Learning Package

(LP:18:10)

Neonatal Hyperbilirubinemia (Jaundice)

Sites where Learning package applies	All sites who provide care for neonates under 29 days old
Description	This package is an education program which will allow nurses to provide timely and expert care for neonates within Hunter New England Local Health District (HNE LHD)
Target audience	Nurses required to provide care for neonates in Neonatal Intensive Care Unit (NICU) or Special Care Nursery (SCN) settings
Learning Outcomes, On completion of this package you will be better able to:	1. Understand the theoretical background required to safely and efficiently care for the jaundiced neonate. 2. Understand treatment methods for hyperbilirubinemia 3. Understand side-effects and complications of treatment

Keywords	Neonatal, jaundice, hyperbilirubinemia, phototherapy
Document registration number	LP:18:10
Replaces existing document?	Yes

Related Legislation, Australian Standard, NSW Ministry of Health Policy Directive or Guideline, National Safety and Quality Health Service Standard (NSQHSS) and/or other, HNE Health Document, Professional Guideline, Code of Practice or Ethics:

Thermoregulation of the Neonate in NICU
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0010/139618/ThermoregulationJuly2015.pdf

Jaundice in the Neonate
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0007/167623/JaundiceAugust2017.pdf

Kangaroo Care in NICU CPG
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0008/170594/Kangaroo_Care_Guideline_August2017Final.pdf

Admission of babies to NICU, HDU and SCN CPG
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0003/122286/AdmissionNICUFeb2014_.pdf

Skincare Guidelines for babies in NICU CPG
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0003/160149/Skin_Feb_2017.pdf

Giraffe Incubator in NICU CPG
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0007/120220/Giraffe_IncubatorDec13NamechangeWeb_2013.pdf

Developmental care principles in NICU CPG
http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0006/153285/Developmental_Care_PrinciplesJHCHFeb2013.pdf

See recommended reading/ reference list

Is this package recorded in MHL?	Neonatal: Hyperbilirubinaemia (180450742)
Learning package contact person:	Justine Parsons (Nurse Educator, NICU, JHCH)
Contact details:	*justine.parsons@hnehealth.nsw.gov.au* 49223135

Issue date:	September 2017
Review date:	September 2020

Neonatal Hyperbilirubinaemia

Learning Package

2017

NSW GOVERNMENT Health
Hunter New England
Local Health District

Learning Package Overview

Purpose: This learning package provides the theoretical underpinning required before a nurse can safely manage hyperbilirubinaemia and the associated treatments for the neonatal patient.

Author: Justine Parsons – Nurse Educator – NICU JHCH

Peer reviewed by: Vivienne Whitehead - Neonatal Clinical Nurse Educator – NICU JHCH
Julie Gregory - Neonatal Clinical Nurse Educator – NICU JHCH

Date: September 2017

Date Due: September 2020

The package has been designed to be completed **electronically** and returned to your relevant nurse educator.

Contact details: *for further information on this learning package, please contact Justine Parsons (NICU Nurse Educator) on justine.parsons@hnehealth.nsw.gov.au*

Table of Contents **Page**

Introduction	6
Disclaimer	6
Aim	6
Objectives or Outcomes	6
Pre-requisites	7
Learning Package Outline	7
Problem based learning	7
How to use this resource or Instructions to participants	7-8
Legal issues / accountability	8
Recommended Readings / references	9
Activities	11-27
Reflection on the Learning Package	28
Evaluation of the Learning Package	29

Introduction

All babies develop elevated serum bilirubin (SBR) levels, to a greater or lesser degree, in the first week of life. However, only 65% of these present clinically, and of these 60% are full term and 80% are preterm (Lee et al, 2016). This is due to increased bilirubin production (accelerated red blood cell breakdown), decreased removal (transient liver enzyme insufficiency), and increased reabsorption of the bilirubin (enterohepatic circulation).

However, when a baby does become jaundiced, a common dilemma is deciding at what SBR level to intervene. The decision is influenced by whether the baby is term or preterm, well or sick, and the presence or absence of blood factors predisposing to hyperbilirubinaemia. For good background information, refer to the articles mentioned on the reference page.

For HNE LHD nurses outside of JHCH, discuss this education package with your educator.

Disclaimer

This learning package has been prepared by health professionals employed in Hunter New England Local Health District. While all care has been taken to ensure that the information is accurate at the time of development, the authors recommend that all information is thoroughly checked before use if utilised by another unit, context or organisation.

Aim

This package assists the learner to understand the broad pathophysiology associated with hyperbilirubinaemia, the treatment choices, risk factors and complications, as well as nursing care issues.

Learning Outcomes or Learning Objectives

Throughout the package there are readings and activities that you will need to complete. Readings can be accessed on-line through CIAP. When complete return the package to your educator who will review and discuss it with you.

Completion of this package will attract 2 Continuing Professional Development (CPD) points which are a requirement for national registration and a certificate can be issued to you for your portfolio.

At the completion of the program it is expected that the nurse will be able to:

- Describe the pathophysiology of hyperbilirubinaemia in the neonate;
- Understand risk factors for developing hyperbilirubinaemia;
- Describe treatment choices for hyperbilirubinaemia and discuss any complications;
- Understand responsibilities around the care of a jaundiced neonate.

Pre-requisites

In order to complete this education package the nurse must have met the following requirement:

- Currently working in a SCN or area where neonatal jaundice and the treatment of jaundice are part of practice
- Completion of the Neonatal Thermoregulation learning package

Learning Package Outline

The package is designed to be a self-directed learning experience that will guide you through the literature and clinical issues related to neonatal jaundice / hyperbilirubinaemia, as well as the care of those infants afflicted.

