

NEONATAL JAUNDICE



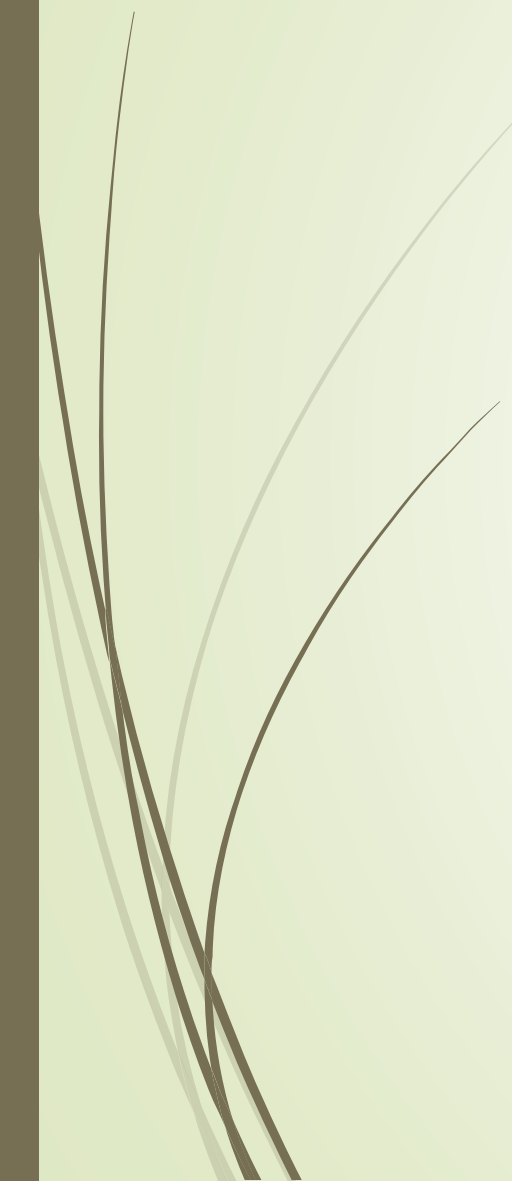
Healthy
Baby



Baby with
Jaundice



Overview:

- Neonatal jaundice
 - Types of Neonatal jaundice
 - Physiological Jaundice (its causes and characteristics)
 - Pathological jaundice (its causes and characteristics)
 - Assessment of a neonate with jaundice
 - History
 - Physical examination
 - Noninvasive assessment of jaundice
 - Laboratory investigation
 - Management of Neonatal jaundice
 - Phototherapy
 - Medication
 - Exchange transfusion
- 



Neonatal jaundice

- Jaundice is A visible manifestation of hyperbilirubinemia. The clinical jaundice in neonates appear on the face at a serum bilirubin level of 5mg/dL, whereas in adults, it is diagnosed as little as 2mg/dL.
- The yellowish discoloration is first seen on the skin of face, nasolabial folds and tip of nose in the neonates.
- It is detected by blanching the skin with digital pressure in the natural light.
- Neonatal jaundice is also termed as icterus neonatorum or as neonatal hyperbilirubinemia.

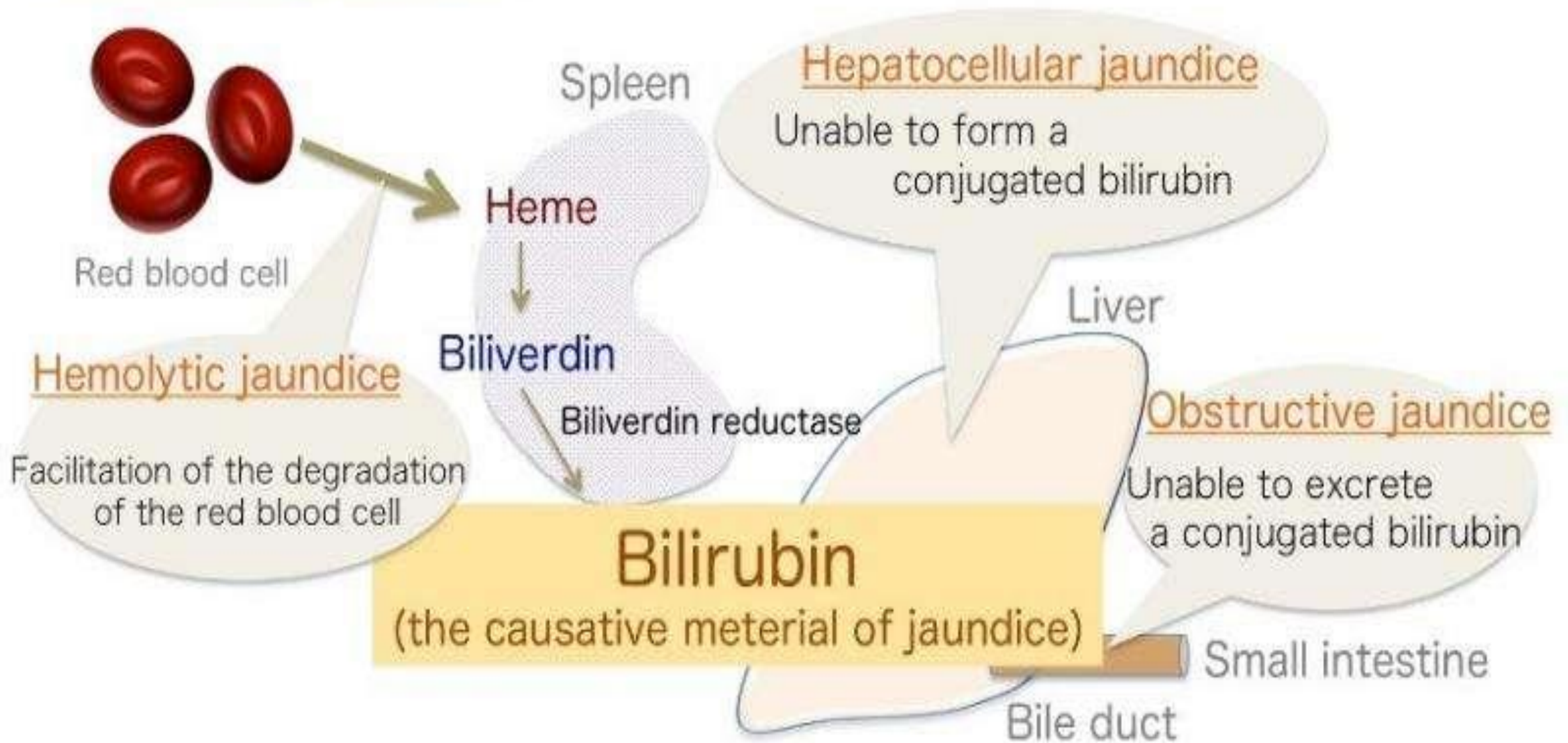
Neonatal jaundice

- Almost 60 % term neonates and about 80 % preterm neonate have bilirubin level greater than 5mg/dL in the first week of life.
- About 6 % of term babies will have bilirubin level exceeding 15 mg/dL

