

Hyperbilirubinemia in Newborns

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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

What is hyperbilirubinemia?

Bilirubin is made by the breakdown of “used” red blood cells.

Newborn's immature livers can't remove bilirubin quickly enough, causing a buildup of the excess in the bloodstream

If excess is not removed quickly enough, it can begin to build up in the brain

Quick Facts!

Gastrointestinal disorder

Diagnosed by elevated total serum bilirubin (TSB)

Values differ depending on gestational age, day of life, and superimposed illnesses

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 Hyperbilirubinemia in Term Infants:

- ❖ Blood type incompatibility
- ❖ Infections
- ❖ Polycythemia
- ❖ Bruising
- ❖ RDS
- ❖ Maternal diabetes
- ❖ 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 weeks)
- ❖ Jaundice in the first 24 hours
- ❖ PredischARGE TcB or TSB close to the phototherapy threshold
- ❖ Hemolysis
- ❖ Phototherapy prior to discharge
- ❖ Parent or sibling requiring phototherapy or exchange transfusion
- ❖ Family/genetic history of inherited red blood cell disorders (G6PD deficiency)
- ❖ Exclusive breastfeeding with suboptimal intake
- ❖ Hematomas or significant bruising
- ❖ Down syndrome
- ❖ Macrosomic infant of a diabetic mother

Late Preterm Infants:

TSB peaks day 5-7

At risk, especially if:

- Jaundice in first 24 hours
- Cephalohematoma/Ecchymosis
- Exclusive breastfeeding
- Blood group incompatibility
- Previous sibling who req. phototherapy
- Predischage TSB in the “high-risk” zone
- Macrosomic infant of 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



Varying levels
of jaundice

ABO Incompatibility

Moms with blood type “O” or “Rh-” who deliver babies that have a different blood type.

These infants can develop hemolysis, which places them at higher risk for hyperbilirubinemia and anemia.

When the DAT (coombs) is positive, it is assumed that the baby has increased levels of hemolysis of the red blood cells and is at a higher risk.

If the mother's blood type is O or Rh-, a cord blood evaluation (includes a direct coombs test) will be ordered at delivery



Unconjugated vs. Conjugated

Unconjugated (indirect) hyperbilirubinemia

Non-Pathologic

Fat soluble

NOT directly excreted in urine or stool

Peaks between days 3-6 of life

Correlation to intake and output

Conjugated (direct) hyperbilirubinemia

Hepatobiliary dysfunction

Water soluble

Excreted in urine or stool

Considered pathological in nature

Conjugated bili serum levels of > 1.5 mg/dL or more when the total bilirubin is less than 5 mg/dL

Physiologic (Unconjugated) 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
▪ <u>Early onset</u> – 1st week after birth ▪ Insufficient milk intake leads to dehydration resulting in hemoconcentration of bilirubin ▪ Fewer bowel movements increases the enterohepatic circulation of bilirubin	▪ <u>Later onset</u> – 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) ▪ <u>Continue breastfeeding</u> ▪ 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 (Conjugated) 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		CONJUGATED HYPERBILIRUBINEMIA	
HEMOLYTIC	NON-HEMOLYTIC	EXTRAHEPATIC	INTRAHEPATIC
<u>INTRINSIC</u> ▪ G6PD deficiency ▪ Hereditary spherocytosis ▪ Thalassemia <u>EXTRINSIC</u> ▪ Drugs ▪ Iso-immune (ABO, Rh) ▪ Sepsis	▪ Sepsis ▪ Hypothyroidism ▪ Cephalohematoma ▪ Gilbert ▪ Crigler-Najjar <u>Work-up:</u> Coombs test, CBC with differential, blood smear, blood culture	▪ 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 ⚠	



Breast Milk Jaundice

Can occur in breastfed infants from 1-12 weeks old

Elevated bilirubin → leading to yellowing of skin and eyes

Cause is believed to be substances in mother's milk that inhibit infants' liver from processing bilirubin effectively

Generally resolves on its own without the need for treatment

Management:

- ❖ Continue breastfeeding!
- ❖ Monitor bilirubin levels if needed
- ❖ Pediatricians may have mothers take a break in breastfeeding for 24-48 hours to drop bili levels and then resume

Keys to Managing Hyperbilirubinemia:

Our goal is preventing complications!

