Neonatal Jaundice

Hyperbilirubinemia

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Objectives

- Discuss and differentiate physiologic and pathologic jaundice
- Discuss and differentiate conjugated and unconjugated bilirubin
- Identify risk factors for developing significant neonatal hyperbilirubinemia (jaundice) and hyperbilirubinemia neurotoxicity
- Identify and discuss sequelae of hyperbilirubinemia
- Discuss tools and updated guidelines for treatment of hyperbilirubinemia

Hyperbilirubinemia

- Gastrointestinal disorder
- Diagnosed by elevated total serum bilirubin (TSB)
- Abnormal values differ depending on gestational age, day of life and superimposed illness
- 60% of term newborns experience some degree of jaundice
- 80% of preterm newborns develop clinical jaundice in the 1st week of life

Risk Factors for Jaundice

- Blood type incompatibility
- Infections
- Polycythemia
- Enclosed hemorrhage
- RDS
- Abnormal red blood cell morphology
- RBC enzyme deficiencies
- Maternal diabetes
- Breastfeeding
- Dehydration
- HSV
- Pyloric stenosis
- Bile duct atresia
- Galactosemia
- Prematurity
- East Asian or Mediterranean descent
- Maternal medications

Risk Factors for Developing SIGNIFICANT Hyperbilirubinemia

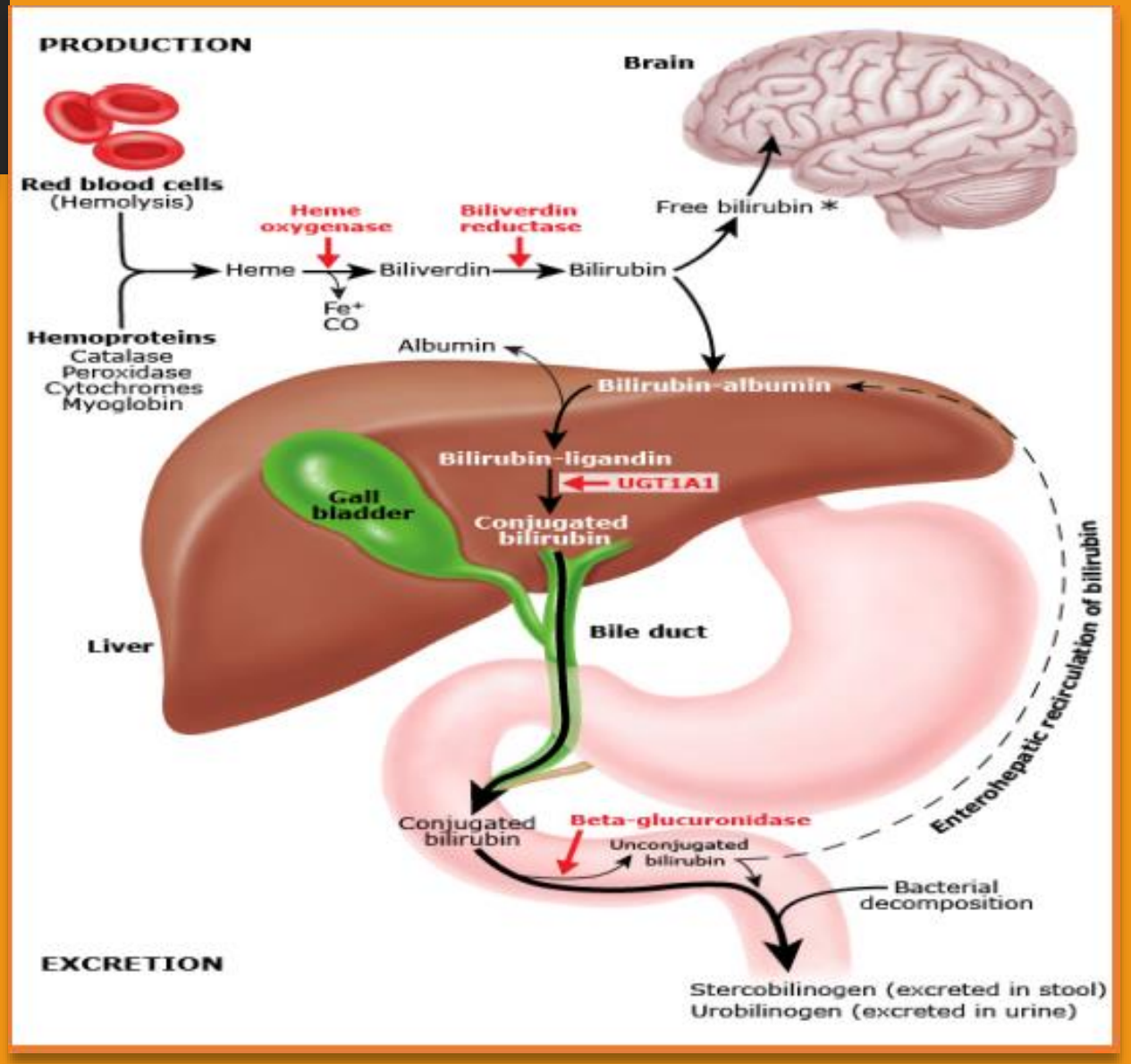
- Lower gestational age (ie, risk increases with each week less than 40 wk)
- Jaundice in the first 24 hours after birth
- Predischarge transcutaneous bilirubin (TcB) or total serum bilirubin (TSB) concentration close to the phototherapy threshold
- Hemolysis from any cause, if known or suspected based on a rapid rate of increase in the TSB or TcB of >0.3 mg/dL per hour in the first 24 h or >0.2 mg/dL per hour thereafter.
- Phototherapy before discharge
- Parent or sibling requiring phototherapy or exchange transfusion
- Family history or genetic ancestry suggestive of inherited red blood cell disorders, including glucose-6-phosphate dehydrogenase (G6PD) deficiency
- Exclusive breastfeeding with suboptimal intake
- Scalp hematoma or significant bruising
- Down syndrome
- Macrosomic infant of a diabetic mother