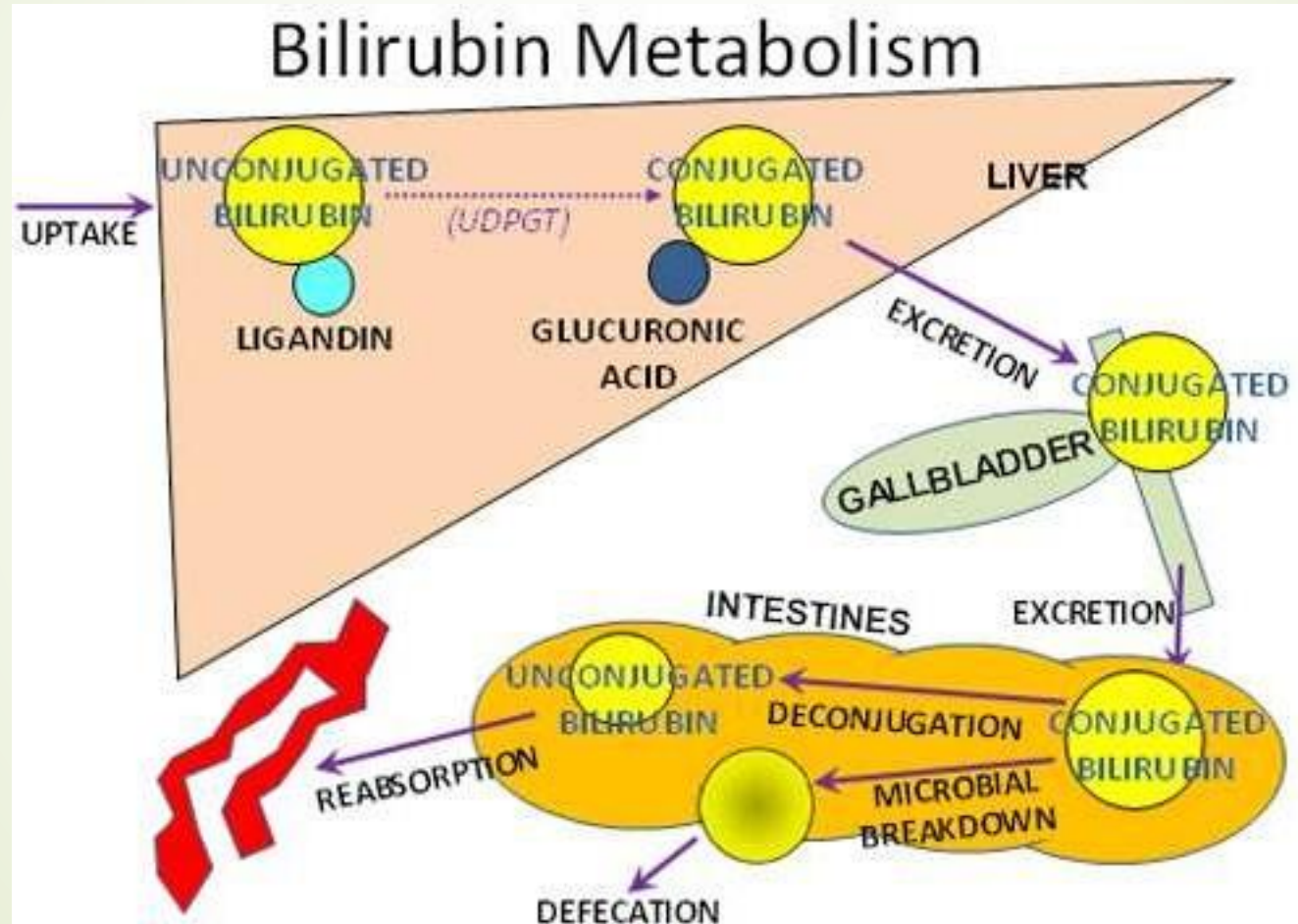


Figure – This infant presented with jaundice 8 weeks after birth. The cause was hemolytic disease of the newborn due to Rh incompatibility. The mother's fingers are shown for contrast.

Cause of jaundice



Pathophysiology



Types of jaundice

Physiological Jaundice

- Appears after 24 hours
- Total bilirubin rises by less than 5 mg/dl per day
- Maximum intensity by 4th-5th day in term & 7th day in preterm
- Serum level less than 15 mg / dl
- Clinically not detectable after 14 days

Pathological jaundice

- Appears age Appears within 24 hours of age
- Increase of bilirubin > 5 mg / dl / day
- Serum bilirubin > 15 mg / dl
- Jaundice days Jaundice persisting after 14 days
- Stool clay / white colored and urine staining yellow staining clothes
- Direct bilirubin > 2 mg / dl



Physiological jaundice

- ▶ Multiple factors are responsible for physiological jaundice, which commonly found in both term and preterm babies.
- ▶ There is elevation of unconjugated bilirubin concentration due to various reasons in the first week of life.

Mechanisms of Physiological jaundice

a. Increase bilirubin load in hepatic cells due to increased volume of RBCs in polycythemia and reduce lifespan of fetal RBCs and increased enterohepatic circulation of bilirubin.



b. Defective bilirubin conjugation due to decrease enzymatic activity of uridine diphosphate glucuronyl transferase (UDPG-T)



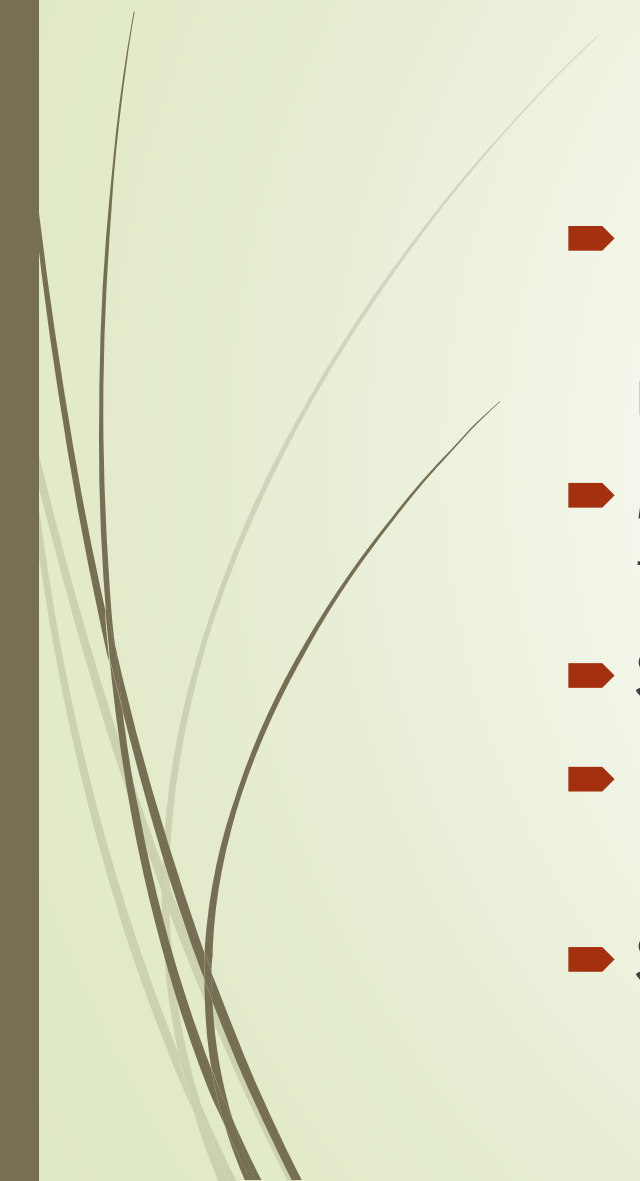
c. Defective uptake of bilirubin by the liver from plasma due to decreased ligandin and increased ligandin-binding by other anions.



d. Defective bilirubin excretion due to congenital infection.

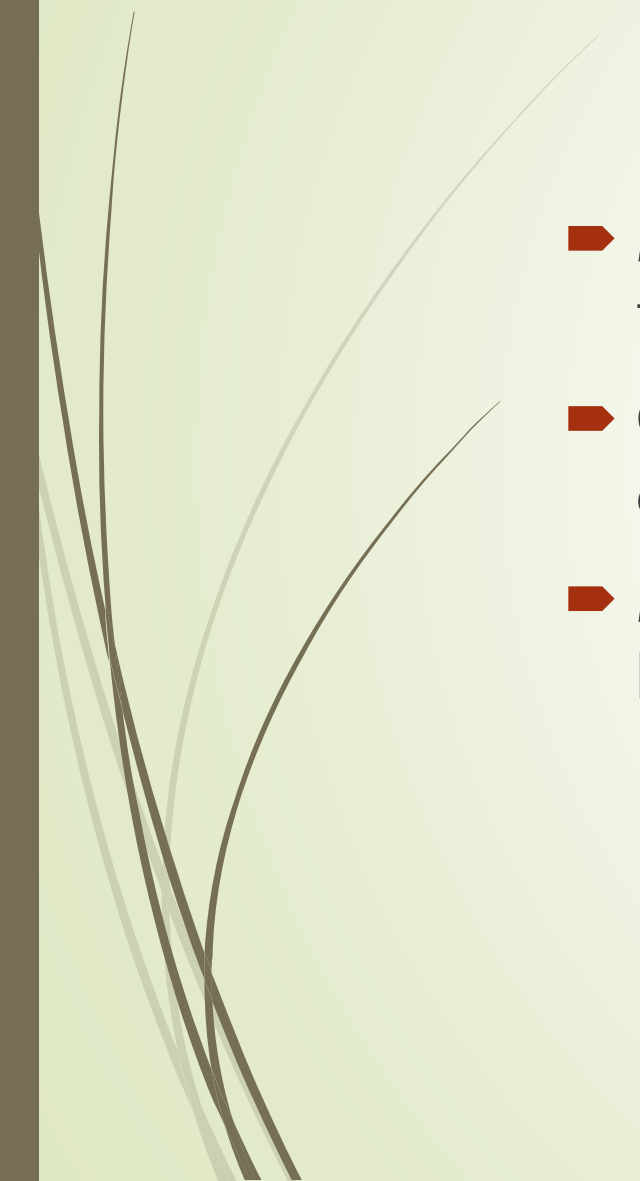


Characteristics of Physiological jaundice

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- It appears in between 30 to 72 hours of age in term babies and in pre term babies may appear earlier but not before 24 hours of age.
 - Maximum intensity of jaundice is found on the 4th day in term babies 5th to 6th day in preterm babies.
 - Serum bilirubin does not exceed 15mg/dL.
 - Usually disappears by 7th to 10th days in term babies and by 14th day in preterm babies.
 - Subside spontaneously and no treatment is needed.

