

Hyperbilirubinemia in Newborns

Ashleigh Shepherd, MSN, RNC-MNN



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)

Abnormal 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

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

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
- Predischarge TSB in the “high-risk” zone
- Macrosomic infant of diabetic mother

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

- **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**

BREAST MILK JAUNDICE

- **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

PREMATURITY

- Occurs in **preterm** infants (< 37 weeks)
- More likely to require **phototherapy**

MANAGEMENT

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ 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) | <ul style="list-style-type: none"> ▪ 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
INTRINSIC <ul style="list-style-type: none"> G6PD deficiency Hereditary spherocytosis Thalassemia 	<ul style="list-style-type: none"> Sepsis Hypothyroidism Cephalohematoma Gilbert Crigler-Najjar 	<ul style="list-style-type: none"> Biliary atresia Choledochal cysts Perforated bile ducts Tumour/mass Cystic fibrosis Galactosemia 	<ul style="list-style-type: none"> Infections: hepatitis, TORCH, UTI, etc. Drugs: eg. ceftriaxone, sulfonamides, etc. Genetic/metabolic: eg. Alagille syndrome, etc.
EXTRINSIC <ul style="list-style-type: none"> Drugs Iso-immune (ABO, Rh) Sepsis 	Work-up: Coombs test, CBC with differential, blood smear, blood culture	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



Varying levels
of jaundice

Keys to Managing Hyperbilirubinemia:

Goal is preventing complications such as:

Increasing jaundice

Acute bilirubin encephalopathy

Kernicterus

- 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



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

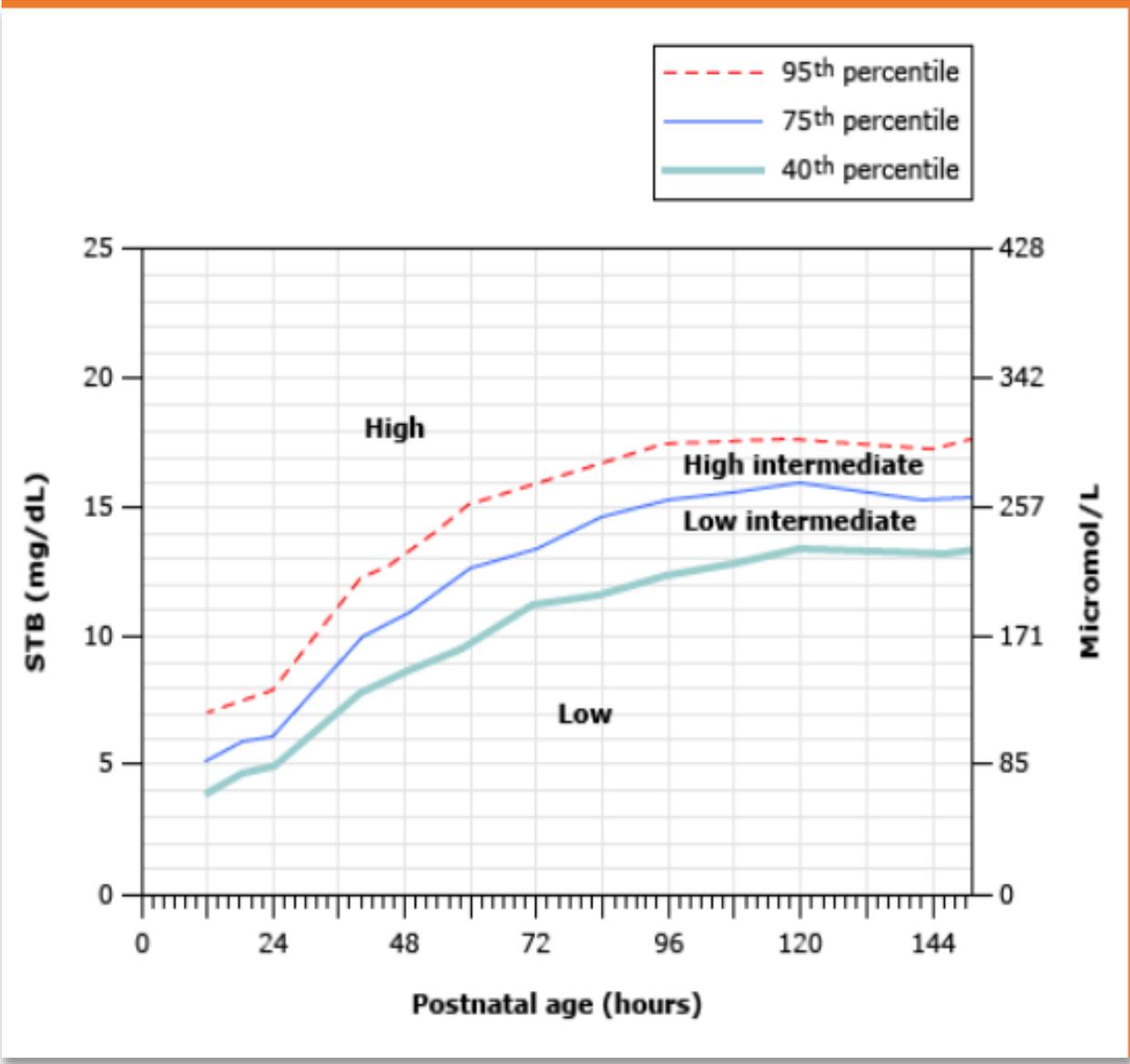
Because phototherapy is recommended, there are no postdischarge recommendations at this time.

