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

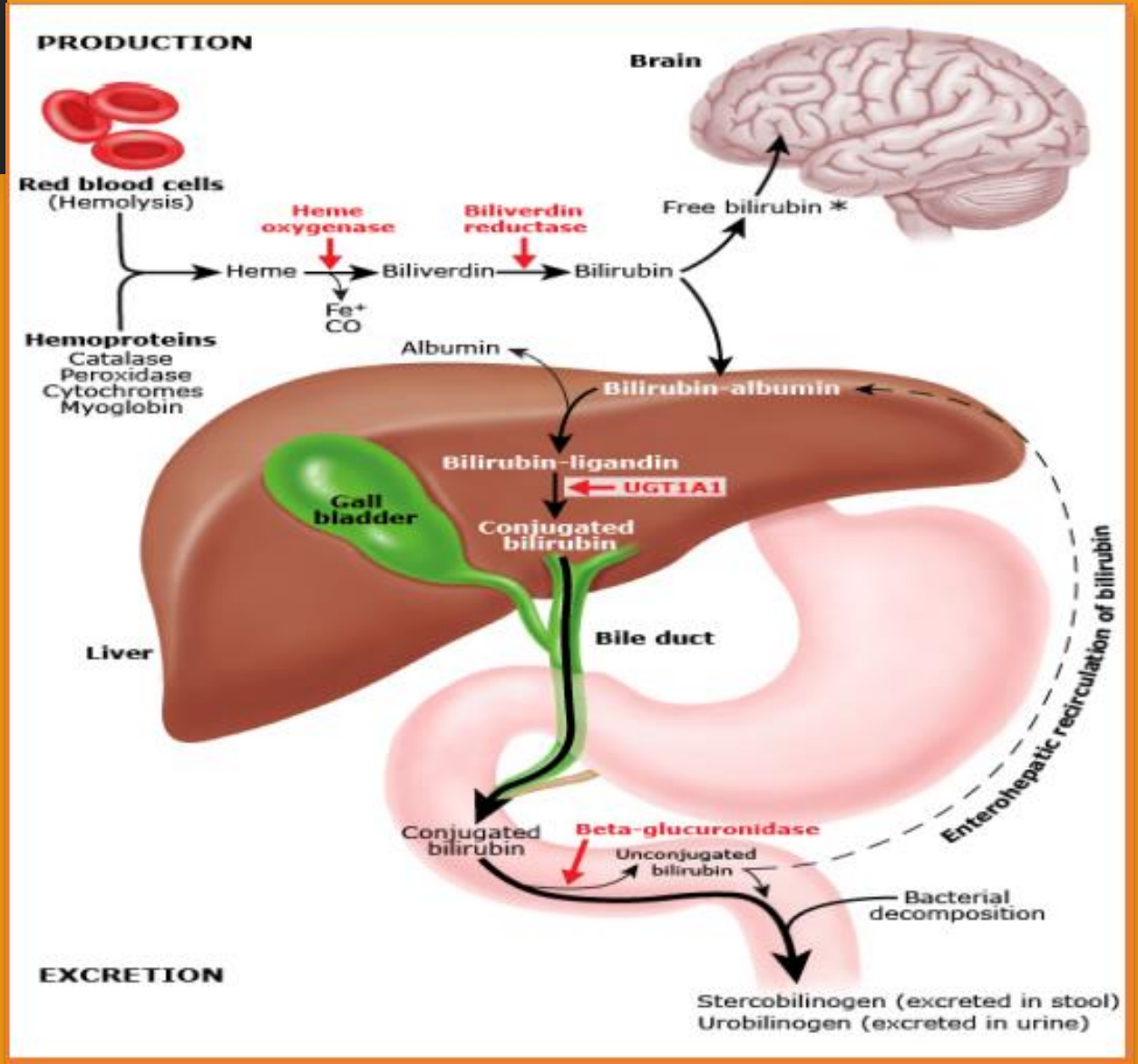
- Lower gestational age (ie, risk increases with each week less than 40 wk)
- Jaundice in the first 24 hours after birth
- Predischarge transcutaneous bilirubin (TcB) or total serum bilirubin (TSB) concentration close to the phototherapy threshold
- Hemolysis from any cause, if known or suspected based 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