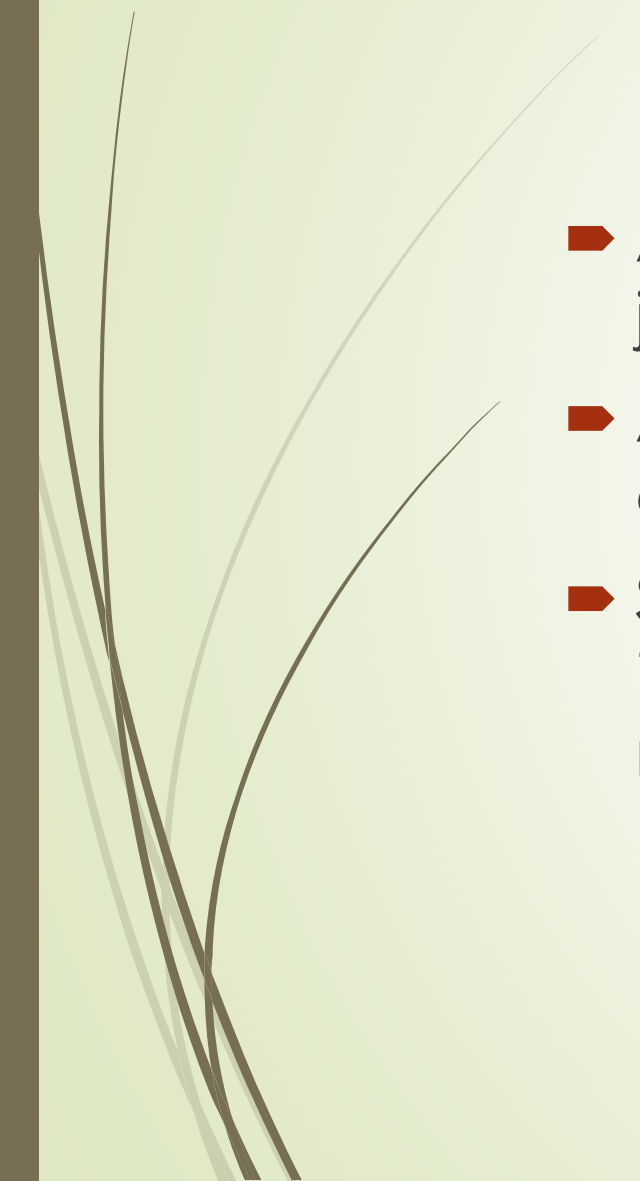


Characteristics of Physiological jaundice

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- Mothers need encouragement for exclusive breast feeding for adequate hydration and reassurance.
 - Careful observation for signs of complications along with essential neonatal care are important.
 - May aggravated by prematurity, asphyxia, hypothermia, infection and drugs.




Pathological jaundice

- ▶ About 5 % of neonates develop pathological jaundice.
 - ▶ Appearance of jaundice within 24 hours of age is always pathological.
 - ▶ Some causes of this condition may appear after 72 hours, though age of appearance of jaundice may overlap.
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Causes of Pathological jaundice

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- a. Excessive destruction of RBCs** due to hemolytic disease of newborn eg: Rh incompatibility, ABO incompatibility, congenital spherocytosis, G-6 PD- deficiency, neonatal septicemia and cytomegalic disease.
 - b. Defective conjugation of bilirubin** due to diminished production of enzyme glucuronyl transferase by the immature liver cells and inhibition of enzymatic activity by breast milk or in congenital familial non hemolytic jaundice (Criglar – Najjar Syndrome).



Causes of Pathological jaundice

- c. **Failure to excrete the conjugated bilirubin** following umbilical sepsis, congenital obstruction by absence or stricture of common bile duct (extrahepatic biliary duct atresia) syphilis and galactosemia.
- d. **Miscellaneous:** Viral hepatitis, toxoplasmosis, malaria, intrauterine infection, hypothyroidism, alpha thalassemia, drug therapy (Vitamin K, salicylates), maternal diabetes, anoxia, concealed hemorrhage (intracranial Cephalhematoma), etc.



Types of Pathological jaundice

- a. Prolong unconjugated hyperbilirubinemia** due to Rh-incompatibility, ABO incompatibility, hereditary spherocytosis, G-6-PD-deficiency, pyruvate kinase deficiency, alpha thalassemia, vitamin K3 induced hemolysis, sepsis, increased enterohepatic circulation in pyloric stenosis or large bowel obstruction, inborn errors of metabolism in Criglar-Najjar syndrome, hypothyroidism and breast milk jaundice

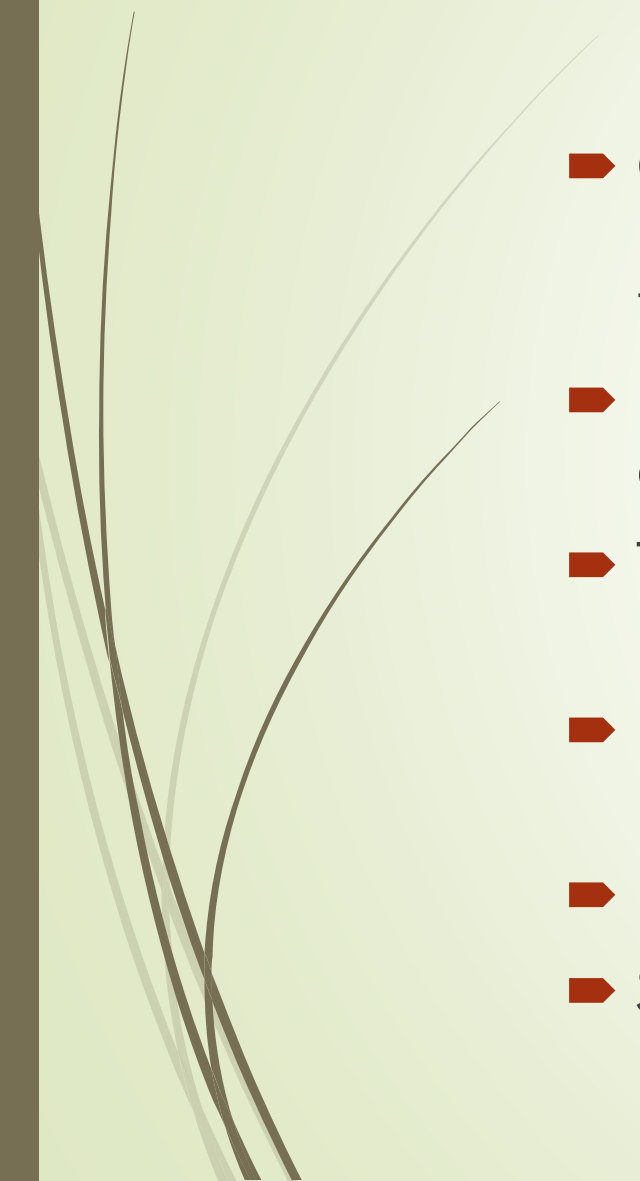


Types of Pathological jaundice

b. Prolong conjugated hyperbilirubinemia due to biliary atresia (extra and intrahepatic), neonatal hepatitis, generalized sepsis, urinary tract infections (E. coli) choledochal cyst, galactosemia, total parenteral nutrition, Down syndrome etc.




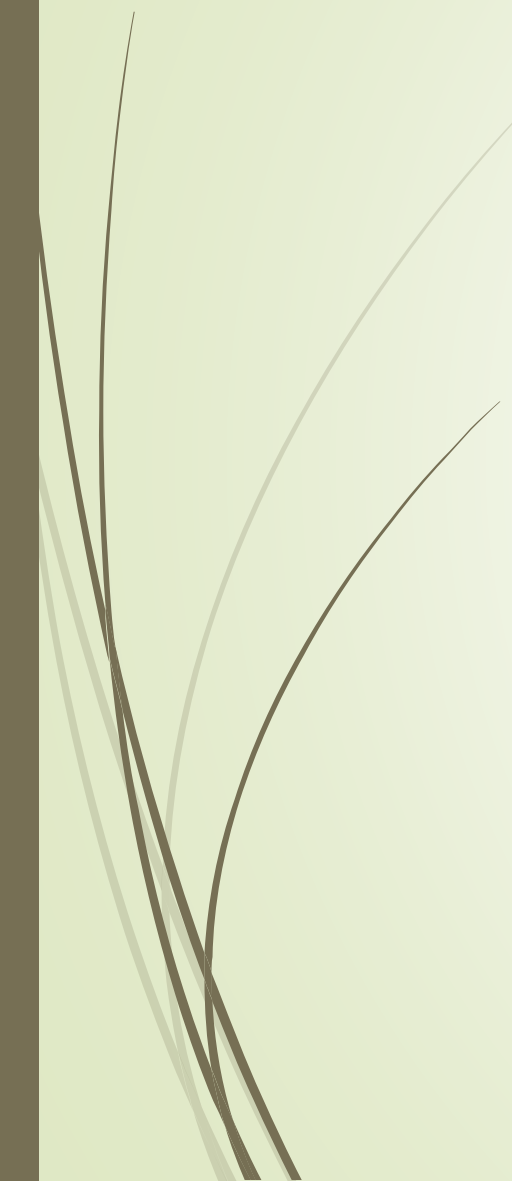
Characteristics of Pathological jaundice



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- Clinical jaundice appears within 24 hours of birth and persist more than one week in term babies and more than two weeks in preterm babies.
 - Bilirubin level is increasing by more than 5 mg/dL per day or 0.5mg/dL per hour.
 - Total bilirubin level is more than 15 mg/dL (hyperbilirubinemia)
 - Direct bilirubin more than 2mg/dL (conjugated hyperbilirubinemia).
 - Palms and soles are yellow.
 - Stool clay or white colored and urine is staining clothes.