- Early and frequent breastfeeding
- Supplementation if necessary
- Assess birth parent for risk factors (blood type, family history, infection or diabetes)
- Phototherapy
- Exchange transfusion
- IVIg infusion



Screening:
TCB

Laboratory Tests:

Coombs/DAT

Total serum bilirubin

Direct bilirubin

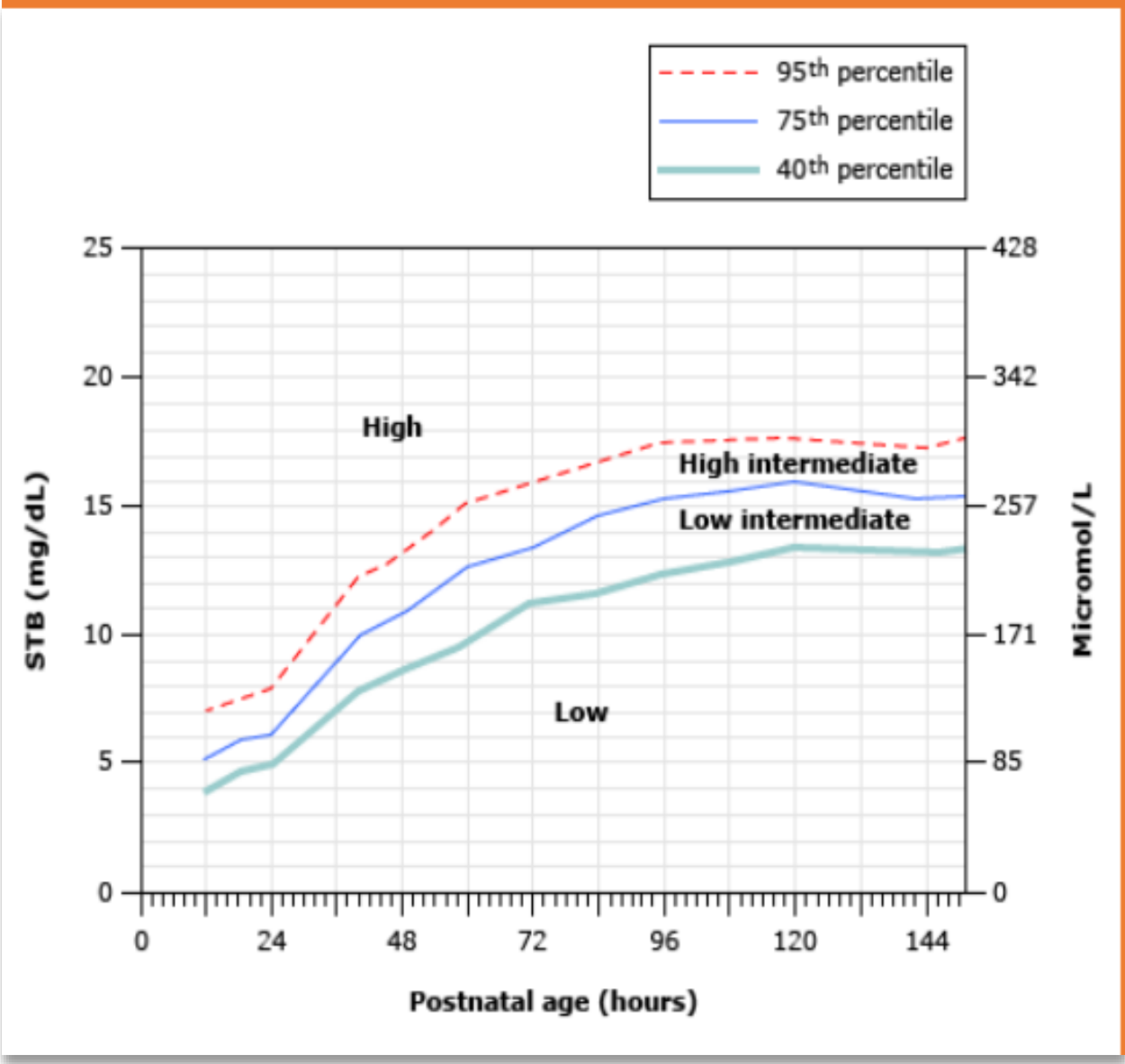
Total and direct bilirubin



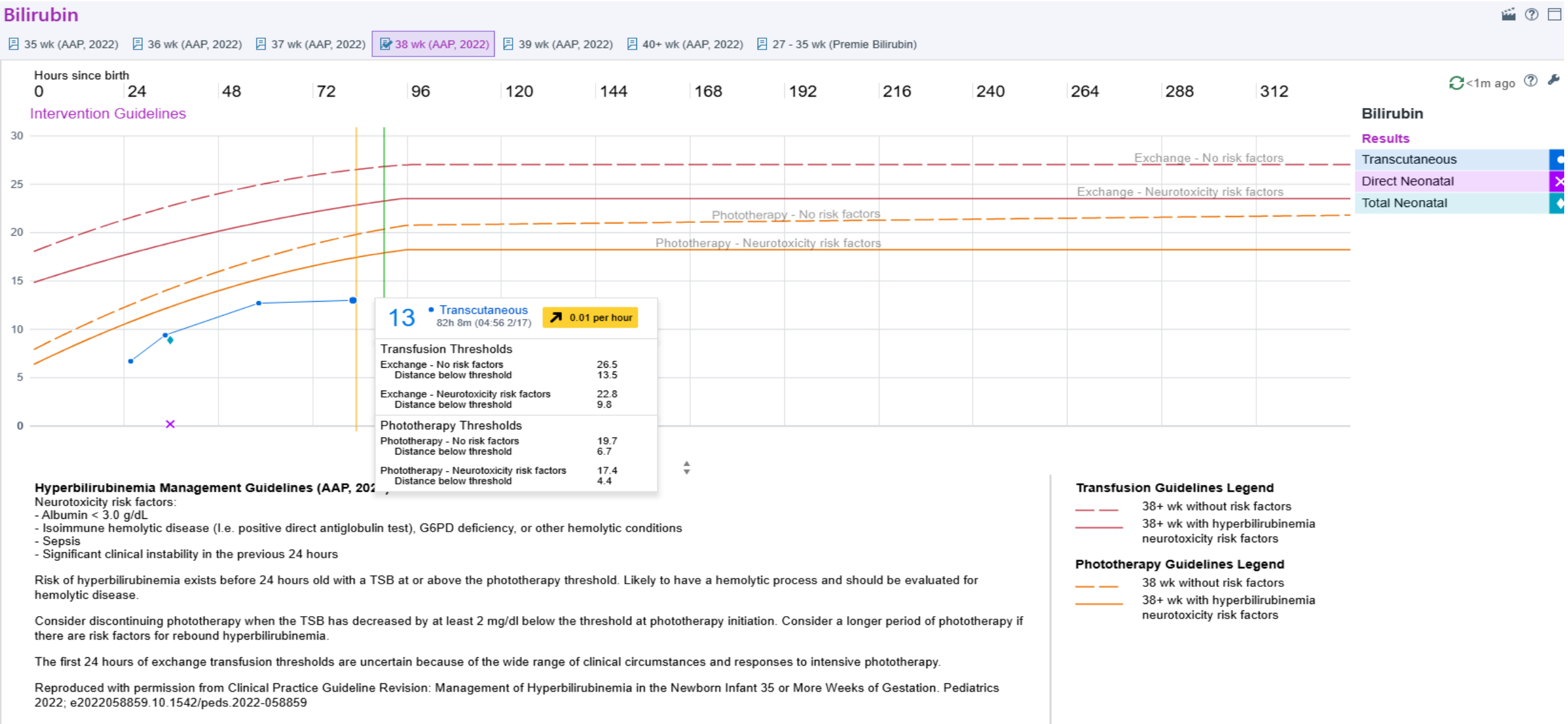


Nomograms

Hour-specific nomogram based total serum bilirubin in healthy term and near-term newborns