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** ⚠	

- 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

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

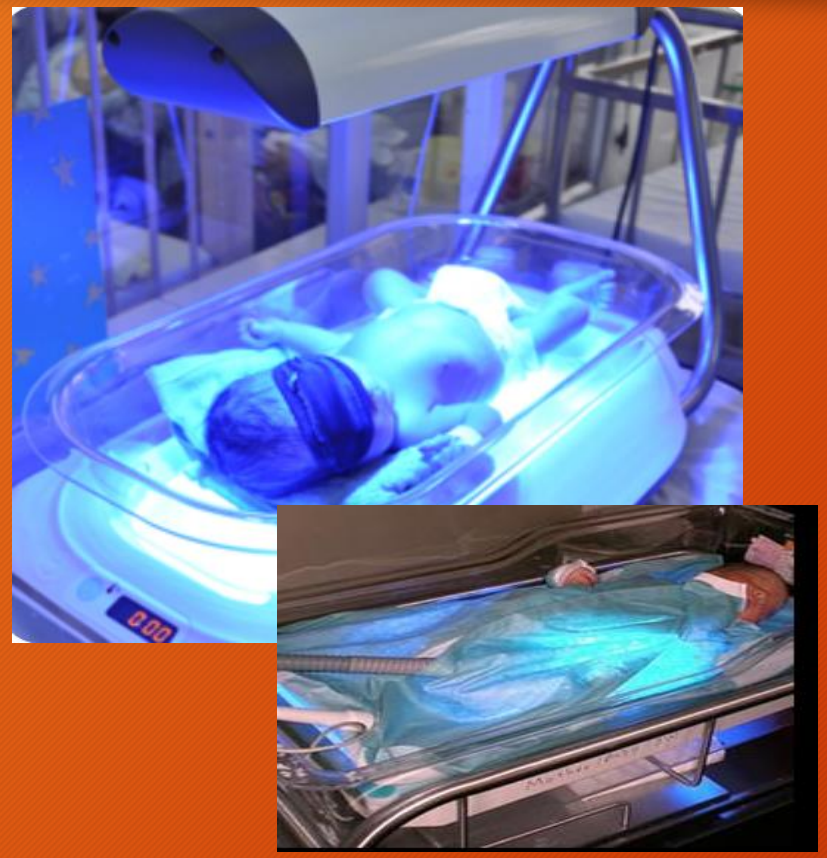
	Recommendation	Threshold
If using TcB, confirm with TSB?	**No**	-0
Phototherapy?		0
Escalation of Care? (learn more)		-0
Exchange Transfusion?		0