Complication of unconjugated hyperbilirubinemia


- Unconjugated bilirubin may penetrate brain cell by crossing blood brain barrier in some circumstances and result in neurological dysfunction and death.
- The bilirubin level should be monitored to prevent the following complication in neonate:
 - Transient encephalopathy
 - kernicterus

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- **Transient encephalopathy:** It is reversible neurological complication suspected in increasing lethargy along with rising bilirubin levels.
 - Recovery is possible with prompt initiation of management and exchange blood transfusion.

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- **Kernicterus:** it is pathological condition of brain due to toxicity by unconjugated bilirubin.
 - It occurs as a result of necrosis of neurons in basal ganglia, hippocampal cortex, subthalamic nuclei and cerebellum followed by gliosis of the areas. The cerebral cortex usually is not affected.
 - Other lesions include necrosis of renal tubular cells, intestinal mucosa and pancreatic cells which may present as GI bleeding or hematuria.
 - The neonate with kernicterus present with **poor sucking, lethargy, hypotonia, poor or absent moro reflex, alteration of consciousness, fever, high pitched cry, convulsions, twitching, nystagmus, progressing hypertonia and opisthotonus position and death.**
 - If the baby survives various complications may develop which include **cerebral palsy, hearing loss, mental retardation**, etc.



Assessment of neonate with jaundice

- 1. History**
 - 2. Physical examination**
 - 3. Noninvasive assessment of jaundice**
 - 4. Laboratory investigation**
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1. History

Presentation and duration of neonatal jaundice

Note the following:

- Typically, neonatal jaundice presents on the second or third day of life.
- Jaundice that is visible during the first 24 hours of life is likely to be nonphysiologic; further evaluation is suggested.
- Infants who present with jaundice after 3-4 days of life may also require closer scrutiny and monitoring.
- In infants with severe jaundice or jaundice that continues beyond the first 1-2 weeks of life, the results of the newborn metabolic screen should be checked for galactosemia and congenital hypothyroidism, further family history should be explored the infant's weight curve should be evaluated, the mother's impressions as far as adequacy of breastfeeding should be elicited, and the stool color should be assessed.



Family history

Obtain the following information:

- Previous sibling with jaundice in the neonatal period, particularly if the jaundice required treatment
- Other family members with jaundice or known family history of Gilbert syndrome
- Anemia, splenectomy, or bile stones in family members or known heredity for hemolytic disorders
- Liver disease in family members

History of pregnancy and delivery


Ascertain the following information:

- Maternal illness suggestive of viral or other infection
- Maternal drug intake, including the use of herbal remedies
- Delayed cord clamping
- Birth trauma with bruising and/or fractures.



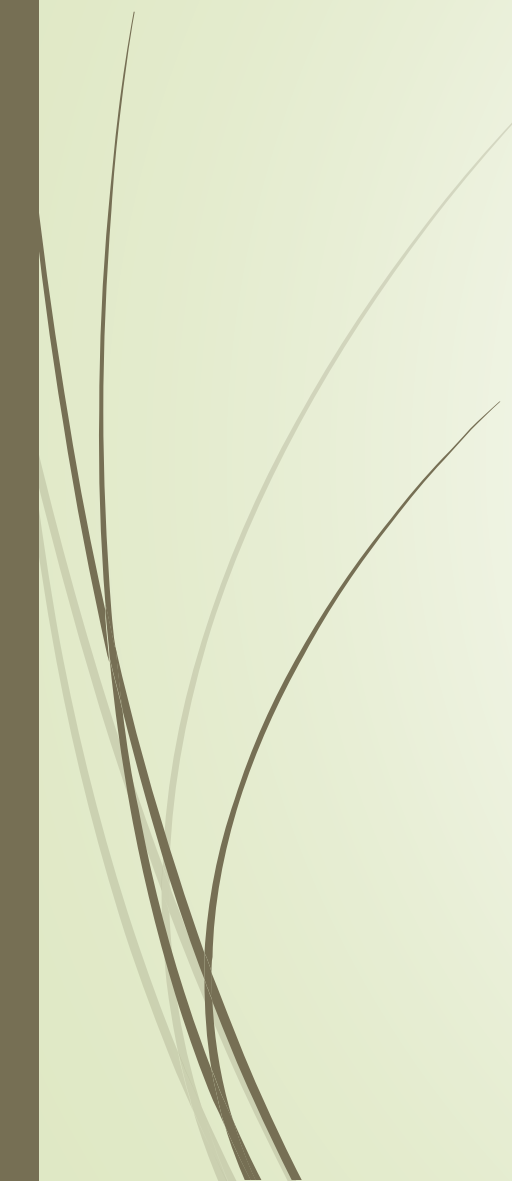
Postnatal history



Obtain details of the following:

- Loss of stool color
 - Breastfeeding
 - Use of drugs and herbal remedies in the lactating mother
 - Greater than average weight loss
 - Symptoms or signs of hypothyroidism
 - Symptoms or signs of metabolic disease (eg, galactosemia)
 - Exposure to total parental nutrition
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2. Physical examination

- Neonatal jaundice first becomes visible in the face and forehead. Identification is aided by pressure on the skin, since blanching reveals the underlying color. Jaundice then gradually becomes visible on the trunk and extremities.
 - Jaundice disappears in the opposite direction. The explanation for this phenomenon is not well understood, but both changes in bilirubin-albumin binding related to pH and differences in skin temperature and blood flow have been proposed.
 - This phenomenon is claimed to be clinically useful because, independent of other factors, visible jaundice in the lower extremities strongly suggests the need to check the bilirubin level, either in the serum or noninvasively via transcutaneous bilirubinometer.
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- In most infants, yellow color is the only finding on physical examination. More intense jaundice may be associated with drowsiness. Brainstem auditory-evoked potentials performed at this time may reveal prolongation of latencies, decreased amplitudes, or both.
 - Overt neurologic findings, such as changes in muscle tone, seizures, or altered cry characteristics, in a significantly jaundiced infant are danger signs and require immediate attention to prevent kernicterus.
 - Clinical assessment of neonatal jaundice is done by the use of Krammer's Rule. Clinical judgment is equally reliable with laboratory value, if done by experienced person.

VISUAL ASESSMENT- KRAMER's RULE

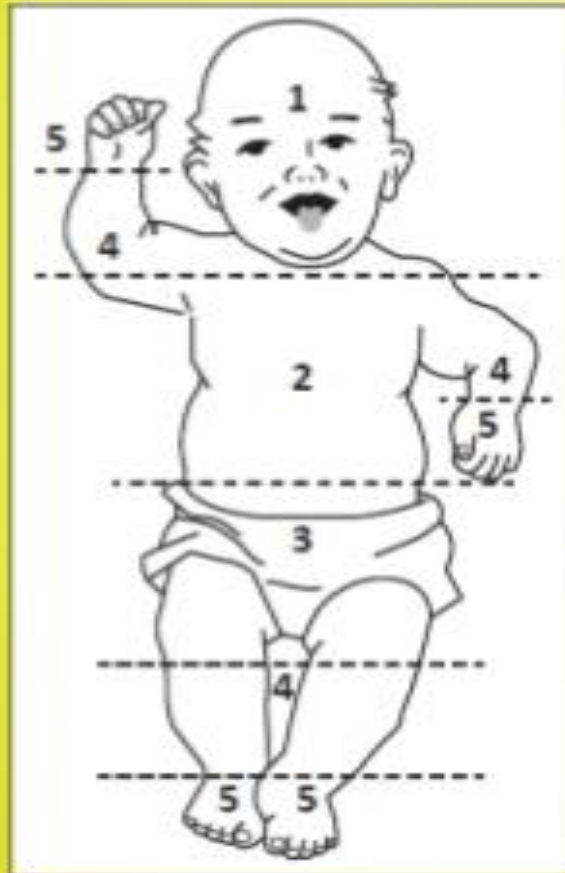


Table 1. Visual Assessment of Neonatal Jaundice (Kramer's rule)

Area of the Body	Level	Range of Serum Bilirubin	
		$\mu\text{mol/L}$	mg/dL
Head and neck	1	68 - 133	4 - 8
Upper trunk (above umbilicus)	2	85 - 204	5 - 12
Lower trunk and thighs (below umbilicus)	3	136 - 272	8 - 16
Arms and lower legs	4	187 - 306	11 - 18
Palms and soles	5	≥ 306	≥ 18

Kramer's rule describes the relationship between serum bilirubin levels & the progression of skin discolouration

3. Noninvasive assessment of jaundice

- Transcutaneous bilirubin (TcB) measurement offers a gentle, painless alternative to traditional jaundice screening. There's no blood draw, removing a major stress from babies and their parents. Instead, bilirubin levels are measured using a quick flash of light sent through the skin on the baby's chest.
- This method is non-invasive and allows a 100% screening of all babies while avoiding Total Serum Bilirubin (TsB) tests. TcB screening can be done with devices like the Dräger JM-105, which is specifically designed to overcome some challenges of jaundice management. It reduces the cost of unnecessary lab tests and eliminates the wait for lab results.