EPIC Nomogram



Phototherapy:



Converts bilirubin to a water-soluble product by photo-oxidation- makes it easier for infant to pass via urine or stool

Things to remember:

- Do you have provider order? How many light sources ordered?
- When is next lab draw?
- Turn off phototherapy lights when drawing lab samples and during assessment
- Cover baby's eyes during therapy



Untreated: Acute Bilirubin Encephalopathy

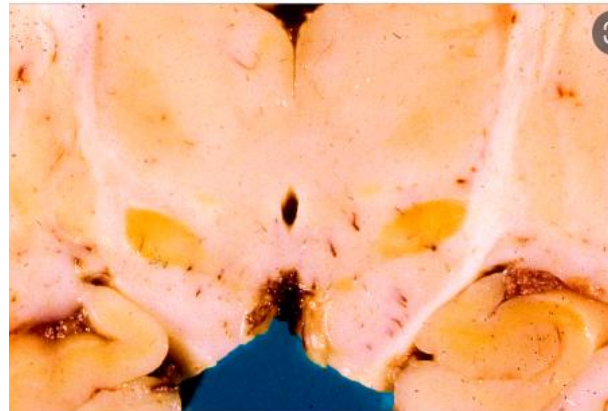
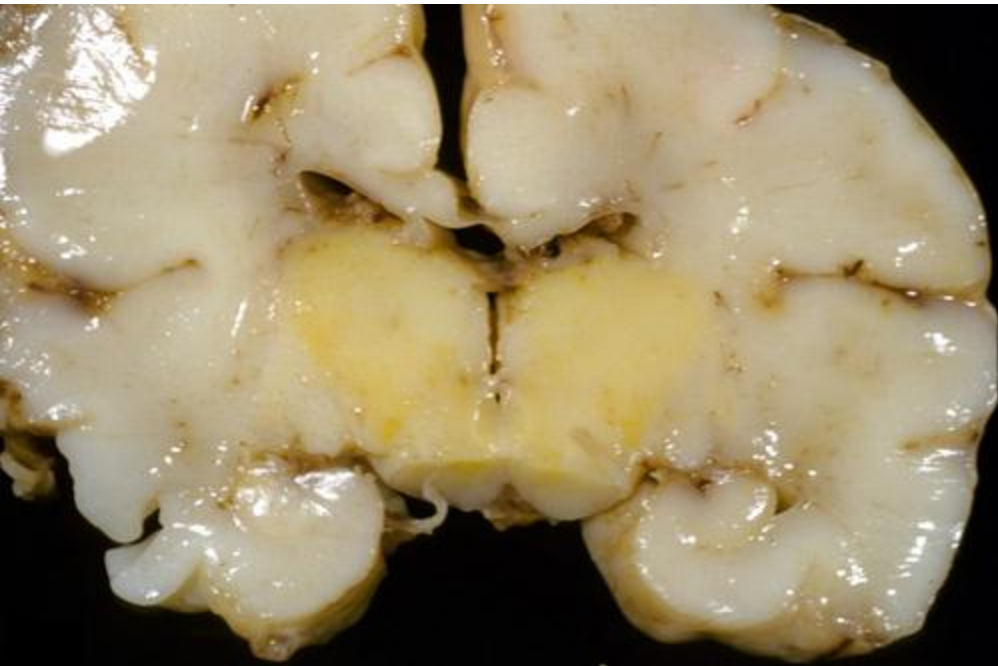
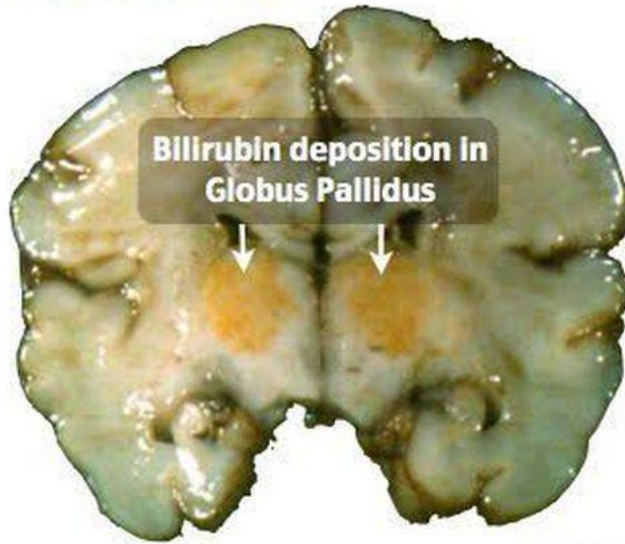
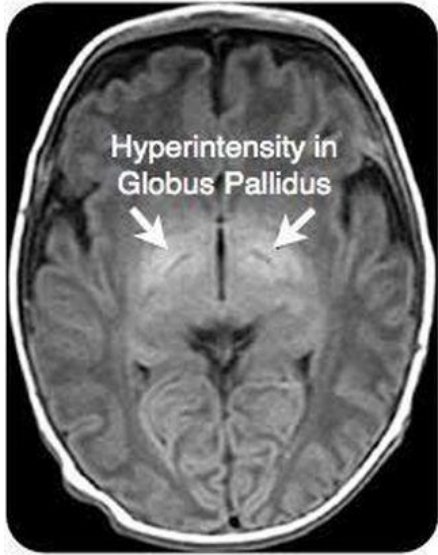
Phase 1: hypotonia, poor sucking, lethargy, severe jaundice, seizures

