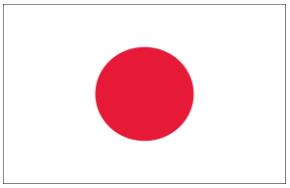
Kingdom of Cambodia

Nation Religion King

Ministry of Health

The NCU Clinical Manual

2019



The NCU Clinical Manual

National Maternal and Child Health Center

Phnom Penh, Cambodia

Foreword

In Cambodia, neonatal care is one of important issue to improve health status of all people. To start all the lives of babies as healthy as possible is closely linked with the prosperity of the country.

According to Cambodia Demographic Health Survey in 2014, 18 babies out of 1,000 livebirths died during the first 28 days in this country. We had the great success to reduce the child mortality and achieved the Millennium Development Goal 4 by 2015. However, there is still space to improve neonatal health in the near future. The Cambodia government has continuously committed this issue. In December 2015, the Ministry of Health developed the 'Five-year Action Plan for Newborn Care in Cambodia, 2016-2020': the road map to improve the quality of early essential newborn care including 'Care for Sick Newborns'. The next goal of neonatal mortality is 14 per 1,000 live births by the year 2020 in Cambodia.

In the National Maternal and Child Health Center (NMCHC), around 7,500 babies including referred or high-risk cases are born annually. 12-13% of them admit to the neonatal care unit (NCU). To improve of quality of care for such sick or small newborn babies at NMCHC, NMCHC-NCU team developed 'The NCU Clinical Manual' in the year 2015 in cooperation with National Center for Global health and Medicine (NCGM), Japan, based on the original since 1992 by Dr.Takako YAMDA. Not only medical doctors but also other staff such as nurses, midwives. interns or medical students have referred to this manual and some trainees brought it to provincial hospitals where they are working.

After four years, it becomes necessary to be updated again because of the progress of neonatology. Therefore, with the support of technical cooperation from Japan International Cooperation Agency (JICA) IINeoC Project, NMCHC developed the second edition of this manual with necessary modification.

This manual aims to improve the internal clinical practice at NMCHC-NCU and for all the NCUs at Complementary Package Activity (CPA) 3 level facilities.

Phnom Penh, July , 2019

Professor Eng Huot

Secretary of State

Acknowledgments

We would like to highly appreciate for those who made special collaboration during their hard work.

Deeply thanks to staff from NCU NMCHC, National Center for Global health and Medicine (NCGM), Japan and Japan International Cooperation Agency (JICA) Project for Improving Continuum of Care with focus on Intrapartum and Neonatal Care in Cambodia (IINeoC Project).

Contents

Abbreviations

ASD	Atrial septal defect
BPD	Bronchopulmonary dysplasia
CHD	Congenital heart disease
CPAP	Continue Positive Airway Pressure
CT	Computed tomography
ECD	Endocardial deficiency
ECG	Electrocardiogram
EEG	Electroencephalogram
EENC	Early essential newborn care
GA	Gestational age (week)
GIR	Glucose infusion rate (mg/kg/min)
HR	Heart rate
IM	Intramascular
IV	Intravenous
IVH	Interventricular hemorrhage
KMC	Kangaroo mother care
MAS	Meconium aspiration syndrome
MRI	Magnetic resonance imaging
NCU	Neonatal care unit
NEC	Necrotizing enteritis
NG tube	Nasogastric tube
NS	Normal Saline
ROP	Retinopathy of prematurity
RPR test	Rapid plasma reagin test
RR	Respiratory rate
PDA	Patent ductus arteriosus
PPHN	Persistent pulmonary hypertension of the newborn
PPV	Positive pressure ventilation
PROM	Premature rupture of membranes
PVL	Periventricular leukomalacia
RDS	Respiratory distress syndrome
TAPVR	Total anomalous pulmonary venous connection
TGA	Transposition of great arteries

TOF	Tetralogy of Fallot
TSB	Total serum bilirubin
TTN	Transient tachypnea in neonates
TTTS	Twin-twin transfusion syndrome
TWI	Total water intake (ml/kg/day)
VSD	Ventricular septal defect

Chapter 1: NCU Staff Call Standard

Before delivery
1. Severe preeclampsia and eclampsia 2. Premature rupture of membranes (PROM) > 18 hrs 3. Mother with a fever ≧ 38.5 ℃ 4. Premature < 37 weeks, <2,500 g 5. Fetal distress, low fetal heart rate 6. Abnormal presentation (Breech) 7. Abnormal delivery (Vacuum, Forceps, Cesarean Section) 8. Multiple births 9. Diabetes mellites in pregnancy
During and After delivery
1. Dirty amniotic fluid 2. Coiling of umbilical cord (>2-3 rounds around newborn infant's neck) 3. No breathing 4. Asphyxia (Apgar score1min 0-3, 5 min < 7) 5. Intrauterine growth restriction (IUGR), low birth weight (birth weight < 2500 g) 6. Big baby >4000 g 7. Well-newborn at risk for sepsis (See Chapter 10: Infection)

Original NMCHC and NCGM, based on the discussion with the midwives, 2014

References:

1) T. Yamada Manual, NMCHC NCU, 1997
2) Recommendation from Dr. Howard Sobel, MCH team leader, WHO, 2012
3) National Clinical Practice Guideline, Cambodian Pediatric Clinical Practice Guidelines Working Group, 2011; 32

Chapter 2: Admission and Discharge Criteria

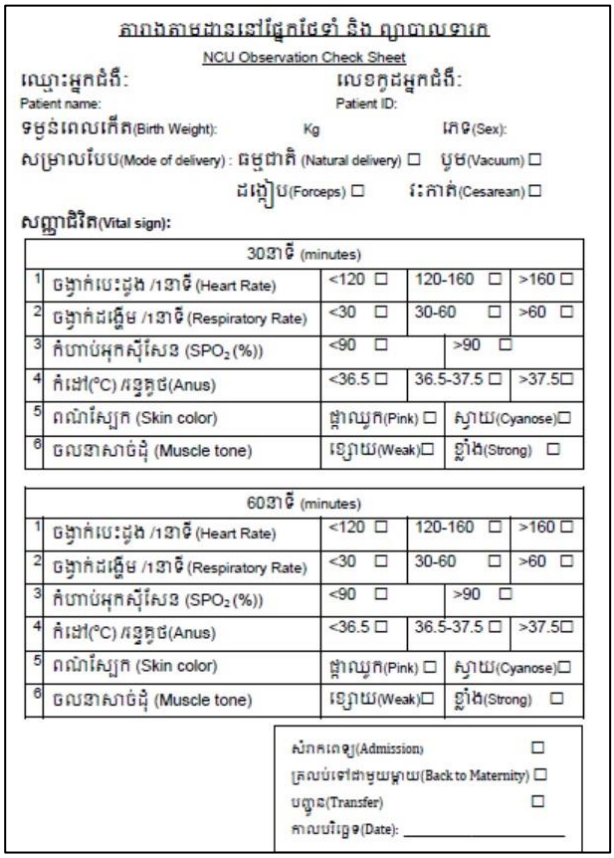
< Observation Criteria >

Observe a newborn if he/she meets at least one of the following conditions.

Observe with monitor
• Cesarean Section • Vacuum delivery • Forceps delivery • Breech presentation • Multiple births • After resuscitation • Birth trauma • Meconium stained amniotic fluid • Premature 1500-2000g

When observe a newborn at NCU, return him/her to mother as soon as assess a condition of newborn is stable.

Use the check sheet at 30 min and 60 min to readily notice high risk newborns



តារាងតាមដាននៅផ្នែកថែទាំ និង ល្បាបាលទារក

NCU Observation Check Sheet

ឈ្មោះអ្នកជំងឺ: Patient name:

លេខកូដអ្នកជំងឺ: Patient ID:

ទម្ងន់ពេលកើត(Birth Weight): Kg ភេទ(Sex):

សម្រាលបែប(Mode of delivery) : ធម្មជាតិ (Natural delivery) ☐ ប្រមូល(Vacuum) ☐

ដង្កៀប(Forceps) ☐ វះកាត់(Cesarean) ☐

សញ្ញាជីវិត(Vital sign):

30នាទី (minutes)				
1	ចង្វាក់បេះដូង /1នាទី (Heart Rate)	<120 ☐	120-160 ☐	>160 ☐
2	ចង្វាក់ដង្ហើម /1នាទី (Respiratory Rate)	<30 ☐	30-60 ☐	>60 ☐
3	កំហាប់អុកស៊ីសែន (SPO_2 (%))	<90 ☐	>90 ☐	
4	កំដៅ(°C) /រន្ធគូថ(Anus)	<36.5 ☐	36.5-37.5 ☐	>37.5☐
5	ពណ៌ស្បែក (Skin color)	ផ្កាឈូក(Pink) ☐	ស្វាយ(Cyanose)☐	
6	ចលនាសាច់ដុំ (Muscle tone)	ខ្សោយ(Weak)☐	ខ្លាំង(Strong) ☐	

60នាទី (minutes)				
1	ចង្វាក់បេះដូង /1នាទី (Heart Rate)	<120 ☐	120-160 ☐	>160 ☐
2	ចង្វាក់ដង្ហើម /1នាទី (Respiratory Rate)	<30 ☐	30-60 ☐	>60 ☐
3	កំហាប់អុកស៊ីសែន (SPO_2 (%))	<90 ☐	>90 ☐	
4	កំដៅ(°C) /រន្ធគូថ(Anus)	<36.5 ☐	36.5-37.5 ☐	>37.5☐
5	ពណ៌ស្បែក (Skin color)	ផ្កាឈូក(Pink) ☐	ស្វាយ(Cyanose)☐	
6	ចលនាសាច់ដុំ (Muscle tone)	ខ្សោយ(Weak)☐	ខ្លាំង(Strong) ☐	

សំរាកពេទ្យ(Admission) ☐

ត្រលប់ទៅជាមួយម្តាយ(Back to Maternity) ☐

បញ្ជូន(Transfer) ☐

កាលបរិច្ឆេទ(Date): _____

If there are any danger signs, refer to physicians immediately and consider admission

If any abnormal signs exist, admit the baby and refer to physicians quickly

< Admission Criteria>

Admit a newborn if he/she meets at least one of the following conditions.

- Admit to NCU	- Admit to maternity ward
・ Severe asphyxia (not recovering) ・ Premature < 1500g ・ Respiratory rate < 30 /min or > 60 /min, continuously ・ Repeated Apnea ・ Retraction, grunting ・ Persistent cyanosis ・ Frequent vomiting ・ Abdominal distension (suspected surgical disease) ・ Lethargy, Floppy ・ Convulsions ・ Jaundice < 24hrs ・ Hypoglycemia ・ Temperature <32℃, <35℃ not respond to warming or >38℃ continuous ・ Bleeding (Oral cavity, umbilical, stool) ・ Severe dehydration ・ Lethal congenital malformations (anencephaly) ・ Bulging fontanel	・ PROM > 18hrs ・ Maternal fever > 38.5 ℃ ・ < 2000g, smaller than gestational age (GA) ・ Congenital malformations not requiring life support ・ Pus from the umbilical cord ・ Skin infection ・ Foul-smelling, purulent appearing amniotic fluid

< Discharge Criteria>

Go back home/ Go to the maternity ward

None of the above signs are present:

- General condition is good
- No need of oxygen, No apnea for more than 24 hours
- Sucking well
- Feeding well orally, milk > 100ml/kg/day
- Temperature is stable in the cot

Counseling family before discharge

- Keeping the baby warm
- How to bathe a baby
- Infection control (e.g. hand washing)
- Danger signs of newborn
- Vaccination

For premature babies

- Continue kangaroo mother care
- Visit ophthalmologist to check retinopathy of prematurity (ROP)

<Notes>

- ✓ All babies, including those who are in the maternity ward, requires close monitoring of vital signs and danger signs.
- ✓ Admission is only based on the baby's condition. No maternal condition determines the need for NCU admission.
- ✓ Unnecessary admission should be avoided to prevent mother-child separation and nosocomial infection.