Transcutaneous bilirubinometer

Transcutaneous bilirubinometer is costly and sophisticated equipment used to measure the intensity of jaundice by reflecting light rays on the blanched skin.



4. Laboratory investigation:

- Serum bilirubin level (total conjugated or unconjugated)
 - Hb%
 - Serum albumin
 - RBC morphology
 - Direct coombs' test
 - Blood culture
 - Acid base level
 - Hematocrit value
 - Reticulocyte count
 - Sepsis screening
 - Liver and thyroid function test
 - TORCH Titers
 - G6PD deficiencies
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Management of neonatal jaundice

Management

- 1. Phototherapy**
- 2. intravenous immune globulin (IVIG)**
- 3. Exchange transfusion**
- 4. Drugs**



1. Phototherapy


- Phototherapy has been used since 1958 for the treatment of neonatal hyperbilirubinemia. It causes unconjugated bilirubin to be mobilized from the skin by structural isomerization to a water soluble form (lumirubin) that can be excreted in the urine.
 - The aim of phototherapy is to decrease the level of unconjugated bilirubin in order to prevent acute bilirubin encephalopathy, hearing loss and kernicterus.
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- Lamps emitting light between the wavelengths of 400 - 500 nanometers (peak at 460nm) are specifically used for administering phototherapy as bilirubin absorbs this wavelength of light. The light is visible blue light and contains no ultraviolet light.





Definition



Phototherapy (light therapy) is a way of treating jaundice. Special lights help break down the bilirubin in your baby's skin so that it can be removed from his or her body. This lowers the bilirubin level in your baby's blood.



PURPOSE

- To support the care of babies with hyperbilirubinemia.
- To decrease infant serum bilirubin levels.
- To maintain phototherapy treatment safely and effectively.
- To minimize infant-maternal separation and facilitate breastfeeding.




LIGHTS USED IN PHOTOTHERAPY






1. Micro White Halogen lights



They deliver light via a quartz halogen bulb and have a tendency to become quite hot so should not be positioned closer to the infant than the manufacturers recommendations of 52cm. The lights can continue to be bright despite having low irradiance levels.



2. Fluoro- 2 Blue and 2 White Fluorescent lights

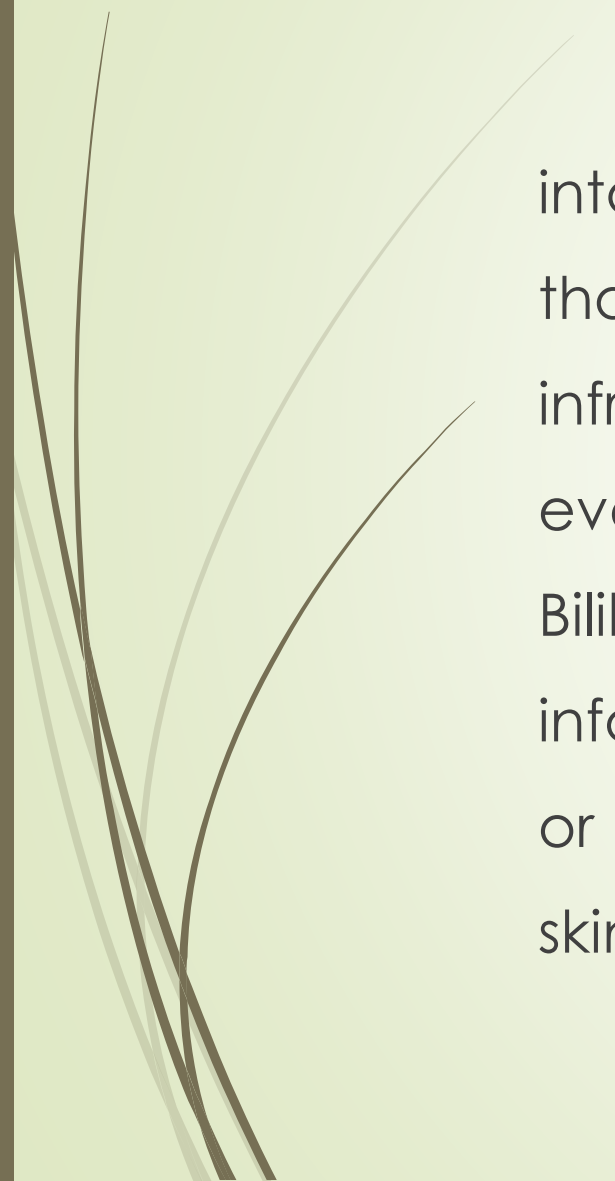
The fluorescent blue tubes must have the serial number F20T12/BB or TL52/20W to be special phototherapy lights.

Blue light is the most effective light for reducing the bilirubin.



3. Ohmeda Biliblanket - Blue Halogen light

This uses a halogen bulb directed into a fiberoptic mat. There is a filter that removes the ultraviolet and infrared components and the eventual light is a blue-green colour. Biliblankets are not to be used on infants less than 28 weeks gestation or infants with broken or reduced skin integrity.



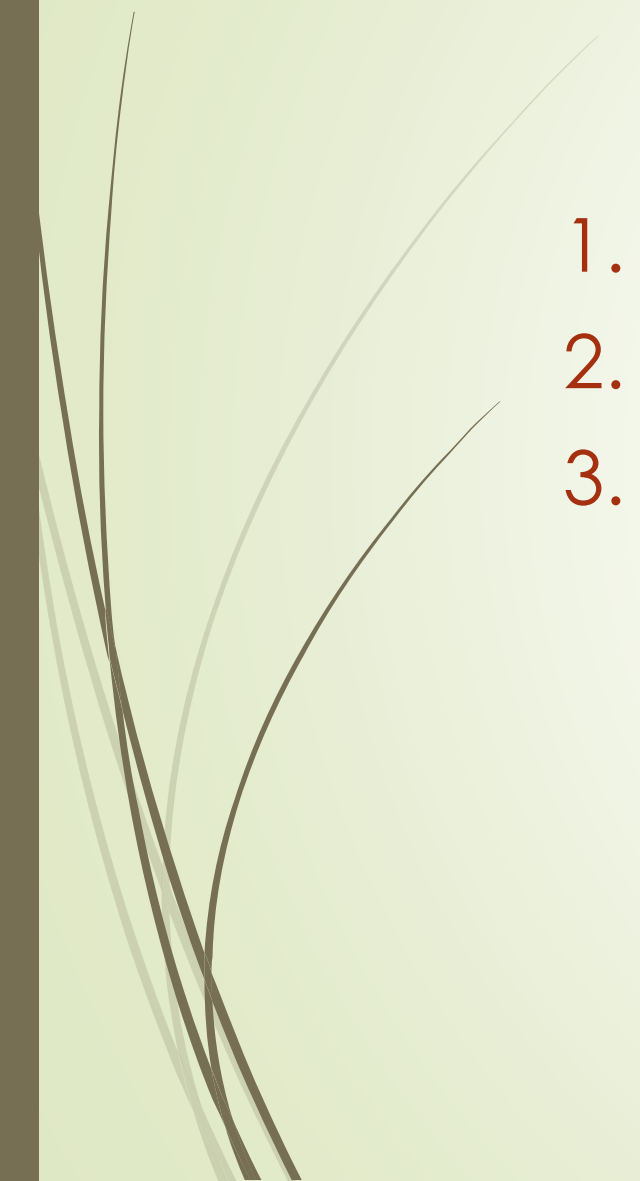


4. Medela Bilibed Blue Fluorescent light

A blue fluorescent tube is fitted into a plastic crib with a stretched plastic cover over the top for the baby to lie on



TYPES OF PHOTOTHERAPY UNIT

1. Single surface unit.
 2. Double surface unit.
 3. Triple surface unit.
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Indication