This package is developed within an adult learning framework so not all activities need to be documented but it is expected that you will complete them in order to facilitate your learning.

Issues that need to be considered when caring for the neonate with hyperbilirubinemia:

- Understanding of legal issues, accountability and professional responsibilities
- Health/safety and risk management
- Infection prevention & control standards
- Understanding of the bilirubin pathways in the neonate
- Equipment required for treating hyperbilirubinemia
- Technique and procedure for using treatment modalities
- Complications associated with hyperbilirubinemia and its treatment
- Relevant NICU procedures and guidelines

Problem based learning

This program is based on a problem-based approach to learning. This approach has been chosen to enhance critical thinking, and to create a body of knowledge that the RN can apply to practice. Problem based learning (PBL) is characterised by the use of patient specific problems or situations as a context for developing problem-solving skills and for acquiring clinical knowledge.

How to use this resource or Instructions for participants

- It is expected that this package will require approx. 2 hours to complete. If you experience difficulty, please discuss this with your educator.
- Completion of this package is equivalent to 2 Continuing Professional Development (CPD) hours which is a requirement for National Registration. Evidence of CPD can be generated using the ‘Reflection on Learning’ page at the end of the template.
- This package can be used as an introduction for nurses wishing to further their knowledge and skills in the area of neonatal jaundice / hyperbilirubinaemia.

- Throughout this learning package you are asked to complete questions or a problem based scenario related to the topic.
- There is a suggested reference list and it is by no means complete. Please read widely to facilitate your learning.
- This resource has been written from a Hunter New England Area Local Health District perspective so it is not specific to any one health facility. Throughout the package procedures from the John Hunter Hospital may have been mentioned as an example of practice only.
- Throughout this self-directed learning package there are readings and activities that you will need to complete. You can access the readings online (journal articles) through CIAP. The online readings are not provided within this document due to copyright law restrictions. You will be provided with information on how to access the online readings. If you have any difficulty locating the readings please seek assistance from your hospital / health facility library.

Understanding of legal issues, accountability and professional responsibilities of practice

This is important when undertaking all care tasks in your role as a nurse. Of all health professionals, nurses spend the majority of time with each newborn infant and therefore play a significant role in protecting newborns from harm associated with hyperbilirubinaemia.

The Canadian Medical Protective Association performed an audit of all medico-legal cases of kernicterus or severe hyperbilirubinaemia reported between 2000 – 2014 and identified 16 cases. 10 of those cases had severe or catastrophic injuries such as CP or hearing loss. The main themes in those cases included poor adherence to clinical guidelines such as:

- failure to consider patient risk factors, including prematurity, Rh incompatibility, ethnicity, and G6PD carrier status
- inadequate monitoring or follow-up of bilirubin levels, including inadequate discharge instructions for follow-up blood work
- delay in transfer of the patient to a tertiary care hospital for treatment or assessment by a specialist
- delay in treating the patient with phototherapy or an exchange transfusion
- early discharge of a premature infant

The article “Neonatology and the Law” by Fanaroff and Martin (2008) provides more insight into accountability and professional responsibility around hyperbilirubinaemia.

Health/safety and risk management

This is a responsibility for all staff and includes knowledge of procedures relating to:

- Use of personal protective equipment (PPE) for procedures
- IIMS reporting of errors or incidences

Infection prevention & control standards

You should become familiar with the HNELHD infection prevention and control standards that are available through HNELHD intranet site and PPG.

Recommended Readings

- Aiyappa,G. (2017) Cord blood albumin as a predictor of neonatal hyperbilirubinemia in healthy neonates. *International Journal of Contemporary Pediatrics* Vol 4 (2)
- Demirel G, Akar M, Celik IH, Erdeve OH, Uras N, Oguz SS. (2011) Single versus multiple dose intravenous immunoglobulin in combination with LED phototherapy in the treatment of ABO hemolytic disease in neonates. *Int J Hematol*.
- Elalfy MS, Elbarbary NS, Abaza HW. (2011) Early intravenous immunoglobulin (two-dose regimen) in the management of severe Rh hemolytic disease of newborn-a prospective randomisd controlled trial. *Eur J Pediatr*. 170
- Fanaroff,J and Martin,G (2008) Neonatology and the Law. *NeoReviews.* Vol 9 (1)
- Fujiwara,R; Maruo,Y; Chen,S and Tukey,R. (2015) Role of extrahepatic UDP-glucuronosyltransferase 1A1: Advances in understanding breast milk-induced neonatal hyperbilirubinemia. *Toxicol Appl Pharmacol* Vol 289 (1)
- Hesaraki M. (2017) A comparison of serum and transcutaneous methods for diagnosis of neonatal hyperbilirubinemia. Int J Res Med Sci Vol 5
- Lee,B; Le Ray,I; Sun,J; Wikman,A; Reilly,M; Johansson,S. (2016) Haemolytic and nonhaemolytic neonatal jaundice have different risk factor profiles. *Acta Paediatrica* Vol 105(12)
- Lopriore E, Rath ME, Liley H, Smits-Wintjens VE (2013) Improving the management and outcome in haemolytic disease of the foetus and newborn. *Blood Transfus* 11(4)
- Nagar G, Vandermeer B, Campbell S, Kumar M. (2013) Reliability of transcutaneous bilirubin devices in preterm infants: a systematic review. *J Pediatrics*.
- Rosenthal,P (2014) Another explanation for breast milk jaundice. *J Pediatrics* Vol 165 (1)
- Smits-Wintjens VE, Rath ME, van Zwet EW, Oepkes D, Brand A, Walther FJ, Lopriore E (2013) Neonatal morbidity after exchange transfusion for red cell alloimmune hemolytic disease. *Neonatology* 103
- Queensland Health. (2012) Neonatal Jaundice : Queensland Clinical Guidelines
- Yu,C; Li,H; Zhang,Q; He,H; Chen,X; Hua,Z. (2017) Report about term infants with severe hyperbilirubinemia undergoing exchange transfusion in Southwestern China during an 11-year period, from 2001 to 2011. *PloS One* Vol 12 (6)

Activities or Problem based Scenario

The activities in the Learning Package should be addressed and assist the learner in achieving the identified learning outcomes for the Learning Package.