Hyperbilirubinemia NEUROTOXICITY Risk Factors

- Gestational age< 38 weeks and this risk increases with the degree of prematurity
- Albumin <3.0 g/dL
- Isoimmune hemolytic disease (ie, positive direct antiglobulin test)G6PD deficiency, or other hemolytic conditions
- Sepsis
- Significant clinical instability in the previous 24 h

Bilirubin production, metabolism & excretion

- Bilirubin is a byproduct of the breakdown of red blood cells
- In a normal healthy person, the body breaks down the red blood cells which creates bilirubin.
- The bilirubin is carried through the bloodstream to the liver.



Unconjugated vs. Conjugated Hyperbilirubinemia

- Unconjugated Hyperbilirubinemia a.k.a. indirect hyperbilirubinemia
- **Unconjugated** bilirubin is a **fat-soluble** product with an affinity for fatty tissues such as subcutaneous and brain tissue
- **Unconjugated bilirubin cannot be excreted in urine or bile**. It can build up in the fatty tissues like the brain and can turn the skin a yellow color (jaundice).

- Almost universal in the newborn population especially in the first week of life
- Usually is non-pathologic
- Level of 2mg/dL or greater is abnormal and can cause visible jaundice
- Usually peaks between 5 and 10 days of life
- Can be affected by prevalence of breastfeeding- predominately formula fed infants have lower peak levels

Unconjugated vs. Conjugated Hyperbilirubinemia

- Conjugated hyperbilirubinemia a.k.a. direct hyperbilirubinemia
- AKA neonatal cholestasis
- Due to hepatobiliary disfunction
  - Obstruction of biliary Flow
  - Infections – CMV, HIV, rubella, Herpes virus, syphilis, toxoplasmosis, UTI, Septicemia
  - Genetic causes

- **Conjugated bilirubin** is **water soluble.**
- Excreted in urine or stool
- However, it is always considered pathological (Gomella et al, 2013)
- Conjugated bili serum levels of > 1.5 mg/dL or more when the total bilirubin is less than 5 mg/dL
- Lesser/rarer connection to bilirubin encephalopathy

Physiologic Hyperbilirubinemia

- Occurs after 24 hours of age
- Newborn's liver may not be able to remove bilirubin quickly enough to prevent a buildup in tissues
- Can clear spontaneously with adequate feeding…but
- May require phototherapy

UNCONJUGATED HYPERBILIRUBINEMIA – PHYSIOLOGIC JAUNDICE		
BREASTFEEDING JAUNDICE	**BREAST MILK JAUNDICE**	**PREMATURITY**
▪ Early onset – **1st week** after birth ▪ **Insufficient milk intake** leads to dehydration resulting in **hemoconcentration of bilirubin** ▪ Fewer bowel movements **increases** the **enterohepatic circulation of bilirubin**	▪ Later onset – **after 1st week of life** ▪ Bilirubin levels **peak during weeks 2-3 of life** ▪ Can persist for **3-12 weeks** ▪ Cause unknown ▪ It is thought that substances in breast milk interfere with the breakdown of bilirubin	▪ Occurs in **preterm** infants (< 37 weeks) ▪ More likely to require **phototherapy**
MANAGEMENT		
▪ **Phototherapy** (use AAP normograms to determine the need for phototherapy – based on TSB and age in hours) ▪ **Continue breastfeeding** ▪ **Supplemental PO or IV fluids** (PO preferred over IV)	▪ Phototherapy makes bilirubin **water soluble** by inducing a **conformational change** ▪ Hyperbilirubinemia is treated to **prevent kernicterus/acute bilirubin encephalopathy**	