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

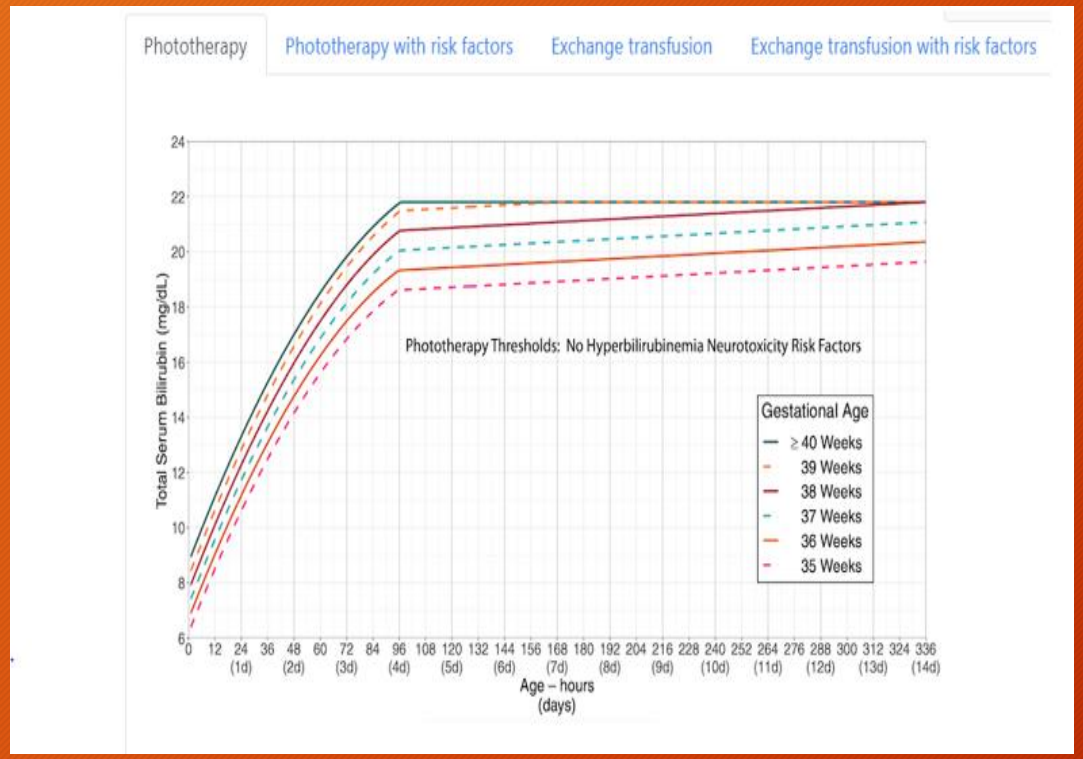
Nomogram: Phototherapy



- Bili light – early treatment, may be single bank, double or triple banked
- Sunlight was the first photo therapy
- Advantage of ultra-violet B promotes vitamin D production
- Bilirubin level is lowered through excretion in stool and urine
- This is why adequate feeding is so important

2022 Phototherapy thresholds by GA and age in hours

No recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age.