References:

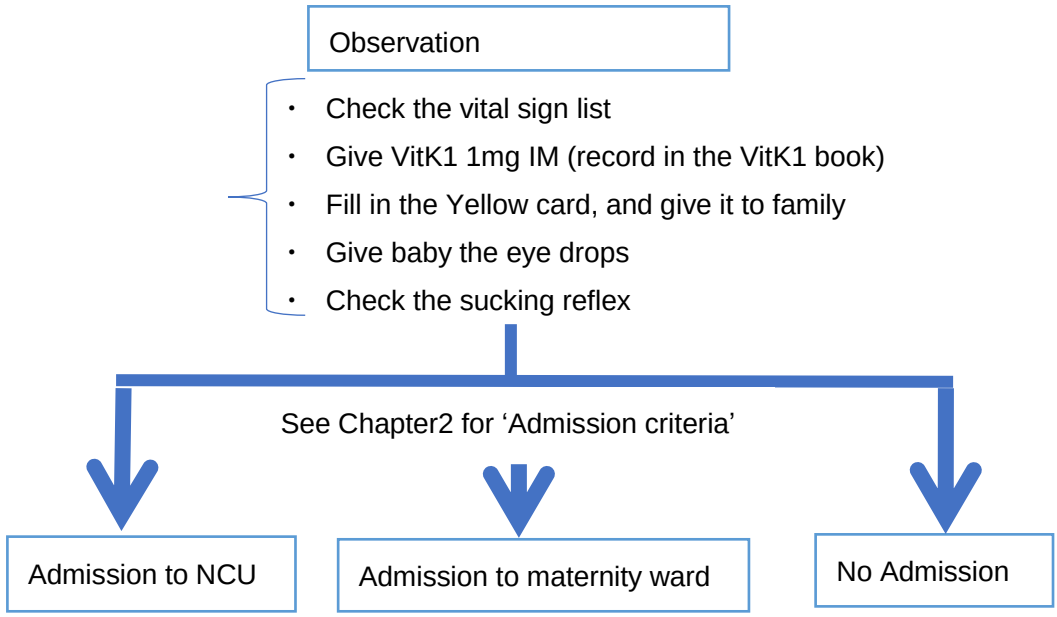
1) Indication of the attendance of pediatrician and Indication of the newborn infants transferred to the NCU, Dr.Takako Yamada, JICA project leader, 1997
2) Recommendation from Dr.Howard Sobel, MCH Team Leader, WHO, 2012
3) Recommendation from Dr.Tomoo Ito, JICA Short Term Expert, 2012
4) Neonatal Clinical Practice Guideline; Cambodian Pediatric Clinical Practice Guidelines Working Group, 2012; 32

Chapter 3: Routine procedure at admission

——Contents————————————————————————

————————————————————————————————

1. Procedure chart



2. Admission to NCU ~Routine work procedure~

——*Nurses' routine work*——

Management

- Check the vital signs
- Insert intravenous (IV) catheter
- Insert a nasogastric tube (Change the tube every 5 days)
- If necessary, Prepare a Continue Positive Airway Pressure (CPAP)

Environment

- Prepare

Cot / Incubator / Towels / Infusion stand / Syringe pomp

Syringe (50ml/1ml /5ml) / Bag & Mask / Nasogastric (NG) tube / Infusion tube

Medicine

- Prepare the main infusion (ex. 10% Glucose)
- Check the prescription (ex. Antibiotics, aminophylline)

For the family

- Explanation（show family the explanation card, explain how to record vital signs・how to feed・attention about hygiene by using explanation sheet. ）
- Tell the family to prepare a feeding cup・diaper

Documents

- Prepare 6 sheets

(Midwife record / Ballad score sheet / Physician's document / Dossier D'Hospitalisation / Agreement of premature baby/ Agreement of accept for admission and treatment)

- Fill in the Yellow card
- Check the transfer letter (midwife's record)
- Take note vital signs to nursing record

——*Physicians' routine work* ——

Management

- Examine physical condition of the babies
- Check the vital signs, body weight and gestational age
- Collect the mother's information

For the family

- Explain the baby's condition

Documents

- Fill in Dossier D'Hospitalisation
- Prescribe all treatments (e.g. medications, milk, oxygen, CPAP)
- Complete the daily record:

  Vital signs・Psychical examination・Lab test order・Examination record

  Problem list・Assessment・Treatment)

3. Admission to maternity ward ~Routine work procedure~

—— *Nurses' routine work* ——

- Check the vital signs
- Inform the care taker to bring the baby back to NCU 2 times/day
  （9am and 6pm, for antibiotic injection）
- Provide antibiotic injection 2 times/day
- Complete the nursing record

—— *Physicians' routine work* ——

Management

- Examine physical status of the baby
- Check the vital signs, body weight and gestational age
- Collect the mothers' information.

Documents

- Fill in Dossier D'Hospitalisation
- Complete the daily record:
  Vital signs・Psychical examination・Examination record・Problem list・Assessment・Treatment

Chapter 4: Resuscitation

——Contents——————————————————————————

————————————————————————————————————

1) Newborn Resuscitation Algorithm

Follow either algorithms, Japan Resuscitation Council: JRC (Figure.1) or Early Essential Newborn Care: EENC algorithm 2 and 3 (Figure.2 and 3).

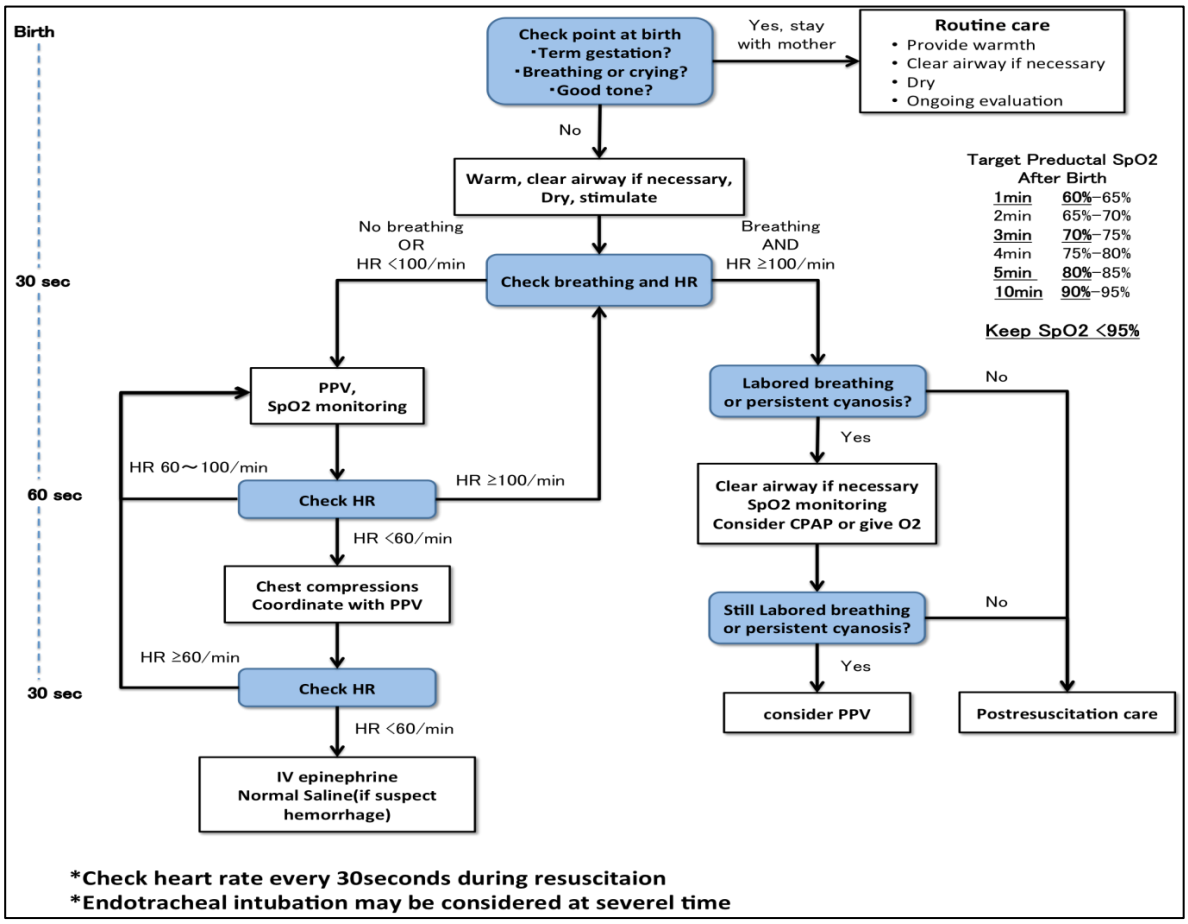


Figure.1 Intensive Newborn resuscitation Algorism, *JRC Guideline 2010

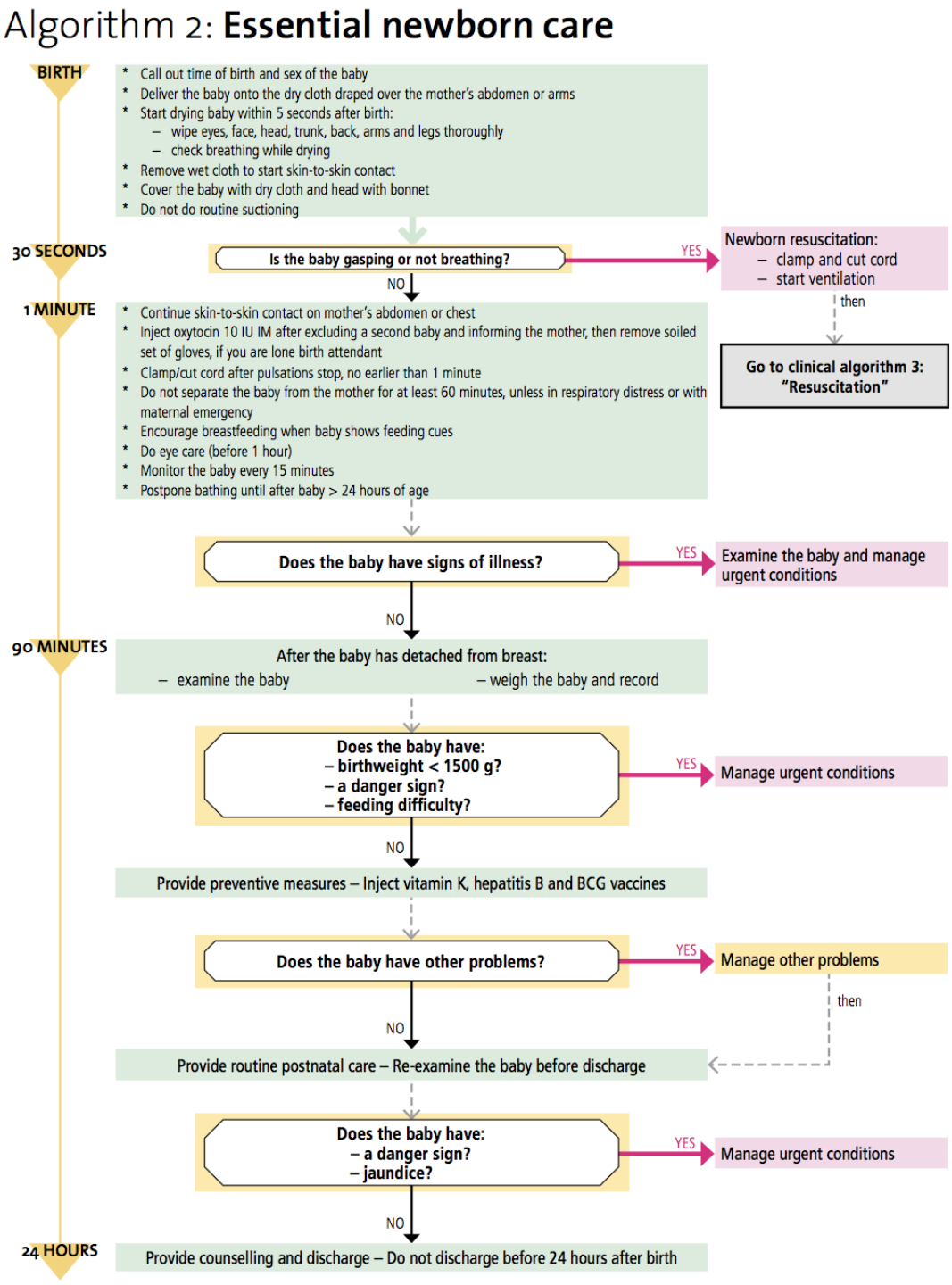


Figure.2 “Algorithm 2: Essential newborn care”, World Health Organization, EENC clinical practice pocket guide 2014