Pathologic hyperbilirubinemia

- Jaundice in the **first 24 hours** of life
- Serum total bilirubin greater than 95% for age
- Direct bilirubin greater than 1.5 mg/dL
- Jaundice persisting for more than 2 weeks if term

- Risk Factors:
  - Family history of jaundice, anemia or metabolic disorder
  - Maternal history of infection or diabetes
- Areas of concern on physical exam –
  - cephalohematoma,
  - LGA
  - pallor with hemolytic disease

PATHOLOGIC UNCONJUGATED HYPERBILIRUBINEMIA

HEMOLYTIC	NON-HEMOLYTIC
INTRINSIC ▪ G6PD deficiency ▪ Hereditary spherocytosis ▪ Thalassemia **EXTRINSIC** ▪ Drugs ▪ Iso-immune (ABO, Rh) ▪ Sepsis	▪ Sepsis ▪ Hypothyroidism ▪ Cephalohematoma ▪ Gilbert ▪ Crigler-Najjar **Work-up**: Coombs test, CBC with differential, blood smear, blood culture

CONJUGATED HYPERBILIRUBINEMIA

EXTRAHEPATIC	INTRAHEPATIC
▪ Biliary atresia ▪ **Choledochal cysts** ▪ **Perforated bile ducts** ▪ **Tumour/mass** ▪ **Cystic fibrosis** ▪ **Galactosemia**	▪ **Infections**: hepatitis, TORCH, UTI, etc. ▪ **Drugs**: eg. ceftriaxone, sulfonamides, etc. ▪ **Genetic/metabolic**: eg. Alagille syndrome, etc.

⚠ **Must rule out biliary atresia!** ⚠
Initial investigation: **abdominal ultrasound**

Varying levels of jaundice

Keys to Management of Hyperbilirubinemia

- Goal is to prevent complications:
  - Increasing jaundice
  - Acute bilirubin encephalopathy
  - Kernicterus
- Early and frequent breastfeeding
- Assess birth parent for risk factors (blood type, family history, infection or diabetes)
- Phototherapy
- Exchange transfusion
- IVIg

