

Phototherapy – Management in Newborn Intensive care Unit (NICU)

Procedure Responsibilities and Authorisation

Department Responsible for Procedure	NICU
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Target Audience	NICU staff, LMCs
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Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
5	Jayne Bennett	Jan 2013	3 yearly review
6	Joyce Mok	Mar 2016	3 yearly review
7	Jenni Richards	Mar 2019	3 yearly review
8	Luci Gravatt	Aug 2020	New phototherapy equipment/Update/Combine/Remove Phototherapy in NICU (2615)

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1 Overview

1.1 Purpose

To outline the management for babies on phototherapy.

1.2 Scope

Waikato District Health Board (DHB) staff working in NICU.

1.3 Patient / client group

Babies and infants in NICU.

1.4 Definitions

BiliCocoon™ Bag	The BiliCocoon™ bag provides soft and flexible phototherapy pads that increases coverage by enclosing the baby between them.
BiliCocoon™ Nest	The BiliCocoon™ nest provides a soft and flexible phototherapy pad that is compatible with radiant warmers, incubators and skin to skin cuddles. It provides a large surface area with posterior and increased lateral coverage
BiliLux™	The BiliLux™ is a compact and lightweight unit with irradiance that can be dimmed in 5 steps to provide individualised therapy for the patient. It can be placed on the incubator hood or mounted with the spring arm to the incubator or radiant warmer.
Bilirubin	The orange-yellow pigment of bile, formed principally by the breakdown of haemoglobin in red blood cells at the end of their normal life-span. Neonate's bilirubin production rate is double that of adults and their clearance of bilirubin is reduced, hence the importance of monitoring levels and detecting jaundice in this early post-natal period.
BiliSoft™	The BiliSoft™ 2.0 Phototherapy System is an LED fiber-optic pad that can be used with a radiant warmer, incubator, bassinet, or while in a caregiver's arms. Its increased surface area, high spectral irradiance, and long lasting blue narrow-band LED light are the features that are needed for intensive, efficacious phototherapy. It supports and promotes developmental care and enables infant-parent bonding.
CNS	Clinical Nurse Specialist
Irradiance	The radiant flux (power) received by a surface per unit area
LMCs	Lead Maternity Carers
Neonatal Jaundice	Jaundice is a common condition in newborn babies and is usually mild and physiological, however it can also be a sign of underlying disease Jaundice that is early in onset (first 24 hours), rises rapidly, late in onset (>7 days) or prolonged (>14 days) falls outside the definition of physiological jaundice and needs careful evaluation Bilirubin is a neurotoxin and high levels can cause irreversible brain damage (bilirubin encephalopathy or kernicterus).

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NICU staff	NICU staff includes nurses, doctors, CNS and NNPs in NICU
NNP	Neonatal Nurse Practitioner
Pathological Jaundice	Jaundice within the first 24 hours after birth, or jaundice that rises rapidly, or bilirubin levels that are abnormally high Risk factors include late preterm babies (35-38 weeks), exclusive breastfeeding, history of sibling requiring phototherapy for jaundice, birth trauma (bruising, cephalohaematoma) Other common causes include Rhesus or ABO incompatibility, other red blood cell (RBC) antibodies, sepsis, G6PD deficiency
Phototherapy	Phototherapy uses light energy absorb through the skin to change the shape and structure of bilirubin, converting it to non-toxic photoisomers which are water soluble and can be excreted in the bile via the intestine, and to a limited degree through urine without conjugation. Blue light waves 425-475nm from the florescent light absorbed by skin and blood converts unconjugated bilirubin to conjugated bilirubin, therefore can be eliminated by the body via bile through the intestine, e.g. in stool, and the kidneys, e.g. in urine.
Physiological Jaundice	Onset day 2-5 after birth in an otherwise well baby Affects about 60% of term and 80% of preterm babies in the first few days after birth Even physiological jaundice can reach levels requiring phototherapy
Radiometer	An instrument for detecting or measuring the intensity of radiation
SBR	Serum bilirubin reports the unconjugated and conjugated bilirubin levels.