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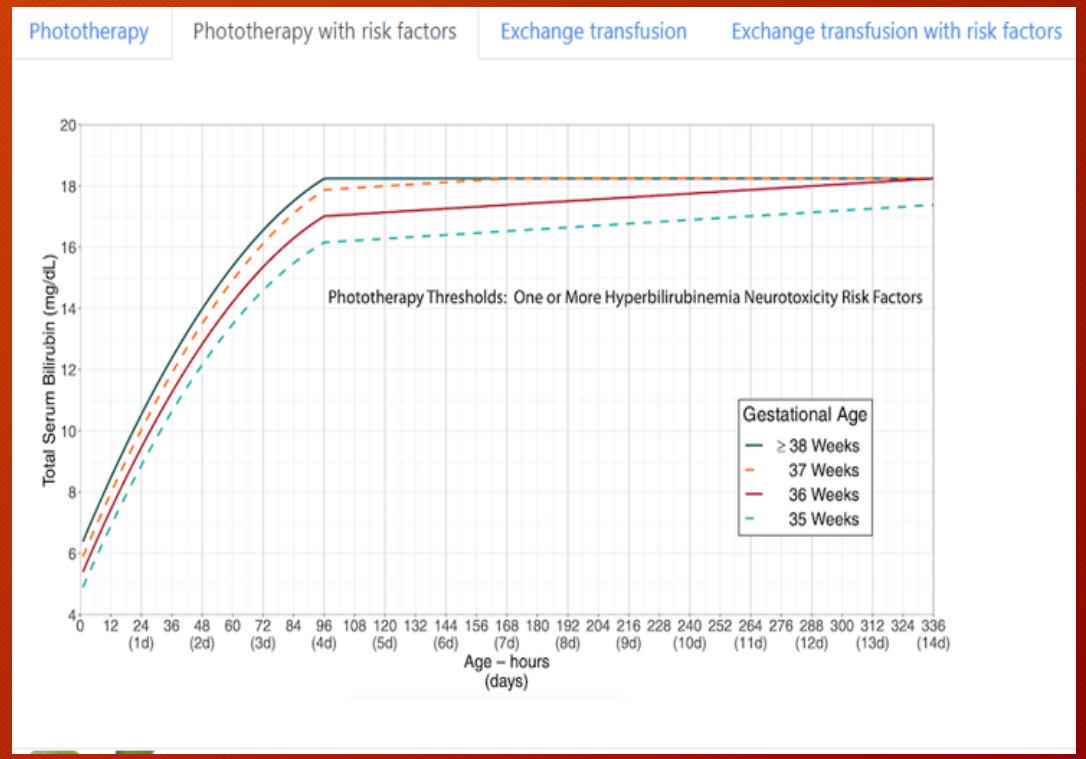
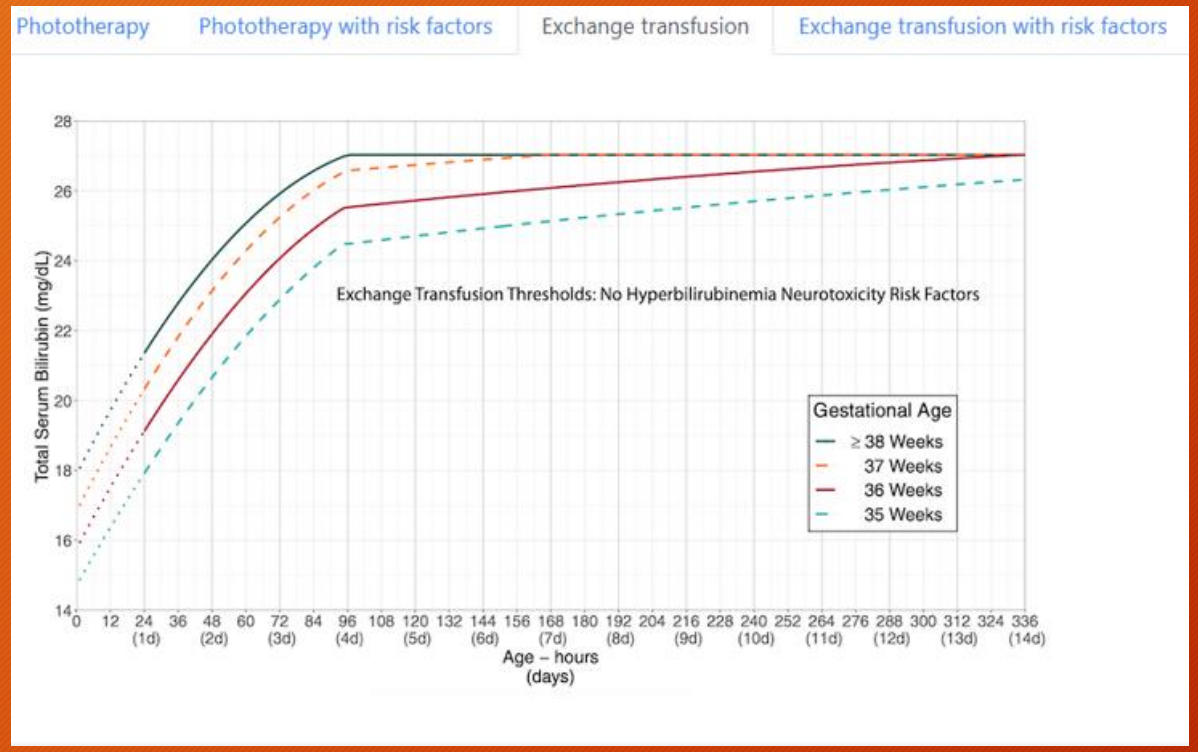


Exchange Transfusion thresholds by GA and age in hours

No recognized hyperbilirubinemia neurotoxicity risk factors other than gestational age.