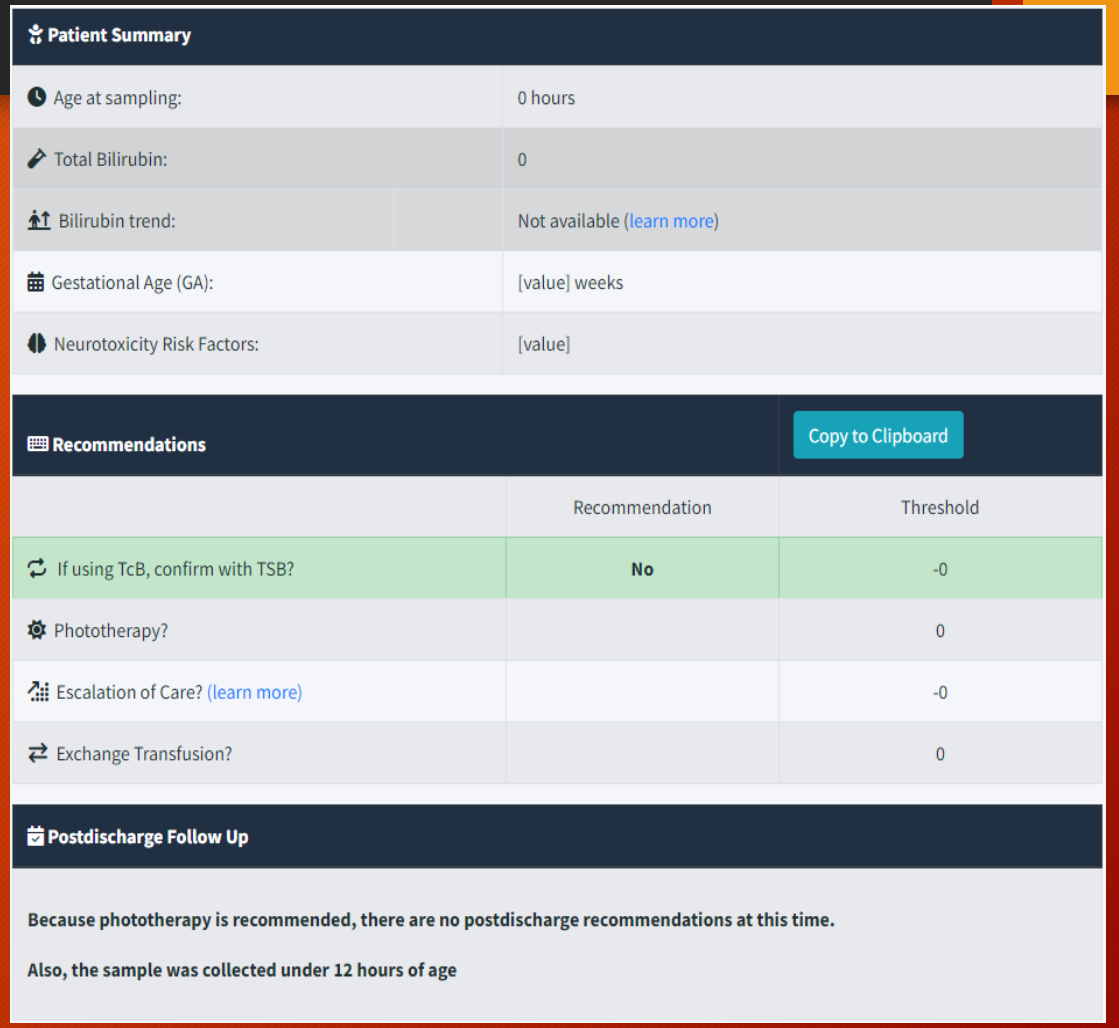
Testing

- Screening:
  - TCB

- Laboratory Tests:
  - Coombs/DAT
  - Total serum bilirubin
  - Direct bilirubin
  - Total and direct bilirubin

Screening Tools

- https://emr.bilitool.org/results.php?ageHours=[value(s)]&totalBilirubin=[value(s)]&bilirubinUnits=[value]&gestationalWeeks=[value]&neuroRiskFactors=[value]



Patient Summary

Age at sampling:	0 hours
Total Bilirubin:	0
Bilirubin trend:	Not available (learn more)
Gestational Age (GA):	[value] weeks
Neurotoxicity Risk Factors:	[value]

Recommendations Copy to Clipboard

	Recommendation	Threshold
If using TcB, confirm with TSB?	**No**	-0
Phototherapy?		0
Escalation of Care? (learn more)		-0
Exchange Transfusion?		0

Postdischarge Follow Up

Because phototherapy is recommended, there are no postdischarge recommendations at this time.

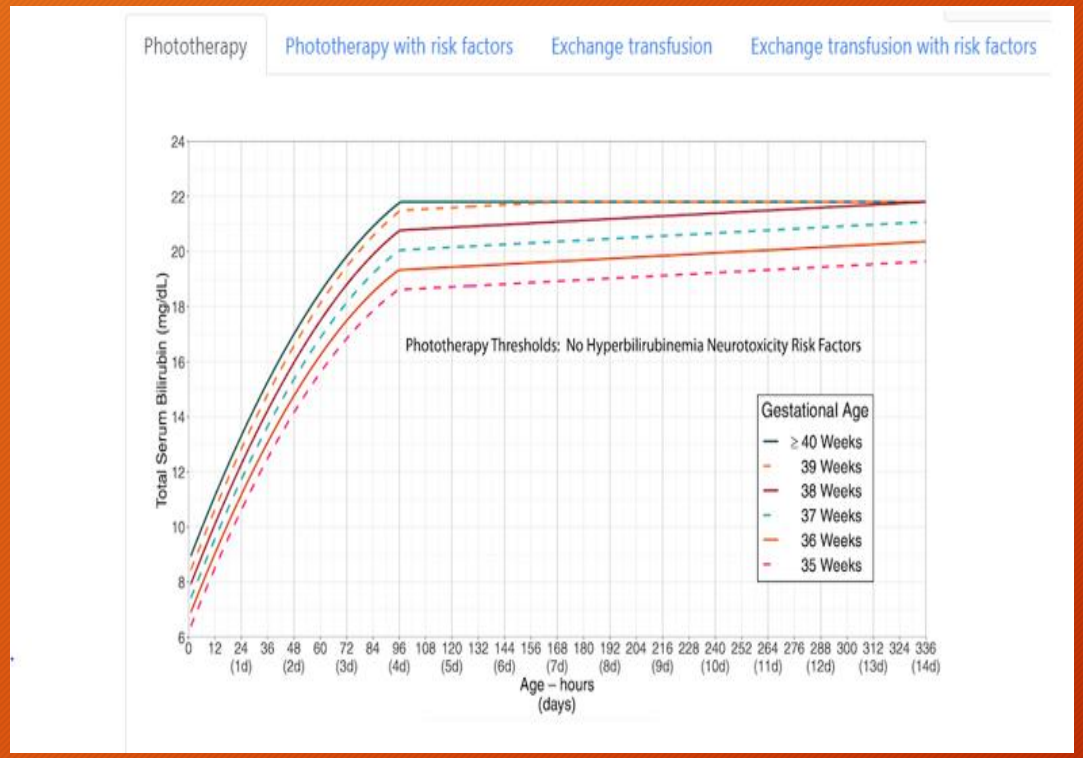
Also, the sample was collected under 12 hours of age