Also, the sample was collected under 12 hours of age

BiliTool™

Nomograms (Pre-2022)

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



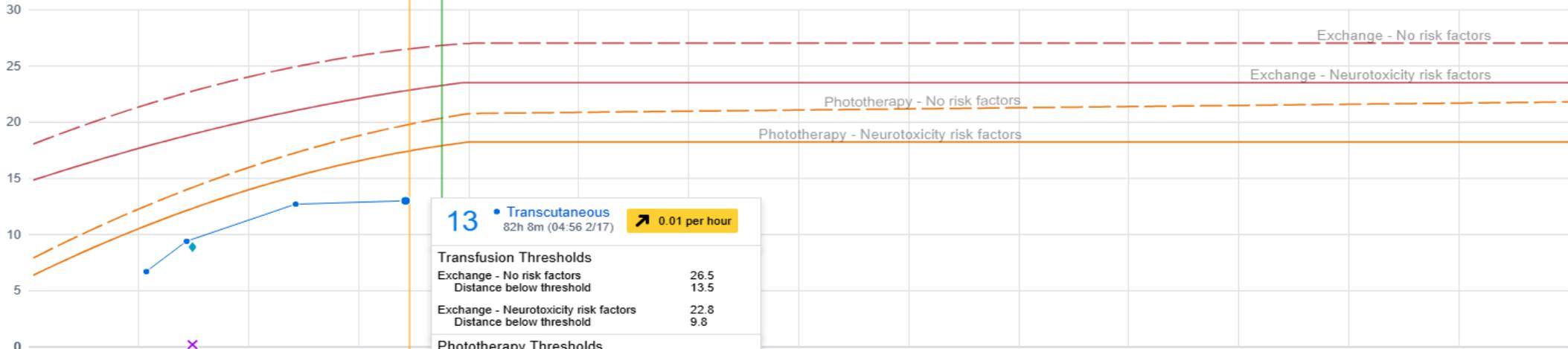
EPIC Nomogram

Bilirubin

35 wk (AAP, 2022) 36 wk (AAP, 2022) 37 wk (AAP, 2022) **38 wk (AAP, 2022)** 39 wk (AAP, 2022) 40+ wk (AAP, 2022) 27 - 35 wk (Premie Bilirubin)

Hours since birth: 0, 24, 48, 72, 96, 120, 144, 168, 192, 216, 240, 264, 288, 312

Intervention Guidelines



13 • Transcutaneous
82h 8m (04:56 2/17) ↑ 0.01 per hour

Transfusion Thresholds	
Exchange - No risk factors	26.5
Distance below threshold	13.5
Exchange - Neurotoxicity risk factors	22.8
Distance below threshold	9.8
Phototherapy Thresholds	
Phototherapy - No risk factors	19.7
Distance below threshold	6.7
Phototherapy - Neurotoxicity risk factors	17.4
Distance below threshold	4.4

Hyperbilirubinemia Management Guidelines (AAP, 2022)

- Neurotoxicity risk factors:
- Albumin < 3.0 g/dL
 - Isoimmune hemolytic disease (i.e. positive direct antiglobulin test), G6PD deficiency, or other hemolytic conditions
 - Sepsis
 - Significant clinical instability in the previous 24 hours

Risk of hyperbilirubinemia exists before 24 hours old with a TSB at or above the phototherapy threshold. Likely to have a hemolytic process and should be evaluated for hemolytic disease.