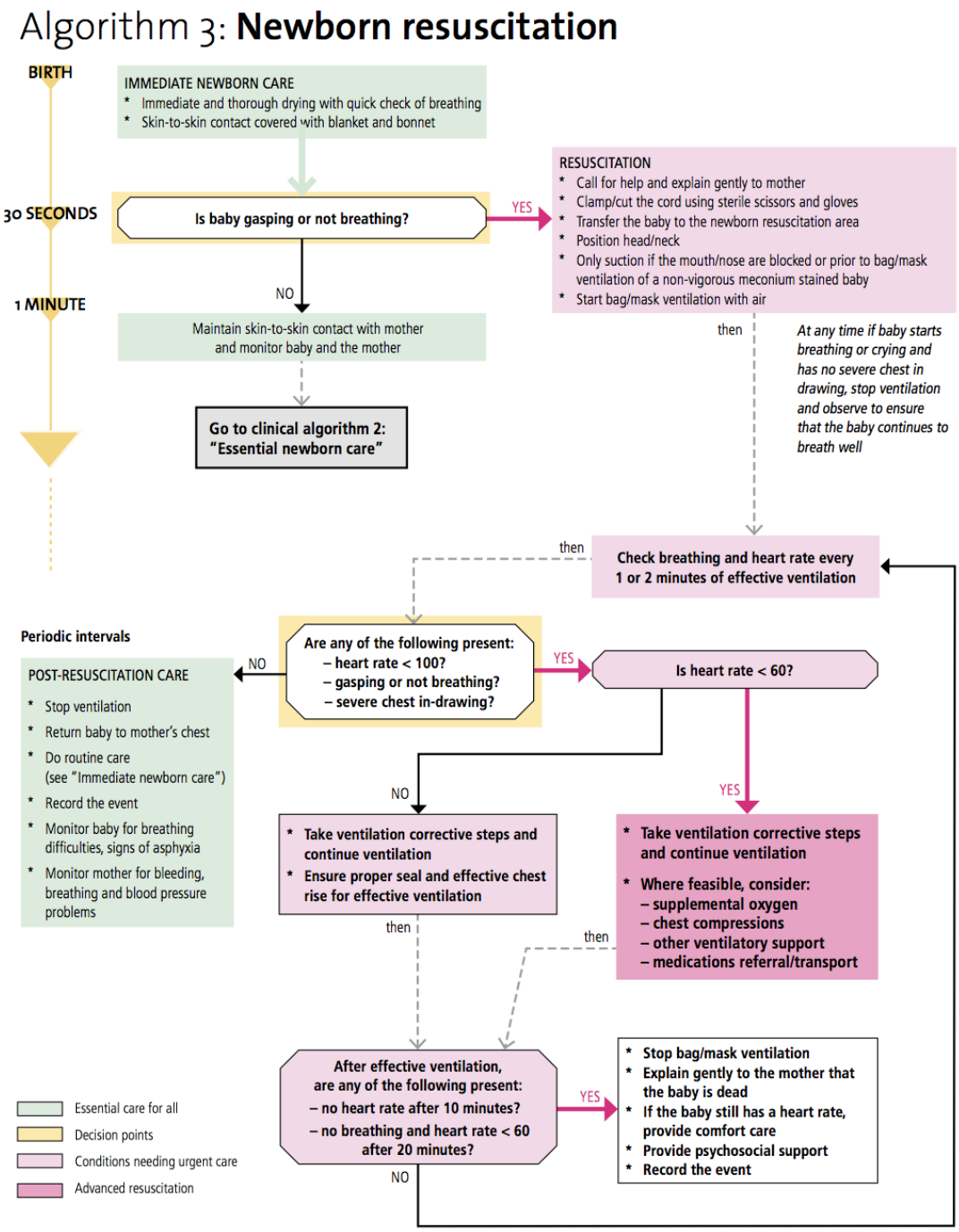
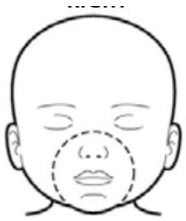


Figure.3 "Algorithm 3: Newborn resuscitation", World Health Organization, EENC clinical practice pocket guide 2014

2) Procedure of resuscitation



Right size and position of the mask. Do not cover eyes.

➢ Bag and mask ventilation

1) Indications for positive-pressure-ventilation
- Apnea/grunting
- Heart rate below 100/min even if breathing
- Persistent central cyanosis and low SpO2 despite of free-flow supplemental oxygen increased to 100%

2) Oxygen vs. room air
- Resuscitation of term newborns may begin with 21% oxygen (room air)
- For babies <32 weeks, it is preferable to start with 30% oxygen, where feasible.
- Pulse oximetry is used to help adjust the amount of supplemental oxygen to avoid giving too much or too little oxygen.

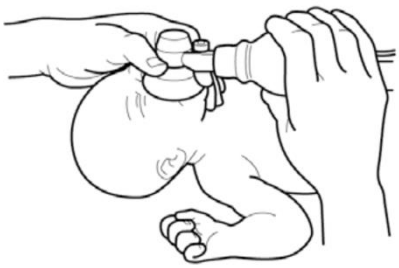
3) Ventilation device: self-inflating bag and masks for neonates (less than 500cm^2).

4) Lift the chin with the third finger of the hand holding the mask.

5) Rate of breaths: 40 breaths /min

6) Amount of pressure
- 30 to 40 cm H_2O (initially), then reduce the inspiratory pressure as long as chest movement is adequate.
- Pressure should keep < 40cmH_2O to prevent air leak syndrome.

7) If you find the following signs, you may stop providing PPV.
   - Heart rate rises to over 100 breaths/ min
   - Improvement in oxygen saturation
   - Onset of spontaneous respirations



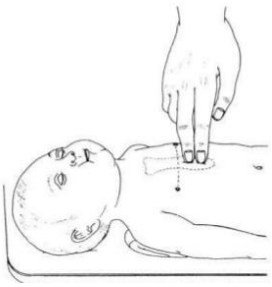
➢ Chest Compression

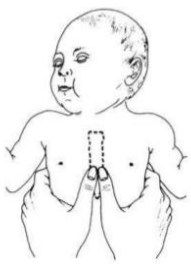
1) Indication of chest compression
   - If the heart rate is below 60 beats/min, despite 30 seconds of effective positive-pressure ventilation

2) Techniques for chest compressions
   - The thumb technique (preferred)
   - The 2-finger technique

3) Place for compressions
   - The lower edge of the sternum

4) Depth of compressions





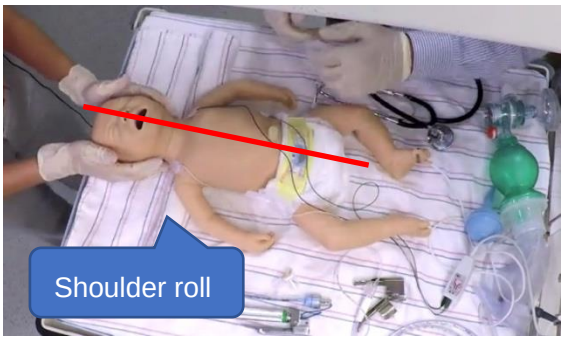
- One-third deep of the anterior-posterior diameter of the chest

5) How to coordinate compressions with ventilation
   - Total of 30 breaths and 90 compressions/ min (press 3 times and 1 bag & mask. Call out “One, two, three, bag!”)

➢ Intubation

In emergency, no absolute contraindications for intubation.

Do bag mask ventilation first, and consider intubation when a baby’s condition becomes stable.



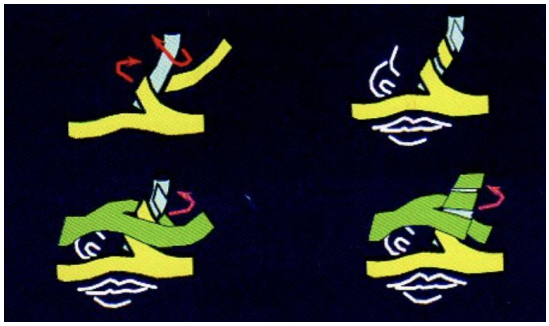
Procedures:

1) Put on monitor
2) Positioning
3) Pre-oxygenation
4) Opening mouth
5) Inserting Laryngoscope
   - Hold a laryngoscope in your left hand.
   - Insert laryngoscope from the right of baby’s mouth.

6) Manipulating laryngoscope
7) Suction if the secretion blocked the way
8) Inserting endotracheal tube
   - Do not look away from the vocal cords during insertion!
   - Attempts to intubate limited to 30 seconds.
9) Check the position at the upper lip
10) Check whether the tube is correctly positioned

    Chest rising, Breath sounds audible, Improvement in heart rate and SpO2, Mist in the endotracheal tube, No air from NG tube if it is already inserted.

11) Taping the tube at the correct position: use two tapes



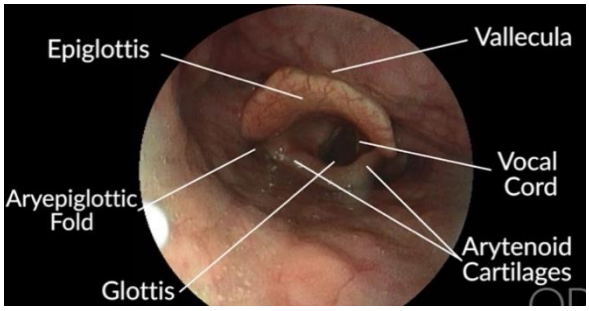


Table 1. Estimated size and depth of intubation tube

Weight (g)	Gestational Age (weeks)	Tube Size (mm) (inside diameter)	Oral tube length at lip (cm)	Nasal tube length at nose (cm)**
< 1,000	< 28	2.5	7*	8
1,000-2,000	28-34	3.0	8	9
2,000-3,000	34-38	3.5	9	10
> 3,000	> 38	3.5-4.0	10	11

*Babies weighing less than 750g may require only 6-cm insertion.

** Nasal tube should use for a short-term to avoid damaging nasal septum.

Careful observation is required.

Table 2. Suction catheter size for intubation tube

Intubation Tube Size (mm)	Catheter Size
2.5	5F or 6F
3.0	6F or 8F
3.5	8F
4.0	8F or 10F

3. Equipment for resuscitation

Table 3. Neonatal Resuscitation Equipment

Basic	*Gloves and appropriate personal protection *Radiant warmer or other heating sources *Clock or timer *Warmed clean linens *Stethoscope *Pulse oximeter and probe or cardiac monitor and electrodes
Suction	*Bulb syringe *Mechanical suction and tubing *Suction catheters, 5 F or 6 F, 8 F, 10 F, 12 F or 14 F *8 F feeding tube and 20 mL syringe
Bag-and-mask	*Neonatal self-inflating bag (500cm^2) and masks (sizes 1 for term and 0 for preterm) *Oxygen sources *Pulse oximeter and probe

Intubation	*Laryngoscope with straight blades, No.0 (preterm) and No.1 (term) *Endotracheal tubes, 2.5-, 3.0-, 3.5-, 4.0-mm internal diameter *Stylets (optional) *Scissors *Tape or securing device for intubation tube *Alcohol sponges
Medication	*Epinephrine 1:10,000 (0.1 mg/mL) 3 ml or 10 mL ampules *Normal saline for volume expansion *10% Glucose

<Medication>

✓ Epinephrine (1:10,000 solution)

	Equipment	Weight(kg)	Volume (ml)	Method
Intravenous (IV): 0.1 to 0.3 mL/kg,	1ml syringe	1 2 3	0.2 0.4 0.6	Flush with saline 2 ml after IV epinephrine
Intra-tracheal administration (IT): 0.5 to 1 mL/kg	3-6ml syringe	1 2 3	0.6 1.2 1.8	Do not require dilution or flushing with saline.

※ Consider intra-tracheal administration (IT), only if an IV line has not yet been established)

✓ Normal saline

Route	Intravenous
Dose	10 ml/kg, administered for 5-10 minutes

<Special care for premature infants>

Plastic bags, wraps or caps combined with other environmental heat sources are effective in reducing hypothermia during stabilization and transfer within hospital for premature infants. Materials used for wrapping included saran wraps (a transparent polythene film or sheet), shopping bags and other manufactured plastic sheets.

4. APGAR score

Table 6. APGAR score（check at **1min**, **5min**, **10min** after birth）

Score	0	1	2
Activity (Muscle tone)	Absent	Arms and legs flexed	Active motion
Pulse	Absent	<100 bpm	>100 bpm
Grimace (Reflex irritability)	No response	Grimaces	Coughs or sneezes, pulls away
Appearance (skin color)	Blue or Pale	Acrocyanosis	Completely pink
Respirations	Absent	Slow, irregular	Good, crying

If the Apgar score at 5 minutes is 7 or greater, it is unlikely that peripartum hypoxia–ischemia caused neonatal encephalopathy.

References:

1) Neonatal Resuscitation: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Pediatrics Vol. 126 No. 5 November 1, 2010 pp. e1400 -e1413, http://pediatrics.aappublications.org/content/126/5/e1400.full
2) Neonatal Resuscitation Program, http://www.aap.org/nrp/default.html

3) Neonatal Resuscitation textbook 6th edition
4) Japan Resuscitation Council Guideline 2012, http://jrc.umin.ac.jp/pdf/20121011_NCPR.pdf
5) Openpediatrics Releases new video: Neonatal tracheal intubation. https://www.openpediatrics.org/news/openpediatrics-releases-new-video-neonatal-tracheal-intubation, Accessed Feb 2019
6) What is the appropriate endotracheal tube insertion depth in a 345 g extremely preterm infant? Swiss society of neonatology. September 2015. https://www.neonet.ch/files/7614/3858/3391/Cotm_September_2015.pdf
7) WHO recommendations on interventions to improve preterm birth outcomes. 2015. ISBN 978 92 4 150898 8
8) The Apgar Score. Pediatrics Oct 2015, 136 (4) 819-822; DOI**:** 10.1542/peds.2015-2651