2 Clinical Management

2.1 Roles and Responsibilities

All Staff

Appropriate use of phototherapy equipment.

Clinicians

Correct charting of irradiance requirement

2.2 Competency required

- Registered Nurse who has completed Level 2 orientation.
- Enrolled Nurse who has completed Level 2 orientation and is working under the direction and delegation of a Registered Nurse.

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2.3 Equipment

- Incubator, radiant warmer or bassinette
- Phototherapy light (BiliSoft™ or BiliCocoon™ nest or bag with cover, and/or BiliLux™)
- Radiometer
- Eye shield
- Thermometer
- Individualised Treatment Threshold Graph for Babies with Neonatal Jaundice

Note:

1. More than one phototherapy light may be required, depending on SBR level; for more skin exposed from multiple sides
2. **Radiant warmer caution:** Position the BiliLux™ at an angle and not directly under the heater to prevent fire and burning of the phototherapy unit.

2.4 Procedure

1. Preparations

- Explain procedure to parents and give pamphlet “Newborn unit Jaundice”.
- Ensure blood has been taken for:
 - Blood group
 - Direct Coombs’ test to check for ABO incompatibility and Rhesus disease
 - Complete Blood Count (CBC)
 - Formal SBR to obtain bilirubin level to determine appropriateness of treatment. (Gas SBR may show higher levels.)
- Undress the baby - Baby may have nappy on as it does not prolong physiological jaundice and may aid self-regulated infant behaviour in the short term. Use the smallest nappy to cover infant, only up to the groin area or leave nappy open.
- Commence phototherapy as prescribed by the medical staff /CNS/NNP on the General Treatment Sheet (T1481HWF)

2. Recommended initial phototherapy prescriptions

- If SBR is in the exchange transfusion zone use a Bilisoft™ (for infants >1500g) and 100% BiliLux™ (positioned 30cm above the infant). If infant is polycythemic, check SBR on laboratory sample. Recheck SBR at 2-4 hours and adjust prescription as required.
- Do not remove from phototherapy for feeding until SBR is out of exchange transfusion range (use nasogastric feeds and /or intravenous fluids to maintain hydration)

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- If SBR is close to the top of the phototherapy line, use 100% BiliLux™ at 30cm and repeat SBR in 4 hours and adjust prescription as required.
- If SBR is close to bottom phototherapy line, start either 60% BiliLux™ at 30cm or a BiliCocoon™ and repeat SBR in 4-6 hours and adjust prescription as required.
- For infants with low/stable SBR rooming in, use a BiliCocoon™ and recheck SBR in about 12hours

3. Using BiliLux™ phototherapy

- Cover the infant's eyes with eye shield for comfort and protection to prevent retinal damage.
- BiliLux™ phototherapy light can be placed directly onto the top of the incubator or attached to the spring arm for use with a cot or radiant warmer.
- NOTE: Ensure the BiliLux™ is not directly under the radiant warmer
- Secure unit or position on top of incubator before plugging cord into light.
- Turn phototherapy unit on using switch at the rear.
- Press the start key to commence or pause the phototherapy.
- Adjust the irradiance setting using the two lightbulb keys to increase or decrease in 20% increments according to the prescription.
- Check correct irradiance with radiometer. Plug radiometer into rear of BiliLux™, select the radiometer screen, position the sensor next to the skin (without touching the infant), press store button on radiometer or screen. This should be done 24 hourly or 8 hourly if at exchange level.
- Ensure the distance between the light and the baby is 30cm minimum.
- Ensure the light shines on infant's head and body to ensure maximum exposure to phototherapy.
- Check infant's temperature one hour after commencement of phototherapy, and thereafter 3-4 hourly. LED phototherapy should not cause a change in the baby's temperature, however increasing exposed surface area can cause the temperature to drop.
- Turn infant 3-4-hourly during cares and assess pressure areas.
- Turn off phototherapy and remove eye shield to perform eye care 3-4 hourly. Provide infant with visual stimulation and interaction with parents, and check for eye infection and irritation.
- Do not use baby oil, creams or lotions to avoid possibility of burns to the skin.