Consider discontinuing phototherapy when the TSB has decreased by at least 2 mg/dl below the threshold at phototherapy initiation. Consider a longer period of phototherapy if there are risk factors for rebound hyperbilirubinemia.

The first 24 hours of exchange transfusion thresholds are uncertain because of the wide range of clinical circumstances and responses to intensive phototherapy.

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Bilirubin

Results

- Transcutaneous
- Direct Neonatal
- Total Neonatal

Transfusion Guidelines Legend

- 38+ wk without risk factors
- 38+ wk with hyperbilirubinemia neurotoxicity risk factors

Phototherapy Guidelines Legend

- 38 wk without risk factors
- 38+ wk with hyperbilirubinemia neurotoxicity risk factors

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

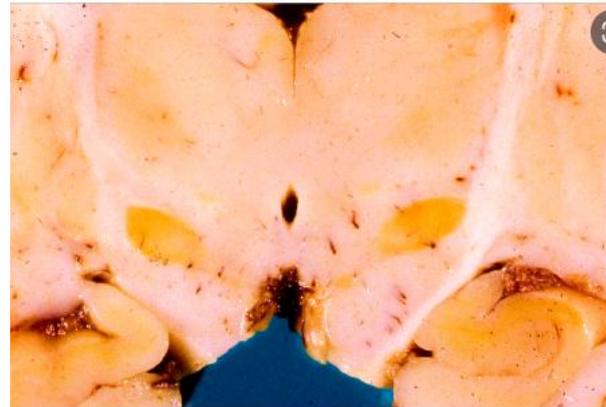
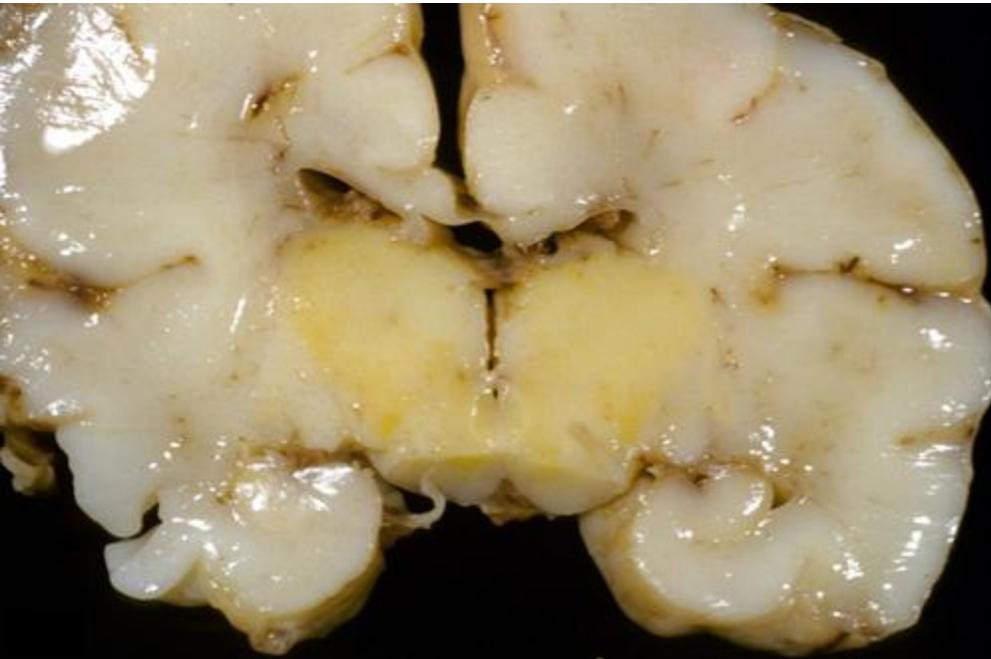
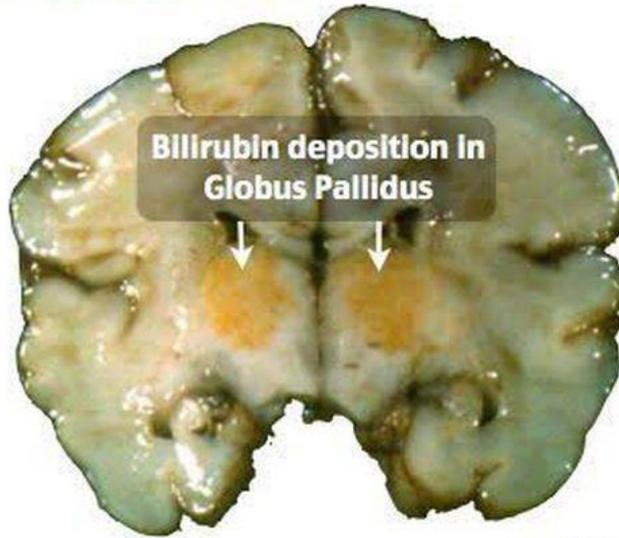
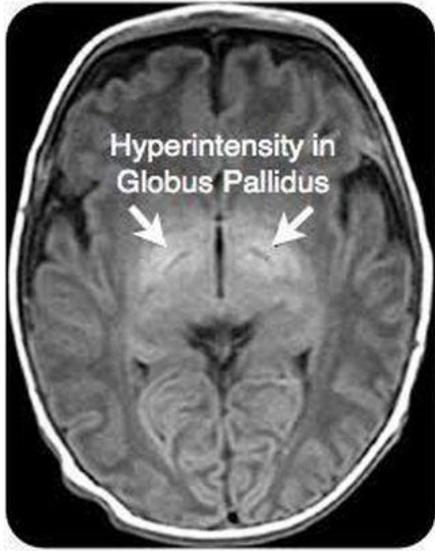
Phase 1: hypotonia, poor sucking, lethargy, severe jaundice, seizures