Reflection tool

At the completion of the Learning Package we have added a reflection form that will assist you in reflecting on the package and how it meets your professional development needs. This is kept in your Professional Portfolio.

Evaluation

We have also added a Learning Package Evaluation form for completion by staff members who complete the package.

Neonatal Jaundice – Hyperbilirubinemia

Jaundice is the yellow discolouration of the skin and sclera caused by the accumulation of bilirubin in the skin and mucous membranes. Most jaundice in newborns is physiologically normal and usually benign. However, if unconjugated serum bilirubin levels get too high, bilirubin can cross the blood brain barrier where it is neurotoxic, particularly to the auditory nerve and basal ganglia. Brain injury and lifelong disability can result.

Preterm infants are more likely than term infants to develop significant hyperbilirubinaemia, with one in every four late preterm infants requiring phototherapy treatment.

Hyperbilirubinemia is an excess of bilirubin in the blood. A jaundiced appearance results from excess bilirubin being deposited in the skin and mucous membranes.

Pathophysiology of bilirubin production

Production or Supply

• Aged, immature or malformed (senescent) red blood cells (RBC) are broken down and destroyed. This is a normal physiological process.

• Haemoglobin breaks down into heme, globin and iron.

• Heme is converted to unconjugated bilirubin.

• One gram of haemoglobin produces approx 35mg of unconjugated bilirubin.

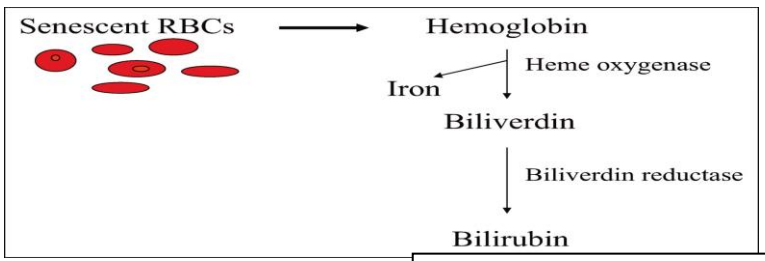


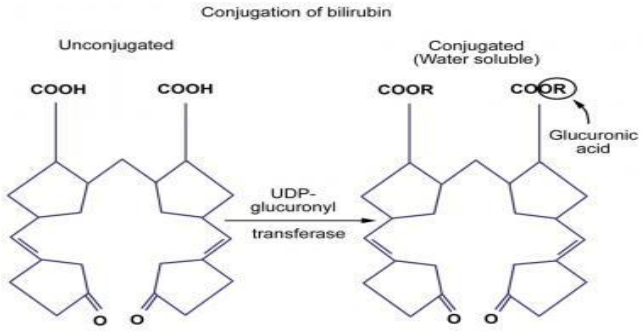
Image from AAP News & Journals Gateway

Transport

• The unconjugated bilirubin is then bound to albumin for transport to the liver for conjugation.

Conjugation

• Conjugation is a process taking place in the liver. Each molecule of bilirubin is conjugated with 2 molecules of glucuronic acid, converting the bilirubin from a fat-soluble product to a water-soluble product. To do this, the liver requires O2 + glucose.



Excretion

• The water-soluble bilirubin is then transported to small intestine and is excreted.