Nomogram: Phototherapy

Phototherapy nomogram based on total serum bilirubin in healthy late pre-term up to term newborn

2022 Phototherapy thresholds by GA and age in hours

No recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age.



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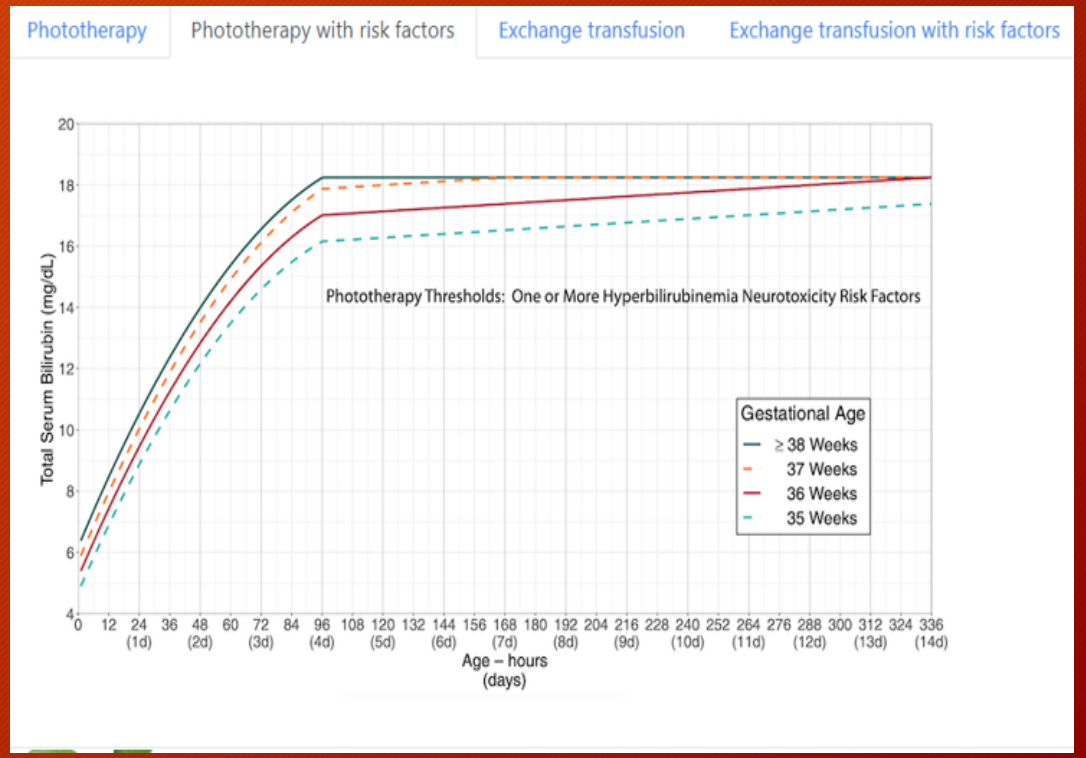