- The initiation and duration of PT decided by
 - total bilirubin values
 - an infant's postnatal age
 - the potential risk for bilirubin neurotoxicity

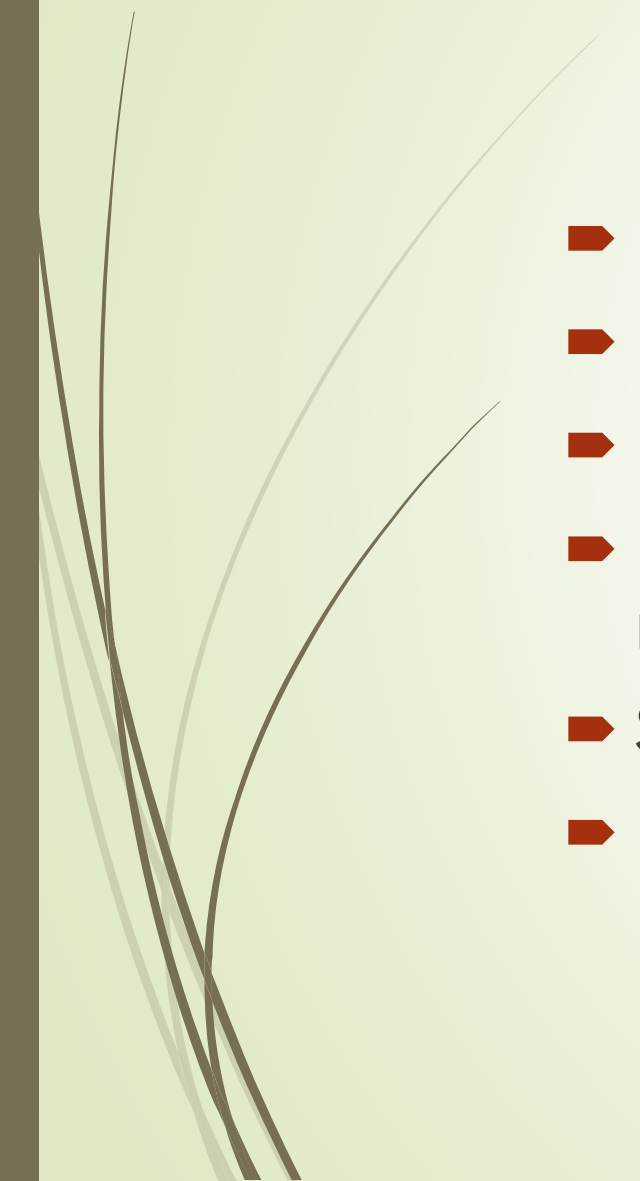


Contraindication

- Photosensitive conditions such as lupus erythematosus and xeroderma pigmentosum.
- History of cutaneous malignancies.
- Patient on arsenic or ionizing radiation therapy
Patient on photosensitizing drugs .

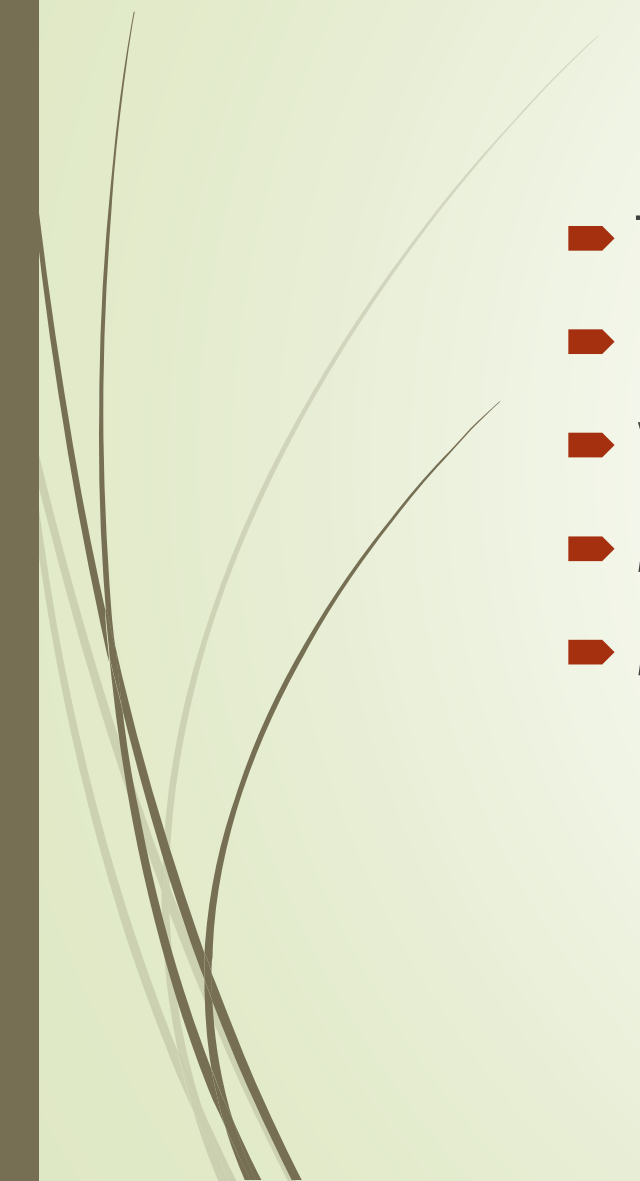


Phototherapy Technique

- Perform hand wash.
 - Place baby naked in cradle or incubator.
 - Fix eye shades & genital area.
 - Keep baby at least 45 cm from lights,if using closer monitor temperature of baby.
 - Start phototherapy.
 - Frequent extra breast feeding every 2 hourly
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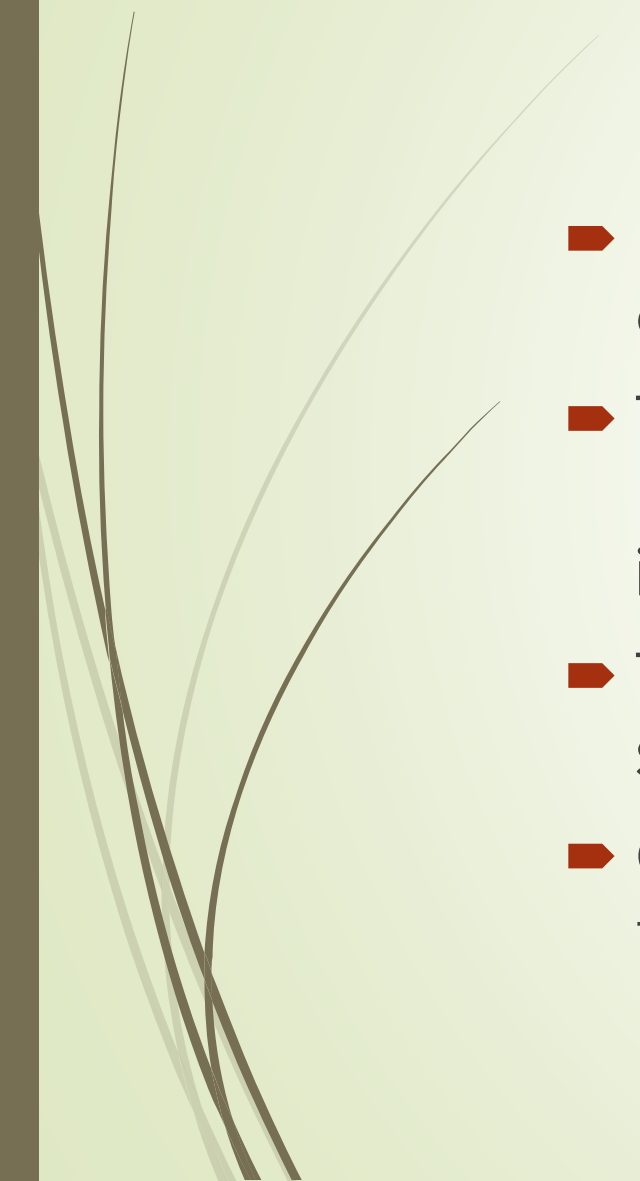


Phototherapy Technique cont.....