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4. Using BiliSoft™ phototherapy

- BiliSoft™ can be used for infants over 1500g and delivers 35nm of irradiance. It can be used in a cot, incubator or radiant warmer.
- Place the light box on a stable surface where it will not be knocked over or fall off.
- Cover the pad with the correct disposable nest or pad cover, ensuring the illuminated side is facing up.
- Settle the infant in the nest or pad using the ties as needed, with the fibre-optic cord at the foot end.
- Swaddling can be used around the outside so long as the infant remains in contact with the surface of the pad. Additional nesting can be used for a bigger boundary and to increase exposure by curving the pad around the sides of the infant.
- Cover the infant's eyes with eye shield for comfort and protection to prevent retinal damage.
- If in a cot: Place a sheet or quilt on top of infant to provide warmth.
- Plug the light pad into the light box, then plug in the power cord.
- Turn on using the switch on the front of the light box.
- Check infant's temperature one hour after commencement of phototherapy, and thereafter 3-4 hourly.
- Turn infant 3-4-hourly during cares and assess pressure areas.
- Remove eye shield and perform eye care 3-4 hourly to provide infant with visual stimulation and interaction with parents, and to check for infection and irritation.

5. Using BiliCocoon™ nest phototherapy

- BiliCocoon™ nest can be used for preterm infants >1000g and delivers 35nm of irradiance. It can be used in a cot, incubator or radiant warmer.
- Place the light box on a stable surface where it will not be knocked over or fall off. Use the fixation system if possible.
- Cover the pad with the correct disposable pad cover, ensuring the illuminated side is facing up.
- Settle the infant on the pad, using the strap as needed, with the fibre-optic cable at the foot end.
- Swaddling can be used around the outside so long as the infant remains in contact with the surface of the pad. Additional nesting can be used for a bigger boundary and to increase exposure by curving the pad up around the sides of the infant.
- Cover the infant's eyes with eye shield for comfort and protection to prevent retinal damage.
- If in a cot: Place a sheet or quilt on top of infant to provide warmth.
- Carefully plug the light pad into the light box, then plug in the power cord.

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- Turn on using the switch on the front of the light box, and increase the timer to 24 hours.
- Check infant's temperature one hour after commencement of phototherapy, and thereafter 3-4 hourly.
- Turn infant 3-4-hourly during cares to allow for all areas of skin to be exposed.
- Remove eye shield and perform eye care 3-4 hourly to provide infant with visual stimulation and interaction with parents, and to check for infection and irritation.
- NOTE:
 - The Light boxes and Light pads are calibrated to be paired and cannot be mixed up.
 - The unit will turn off at the end of the allocated time and may need to be turned on again to continue therapy.

6. Using BiliCocoon™ bag phototherapy

- BiliCocoon™ bag can be used for preterm infants >1500g and delivers 35nm of irradiance. It can only be used in a cot
- Place the light box on a stable surface where it will not be knocked over or fall off. Use the fixation system if possible.
- Cover the pads with the correct disposable pad covers, ensuring the illuminated side is facing in.
- Settle the infant between the pads, using the straps at the shoulders and sides to secure, with the fibre-optic cable at the foot end.
- Cover the infant's eyes with eye shield for comfort and protection to prevent retinal damage.
- Place a sheet or quilt on top of infant to provide warmth.
- Carefully plug the light pad into the light box, then plug in the power cord.
- Turn on using the switch on the front of the light box, and increase the timer to 24 hours
- Check infant's temperature one hour after commencement of phototherapy, and thereafter 3-4 hourly.
- Turn infant 3-4-hourly during cares to allow for all areas of skin to be exposed.
- Remove eye shield and perform eye care 3-4 hourly to provide infant with visual stimulation and interaction with parents, and to check for infection and irritation.
- NOTE:
 - The Light boxes and Light pads are calibrated to be paired and cannot be mixed up.
 - The unit will turn off at the end of the allocated time and may need to be turned on again to continue therapy.