Chapter 5: Respiration

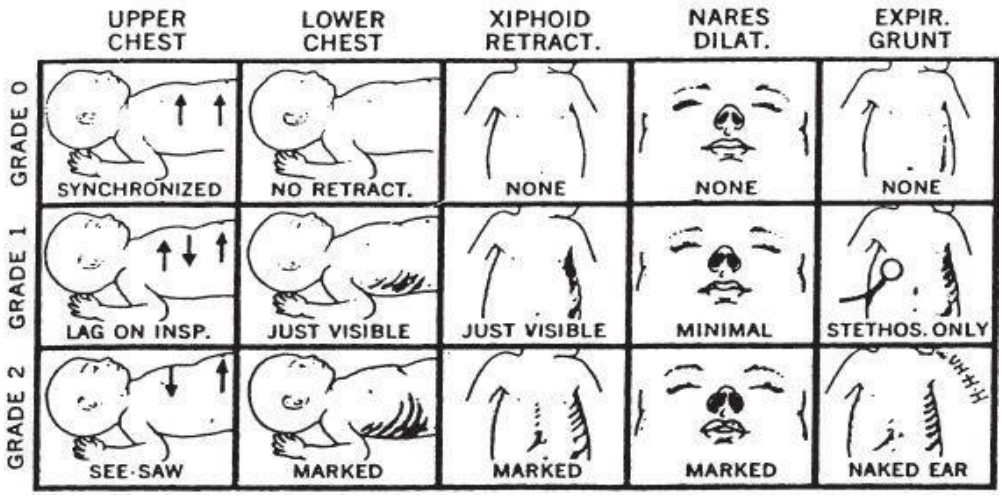
——Contents————————————————————————

————————————————————————————————

1. Approaches to diagnosis

<Clinical signs of breathing difficulty>

- Retraction: decreased lung compliance (often seen in RDS, TTN)
- Grunting: decreased functional residual capacity (often seen in RDS, TTN)
- Nasal flaring: physiological reaction to support the respiratory muscle
- Chest indrawing
- Tachypnea: Respiratory Rate > 60 /min
- Severe cyanosis
- Low SpO_2: SpO_2 < 90 %
- Apnea: stop breathing > 20 seconds, accompanied by desaturations and/ or bradycardia
- Wheezing or sweating



Silverman score.(Adapted from silverman, W.A. and Andersen, D.H. Pediatrics 17(1956, 1-10)

Respiratory Distress Grade	None Ⅰ	Moderate Ⅱ	Severe Ⅲ
Term	1	2-5	6-10
Preterm	1-4	5-8	8-10

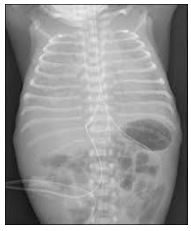
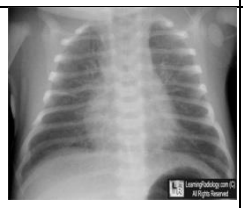
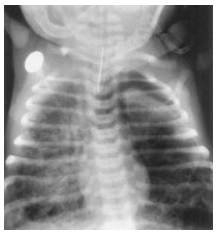
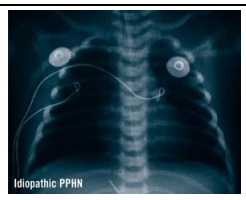
When seeing the signs above, we should make diagnosis and start treatment. Silverman score can show severity of respiration in number from 0 to 10.

※ Monitor and record respiratory rate and oxygen saturation every hour until the baby no longer requires oxygen or CPAP.

2. Evaluation to determine cause of respiratory disorder

Factors before birth	**Possible diseases**
1. Premature	RDS
2. IUGR	MAS, respiratory problems due to polycythemia
3. Multiple birth	TTTS
4. High volume of amniotic fluid	Respiratory problems due to neuromuscular disease and chromosomal disease
5. Low volume of amniotic fluid / long term PROM	Lung hypoplasia, Potter syndrome
6. Maternal diabetes	RDS, respiratory problems due to polycythemia
7. Cesarean section	TTN
8. Fetal low heart rate	MAS
Factors after birth	Possible disease
1. Asphyxia	RDS
2. Dirty amniotic fluids	MAS
3. Foamy saliva	Post nasal atresia
4. Abdominal shrinkage	Diaphragmatic hernia
5. Persistent cyanosis	PPHN
6. Right > left hand SpO2 difference for more than 10%	PPHN

3. Neonatal common respiratory diseases

	RDS	TTN	MAS	PPHN
pathology	deficiency of pulmonary surfactants,due to low production / production inhibitor such as meconium	pulmonary edema due to delayed absorption & clearance of fetal alveolar fluid	aspiration of intrauterine passage of meconium	pulmonary hypertension causes hypoxemia, right-to-left intracardiac shunting of blood.
risk factors	premature, male, low birth weight, asphyxia, Cesarean, induced labor, twin, maternal bleeding, hydrops fetal	term and near term, Cesarean	2-10% of born through meconium-stained amniotic fluid	mother's obesity / diabetes/ asthma, Cesarean, late/ post preterm
clinical course	**24-48 hrs** most severe **3-4days** continue, **>5days** improving due to auto-production	improve in **24-96hrs**	improve in **several days-** **several weeks**	
clinical signs	retraction, grunting, cyanosis, tachypnea, low SpO2	tachypnea, intermittent grunting	tachypnea, cyanosis retractions, grunting and nasal flaring	cyanosis, strong single second heart sound, tachycardia, gray color, capillary refill time> 3 sec
occurrence time	**just after birth**	**just after birth – within 6hrs**	**just after birth- several hrs**	**just after birth- several hrs**
laboratory	weak microbubble		**Many disorders**	Many disorders
management	oxygen and CPAP if severe→**transfer** (artificial surfactant) (severe case needs mechanical ventilation)	supportive oxygen, CPAP for severe cases	aspirate at resuscitation, no bagging, oxygen if pneumonia → Antibiotics if airleak /pneumothorax →high concentration of O_2 if severe→**transfer**	give high concentration of oxygen and **transfer**
prognosis	**not good**	**good**	**not good if symptoms appeared early**	**severe, some have neurological sequelas**
chest Xray	A low lung volume and the classic diffuse reticulogranular ground-glass appearance with air bronchograms.	Prominent vascular markings in sunburst pattern, increased lung volumes with flat diaphragms, mild cardiomegaly, interlabor fissures fluid	Pleural effusions can be seen, asymmetric, patchy pulmonary opacities, pneumothorax in 20-40%	mostly normal
Typical X-rays				

4. Apnea

< Definition >

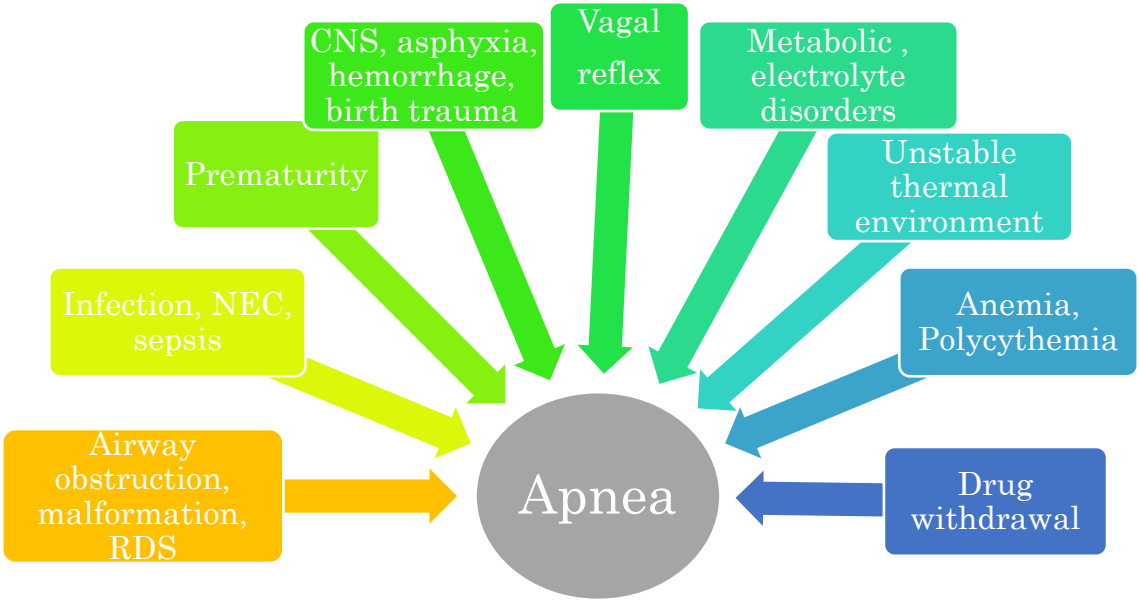
Stop breathing for more than 20 seconds OR A shorter respiratory pause associated with desaturations and/or bradycardia

The incidence of apnea in term infants is quite low. It increases with decreasing gestational age. Apnea occurs in all infants born at less than 28 weeks.

< Classification >

1. Central apnea	・ Inspiratory efforts are absent, no upper airway obstruction ・ Mostly short pauses ・ Common in premature
2.Obstructive apnea	・ Inspiratory efforts persist, but ineffective when upper airway obstruction exists
3. Mixed apnea	・ Upper airway obstruction with inspiratory efforts persist ・ Precedes or follows central apnea ・ Mostly long episodes ・ Common in premature

※ Apnea of prematurity is diagnosed after excluding other condition. Therefore, it is important to rule out those causes in the chart below;



<Notes>

- Apnea becomes evident in the first 1-2 days in premature who has no respiratory support such as CPAP.
- Regardless of respiratory support, the frequency of desaturation episodes typically increases in after 2 -3 weeks of life in premature.
- These episodes continue for several weeks, especially in infants who have a low baseline SpO_2.

< What to do when apnea happens >

- If the baby's respiratory rate is <20 breaths per minute, start resuscitation using bag and mask.
- Apnea; if the baby has apnea, stimulate by rubbing the baby's back for 10 seconds. After that if the baby does not begin to breath, start resuscitation using bag and mask.

< Basic managements >

Monitoring	Keep the SpO_2 monitor on
Preventing	Keep in appropriate temperature and avoid hyperthermia, head-up position, keep enough time for feeding, make sure to eliminate gas after feeding
Oxygenation	Give oxygen, prevent low oxygen, give bag and mask if necessary
Stimulating	Stimulate by rubbing back or sole of foot, give bag and mask immediately if not recovering
Medicine	Give aminophylline for apnea of prematurity
CPAP	Provide CPAP (obstructive / mixed apnea will decrease, be careful with abdominal distention)
Waiting	Wait until matured, 37-40 gestational weeks (98% will be cured)

< Indication for Aminophylline >

Aminophylline is only effective for the apnea caused by **prematurity (primary apnea, central apnea)**. But if you cannot check all courses, using aminophylline is another choice.

- Dosage of Aminophylline

Type	dosage and frequency
Loading dose	5-6mg/kg, liquid concentrate, iv
Maintenance dose	2-3mg/kg, liquid concentrate, iv, every 12hr

<Notes>

- DO NOT use aminophylline during resuscitation period, first try bag and mask.
- If the baby has no intravenous access, you can give aminophylline by NG tube as the same dose.
- If the baby has been already fed well, you can use NG tube for the same dose
- You can use solutions, tablets any kind for NG tube.
- Be aware of side-effects. If you think baby's condition is due to aminophylline, you should consider stopping.

<Adverse events>

- Feeding intolerance
- Tachycardia
- Gastro esophageal reflux (perhaps because of delayed gastric emptying)
- Seizure (if have fever)
- Shock, anaphylaxis
- Encephalitis
- Gastric bleeding
- Tachypnea
- Hyperglycemia
- Jaundice
- Elevation of the liver enzyme, disorder of liver function

4. Oxygen therapy

Oxygen is necessary for human life. People with breathing disorder may need supplemental oxygen therapy. Hypoxia in the newborn infants should be treated.

<When to provide oxygen>
Provide oxygen to newborn infants with clinical sign of breathing difficulty:
SpO2<90%, central cyanosis, respiratory rate > 70 /min, apnea

<How to provide oxygen>
For resuscitation → Go to Chapter 4 Resuscitation.
Devices during admission: Nasal prong, Face mask, Incubator, Continue Positive Airway Pressure (CPAP), Positive Pressure Ventilation (PPV)

- Give oxygen at a moderate flow rate (0.5 to 1 L per minute) and measure saturation by pulse oximetry. Maintain saturation levels between 88 to 92% for preterm baby and 95-97% for full term.
- If the baby's respiratory rate is >60 breaths per minute and the baby has central cyanosis (even if receiving oxygen at a high flow rate), suspect a congenital heart abnormality.

※ If respiratory condition does not improve or worsen in two hours, consider to use CPAP.

<When to stop>

- When the patient's respiratory rate is within the normal rang and there are no other signs of breathing difficulty.
- Observe the baby for 24hr after stop providing oxygen.

<Oxygen toxicity>

Major oxygen toxicity for neonates.

- Bronchopulmonary dysplasia (BPD)

  High concentrations of inspired oxygen can damage the lungs, and cause BPD. Preterm infants are most susceptible to oxygen toxicity compared with term infants.
- Retinopathy of prematurity (ROP)

  Prolonged oxygen cause vasoconstriction in the retina. ROP is a high risk of long-term vision problem. Approximately 65% of infants with a birth weight < 1,250g and 80% if those with a birth weight < 1,000g will develop ROP. All preterm and sick infants should be screened.

5. Continuous Positive Airway Pressure (CPAP)

< When to use CPAP>

Clinical indications for CPAP

Clinical Indications for Continuous Positive Airway Pressure
(Delivery room resuscitation)
Management of respiratory distress syndrome

(Postextubation support)

Prevention for Apnea

Mild upper airway obstruction

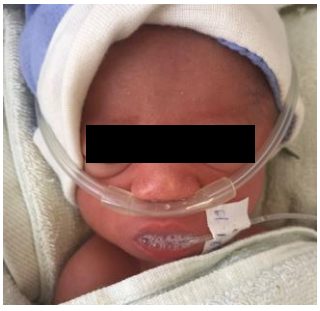
Notes:

- Manage the pressure at 4-7 cm of H2O pressure.
- Some observational studies suggest CPAP may prevent the use of surfactant and intubation for some babies, but still under discussion.
- Pneumothorax develops 3 times more than intubation.