- Turn baby after each feed.
 - Temperature record 2 to 4 hourly.
 - Weight record- daily.
 - Monitor urine frequency.
 - Monitor bilirubin level.
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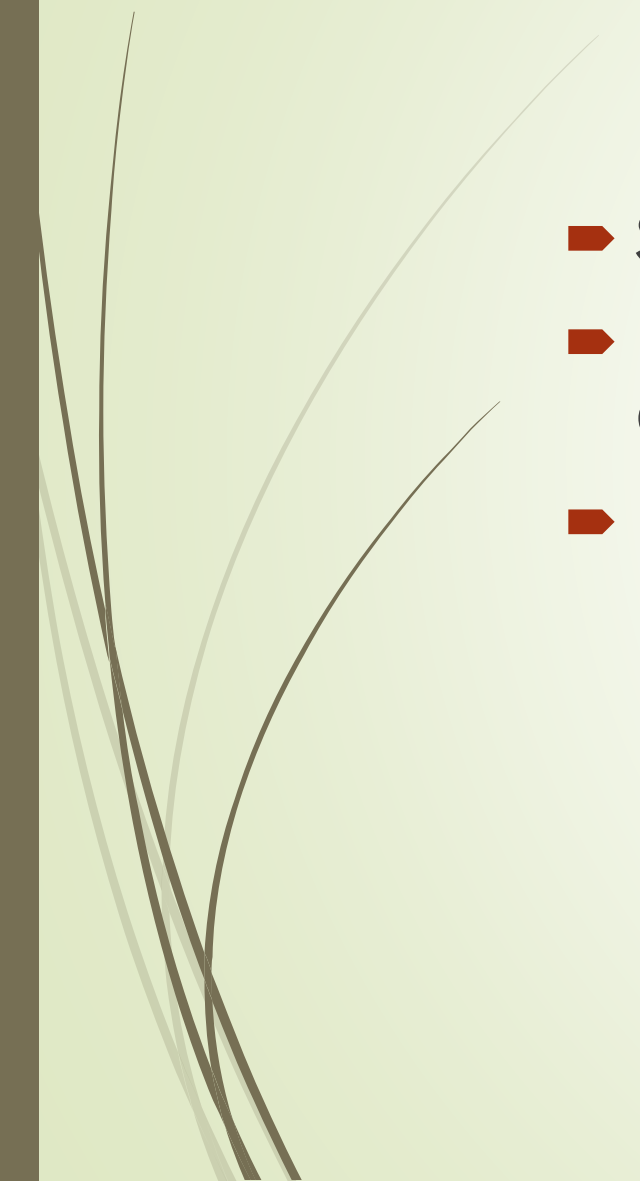


Mechanism of phototherapy

- Blue-green light in the range of 460-490 nm is most effective for phototherapy.
 - The absorption of light by the normal bilirubin (4Z,15Z-bilirubin) generates configuration isomers, structural isomers, and photooxidation products.
 - The 2 principal photo isomers formed in humans are shown.
 - Configurational isomerization is reversible and much faster than structural isomerization.
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Mechanism of phototherapy



- Structural isomerization is slow and irreversible.
 - Photo oxidation occurs more slowly than both Configurational and structural isomerization.
 - Photo oxidation products are excreted mainly in urine.
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Nursing care of phototherapy


➤ Skin care

- Infants in isolates who are $< 1200\text{gm}$ are generally nursed without a nappy on an absorbent sheet protector. (In cohelp)
- Infants in isolettes who are $> 1200\text{gm}$ may be nursed with a nappy on if the bilirubin is not rising rapidly.
- If intensive phototherapy is required then the nappy should be removed.

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- Keep the infant clean and dry.
 - Clean only with water. Do not apply oils or creams to the exposed skin.
 - Eucerin (a stable emulsion to keep the baby skin moisturize and have ability to resist degradation) has been proven to be safe for use when the infant is receiving phototherapy.
 - Infants nursed in nappies where the buttocks are not exposed may have zinc and castor oil applied to areas of skin excoriation.



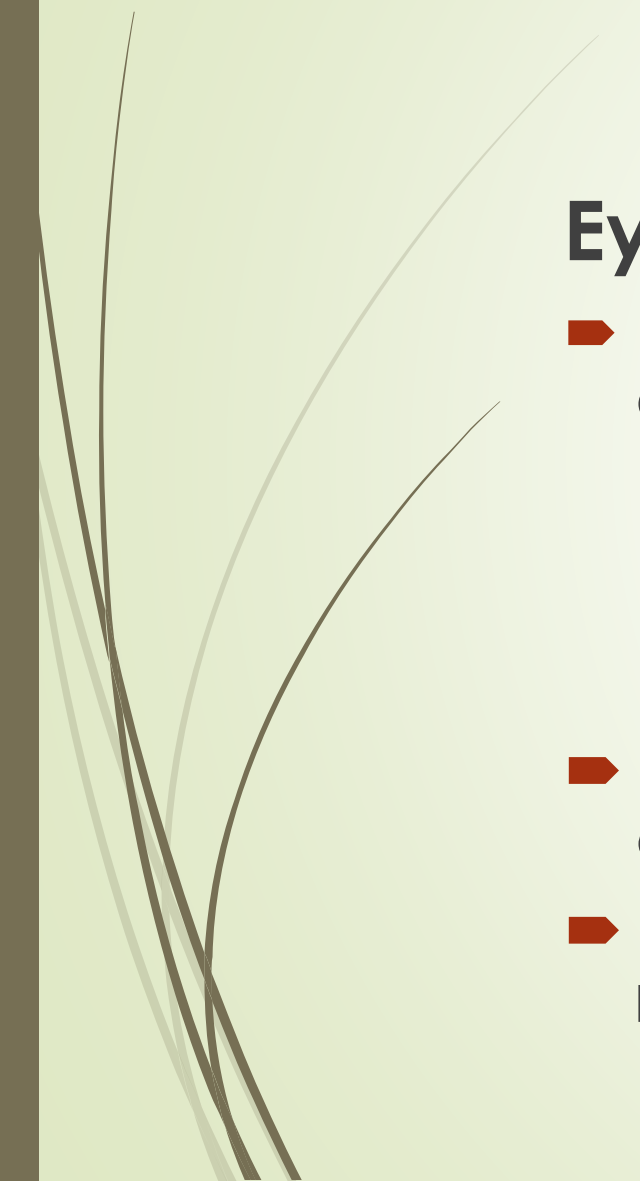
Observations


- All infants in Newborn Care receiving phototherapy should have a temperature, pulse and respiration rate documented 4 hourly & prevent dehydration.
 - If an infant requires continuous cardiorespiratory monitoring for other reasons, then, this should continue whilst under phototherapy.
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Nursing care of phototherapy cont.

Eye care

- ▶ Eye pads are required for the infants comfort if overhead white or blue fluorescent lights are used :
 - ▶ Size N720 (micro) if $< 1500\text{g}$
 - ▶ Size N721 (small) if $1500 - 2500\text{g}$
 - ▶ Size N722 (large) if $> 2500\text{g}$
 - ▶ Eye pads should be removed 4 hourly and eye cares attended with normal saline.
 - ▶ There have never been human studies showing that retinal damage occurs from with phototherapy
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Fluid Requirements

I. All Infants

- Accurately document fluid intake (oral or intravenous) and output.
- Urinalysis and specific gravity should be checked 8 hourly.
- Assess and record stools.

II. Term Infants

- Breast fed infants should continue on demand breast feeds.
- Bottle fed infants should be fed on demand 4-6th hourly.

III. Preterm Infants

- The daily fluid rate may need to be increased by 10ml-15ml/kg/day to prevent dehydration.



When to stop phototherapy

Term babies:

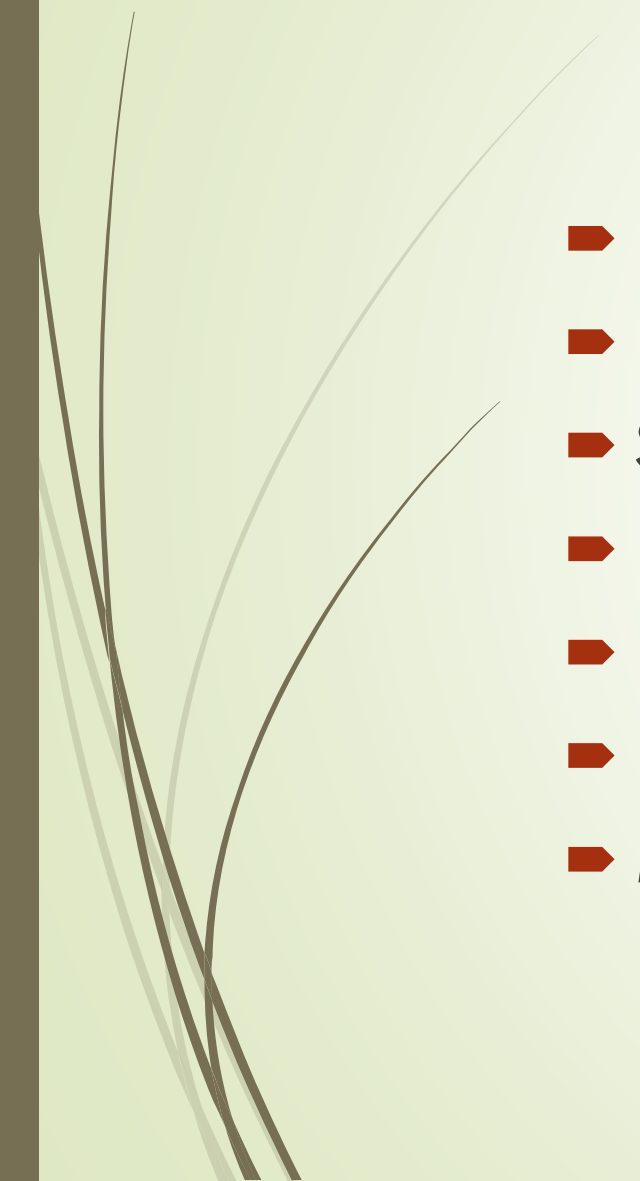
- Day 3: Stop at the discretion of the consultant as the jaundice is likely to be pathological.
- Day 4: Stop phototherapy when the SBR is 280 mmol/L for term infants with physiological jaundice.