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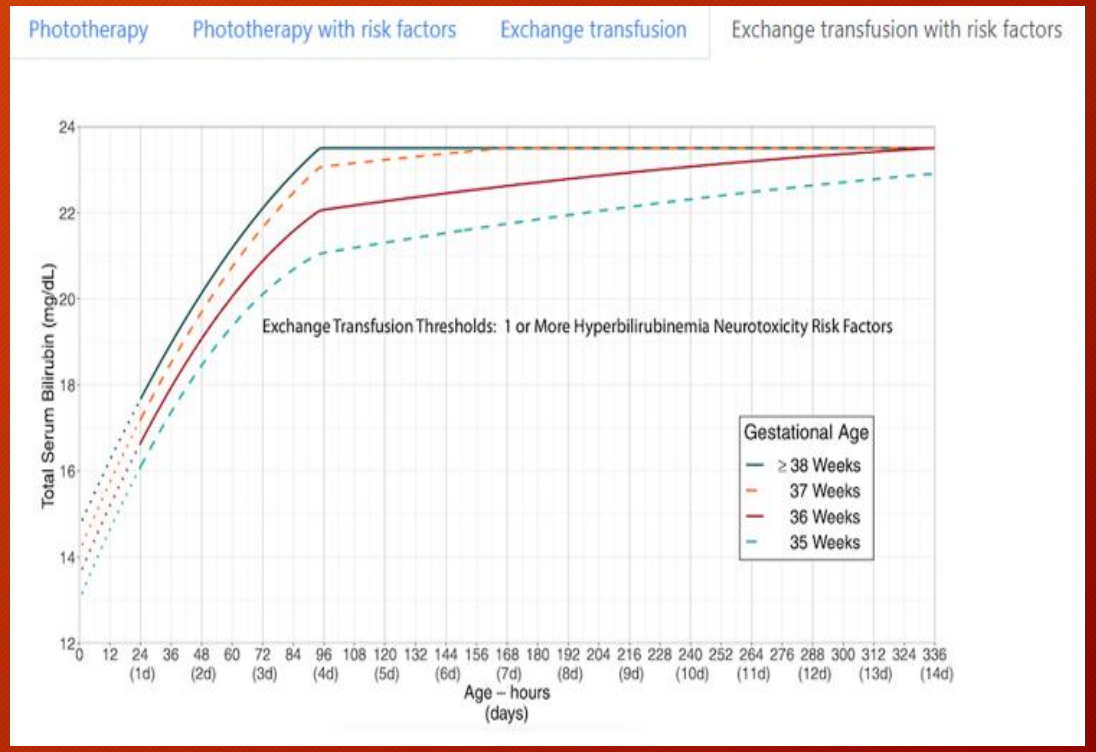
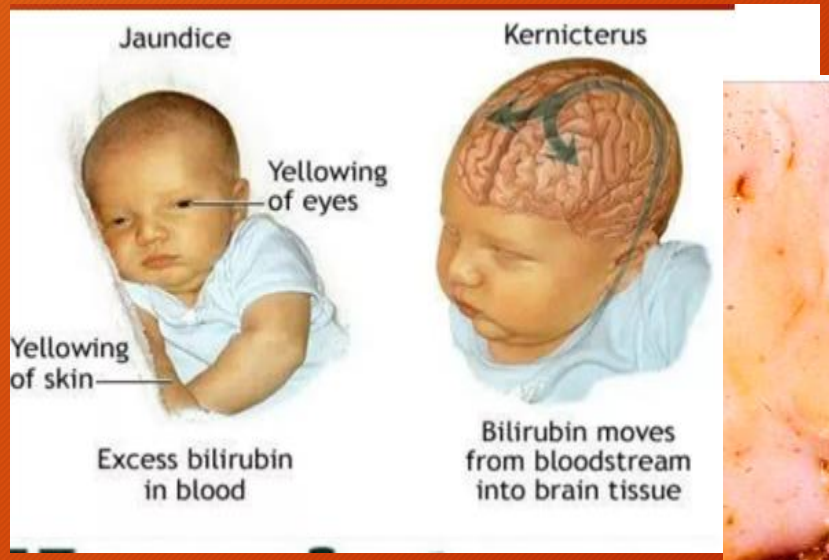