<How to control oxygen concentration of CPAP>

	Air (21% O_2) L/min							
Oxygen (100% O_2) L/min	0	1	2	3	4	5	6	7
0	n/a	21	21	21	21	21	21	21
1	100	61	47	41	37	34	32	31
2	100	74	61	53	47	44	41	39
3	100	80	68	61	55	51	47	45
4	100	84	74	66	61	56	53	50
5	100	87	77	70	65	61	57	54
6	100	89	80	74	68	64	61	57
7	100	90	82	76	71	67	64	61

※ If the respiratory condition does not improve with CPAP, refer the baby to a hospital where has mechanical ventilations!



< CPAP devices>

➢ **Nasal prongs:** simple and easy to apply.

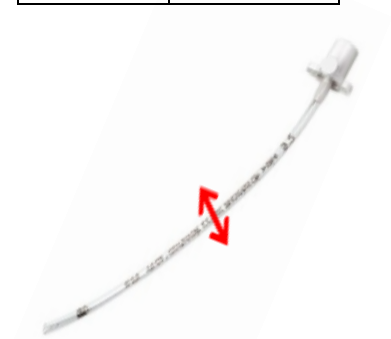
Note:

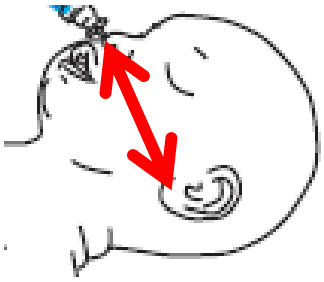
- Keep an appropriate posture.
- Trauma to nasal septum.
  Use sponge / fabric tape for prevention.

➢ **Nasopharyngeal tube**

BW (kg)	Diameter (mm)
< 1.0	2.5
1.0-2.0	3.0
2.0-3.0	3.5
3.0<	4.0

BW (Kg)	Depth (cm)
< 1.5	4
1.5-2.0	5.5
2.0 <	5





Measure the length from the nostril to the ear lobe on the same side.

Note:

- May become occluded or plugged with secretions despite suctioning
- Higher resistance to spontaneous breathing

< When to stop CPAP >

Keep CPAP until tachypnea and retractions have resolved.

If apnea still occurs after removal of nasal CPAP, you should restart and wait until the infant weight is > 1,000g.

Reference:

1) Japanese neonatal association: Manual of neonatal intensive care unit 4ed Chapter Ⅱ B-1 Respiratory disorder: 87, 2007

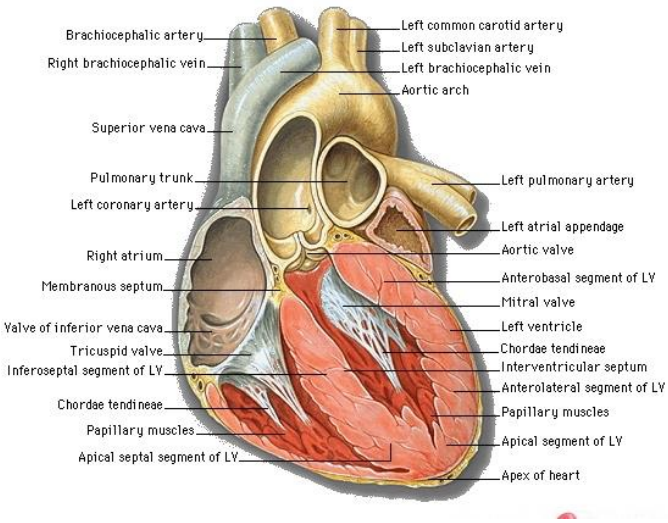
2) Richard Martin et al: Pathogenesis, clinical presentation, and diagnosis of apnea of prematurity, Up to date 2013:
3) Trica L. Gommela, et al: Apnea and Bradicardia. LANGE, Neonataolgy 7ed: 333-349, 2013
4) Furuse Y, et al: Apnea of premature infants. Clinics in Perinatal Medicine 2010 the practical and essential reference:650-654, 2010
5) Fanaroff & Martin's Neonatal-Perinatal Medicine 9th edition Chapter 44 The respiratory System: BOX 44-5, 1118, 2011
6) Safe Motherhood Protocol for referral hospital, 2013. MoH Cambodia
7) Daniel Limmer and Michael F. O'Keefe. 2005. Emergency Care 10th ed
8) Iowa Neonatology Handbook, University of Iowa Stead Family Children's Hospital. https://uichildrens.org/health-library/iowa-neonatology-handbook
9) Steven Abman, Pulmonary Hypertension Association PHA online university, Vol 5, No 2 (Summer 2006);http://www.phaonlineuniv.org/Journal/Article.cfm?ItemNumber=662
10) Mary Celeste Klingner, MD, and Jerry Kruse, MD, MSPH, Meconium Aspiration Syndrome: Pathophysiology and Prevention: Journal of the American Board of Family medicine 1999; 12(6)

