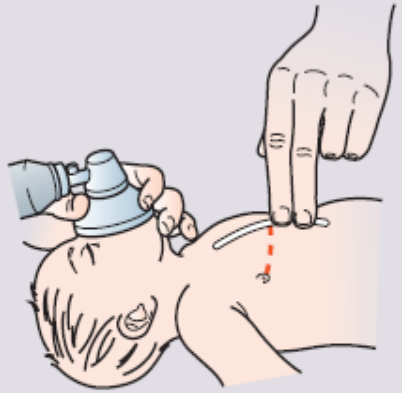
Apply pressure to lower third of sternum, just below imaginary line joining the nipples. Depress to reduce antero-posterior diameter by one-third (1–1.5 cm).

(m)



Thumb technique, with hands encircling the chest. In larger infants thumbs can be placed side by side.

(n)



Two-finger technique – less effective but easier if alone.

(q) Drugs used in neonatal resuscitation

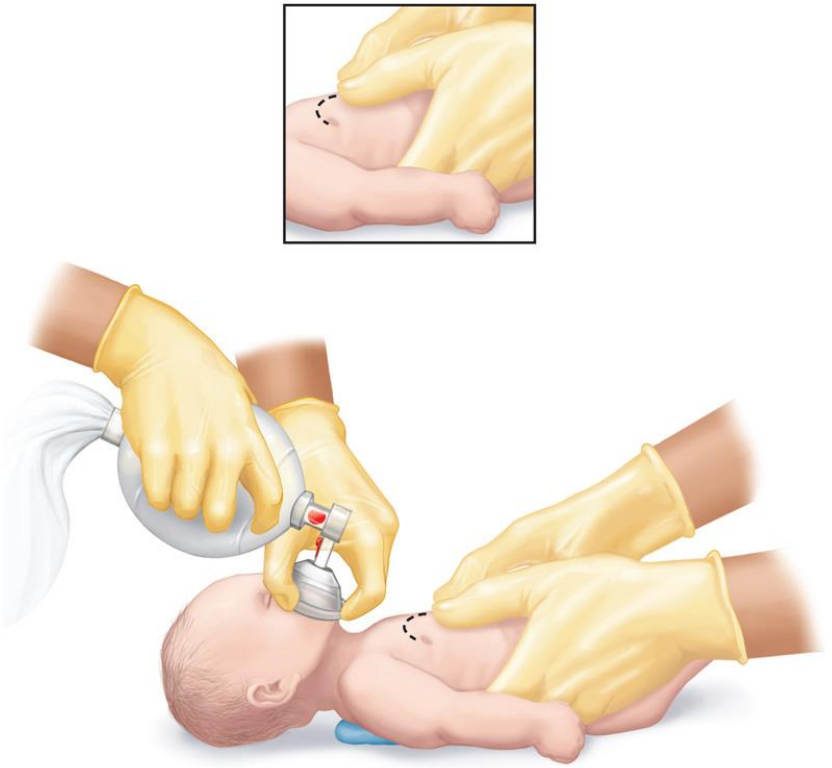
Drug	Concentration	Route/dosage	Indications
Epinephrine (adrenaline)	1:10 000	IV: 0.1 ml/kg (10 μg/kg), then 0.1–0.3 ml/kg (10–30 μg/kg) ET: 0.5–1ml/kg (50–100 μg/kg), i.e. 5–10 times the IV dose, whilst IV access is obtained	Heart rate <60 beats/min in spite of adequate ventilation and external cardiac compression
Sodium bicarbonate	4.2%	2–4 ml/kg (1–2 mmol/kg)	Severe lactic acidosis
Dextrose	10%	2.5 ml/kg (250 mg/kg)	Hypoglycaemia
Volume expander	0.9% Sodium chloride Blood	10 ml/kg, repeat if necessary	Blood loss

Neonatal Assessment and Resuscitation

- Reassess after 30 sec. of ventilation.
- If the breathing has not improved & the HR is less than 100/min., continue ventilations & reassess every 30 sec.

Neonatal Assessment and Resuscitation

- Use either the hand-encircling technique or the two-finger technique.
- Coordinate chest compressions with ventilations at a ratio of 3:1.