Bilirubin Metabolism Pathway

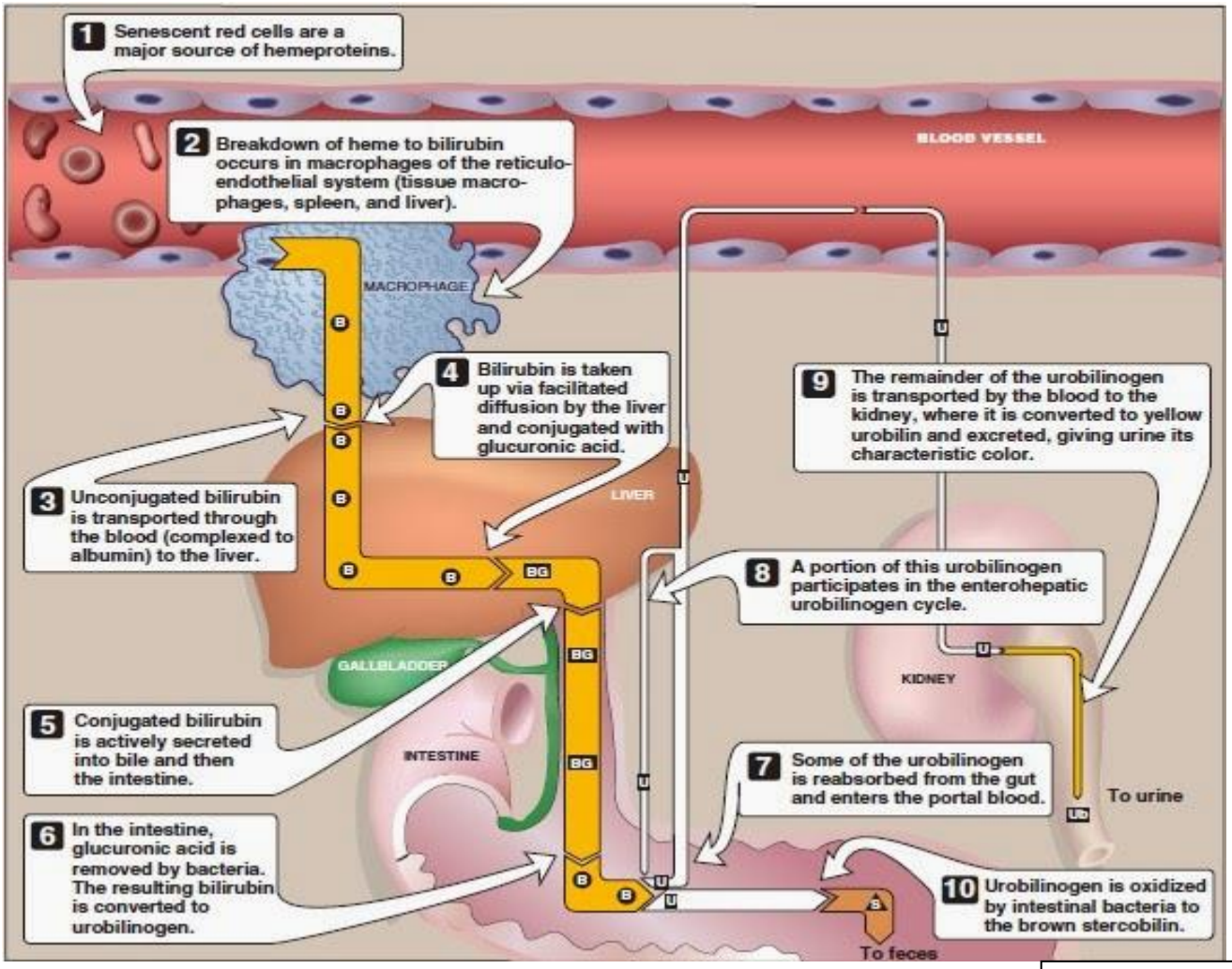


Image from PicQuery

Types of Hyperbilirubinemia

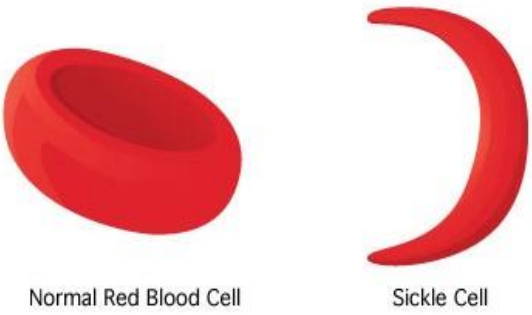
Physiological Jaundice

This is a normal process for all newborns. Neonates have a large number of foetal RBC's which are used for improved oxygenation throughout labour and the birthing process. These are no longer required once the neonate is breathing, and are therefore broken down rapidly. The haem load reaching the liver from the breakdown of RBC is transiently greater than the liver's capacity to conjugate it.

Pathological Jaundice

Pathological jaundice is anything that interferes with the normal pathway of bilirubin production, transport, conjugation and excretion. For example –

Haemolytic jaundice (congenital spherocytosis)

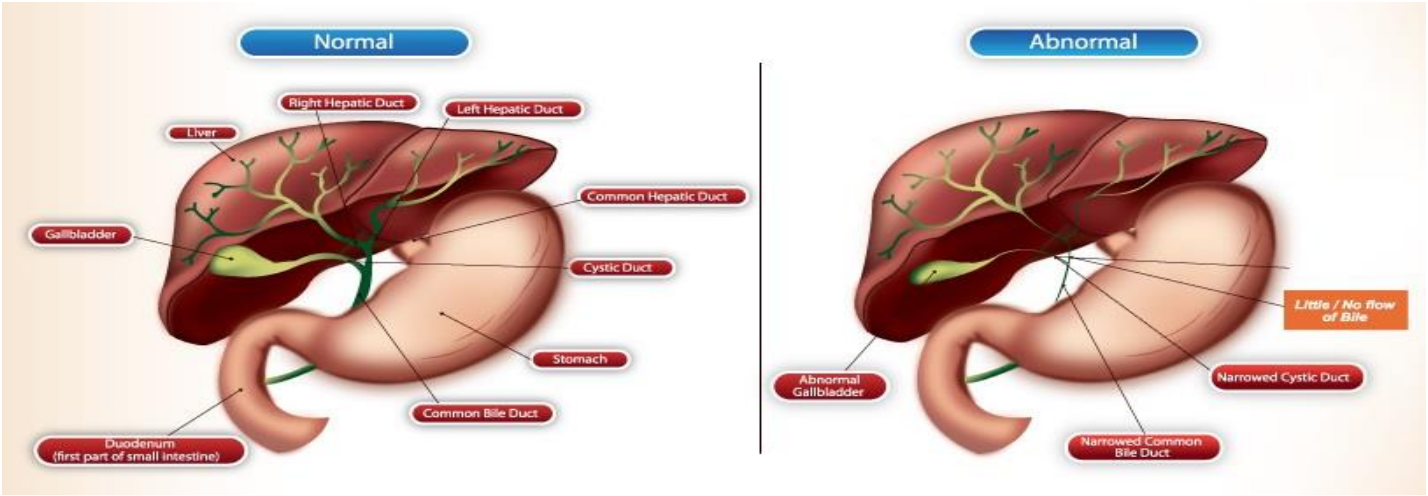


- Maternal-foetal blood group incompatibility (rhesus, ABO, etc).
- Extravascular haemolysis – reabsorption of haematoma and petechiae.
- Congenital disorders of the red cell – sickle cell anaemia, haemoglobinopathies, G6PD deficiency, pyruvate kinase deficiency.