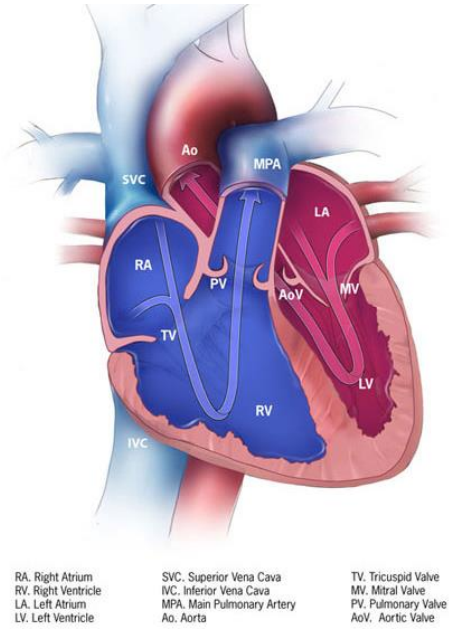
Chapter 6: Circulation

——Contents————————————————————————

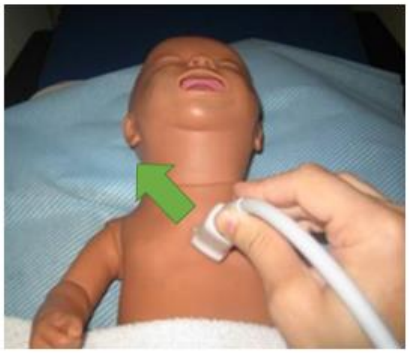
————————————————————————————————

1. Normal heart anatomy and echocardiography

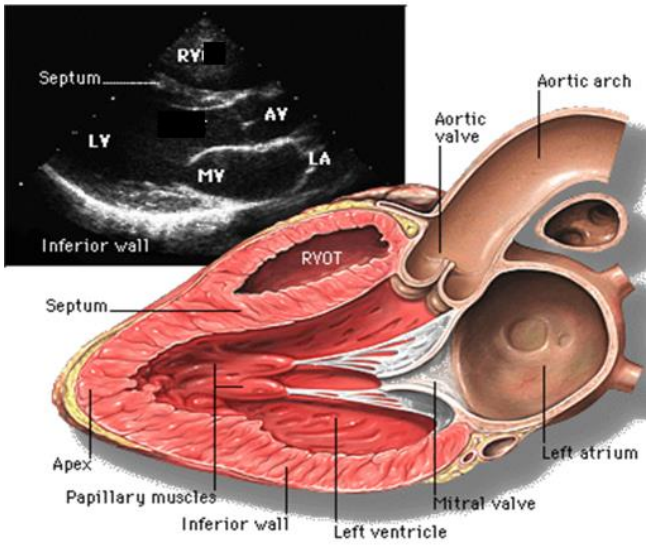




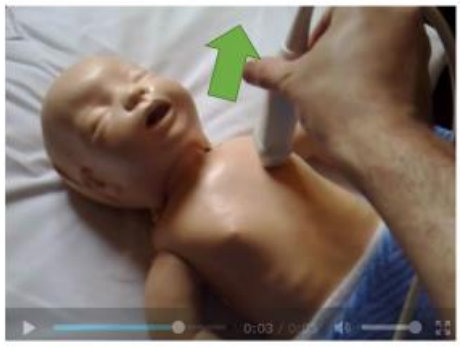
Parasternal long axis view

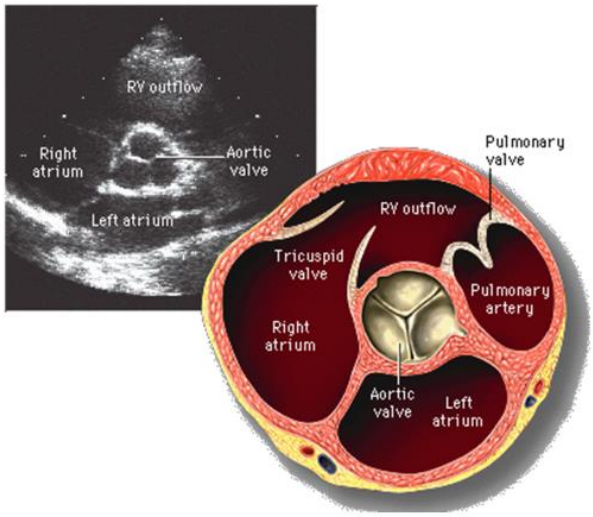


✓ Marker pointing to Right shoulder

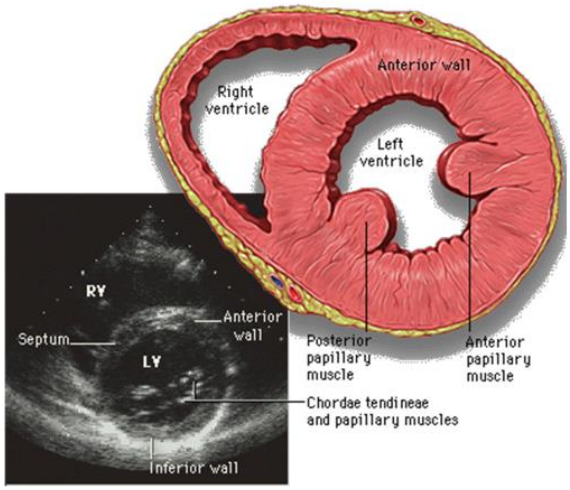


Parasternal short axis view

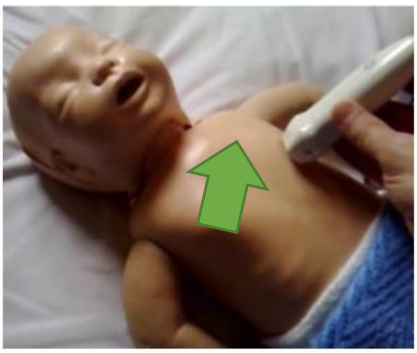


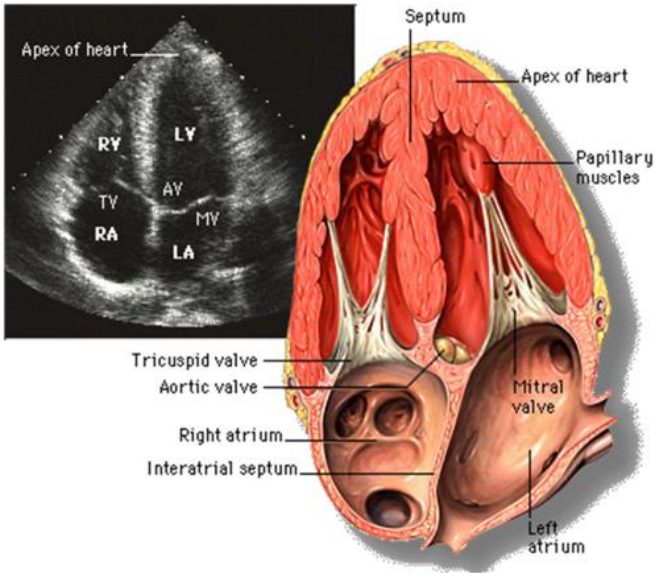


✓ Marker pointing to Left shoulder



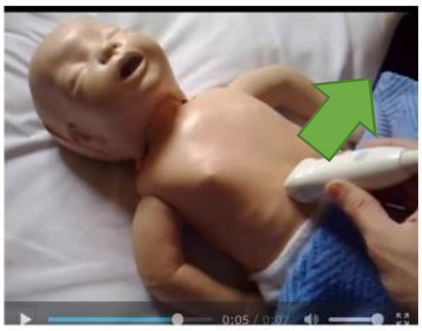
Apical 4-chamber view

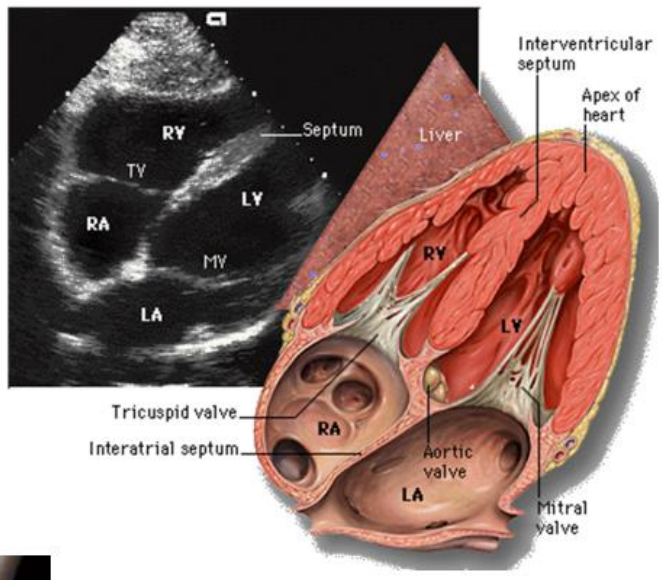




✓ Marker pointing to Left shoulder

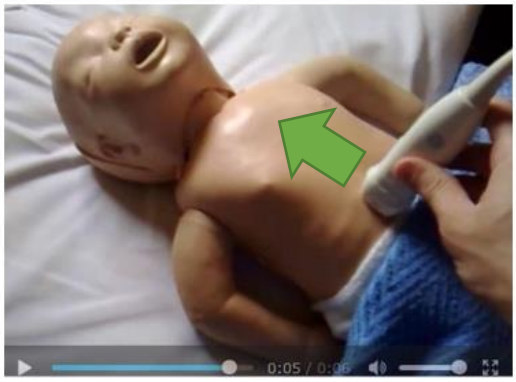
Subcostal 4 chamber view





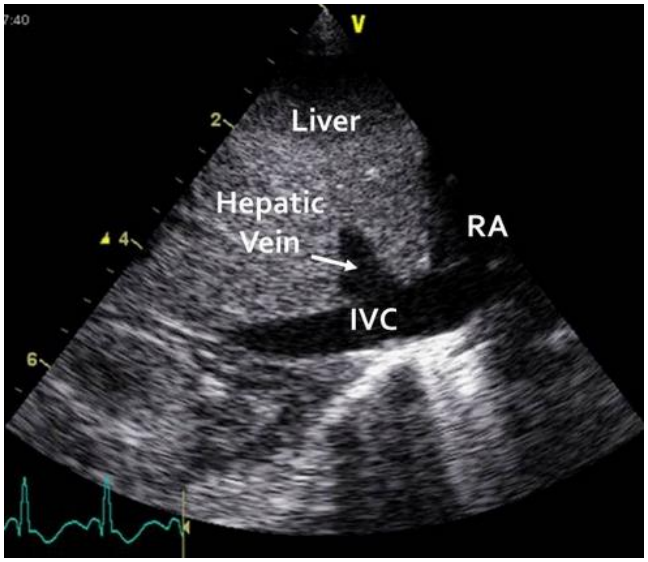
✓Marker pointing to Left

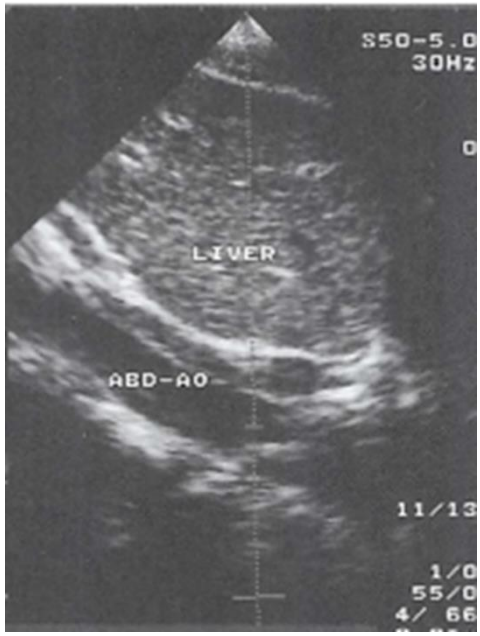
Subcostal sagittal view



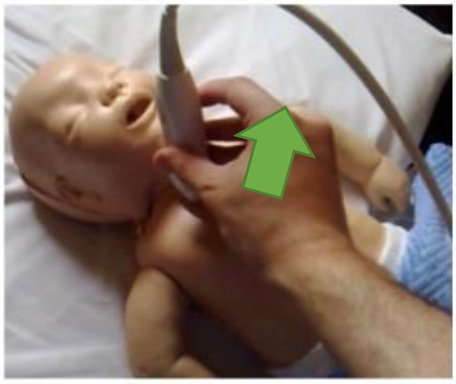
IVC / Abdominal aorta >1: volume +

IVC / Abdominal aorta <0.5: volume loss

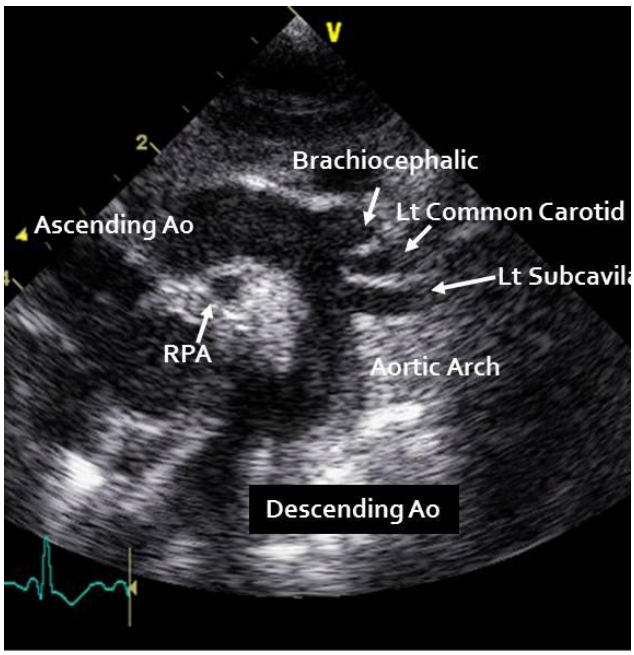




Suprasternal notch view

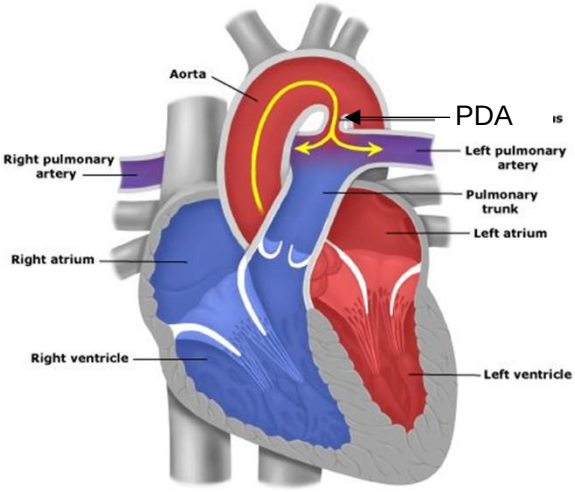


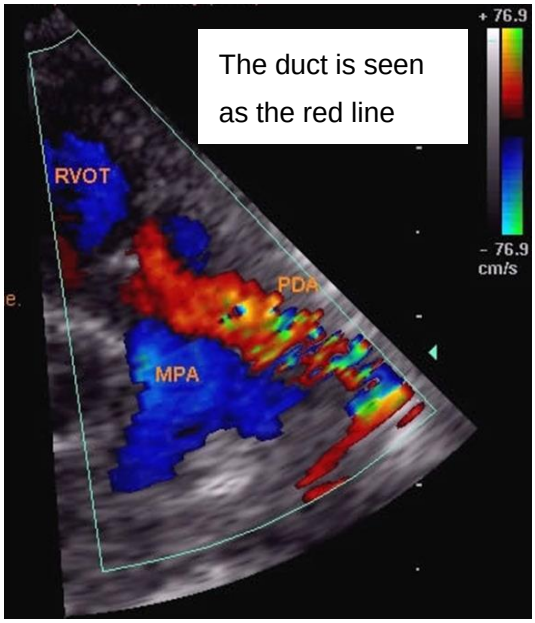
✓Marker pointing to Left shoulder



2. Patent ductus arteriosus (PDA)

Functional closure occurs in almost 50% of full-term infants by 24 hours of age, in 90% by 48 hours, and in all by 96 hours of age. In preterm babies, the closure occurs 60% by 48 hours. If PDA remains open, pulmonary flow would be increased and the body blood flow would be decreased. It causes many symptoms.





< Symptoms >

Tachypnea / Retraction / Pulmonary edema / oliguria / Heart failure

Risk factors of PDA
Prematurity / Respiratory distress syndrome / Excess fluid administration / Asphyxia

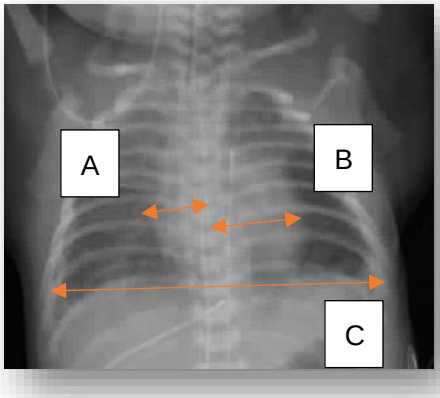
< Diagnosis >

① CVD (cardiovascular dysfunction) score

If the total score is more than **3** points, it is considered to be a symptomatic PDA.

	0	**1**	**2**
Heart rate	< 160 bpm	160 - 180 bpm	> 180 bpm
Heart murmur	None	Systolic murmur	Murmur continues to diastole
Peripheral pulse	None	Bounding brachial	Bounding brachial and dorsal pedis
Cardiothoracic Ratio	None	0.6 - 0.65	> 0.65
Precordial pulsation	None	Palpable	Visible

② X-ray



Cardiomegaly & Pulmonary edema
(These symptoms are noted later.)

※Cardiomegaly:
The transverse cardiothoracic ratio:
(A + B / C) ≧60%

③ Echocardiography

Check the parasternal short axis view with color doppler. (See above)

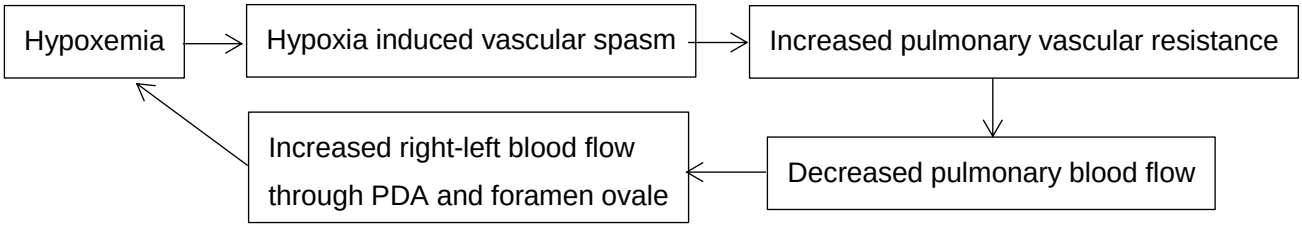
< Management >

1. Fluid restriction	Less water intake would lead to decreasing the PDA shunt, so as to the lungs
2. Ventilatory support	Increasing positive end-expiratory pressure is helpful in controlling pulmonary edema.
3. Indomethacin 0.1-0.2mg/kg/time	A prostaglandin synthetase inhibitor has been proved to be effective to promote ductal closure.

every12-24hours (Maximum 3 times)	< Complication > Renal effect(oliguria) / Gastrointestinal bleeding < Cases CANNOT be provided > Serum creatinine > 1.7 mg/dl Gastric bleeding NEC / Sepsis
4. Surgical operation	Cases which medicine is not effective or impossible to use; Oliguria, Serum creatinine > 3mg/dl, has a bleeding tendency, Suspected NEC

3. Persistent pulmonary hypertension of the newborn (PPHN)

< Etiology >



< Clinical presentation >

The primary finding is respiratory distress with cyanosis. Isolated Cyanosis (Especially Lower limb SpO2 is low) / Cyanosis attack (flip-flop) / Decreased urine / a single second heart sound, a murmur of tricuspid insufficiency

< Management >

1. Prevention of cyanosis attack	Repeating cyanosis attack makes pulmonary hypertension worse. To prevent that, sedation is commonly used. Phenobarbital (0.05-2 mg/kg, NG tube) or midazolam (0.1mg/kg) is frequently used.
2. High concentration oxygen therapy	This is effective to decrease pulmonary hypertension (FiO2 > 40%).
3. General management	Prevent from hypoglycemia and hypocalcemia, control body temperature in an appropriate level, significant acidosis should be avoided.

If the above management is not effective, the baby needs more advanced treatment (mechanical ventilation, pressor agents or nitric oxide). We should transfer the baby to higher level hospitals.

4. Congenital heart disease

Congenital heart disease occurs in ~ 1 % of live-born infants.

It is important to know and learn about its diagnosis and management.