Exchange Transfusion thresholds by GA and age in hours

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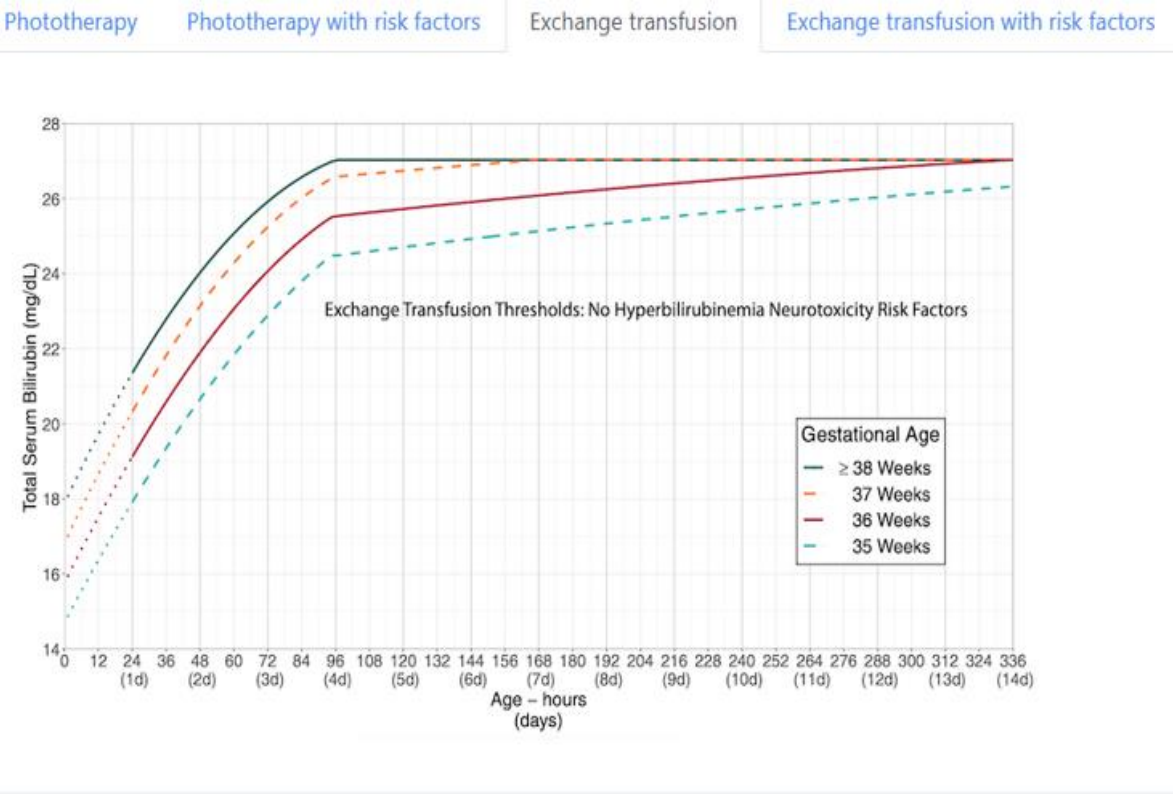