Infection

- Bacterial (generally Gram negative – E. coli, Klebsiella, Pseudomonas)
- Viral – hepatitis, herpes, cytomegalovirus, rubella, other virus infections
- Other infections – toxoplasmosis, syphilis

Obstructive jaundice



- Congenital atresia of the bile ducts (biliary atresia)
- Choledochal cyst
- Inspissated bile or cholestasis syndrome
- Cystic fibrosis

Competition for albumin binding sites

- Drugs – sulphonamides (Frusemide), cephalosporins (Cefotaxime), Vit K, Indomethacin
- Free fatty acids produced by starvation or cold stress will compete for binding sites, as will intravenously administered lipids
- Oxytocin (sometimes used during labour)

Other causes of neonatal jaundice

- Asphyxia
- Acidosis (displaces bilirubin from albumin)
- Hypothermia
- Hypoglycaemia
- Galactosaemia
- Breast milk jaundice
- Polycythaemia
- Hereditary hepatic enzyme deficiencies
- Oxytocin in labour

Incidence and risk factors

Virtually all babies have a transient rise in SBR, but only about 50% are visibly jaundiced. This varies with race, those of Asian background having a higher incidence.

It is clinically useful to classify jaundice according to the age of the baby when he/she becomes visibly jaundiced.

Day	**Unconjugated Jaundice**	**Conjugated Jaundice**
1 (rare)	Haemolytic disease assumed until proven otherwise : Rhesus disease ABO incompatibility	Neonatal hepatitis Rubella CMV Syphilis
2-5	Physiological Sepsis Haemolysis G6PD Polycythaemia	Neonatal hepatitis CMV Rubella Syphilis
5-10	Sepsis Drugs Breastmilk jaundice Galactosaemia Hypothyroidism	Neonatal hepatitis CMV Rubella Syphilis
10+	Sepsis UTI	Biliary atresia Neonatal hepatitis Pyloric stenosis

Maternal Risk Factors

- Diabetes – babies have increased production of bilirubin, are larger and may have more birth trauma and bruising
- Hypertension
- Retained products – decreased lactation
- Birth trauma – separation from infant - delayed feeding
- Ineffective breast feeding - dehydration

Newborn with bruising to face immediately following birth.

Infant Risk Factors

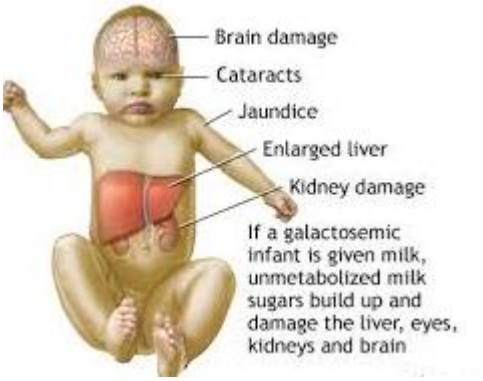
- Ineffective feeding
- Delayed passage of meconium
- Congenital abnormality ie: cleft palate, Trisomy 21 (ineffective feeders)
- Oral motor difficulties (HIE)
- Prematurity

Galactosaemia

Galactosaemia is an autosomal recessive disorder characterized by increased jaundice in infants fed breast milk or formula containing lactose. It is due to the inability of the body to convert galactose to glucose which results in an accumulation of galactose phosphate in the liver which is hepatotoxic. The predominant carbohydrate in human milk is lactose, a composition of glucose and galactose.

Galactose provides 50% of the calories derived from lactose making its major metabolic role one of energy storage. Symptoms are hyperbilirubinemia, cholestasis, vomiting, and failure to thrive and usually appear in the second half of the first week of life (after feeding has been introduced).

Galactosaemia is detected via the NBST (newborn screening test) however; the presence in the urine of non-glucose reducing substances suggests galactosaemia. A lactose free diet is required.



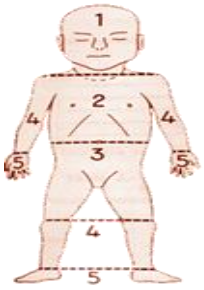
Activity 1

A 3.11-kg male infant was delivered to a 32-year-old Caucasian woman with an essentially uncomplicated pregnancy until the spontaneous onset of labor and rupture of membranes at 36 weeks gestation. Maternal blood type was O negative. Delivery was uneventful with smooth perinatal transition, and the newborn appeared normal in all respects. Mother and baby were discharged home on day 2 of life, with the infant breastfeeding. Can you identify any risk factors for developing hyperbilirubinaemia?

Investigations

Kramer's Rule

Rather than estimating the level of jaundice by observing the baby's skin colour, one can utilise the cephalocaudal progression of jaundice. Kramer in 1969 drew attention to the observation that jaundice starts on the head, and extends towards the feet as the level rises. This is useful in deciding whether or not a baby needs to have the SBR measured. Kramer divided the infant into 5 zones; the SBR range associated with progression to the zones is as follows:



Zone	1	2	3	4	5
SBR (umol/L)	100	150	200	250	>250

Transcutaneous Bilirubinometer (TcB)

The TcB is a non-invasive handheld device designed to measure the yellow pigments including bilirubin in the skin. Results from two Australian studies found that TcB's reduce the number of painful heel stabs to collect samples without adverse outcomes to the newborn.