< Classification >

	Acyanosis	Cyanosis
Type of increasing pulmonary blood flow	Ⅰ VSD, ASD PDA, ECD	Ⅱ TAPVR TGA
Type of decreasing pulmonary blood flow		Ⅲ TOF Ebstein anomaly

< Symptoms >

Ⅰ Ⅱ Pretibial pitting edema, Puffy eye lids**,** Hepatomegaly**,** Gallop sounds

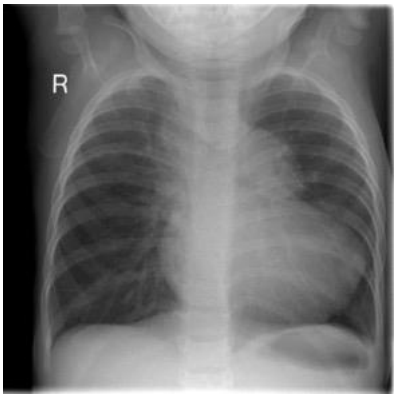
Ⅲ Cyanosis(check lips and nails)

<Diagnosis>

Echocardiography: views look different from normal. (See above for normal views)

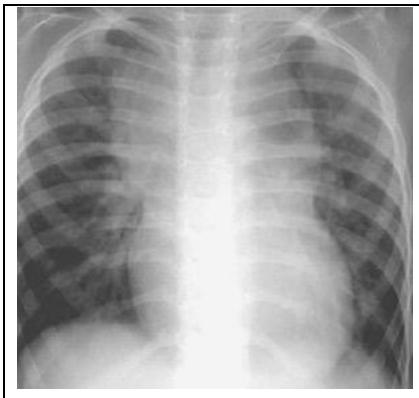
Chest X-ray: the size of heart, the aortic arch side*, pulmonary blood flow

* A right-sided aortic arch is associated with congenital heart disease in >90% of patients.



TOF

'Boot shaped' heart, with decreased pulmonary vascular markings. A right aortic arch is seen in ~ 20% of these infants.

	TAPVR 'Snowman shape' The dilated vertical vein on the left, brachiocephalic vein on the top, and the superior vena cava on the right form of the head of a snowman; the body line of the snowman is formed by the enlarged right atrium.

< Management >

Ⅰ Type of increasing pulmonary blood flow / Acyanosis

Avoiding managements which would lead to decrease pulmonary hypertension, such as oxygen

- Fluid restriction…Decreasing fluid intake as much as possible
- Diuretic…furosemide 1-3mg/kg/day iv

Ⅱ Type of increasing pulmonary blood flow / Cyanosis

Stop oxygen… to prevent PDA closure

※ If we provide the baby with oxygen, the baby's condition will become worse.

- Operation… Emergency transfer to higher level hospital is necessary

Ⅲ Type of decreasing pulmonary blood flow

- Oxygen, fluid restriction, diuretics are not necessary
- β-blocker…Prevention from attack on TOF

If the baby's condition is not good due to congenital heart disease, consider to transfer the baby to hospital with pediatric cardiologist.

References:

1) Centers for disease control and prevention, Congenital heart defects (CHDs). https://www.cdc.gov/ncbddd/heartdefects/index.html
2) Tricia Lacy Gomella, Neonatology 7th Edition, 815-822, 2013
3) Hiroshi Nisida, Guideline of Neonatology 3rd edition
4) Masahiko Kawai, Diagnosis and Treatment on NICU bedsides 3rd edition
5) Masao Kaneshige, Neonatal Care 2013 vol.26 461-467

6) R. Arthur, The neonatal chest X-ray PAEDIATRIC RESPIRATORY REVIEWS (2001) 2, 311–323 doi:10.1053/prrv.2001.0169, available online at http://www.idealibrary.com
7) Yeh TF, Raval D, Luken J, et al. Clinical evaluation of premature infants with patent ductus arteriosus: a scoring system with echocardiogram. Acid-base, and blood gas correlations. Crit Care Med 1981c;9:655-7.
8) J. Cloherty, Manual of Neonatal Care Seventh edition. Lippincott Williams & Wilkins, 2012. ISBN-13: 978-1-60831-777-6

Chapter 7: Fluid Management

——Contents————————————————————————

————————————————————————————————

1. In/Out Water balance

Newborn infants normally lose water during the first week of birth. In the first 24 to 48 hours after birth, neonates have decreased urine output, followed by a diuresis phase, with urinary losses of water and sodium resulting in weight loss. Preterm infants are more vulnerable to fluid and electrolyte problems because of immaturity of renal function, increased evaporative losses due to a thin dermis that may be exacerbated by the use of radiant heaters, and increased respiratory loss compared with term infants.

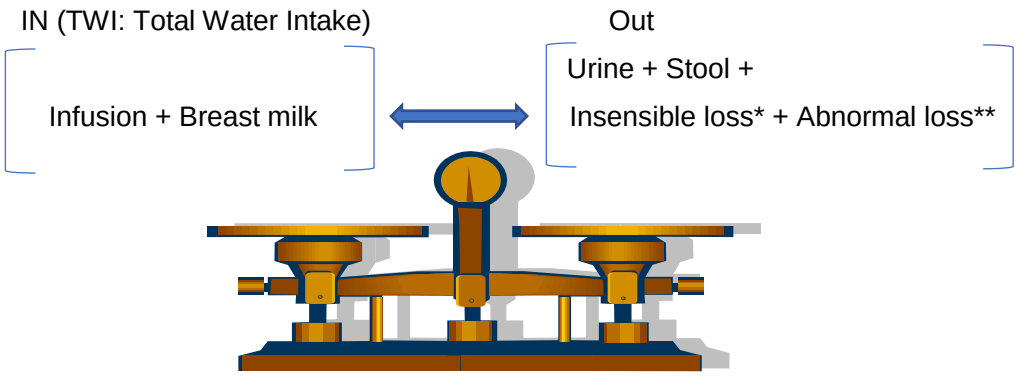


Figure: Basic scheme for monitoring and modifying fluid therapy

* From the skin and lung / ** From gastrointestinal/diarrhea, ostomy, and chest tube drainage

Weight loss

Birth weight (g)	**The rate of the weight loss (%)**
－1,500	15 (－20)
1,500－2,000	10－15
2,000－2,500	5－10
2,500－	5 (－10)

2. Fluid recommendations

Day	After birth	Total Water Intake (ml/kg/day)			Content
		< 1250g	1250 -1750g	1750g <	
Day 0	~24 hours	60-100	60-80	50-80	(Preterm, Hypoglycemia, Severe Asphyxia, SFD, HFD) 10%dextrose 95ml+Calcium gluconate 5ml (Term admitted to NCU and unable to suck) 10%dextrose 100ml
Day 1	~48	70-100	70-80	60-80	10%dextrose 95ml+Calcium gluconate 5ml (Baby admitted to NCU and unable to suck) 10%dextrose 100ml
Day 2	~72	80-120	80-100	70-100	10%dextrose 75ml+Normal Saline 20 ml +Calcium gluconate 5ml
Day 3	~96	90-140	90-140	80-150	Ditto
Day 4		100-140	100-140	90-150	Ditto
Day 5		110-140	110-140	100-150	Ditto
Day 6		120-140	120-140	110-150	Ditto
:					
Day 14		-150	-150	-180	
Day 28		-150	-150	-200	

Modified 2013 of T. Yamada Manual, NMCHC NCU, 1997

<Notes>

- Body weight < 1,500g or Gestational age < 34weeks →start drip infusion
- All sick babies require IV access for fluid administration.
- Start with minimum TWI.
- Water intake should be restricted when the following disease or symptoms are present. Respiratory Distress Syndrome (RDS), Patent Ductus Arteriosus (PDA), term with severe asphyxia.
- If estimated insensible loss is high (check by clinical signs: poor skin turgor, weight loss, dry mucus membrane, depressed anterior fontanel), start fluids at higher rate, 60－100 mL/kg/day.

3. Problems and diseases caused by inappropriate water balance

Problems caused by water restrictions	**Problems caused by water surplus**
Dehydration	Patent Ductus Arteriosus (PDA)
Metabolic acidosis	Necrotizing enteritis (NEC)
Renal failure	Retinopathy of prematurity
Hypernatremia, hyperkalemia, Hypocalcemia	Interventricular hemorrhage (IVH)
Hypoglycemia	Hyponatremia
Hyperbillirubinemia, Jaundice	Bronchopulmonary Dysplasia (BPD)
Hyperviscosity syndrome, Polycythemia	

Start fluid at higher rate 60-100ml/kg/day

or

Increase 10-30ml/kg/day

Keep the same amount

or

Decrease about 10-20ml/kg/day

Cases better to increase water	**Cases better to restrict water**
Photo therapy	Term with severe asphyxia
Keeping in an infant warmer (radiant warmer)	Transient tachypnea of the newborn (TTN)
Hypotension	Ventilator use (including CPAP)
Hyperthermia	Respiratory distress syndrome(RDS)
Small for Gestational Age (SGA)	Patent Ductus Arteriosus(PDA)
Intrauterine Growth Restriction(IUGR)	
Tachypnea	

Start fluid at higher rate 60-100ml/kg/day

or

Increase 10-30ml/kg/day

Keep the same amount

or

Decrease about 10-20ml/kg/day

4. Glucose infusion rate

Premature babies are at risk for disturbances in glucose homeostasis because of their immaturity comparing to term babies. This recognition is the most important step in preventing both hypoglycemia and hyperglycemia.
GIR (glucose infusion rate: *mg/kg/min*) is one of the key calculations for this management and nutrition of infants. (See Chapter 11. Nutrition)

Suggested initial glucose infusion rate (GIR)

Premature	Term
4-8 mg/kg/min	Approximately 4 mg/kg/min

$$\mathrm{GIR} = \frac{\frac{V}{60} \times \frac{D}{100}}{1000 \times BW} = \frac{V \times D}{6 \times BW}$$

V (ml/h): Infusion speed,
D (%): Glucose concentration,
BW (kg): Body weight

- To reach appropriate GIR, you need high glucose concentration.
- For premature babies, check the blood sugar before start infusion, and every morning until day 3.
- For premature babies, start with at least 9.5 % glucose concentration.
- Maximum glucose concentration for peripheral infusion is 12.5 %. For premature babies, maximum is suggested to be 11.5 %, because of immature vessels.
- GIR should be carefully decreased. Maximum 2 mg/kg/min at once.
- After decreasing GIR, you need to check the blood sugar to prevent hypoglycemia.

5. Glucose concentration of Infusion

A. within 48 hours after birth

Glucose concentration	10%dextrose	5%dextrose	50%dextrose	Calcium gluconate
7.25%	50ml	45ml	×	5ml
9.5	95	×	×	5
9.9	94	×	1	5
10.3	93	×	2	5
10.7	92	×	3	5
11.1	91	×	4	5
11.5	90	×	5	5
11.9	89	×	6	5

12.3	88	×	7	5

B. More than 48 hours after birth

Glucose concentration	10%dextrose	Normal Saline	50%dextrose	Calcium gluconate
7.5%	75ml	20ml	×	5ml
7.9	74	20	1	5
8.4	73	20	2	5
8.7	72	20	3	5
9.1	71	20	4	5
9.5	70	20	5	5
9.9	69	20	6	5
10.3	68	20	7	5
10.7	67	20	8	5
11.1	66	20	9	5
11.5	65	20	10	5
12.3	63	20	12	5

Modified 2013 of T. Yamada Manual, NMCHC NCU, 1997

References:

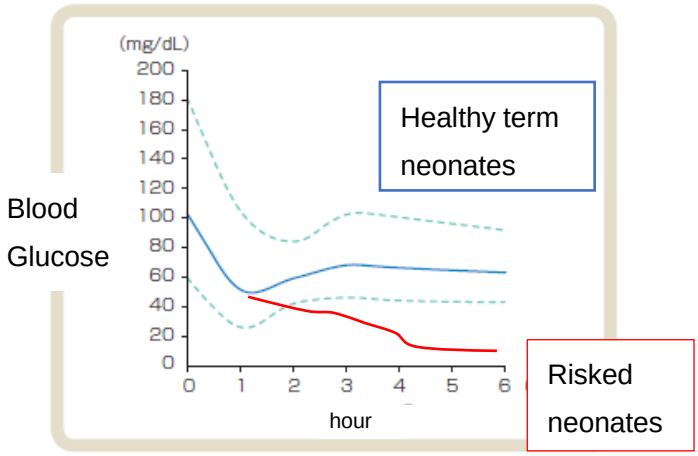
1) Jochen Profit et al: Fluid and electrolyte therapy in newborns, Up to date http://www.uptodate.com/ , Literature review current through: Jul 2013. | This topic last updated: 12 19, 2012.
2) Fanaroff & Martin's Neonatal-Perinatal Medicine 9th edition Chapter 36 :669, 2011
3) Sandra L. Gardner et al: Merenstein& Gardne's Handbook of Neonatal Intensive Care Ed 7: 342, 2011
4) H Nishida: Introductory guide for Neonatalogy, 3rd edition 2009; Igaku shoin
5) Richard A.Polin and Alan R.Spitzer: Fetal&Neonatal Secrets, 2nd edition, 159;8,2007

Chapter 8: Hypoglycemia, Metabolic acidosis Electrolytes,

——Contents————————————————————————

————————————————————————————————

1. Hypoglycemia



The glucose level of healthy term babies would be stable within 3 hours after birth.
However, some infants, the glucose level remains persistently low, requires medical intervention.