Conditions to consider if, after tracheal intubation, the HR does not ↑ & good chest movement is not achieved

For this purpose, the mnemonic 'DOPE' may be used:

- **d**isplaced tube: often in the oesophagus or right main bronchus
- **o**bstructed tube: especially meconium
- **p**atient:
  - tracheal obstruction
  - lung disorders: lung immaturity or respiratory distress syndrome, pneumothorax, diaphragmatic hernia, lung hypoplasia, pleural effusion
  - shock from blood loss
  - perinatal asphyxia or trauma
  - upper airways obstruction: choanal atresia.
- **e**quipment failure: gas supply exhausted or disconnected

If there is any uncertainty about the adequacy of ventilation in an intubated baby, consider removing the tracheal tube, give mask ventilation, and then re-intubate if necessary.

Neonatal Assessment and Resuscitation

- If cyanosis is present but breathing & HR are adequate, provide blow-by O2

Hypoxic-Ischemic Encephalopathy

Anoxia.
Hypoxemia
Hypoxia refers to a decreased oxygenation to cells or organs.
Ischemia
Hypoxic-ischemic encephalopathy (HIE) is an important cause of permanent damage to CNS tissues that may result in NN death or manifest later as CP or developmental delay.
About 20-30% of infants with HIE die in the NN period, &≈ 33-50% of survivors are left with permanent neurodevelopmental abnormalities (CP,MR).
The greatest risk of adverse outcome is seen in infants with severe fetal acidosis (pH <6.7) (90% death/impairment) & a base deficit >25 mmol/L (72% mortality).

*Babies with encephalopathy are lethargic &floppy with ↓level of spontaneous activity at first.

*They then become irritable with seizures which are the whole mark of the disease .

*Babies who have seizures without encephalopathy are likely to have suffered a stroke .

*The most common is HIE .

*NN encephalopathy is a serious condition occurring in 1-6/1000livebirths at term .

*The MR is ~15% & 25% of survivors will suffer significant neurologic disability

Fetal hypoxia may be caused by various disorders in the mother, including

(1) Inadequate oxygenation of maternal blood from hypoventilation during anaesthesia, cyanotic heart disease, respiratory failure, or CO poisoning;
(2) Low maternal BP from acute blood loss, spinal anaesthesia, or compression of the vena cava & aorta by the gravid uterus;
(3) Inadequate relaxation of the uterus to permit placental filling as a result of uterine tetany caused by the administration of excessive oxytocin;
(4) Premature separation of the placenta;
(5) Impedance to the circulation of blood through the umbilical cord as a result of compression or knotting of the cord;
(6) Placental insufficiency from toxemia or postmaturity.

MULTIORGAN SYSTEMIC EFFECTS OF ASPHYXIA

SYSTEM	EFFECT(S)
Central nervous system	HIE ,infarction, ICH, seizures, cerebral edema, Tone ↓↑
Cardiovascular	Myocardial ischemia, poor contractility, cardiac stunning, tricuspid insufficiency, hypotension
Pulmonary	Pulmonary hypertension, pulmonary hge, RDS
Renal	Acute tubular or cortical necrosis
Adrenal	Adrenal hemorrhage
Gastrointestinal	Perforation, ulceration with hemorrhage, necrosis
Metabolic	SIADH, Na ↓, hypoglycemia, Ca ↓, myoglobinuria
Integument	Subcutaneous fat necrosis
Hematology	DIC

HYPOXIC-ISCHEMIC ENCEPHALOPATHY IN TERM INFANTS

SIGNS	STAGE 1	STAGE 2	STAGE 3
LOC	Hyperalert	Lethargic	Stuporous, coma
M. tone	Normal	Hypotonic	Flaccid
Posture	Normal	Flexion	Decerebrate
Tendon reflexes/clonus	Hyperactive	Hyperactive	Absent
Myoclonus	Present	Present	Absent
Moro reflex	Strong	Weak	Absent
Pupils	Mydriasis	Miosis	Unequal, poor light reflex
Seizures	None	Common	Decerebration
EEG findings	Normal	Low voltage changing to seizure activity	Burst suppression to isoelectric
Duration	<24 hr if progresses; otherwise, may remain normal	24 hr-14 days	Days - wks
Outcome	Good	Variable	Death, severe deficits

Neonatal Assessment and Resuscitation

•Skilled resuscitation & stabilisation of sick infants will ↓ asphyxial damage.
•Infants with HIE may need:
•Respiratory support
•Treatment of clinical seizures with anticonvulsants; continuous amplitude-integrated EEG (cerebral function monitoring) is increasingly used to confirm early encephalopathy & to help with prognosis & interpretation of abnormal movements
•Fluid restriction because of transient renal impairment & SIADH
•Treatment of hypotension by volume & inotrope support
•Monitoring & treatment of hypoglycemia & electrolyte imbalance.