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



Untreated Hyperbilirubinemia: Chronic Bilirubin Encephalopathy & Kernicterus

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

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

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?

Nurse's Notes:

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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

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 Protection

Monitor skin temperature frequently (per policy)

Kangaroo care

Monitor phototherapy irradiance level (intensity)

Measure light distance from crib

A follow up bili draw

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 16mg/dL. Sclera continued yellow.

Case Study Inquiry 4

Which findings indicate the baby's status has improved?

Bilirubin level

Breastfeeding episode

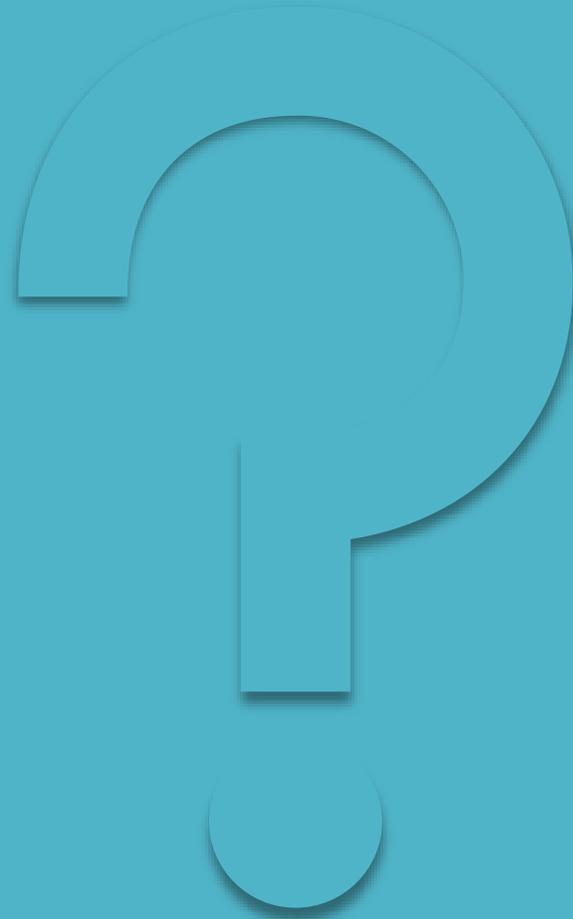
Yellow sclera

Output

Vital signs



Questions???



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