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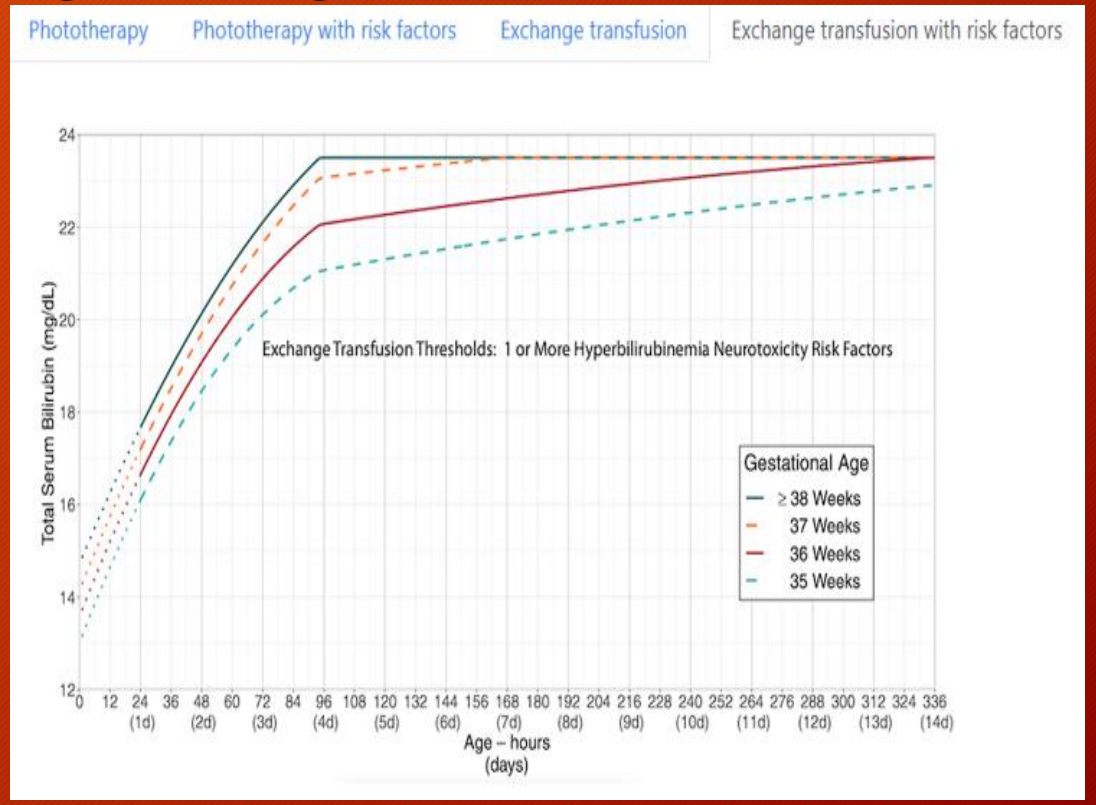
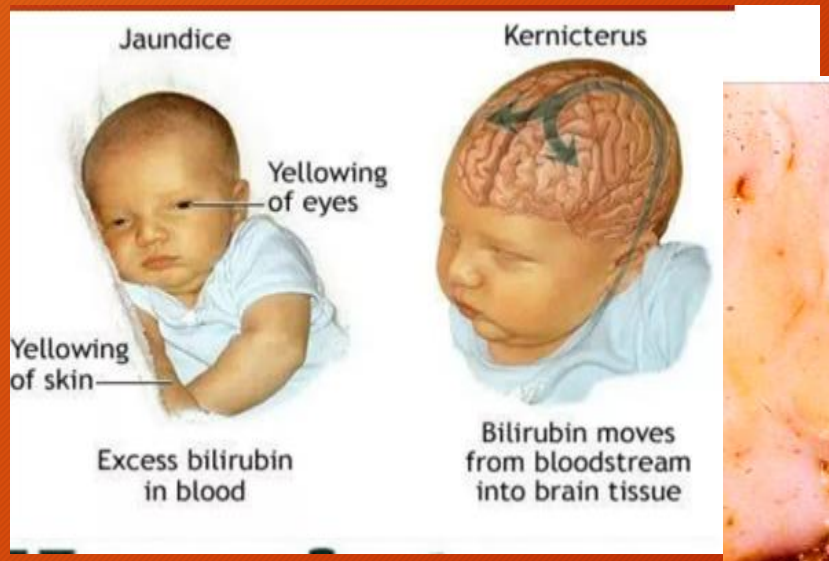


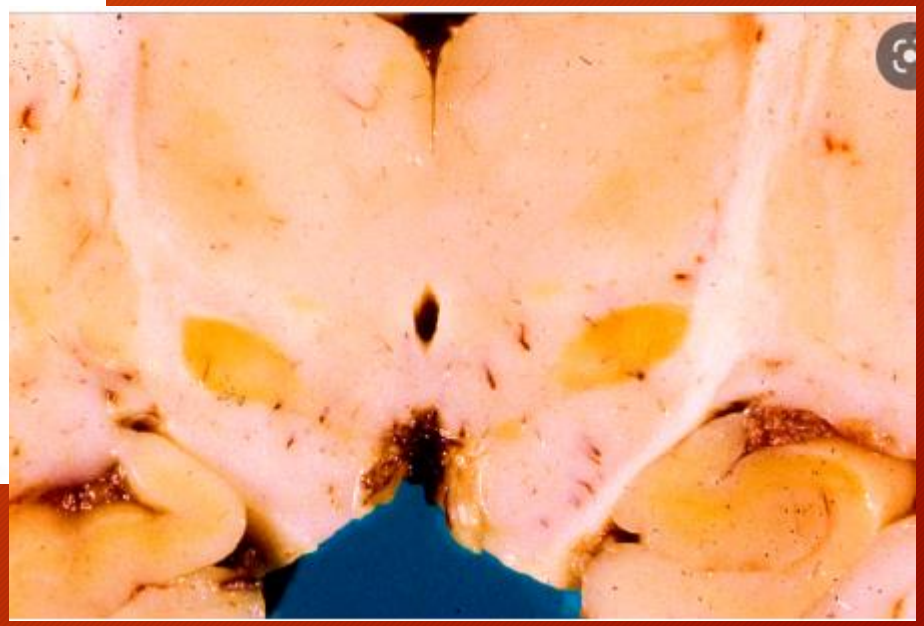
Untreated Hyperbilirubinemia: Acute Bilirubin Encephalopathy