Randomised clinical trials have shown that mild hypothermia (cooling by 3-4°C can ↓ brain damage if started within 6 hrs of birth

What management are you going to arrange?

*Admission to NICU, establish monitoring

*Urgent glucose & blood gas

*Establish i.v & ventilatory support if required

*Arrange 1st line investigations including LP

*Consider initiating Tx with a loading dose of Phenobarbital if seizures quickly recur or if a single seizure is prolonged

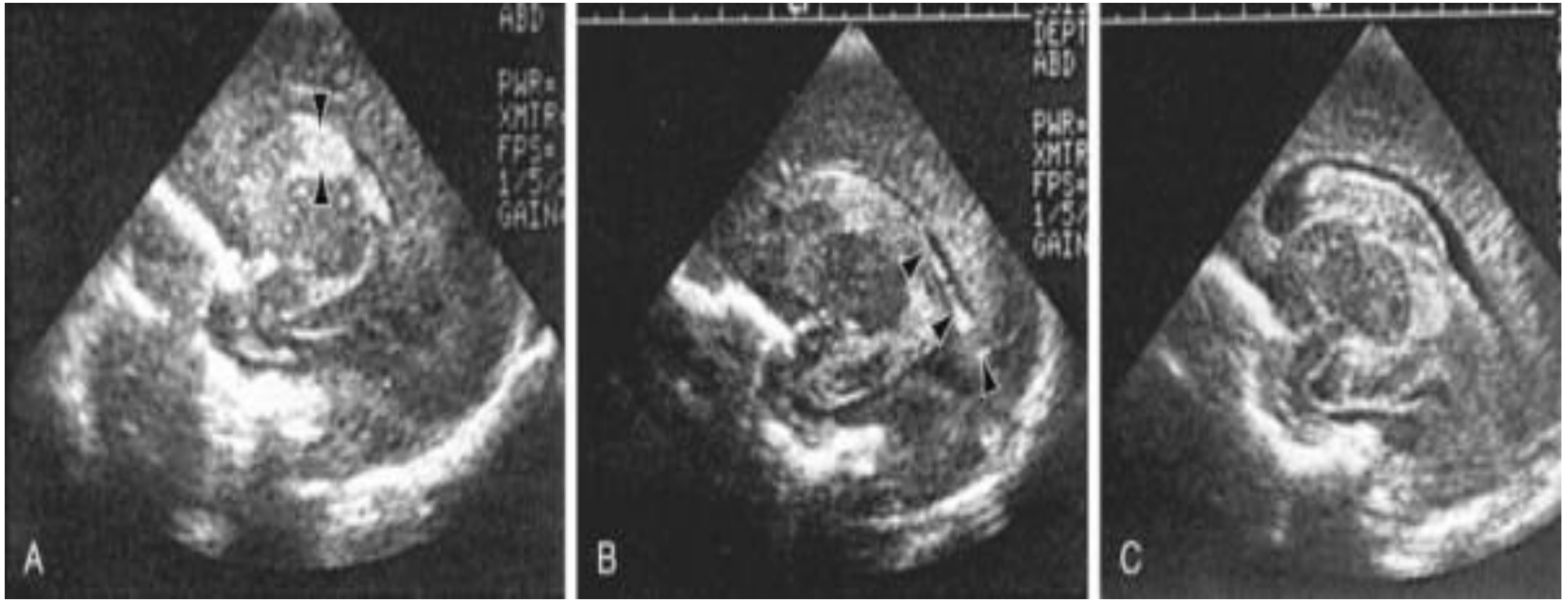
(rare in NN)

*Restrict fluid in babies thought to have HIE but maintain glucose level

*Explain seizures to parents but do not try to prognosticate too early ,the prognosis varies considerably according to the cause & accurate prognosis requires information from EEG& MRI

Predisposing factors for IVH include

Prematurity, RDS, hypoxic-ischemic or hypotensive injury, reperfusion injury of damaged vessels, ↑ or ↓ cerebral blood flow, ↓ vascular integrity, ↑ venous pressure, pneumothorax, thrombocytopenia, hypervolemia, & hypertension.