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7. Multiple phototherapy

- When multiple phototherapy is indicated to reduce bilirubin levels which are approaching exchange level, nurse baby on the BiliSoft™ or BiliCocoon™ nest, which can be placed on cot, radiant warmer, or incubator as well as the BiliLux™ light overhead.
- If using the BiliLux™ light for a baby on a radiant warmer, the phototherapy lights must be placed away from the heater to prevent fire hazard.
- A large or term baby may benefit from a BiliLux™ light directed from each side to ensure greater coverage of lateral sides
- Use a nest boundary around the baby to facilitate a flexed and secure position.

8. Monitoring of infant

- Baby on BiliLux™ light: ensure distance between light and the baby is about 30m to avoid burning the infant and to provide appropriate irradiance.
- Document phototherapy setting on observation chart
- Monitor baby's temperature 3-4 hourly to ensure the infant's axilla temperature is within 36.7 – 37.2°C.
- Monitor and record respiratory rate and heart rate 3-4 hourly.
- Monitor fluid balance: record all intake and output and weigh all nappies as required. Phototherapy increases insensible fluid loss.
- Ensure adequate fluid intake to prevent dehydration.
- Weigh baby on alternate days or daily as indicated.
- Maintain skin cleanliness to prevent skin breakdown because increased bile flow during phototherapy appears to stimulate gastrointestinal tract resulting in increased loose stools.
- Monitor blood sugar levels as directed: hypoglycaemia can be caused by liver disease, e.g. galatosaemia
- Take blood for serum bilirubin daily or more frequently as required.
- **Phototherapy light must be turned off when drawing blood samples.**
- Record and monitor baby's blood results on infant's flow sheet and individualised Treatment Threshold Graph for Babies with Neonatal Jaundice.
- Increase or decrease phototherapy light, depending on infant's bilirubin level and clinical condition as prescribed by medical staff/NNP/CNS.
- Check SBR 24 hours after phototherapy is discontinued to assess for rebound.

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9. Feeding

- Time out from phototherapy depends on the severity of jaundice: Breast or bottle feeds should not exceed 20 minutes at a time for infants under multiple phototherapy therapy and the infant should be placed in a BiliCocon™.

2.5 Potential complications

- Water loss from increased peripheral blood flow and diarrhoea (if present)
- Overheating
- Diarrhoea from intestinal hyper motility
- Interference with maternal-infant interaction
- Disorder of circadian rhythms
- Ileus (preterm infants)
- Rash
- Retinal damage
- 'Bronzing' of neonates with conjugated hyperbilirubinaemia
- Temporary lactose intolerance

2.6 After care

- When phototherapy is discontinued, allow the unit to cool before cleaning the equipment.
- Return to the store room ready for use.
- Discard BiliSoft™ or BiliCocon™ covers

3 Patient information

- Pamphlet called "Newborn Unit Jaundice".

4 Audit

4.1 Indicators

- All babies have preparatory investigations as per 2.4.1
- All babies have physiological tests and investigations at designated intervals as per 2.4.3 / 2.4.8
- Parents/caregivers are given a Newborn Unit Jaundice pamphlet.

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5 Evidence base

5.1 Bibliography

- BiliCocoon™ [user manual](#)
- BiliLux™ user manual <https://www.draeger.com/Products/Content/bililux-sw-1n-ifu-mu26125-en.pdf>
- BiliSoft™ [user manual](#)
- Gardiner Gardner, S., et al (2016). Merenstein & Gardner’s handbook of neonatal intensive care (8th Ed.) St Louis; Missouri: Elsevier.
- Itoh, S. et al. (2017). Phototherapy for neonatal hyperbilirubinemia. Cochrane Library.
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- The Royal Children’s Hospital Melbourne (2018). Phototherapy for neonatal jaundice. Clinical Guidelines (Nursing). Retrieved on November, 2020 from https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Phototherapy_for_neonatal_jaundice/

5.2 Associated Waikato DHB Documents

- Waikato DHB NICU Medical Protocol – Phototherapy (2615)

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