The device transmits light into the skin when directed over the sternum or the forehead and analyses the reflected light by spectral subtraction to obtain the bilirubin concentration. Similar devices as those currently in use across the HNE LHD have proven ability to provide a reliable measure that is comparable to the SBR within a range difference of 34-50µmmol when the total SBR is ≤ 260µmmol.

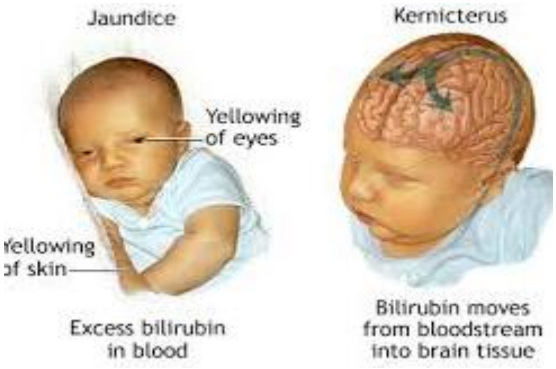
Although the SBR remains the gold standard for jaundice screening in most hospitals, the TcB can identify infants who may not need a formal SBR and may avoid delays in discharge. It is important to remember that a TcB level is inaccurate on babies who have already been treated with phototherapy.

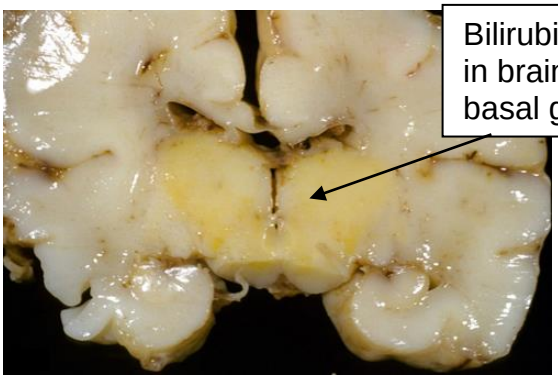
Drager ™
Jaundice Meter

Total SBR

Although an indirect measure of risk, the total SBR continues to be the "gold standard" for deciding if a baby's jaundice requires intervention. Unfortunately, it is not known what SBR level is safe for any given baby.

In the case of preterm infants, greater caution should be exercised. Again, no safe level has ever been determined, and it is clear from post-mortem evidence that these babies are at risk of kernicterus at lower SBR levels.





Images from Neuropathology.web.org

Other investigations

These are guided by day of onset and clinical features -

Early onset (day 1-2) “Too early”

- Group & Direct Coombs test - exclude haemolytic jaundice (Rhesus disease, ABO incompatibility
- Full blood count & film - may reveal spherocytes c/w haemolysis

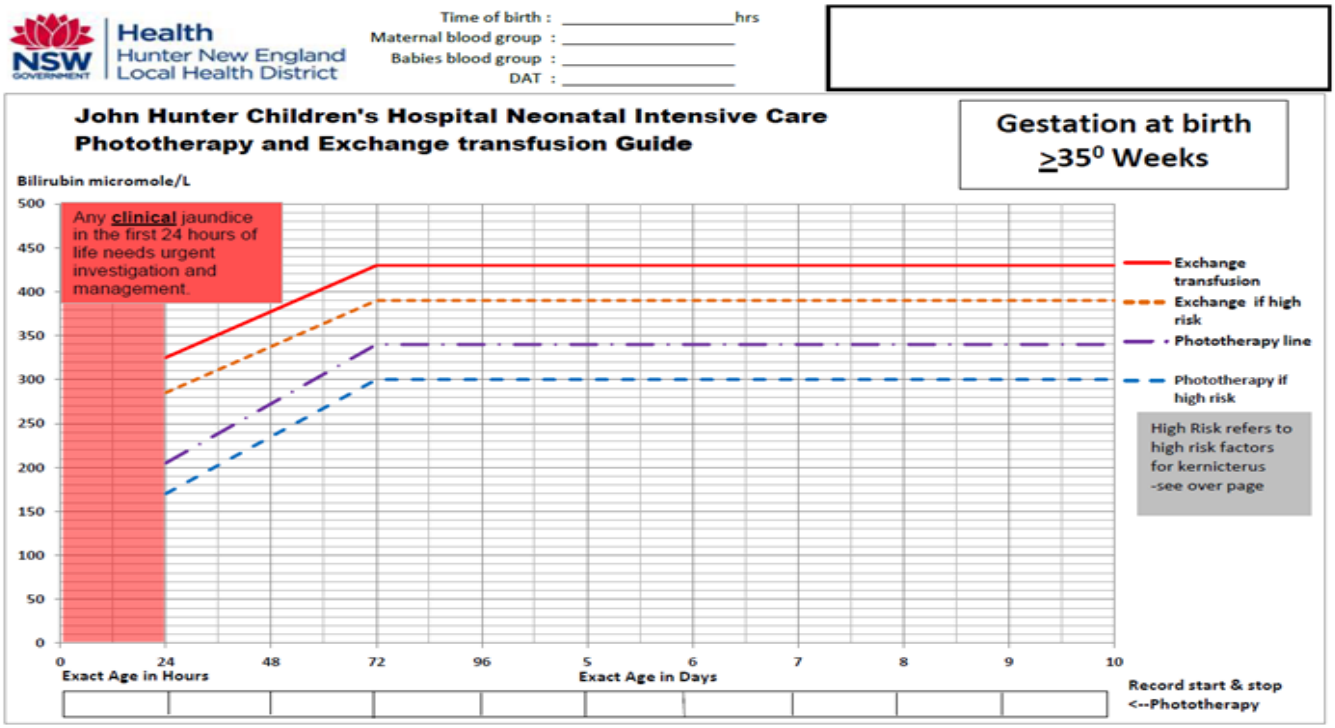
Normal onset (day 3-8) “Too high”