Grading the severity of germinal matrix intraventricular hge with parasagittal USS.
A, Grade I: Note the echogenic blood in the germinal matrix *(arrowheads)* just ant. to the anterior tip of the choroid plexus, which (normally) is also echogenic.
B, Grade II: Note the echogenic blood *(arrowheads)* filling <50% of the ventricular area.
C, Grade III: Note the large blood clot nearly completely filling & distending the entire lateral ventricle.

The severity of hge may be defined on CT scans by the location & degree of ventricular dilatation.

In a **grade I** Hge, bleeding is isolated to the subependymal area.

In **Grade II** Hge, there is bleeding within the ventricle but without evidence of ventricular dilatation.

Grade III Hge consists of IVH with ventricular dilatation.

In **Grade IV** Hge, there is intraventricular & parenchymal hemorrhage.

Another grading system describes 3 levels of increasing severity of IVH detected on ultrasound:

In **grade I,** bleeding is confined to the germinal matrix–subependymal region or to <10% of the ventricle (≈35% of IVH cases);

grade II is defined as intraventricular bleeding with 10-50% filling of the ventricle (≈40% of IVH cases)

grade III, more than 50% of the ventricle is involved, with dilated ventricles

Ventriculomegaly is defined as mild (0.5-1 cm), moderate (1.0-1.5 cm), or severe (>1.5 cm).

Treatment

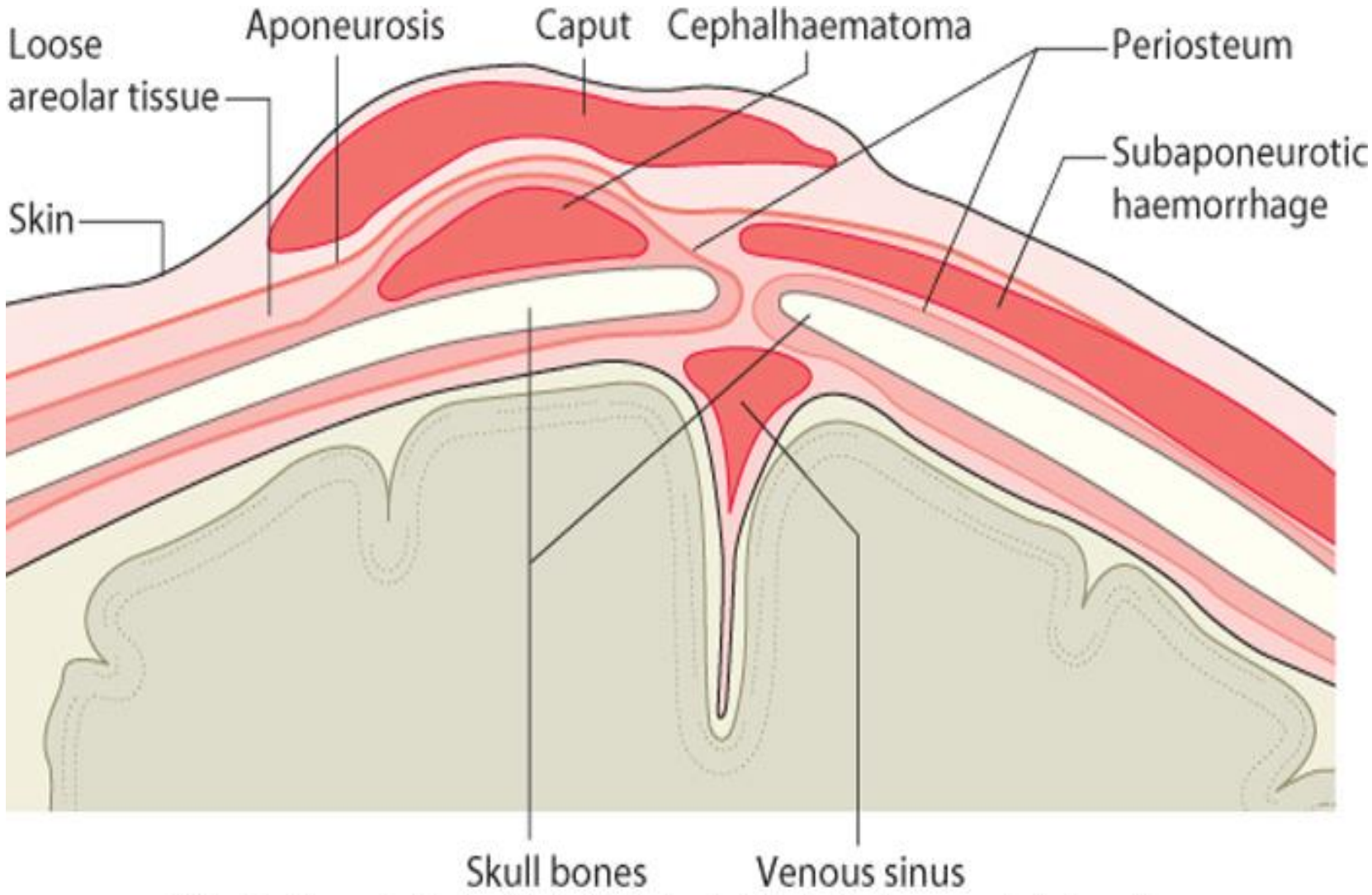
Although no treatment is available for IVH, it may be associated with other complications that require therapy.
Seizures should be treated with anticonvulsant drugs.
Anemia & coagulopathy require transfusion with packed RBCs or FFP.
Shock & acidosis are treated with the judicious & slow administration of Na HCO_3 & fluid resuscitation.