Premature babies:

- Stop at the discretion of the consultant



Side effects of phototherapy

- Increased insensible water loss.
 - Loose stools.
 - Skin rash.
 - Bronze baby syndrome.
 - Hyperthermia .
 - Upsets maternal baby interaction.
 - May result in hypocalcemia.
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2. Medications

- Medications are not usually administered in infants with physiologic neonatal jaundice.
- However, in certain instances, phenobarbital, an inducer of hepatic bilirubin metabolism, has been used to enhance bilirubin metabolism.
- Phenobarbital is effective in reducing mean serum bilirubin values during the first week of life.
- Phenobarbital may be administered prenatally in the mother or postnatally in the infant



Medications cont...

- Intravenous immunoglobulin (IVIG) at 500 mg/kg has been shown to significantly reduce the need for exchange transfusions in infants with isoimmune hemolytic disease.
- The mechanism is unknown but may be related to the way the immune system handles red cells that have been coated by antibodies.

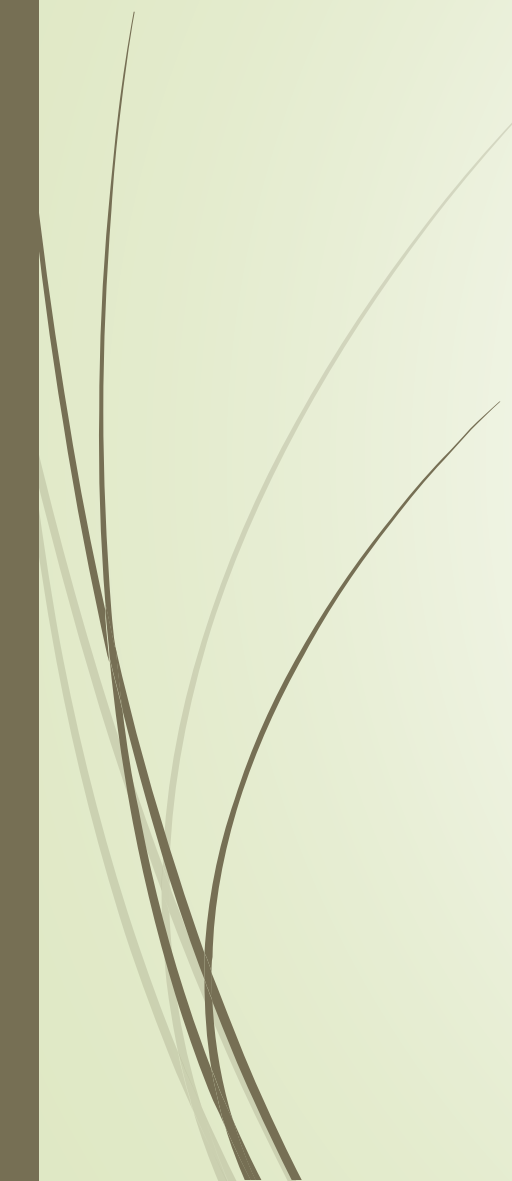


Medications cont...

- A new therapy currently under development consists of inhibition of bilirubin production through blockage of heme oxygenase.
- This can be achieved through the use of metal mesoporphyrins and protoporphyrins.
- Apparently, heme can be directly excreted through the bile; thus, inhibition of heme oxygenase does not result in accumulation of unprocessed heme.
- This approach may virtually eliminate neonatal jaundice as a clinical problem.
- Supplementation of probiotics appears to show promise for newborns with pathologic neonatal jaundice.



3. Exchange Transfusion

- An exchange transfusion involves removing aliquots of patient blood and replacing with donor blood in order to remove abnormal blood components and circulating toxins whilst maintaining adequate circulating blood volume.
 - It is primarily performed to remove antibodies and excess bilirubin in isoimmune disease, the incidence of exchange transfusion is decreasing secondary to the prevention, and improved prenatal management of alloimmune haemolytic disease and improvements in the management of neonatal hyperbilirubinaemia.
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Indications

1. Alloimmune haemolytic disease of the newborn

- Remove circulating bilirubin to reduce levels and prevent kernicterus
- Replace antibody-coated red cells with antigen-negative red cells

Severe hyperbilirubinaemia secondary to alloimmune haemolytic disease of the newborn is the most common reason for exchange transfusion in the neonatal intensive care unit.

A total serum bilirubin level at or above the exchange transfusion level should be considered a medical emergency and intensive phototherapy (multiple light) should be commenced immediately. The Consultant Neonatologist on service should be contacted without delay.



Indications cont...

2. Significant unconjugated hyperbilirubinaemia with risk of kernicterus due to any cause when intensive phototherapy is unsuccessful
3. Severe anaemia (where there is normal or increased circulating blood volume)
4. Antibodies in maternal autoimmune disease
5. Polycythaemia (to reduce haematocrit, usually accomplished with partial exchange transfusion using normal saline replacement)
6. Severe disturbances of body chemistry



Blood Volumes

The volume of blood for exchange is calculated using an estimate of the neonate's circulating blood volume:

- Term infants 80ml/kg
- Preterm infants 100ml/kg

Double volume exchange transfusion

- Most commonly used for removal of bilirubin and antibodies
- 2 x circulating blood volume (for example, for a term infant $2 \times 80\text{ml/kg} = 160\text{ml/kg}$)
- Replaces approximately 85% of the blood volume
- This will cause an approximate reduction of 50% of the pre-exchange bilirubin level (but can be expected to rebound 4 hours post transfusion to approximately two thirds of pre-exchange level)

Blood Volumes

Single volume exchange transfusion

- 1 x circulating blood volume (for example, for a term infant 80ml/kg)
- Replaces approximately 60% of the blood volume
- Consider when aetiology is not Haemolytic Disease of the Newborn

Partial exchange transfusion for polycythaemia using normal saline

Where desired haematocrit following exchange transfusion is 0.55, the volume of exchange (mls) can be calculated as follows:

$$\frac{(\text{actual Hct} - \text{desired Hct}) \times \text{infant's blood volume (mls)}}{\text{actual Hct}}$$



Complications

The most commonly reported adverse events during or soon after exchange transfusion:

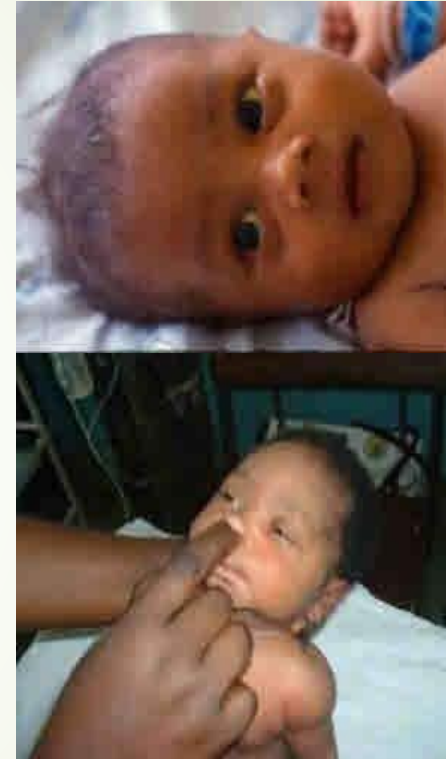
- Catheter related complications; air emboli; thrombosis; haemorrhage
- Haemodynamic (related to excess removal of injection of blood): hypo or hypertension, intraventricular haemorrhage (preterm)
- Hypo or hyperglycaemia
- Hypocalcaemia, hyperkalaemia, acidaemia
- **Potential complications related to exchange transfusion:**
Arrhythmias Bradycardia Neutropenia, dilutional coagulopathy
Feed intolerance, necrotizing enterocolitis Septicaemia, blood born infection Hypo or hyperthermia



Nursing Management

Nursing considerations of Hyperbilirubinemia

- **Assessment:**
 - ❖ observing for evidence of jaundice at regular intervals.
 - ❖ Jaundice is common in the first week of life and may be missed in dark skinned babies



Blanching the tip of the nose



The goals of planning

- Infant will receive appropriate therapy if needed to reduce serum bilirubin levels.
 - Infant will experience no complications from therapy.
 - Family will receive emotional support.
 - Family will be prepared for home phototherapy (if prescribed).