- G6PD screen (consider if male and appropriate ethnic group)
- sepsis screen if indicated
- galactosaemia - check newborn screening test, beware of coexisting gram-negative sepsis
- full blood count & film - may reveal spherocytes or septic changes

Late onset (2-4 weeks) “Too late”

- conjugated SBR - if elevated suspect liver disease
- Full blood count & film - may reveal septic changes
- Thyroid function tests: high TSH & low T4 - suspect hypothyroidism; low TSH & low T4 - suspect hypopituitarism

Most facilities have in-house charts which define levels for initiating phototherapy or exchange transfusion, according to gestation and/or aetiology. No single chart is widely accepted as "correct", and wide variations in practice are evident. Below there is an example of the John Hunter Children's Hospital NICU Phototherapy Guideline chart for >35 weeks gestation.



***"Need to Treat"* guides**

Prediction of likelihood of requiring treatment may be assisted by the following:

Likelihood calculators

- Bilitool - an online tool to assess the risk of developing hyperbilirubinaemia (American Academy of Paediatrics)
- Biliapp (based on NICE guidelines). Available for download from the App store or Google play.

Established nomograms

- Threshold graphs for babies with neonatal jaundice (pages 14-29) (health.vic.gov.au)

Cord blood albumin levels

- There is emerging evidence that collecting cord albumin levels can help identify those infants at greater risk of developing hyperbilirubinaemia. Values of <2.8 mg/dl are more associated with clinical jaundice. (Aiyappa, 2017)

Activity 2

You are caring for a 36 week infant, who was born at 9am on January 14th. The baby presents for an SBR for suspected hyperbilirubinaemia, which has been collected by the registrar at 11am on January 16th. You check the baby's results and find the SBR to be 320. What are your actions? Is there anything else you need to know?

Treatment

If an underlying pathological cause was identified in the investigations, then this should be attended to appropriately. In any jaundiced infant, 2 questions need to be asked –

1. Is the hyperbilirubinemia likely to cause neurological damage?
2. Is the bilirubin conjugated?

Managing hyperbilirubinemia could include the following:

Phototherapy

First used by Cremer in 1958 in the UK, phototherapy is now widely used. The phototherapy lights emit light with a wavelength of about 450 nanometers which is most effective for photo degradation. The light changes the fat soluble bilirubin molecule into a water-soluble molecule via a process called "photoisomerisation". Phototherapy has been shown in large multicentre RCT's to be a safe and effective method for lowering the SBR level.

Phototherapy may be used via a Biliblanket™ or by using a set of portable or fixed lights. When using phototherapy lights, it is useful to measure the amount of light energy being emitted. This can be done using a light metre that detects the light and provides a digital readout.

Example of light metre used to measure output from phototherapy lights

Side effects of Phototherapy

Side Effect	Considerations
Insensible water loss	• Changes in the baby's thermal environment leads to increased peripheral blood flow and insensible water loss • More common with conventional rather than LED phototherapy
Intestinal hypermotility	• Associated with distended abdomen, loose stools and diarrhoea
Photosensitivity	• Congenital porphyria or a family history of porphyria is a contraindication to the use of phototherapy. Babies with congenital erythropoietic porphyria can develop severe blistering and photosensitivity during phototherapy • Concomitant use of photosensitising drugs or agents is a contraindication to phototherapy
Bronze baby syndrome	• Babies with cholestatic jaundice may development bronze baby syndrome and, rarely, purpura and bullous eruptions
Parental and carer anxiety	• Potential separation may cause interference in mother baby interaction • Some parents find eye patching disturbing

(Queensland Health 2012)

Ceasing Phototherapy

Phototherapy is generally stopped when the SBR is more than 50 below the phototherapy line in use.

A rebound in total serum bilirubin levels can occur after phototherapy is discontinued. Babies at increased risk of clinically significant rebound are those:

- born at less than 37 weeks gestation
- with haemolytic disease

Intravenous Immunoglobulin (IVIG)

IVIG combined with phototherapy, compared with phototherapy alone, has been shown in many randomised, controlled trials to significantly reduce the maximum serum bilirubin and the need for exchange transfusion in babies with isoimmune haemolytic jaundice. However, exact dosage for maximum effect is a controversial topic – 0.5g/kg vs 1 g/kg, as is the number of required doses. (Elalfy et al, 2011 and Demirel et al, 2011)

Exchange transfusion

This procedure removes bilirubin, removes haemolytic antibodies, and corrects anaemia. It is very uncommon to need to exchange without there being rhesus disease, ABO incompatibility or G6PD. Exchange transfusion is an emergency intervention for extreme neonatal hyperbilirubinemia. This therapy has been implemented for many years throughout the world, and its timeliness and efficacy in reducing bilirubin load and preventing encephalopathy have been widely acknowledged. (Yu et al, 2017) Extremely preterm infants occasionally need an urgent exchange when their level becomes dangerously high, bearing in mind that "safe" levels are undefined for such babies. However, extremely premature babies are generally very responsive to phototherapy, and so exchange transfusion is usually avoided.