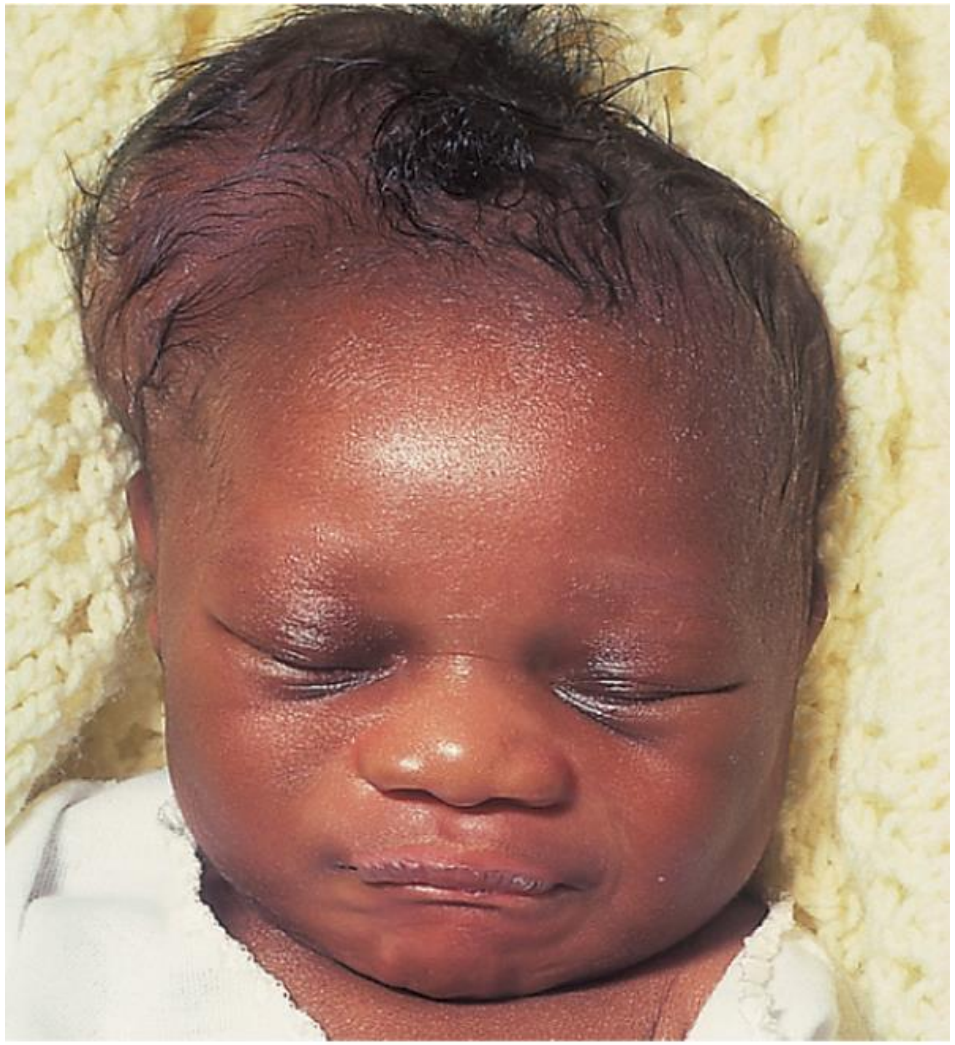
Birth injuries

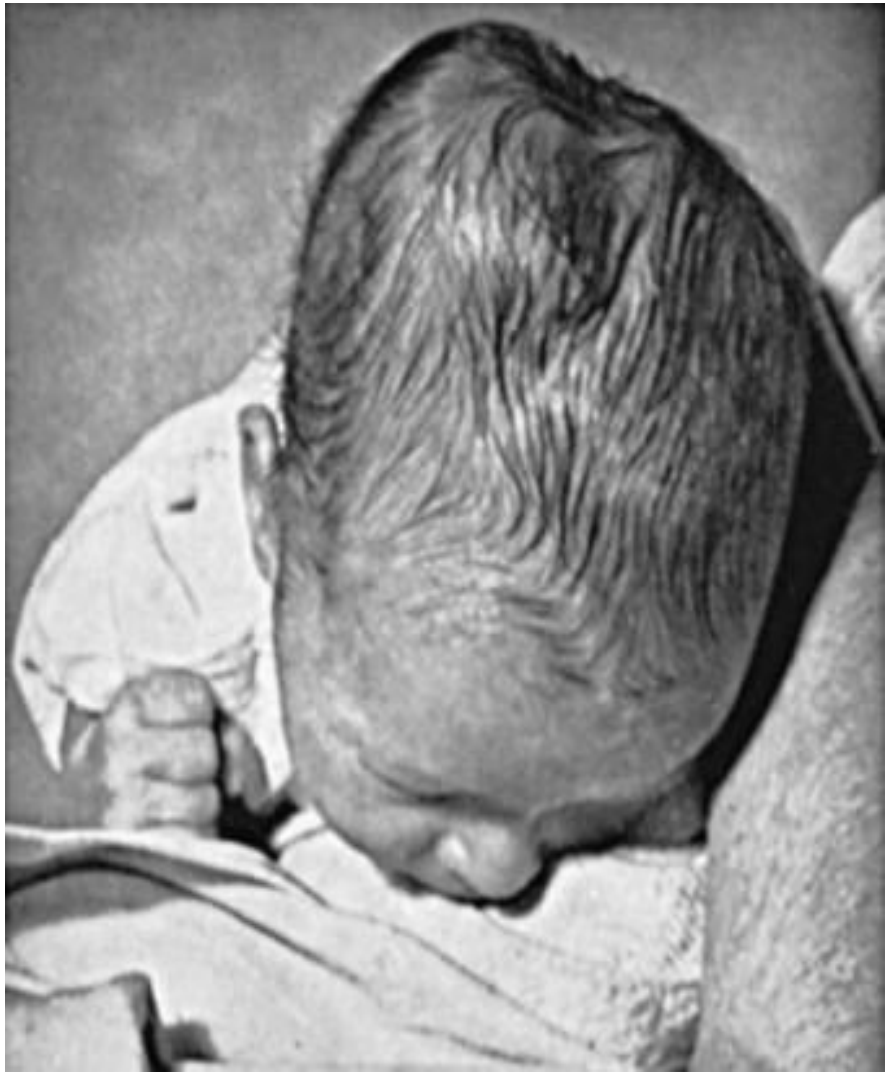
- **Soft tissue injuries**: caput succedaneum, cephalhematoma, chignon, bruises and abrasions
- subaponeurotic hemorrhage

- **Nerve palsies:** brachial plexus - Erb's, Klumpke's
- facial nerve

- **Fractures:** clavicle, humerus, femur







klumpke's palsy