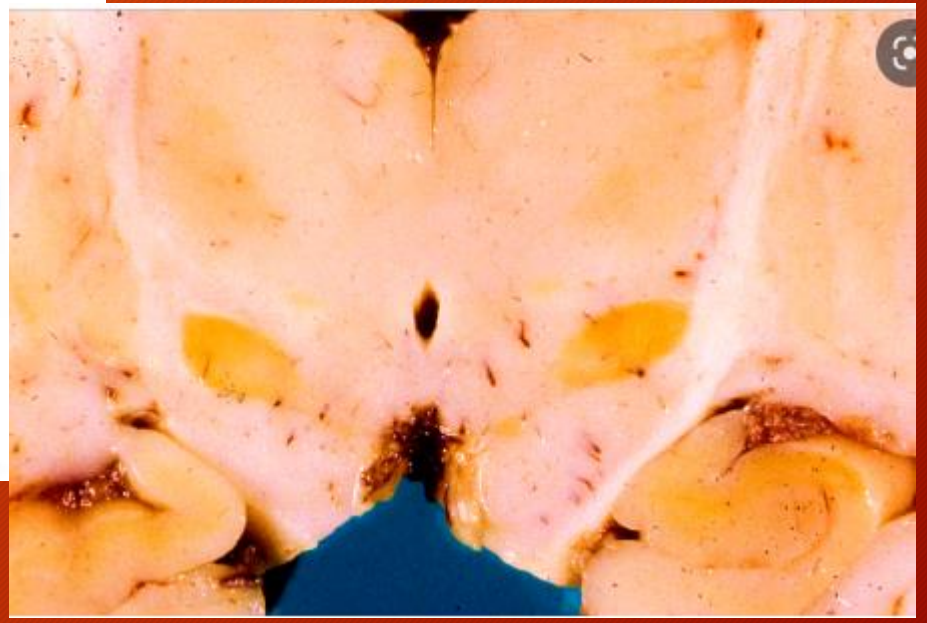
Untreated Hyperbilirubinemia: Acute Bilirubin Encephalopathy

- 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. Follow-up as determined by provider
- 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! Lactation consult if needed. The use of supplementation will be guided by physician and LC
- 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: 0+
- **Nurse's Notes:**
  0900: 18-hour old newborn female born by spontaneous vaginal delivery to a 23-yearold gravida 2, para 1, blood type O-negative mother. 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 poor latch and is easily frustrated. Mom reports sore nipples.
- **History and Physical:**
  General: Slightly lethargic, cries with exam, flexed posture, visible jaundice of face and chest
  Vital Signs: T 37.3C/99.1F, HR 144, RR 48
  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

Question 1

- Select 5 findings that need immediate follow-up.
  - **Activity level**
  - **Color**
  - **Epstein pearls**
  - **Fontanelle**
  - **Mucous membranes**
  - **Stool output**
  - **Sclera**
  - **Urine output**
  - **Umbilical stump**

Question 2

- Select the following findings that are risk factors for jaundice.

  - **Breastfeeding problems**
  - **Current hydration status**
  - **Maternal blood type**
  - **Length of rupture of membranes**
  - **Second pregnancy**
  - **Current stooling pattern**

Question 3

- Complete the sentence from the italicized options:
- The baby is most likely experiencing _____ jaundice due to_____.

- ***breastfeeding***
- ***pathologic***
- ***physiologic***
- ***poor intake***
- ***hemolysis***
- ***impaired excretion***

Laboratory Report and Orders

- **Laboratory report:**
-

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

- Orders:
- - Start phototherapy - 3 banks of lights per protocol
  - Obtain transcutaneous bilirubin level every 2 hours on covered skin
  - Obtain serum bilirubin every 6 hours
  - Lactation consult
  - Strict I&O
  - VS Q 1 H X 2 hours then Q 2 H

Question 4

- 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 intensity level**

Question 5

- Which of the following nursing actions should be anticipated in the feeding plan of care?