- 3 distinct clinical phases:
  - 1) First few days: Stupor, hypotonia, poor sucking
  - 2) Hypertonia (retrocolis – backward arching of neck, opisthotnonus –arching of the trunk) and fever. All infants who develop this will develop chronic encephalopathy
  - 3) Third phase (after the first week) Disapperance of hypertonia
  - Muscle rigidity, paralysis of upward gaze, periodic oculogyric crisis and irregular respirations are present in the terminal phase. (4% die in acute phase)

Untreated Hyperbilirubinemia: Chronic Bilirubin Encephalopathy

- Persistent brain dysfunction
- Athetoid cerebral palsy
- Hearing deficit
- Oculomotor disturbances
- Dental Dysplasia
- Intellectual impairment





Parent Teaching

- Identify jaundice, causes and treatment options
- Signs of increasing jaundice and the importance of notifying their provider if they occur
- Phototherapy and the importance of consistency of maintaining time under the lights
- Eye shields importance and removing them during feeding
- Skin care measures, including frequent turning
- Feeding! Frequently! And the use of supplementation if needed
- Output: Stool frequency and change in color
- Followup with provider and frequency of serum bilirubin testing

A Case Study

- You are caring for a term newborn on the first day of life on the postpartum unit.
- Baby's Name : BG Wang Gender: Female
  Gestation: 39.5 weeks Birth Weight: 2980 gm (6#9oz) Blood Type: O+
- **Nurse's Notes:**
  0900: Situation: 18-hour old newborn female born by spontaneous vaginal delivery with visible jaundice of face and chest. **Vital Signs:** T 37.3C/99.1F, HR 144, RR 48
- **Background**: Mother is 23-yearold gravida 2, para 1, blood type O-negative. Uncomplicated pregnancy. Rupture of membranes 7 hours prior to delivery with clear fluid. Apgar scores 7 @ 1 minute and 9 @ 5 minutes. Mother states that breast feedings are a struggle, baby has shallow latch and is easily frustrated. She also reports sore nipples.

History and Physical:

- **General Physical Assessment**: Slightly lethargic, cries with exam, flexed posture, visible jaundice
- **HEENT:** Normocephalic, fontanelle slightly depressed, eyes and ears normal in set/shape, sclera yellow, palate intact, tongue with Epstein pearls, dry appearing mucous membranes
  Cardio/respiratory: No murmur, pulses +2 bilaterally, breath sounds clear through all fields
  GI/GU: Abdomen soft, non-distended, liver palpable, umbilical stump intact/clamped; passed 1 meconium stool and voided 1 time since birth
  Musculoskeletal: Hips stable bilaterally, all WNL

Case Study

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Laboratory Test	Result	Reference Range
Total Bilirubin	16mg/dl	<5.2 mg/dl within 24 hours of birth
Direct Antiglobulin Test	Positive	Negative
Hematocrit	39%	Females: 35-47% Males: 42-52%
Hemoglobin	13 g/dl	Females: 12-16 g/dl Males: 13-18 g/dl

Case Study Inquiry

- Which of the following findings need immediate follow-up?
    - Activity level
    - Color
    - Epstein pearls
    - Fontanelle
    - Mucous membranes
    - Stool occurances
    - Urine output
    - Umbilical stump status

Case Study Inquiry 2

- Which of the following findings are risk factors for jaundice?
  - Breastfeeding difficulties
  - Length of rupture of membranes
  - Current hydration status
  - Maternal blood type
  - Current stooling pattern
  - Second pregnancy

Provider Orders

- Start triple bank phototherapy
- Obtain transcutaneous bilirubin level every 2 hours on covered skin
- Obtain serum bilirubin every 6 hours
- Lactation consult
- Strict I&O
- VS Q 1 hour X 2 then Q 2 hours

Case Study Inquiry 3

- Which of the following nursing actions should be anticipated in the plan of care for phototherapy?
  - Eye shield
  - Monitor skin temperature hourly
  - Kangaroo care
  - Monitor phototherapy light level (intensity)

Additional Nurses Notes for Case Study

- 0930: Phototherapy started.
- 1030: T 37.2C/99.0 F, HR 140, RR 42
- 1130: T 37.0C/98.6F, HR 144, RR 40. Lactation consultant worked with mom and baby. Latched and breastfed 10 minutes. Voided 10 ml and passed a meconium stool TCB 18mg/dL. Sclera continued yellow.

Case Study Inquiry 4

- Which findings indicate the baby's status has improved?
    - Bilirubin level
    - Breastfeeding episode
    - Yellow sclera
    - Output

Questions???

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