Phase 2: Fever, abnormal back/neck arching, muscle spasms, high-pitched cry All infants who develop this will develop chronic encephalopathy

Phase 3: Shrill cry, no feeding, hearing derangements, profound hypertonia, apnea, seizures, coma, death



Kernicterus



Kernicterus

Caused by untreated, severe jaundice, where excessive unconjugated bilirubin crosses the blood-brain barrier and deposits in brain tissue

Chronic, irreversible brain damage



If left untreated...

Persistent brain dysfunction

Hearing deficit

Oculomotor disturbances

Dental Dysplasia

Intellectual impairment

Cerebral Palsy

Seizures

Parent Teaching

Identify jaundice,
causes and treatment
options

Signs of increasing
jaundice and the
importance of notifying
their provider if they
occur

Phototherapy:
maintaining consistency
of 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

Case Study

You are caring for a term newborn on the first day of life on the postpartum unit.

Baby's Name : BG Wang

Gestation: 39.5 weeks

Birth Weight: 2980 gm (6#9oz)

Gender: Female

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 1small meconium stool and voided 1 time since birth

Musculoskeletal: Hips stable bilaterally, all WNL

Case Study

Laboratory Test	Result	Reference Range
Total Bilirubin	16mg/dl	<5.2 mg/dl within 24 hours of birth
Direct Antiglobulin Test (DAT Coombs)	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 findings concern you?

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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/Coombs status

Current stooling pattern

Second pregnancy

Provider Orders

- Start Double bank phototherapy
- Obtain serum bilirubin every 6 hours
- Lactation consult
- Supplement 10-15mLs per feeding with donor milk, mother's pumped milk, or formula
- 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?

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. Supplemented 15 mLs of donor milk. Voided and passed a meconium stool Sclera continued yellow.

1330: T 37.0/98.6F, HR 130, RR 48. Void x2.

1400: Breastfed x 20 minutes and supplemented 10 mLs of donor milk.

1530: Serum Bilirubin results at 14.1

Case Study Inquiry 4

Which findings indicate the baby's status has improved?

Bilirubin level

Breastfeeding episode

Yellow sclera

Output

Vital signs



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>
- 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.