Side effects of Exchange Transfusion

Side effects
• Thrombocytopenia • Hypocalcaemia • Catheter malfunction • Hypotension • Venous thrombosis • Hypokalaemia • Hypoglycaemia • Vasospasm • Apnoea • Bradycardia • Cyanosis • Necrotising enterocolitis

SBR levels at which Exchange Transfusion may be considered

Gestational age in weeks	SBR level
<27	250 mmol/L
28-32	300 mmol/L
33-37	380 mmol/L
>37	450 mmol/L

ALERT!

Increased acidosis increases risk of bilirubin deposition in the brain. If blood gases indicate increasing acidosis, then ventilation and bicarbonate treatment are advised. If the bilirubin is very high, acute encephalopathy is likely, and hypoventilation is commonly present.

Activity 3

You are caring for a term baby, Jasmine, now 3 days old, who has just been brought from the post-natal ward for phototherapy. What do you tell Jasmine's mother about the treatment, and how will you continue to provide family-centered care?

Breast Milk Jaundice

This occurs infrequently (approx. 1 in 200 babies), peaks in the 2nd or 3rd week, and may persist at moderately high levels for 3-4 weeks before declining slowly. It usually appears in an otherwise healthy infant with good weight gain and effective breast feeding technique. It is a diagnosis of exclusion. In an otherwise well infant, it is considered a benign condition. If feeding with breast milk is stopped, the serum bilirubin usually falls, however this would very rarely be indicated. The potential harms of stopping breast feeding would outweigh any risks of a mild or moderate hyperbilirubinemia. The aetiology is unknown, but there is some support for both a hormonal factor in the milk acting on the infant's hepatic metabolism, and an enzyme (lipase) facilitating intestinal absorption of bilirubin. (Fujiwara et al, 2015)

Breast feeding jaundice

Usually presents at 48-72 hours in approx. 1 in 10 babies with a history of ineffective breast feeding and/or delayed passage of meconium (and therefore poor excretion of bilirubin). It can be life threatening due to the sometimes significant dehydration. The management of breast feeding jaundice is initially a quick appraisal and medical referral, initiate stimulation of breast milk supply and establish effective feeding technique. Supplement feed if needed. Continue to monitor SBR and provide phototherapy if levels indicate.

Complications of Hyperbilirubinemia

- Kernicterus (bilirubin encephalopathy). This clinical syndrome includes hypertonia progressing to seizures, and may lead to death (50% of all affected infants). At autopsy, such babies display evidence of bilirubin staining of the basal ganglia. The disease was thought to have disappeared, but is being reported increasingly in first world countries. This resurgence may be due to an increased trend towards early discharge from hospital, and ineffective follow-up.

www.accesspediatrics.com

- Late sequelae to kernicterus. Survivors of kernicterus often demonstrate cerebral palsy, sensorineural hearing impairment, mental retardation, and paralysis of upward gaze (Parinauds sign).

www.opsweb.org

- High-tone frequency hearing loss. The commonest feature of hyperbilirubinaemia, most often seen in premature infants.

ALERT!
The levels at which unconjugated bilirubin causes brain damage are not known. By the time the symptoms of kernicterus appear, brain damage has probably already occurred.

Activity 4

When you have finished the recommended readings, please complete the following questions:

1. **What is bilirubin?**

2. **How does bilirubin travel around the body?**

3. **Which fluids or medications might interfere with moving bilirubin around the body?**

4. **What is meant by conjugation?**

5. **At what SBR level does kernicterus start to occur?**

6. **What are some of the side effects of phototherapy and what nursing strategies can minimise the effects?**

7. **What kind of discharge follow-up should be provided to a baby who has been treated for very high SBR levels while in NICU?**

Learning Package: Reflection on Learning

This document guides your reflection on the extent to which the package meets your professional development needs, and how you plan to apply your learning into practice. This tool is not part of the assessment process, and has been included as a document that you may wish to include in your professional portfolio. Time taken to complete learning package: _____

What was your purpose in completing this learning package?

_____

_____

_____

_____

Did you achieve this by completing the learning package?

_____

_____

_____

_____

Reflecting on the content, what key learning have you obtained?

_____

_____

_____

What learning will you apply to your practice immediately? How will you do this?

_____

_____

_____

_____

What learning needs have you identified as a result of completing this learning package?

_____

_____

_____

How do you plan to address these needs?

_____

_____

Signature:_____Date:_____

Learning Package Evaluation Form

Your feedback regarding this learning package is important to ensure the package meets your learning needs. Please take 5 minutes to answer the following questions to facilitate any change required for future learning packages.

1. The learning outcomes of the learning package were clearly identified	Yes	No
2. The learning outcomes of the package were appropriate		
3. The content provided enabled me to meet the learning outcomes?	Yes	No
4.The activities motivated my interest in the topic	Yes	No
5.The activities and workbook questions supported my understanding of the topic		
6.The package was presented in a logical manner	Yes	No
7.The assessment process related to this package was clearly outlined (if applicable)	Yes	No

8. My most relevant learning outcomes from this package were:

_____
_____

9. The key learning points from this package I can immediately apply to practice include::

_____
_____

10. The least relevant component(s) of this package were:

_____

_____

11 Some suggestions I would like made to improve the package would be:

_____
_____

12. Further comments:

_____
_____

Thank you for your time.

Return to:

Justine Parsons

Nurse Educator, NICU, JHCH

justine.parsons@hnehealth.nsw.gov.au