- **Lactation consult**
- **Encourage breastfeeding every hour**
- **Supplement feedings with infant formula**
- **Weigh diapers**

Question 6

- Of the following orders, which should be implemented immediately?

- **Start Phototherapy**
- **Lactation consult**
- **Parent education on the use of phototherapy**
- **Parent education on follow-up labs**
- **Parent education on Rh incompatibility**
- **Obtain serum bilirubin**

Question 7

- Of the following orders, which should be implemented by the end of the shift?

- **Start Phototherapy**
- **Lactation consult**
- **Parent education on the use of phototherapy**
- **Parent education on follow-up labs**
- **Parent education on Rh incompatibility**
- **Obtain serum bilirubin**

Additional Nurses Notes

- 0930: Phtotherapy 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 deeply and breastfed 10 minutes with audible swallows. Voided 10 ml and passed a meconium stool TCB 18mg/dL. Sclera continued yellow, backward arching noted.

Question 8

- Which of the following findings indicate the baby's status has improved?

- **Bilirubin level**
- **Breastfeeding experience**
- **Yellow sclera**
- **Posturing**

Question 9

- Which of the following findings indicate the baby's status has deteriorated

- **Bilirubin level**
- **Breastfeeding experience**
- **Yellow sclera**
- **Posturing**

Questions???

References

- Anson-Assoku, B,. Shah, S., Adnan, M., Ankola, P., Neonatal Jaundice. StatPearls., https://www.ncbi.nlm.nih.gov/books/NBK532930/?report=printable
- Gomella, T.L., Cunningham, M.D., Eyal, F.G. & Tuttle, D.J. (Eds.). (2013). Neonatology: Management, procedures, on-call problems, diseases and drugs. McGraw Hill Education
- Maisels, M.J., Bhutani, V.K., Bogen, D., Newman, T.B., Stark, A.R., & Watchko, J.F. (2009). Hyperbilirubinemia in the newborn infant ≥35 weeks'gestation: An update with clarifications. https://doi.org/10.1542/peds.2009-0329
- Sessions, L (2023). Maryland Next Gen NCLEX Test Bank Project. Townson University
- Unknown. (n.d.). Red blood cell [Illustration]. Cell. https://www.cell.com/pictureshow/erythrocytes
- Unknown. (n.d.). Water drop [Illustration]. Clipart Library. http://clipart-library.com/clipart/Lcd5ndBri.htm
- Unknown. (n.d.). Human bile duct anatomy [Illustration]. Dreamtime. https://www.dreamstime.com/human-bile-duct-vector-illustration-anatomy-flatstyle-medical-articles-infographics-educational-textbooks-image134136226
- Unknown. (n.d.). Diaper [Illustration]. Needpix. https://www.needpix.
- Wong, R.J. & Bhutani, V.K. (2019). Unconjugated hyperbilirubinemia in term and late preterm infants: Management. UpToDate. https://www.uptodate.com/contents/unconjugated-hyperbilirubinemia-in-term-and-late-preterm-infantsmanagement/print?search=neonatal%20jaundice&source=search_result&selectedTitle=2~99&usage_type=default&display_rank=2
- Rhodes, T., (2022) Hyperbilirubinemia in the Newborn. OU Health Science Center
- Verklan, M. T., Walden, M., Association Of Women's Health, Obstetric, And Neonatal Nurses, American Association Of Critical-Care Nurses, & National Association Of Neonatal Nurses. (2015). *Core curriculum for neonatal intensive care nursing* (5th ed.). Elsevier Saunders.
- Wagle, S. (2017). Hemolytic disease of the newborn. Medscape. Retrieved June 6, 2022, from https://emedicine.Medscape.com/article/9743949-overview