< Symptoms and signs of Hypoglycemia >

Hypothermia / Abnormal crying / Feeding difficulty / Irritability Apnea / Jitteriness tremors / Lethargy or stupor / Tachypnea Hypotonia / Tachycardia

Prolonged blood glucose levels of <45 mg/dl are associated with **poorer neurodevelopment** in later life.

Most infants are asymptomatic. We should check the glucose level of high risk babies.

< Risk factors for Neonatal Hypoglycemia >

Lack of stored Glucose	Preterm, Low birth weight, Small for date
Increased use of Glucose	Asphyxia, Respiratory distress, Infection, Hypothermia, Hypervolemia
Hyperinsulinism	Neonates born from diabetic mothers, Big babies > 4,000 g, Low birth weight,

	Congenital disease, (Endocrine disorders / Amino acid metabolism)

< Management>

We should check the glucose level of

(i) Babies who has symptoms at any time.

(ii) All admitted babies with risk of hypoglycemia.

- At three hours of age or on admission (whichever comes first)
- Check the blood glucose at 3 hours after the first measurement.
- Check the blood glucose at 6 hours after the second measurement.

- If blood glucose is 45 mg/dl or more at the second and third measurement, stop follow up.
- Continue the measurement of blood glucose every six hours until the blood glucose is 45 mg/dl or more for two consecutive measurements.

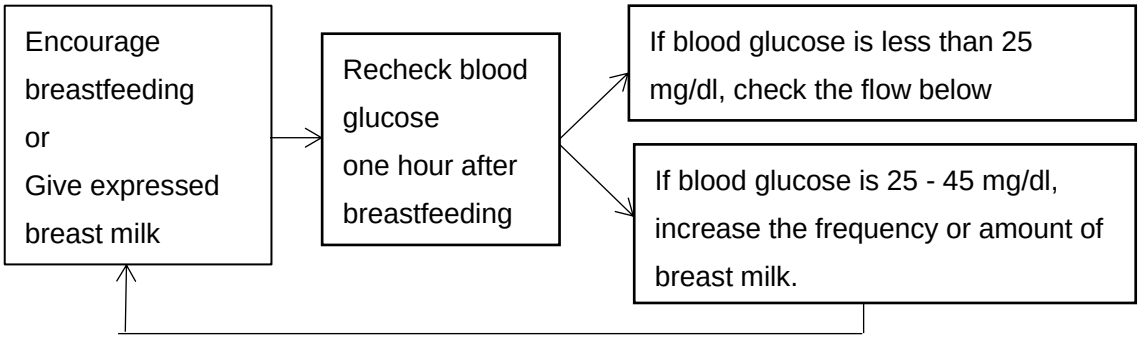
Example: A baby > 4,000 g born at 10 am, with no symptom

Time	10 am	1 pm	4 pm	10 pm	4 am	10 am
Check		✓38 mg/dl	✓48 mg/dl	✓ 62 mg/dl	✓	✓

Stop measurement at 4 am

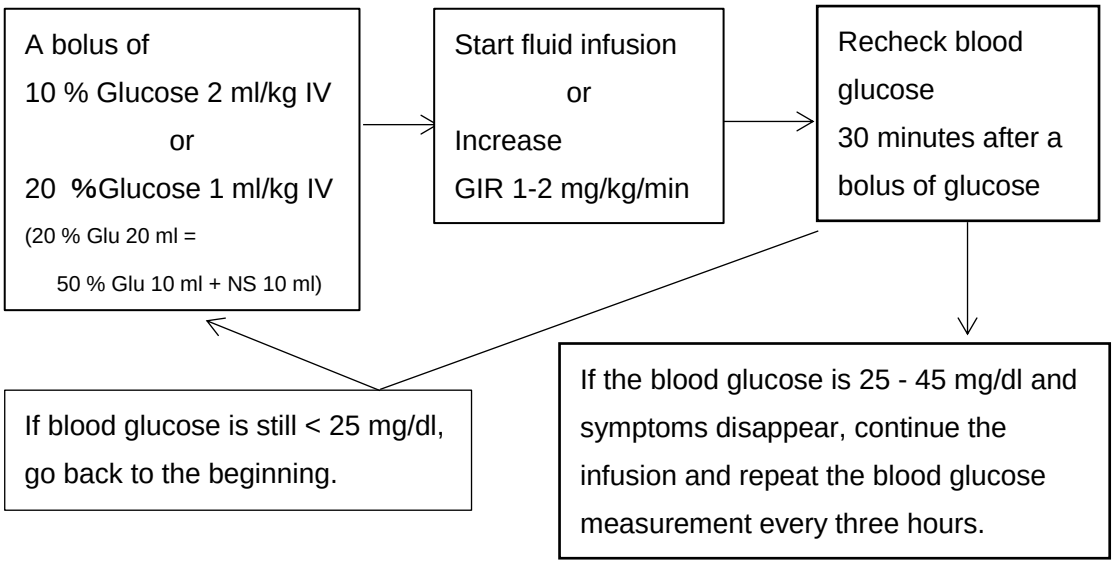
< Treatment>

A) Blood glucose 25 - 44 mg/dl with no symptoms



Once the blood glucose is 45 mg/dl or more on two consecutive measurements, return to normal frequency of monitoring.

B) Blood glucose less than 25 mg/dl or blood glucose 25 – 44 mg/dl with any symptoms



- Once the blood glucose is 45 mg/dl or more on two consecutive measurements, return to normal frequency of monitoring.
- GIR can be increased up to 12-13 mg/kg/min.

If it is difficult to maintain the glucose level in the normal range despite receiving more than 12-13 mg/kg/min, consider the adjunctive treatment.
Hydrocortisone 2.5 mg/kg, IV or oral, every 12 hours, its use should be restricted to a short course (1 to 2 days), unless there is evidence of adrenal insufficiency.

※ <u>If the glucose level would not improve, we should transfer to higher level hospital to provide central venous fluid therapy (GIR can increase up to 20 mg/kg/min with central venous line).</u>

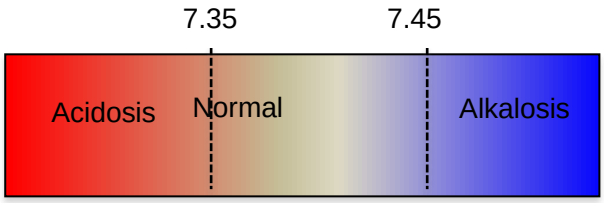
When to provide steroids to newborns?

Hydrocortisone: acute adrenal insufficiency, congenital adrenal hyperplasia, vasopressor-resistant hypotension and adjunctive treatment for persistent hypoglycemia.

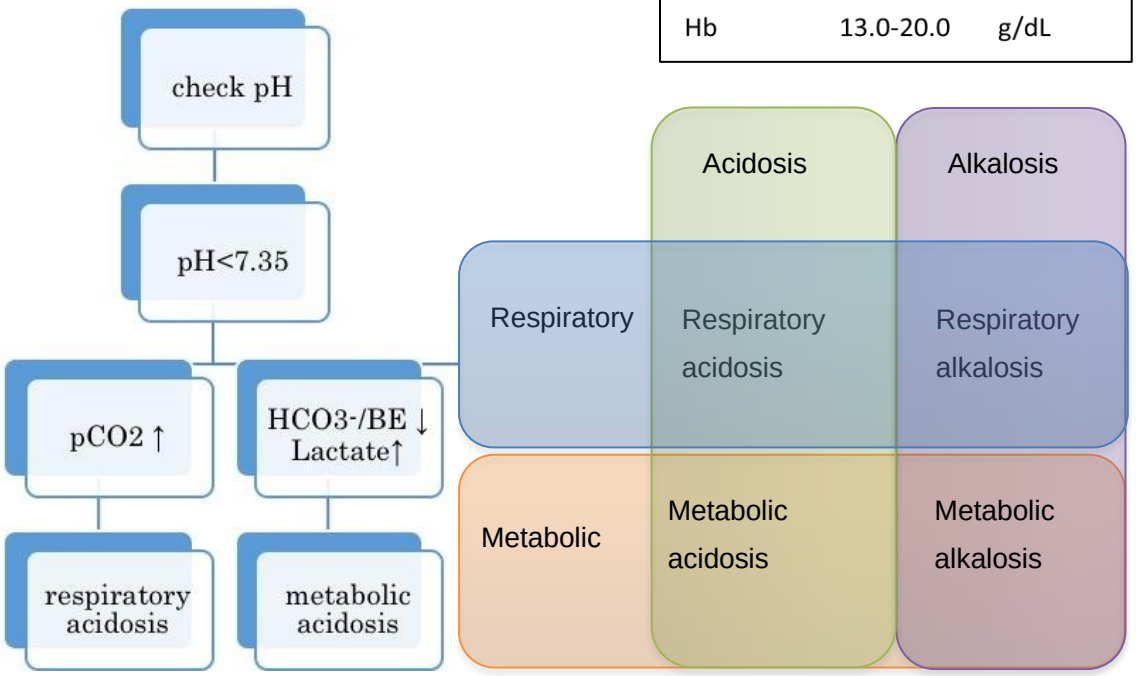
Dexamethasone: treatment of airway edema prior to extubation. Bronchopulmonary dysplasia (facilitate ventilator weaning).

2. Metabolic acidosis

< Standard score >



pH	7.35-7.45	
pCO2	35-45	mmHg
pO2	65.0	mmHg
BEecf	-2 - +2	mmol/L
HCO3-	22-26	mmol/L
Na	135-145	mmol/L
K	3.5-5.5	mmol/L
iCa	1.00-1.25	mmol/L
Glu	40-150	mg/dL
Hct	50-65	%
Hb	13.0-20.0	g/dL



< Etiology & Causes >

Etiology	Causes
Increasing Lactate **(Accumulation of nonvolatile acid)**	Lactic acidosis Congenital metabolic disorder Dehydration Shock (Asphyxia / Sepsis)
Decreasing HCO3-	Renal tubular acidosis Diarrhea

< Treatment >

4.2% NaHCO3 (ml) = weight (kg) × Base Excess (BE) × 0.3

Administer over 30-60 minutes DIV

<Notes>

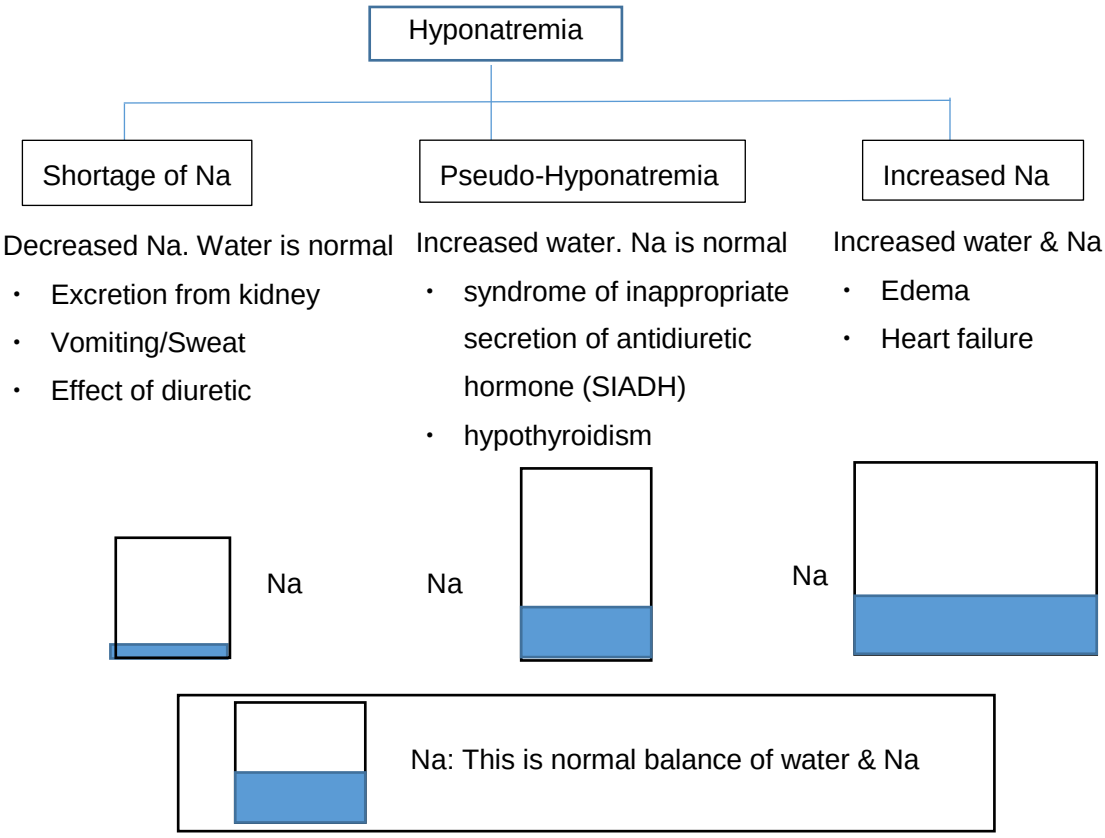
- Start treating acidosis when pH level is lower than 7.25
- Avoid giving rapid infusions of bicarbonate (< 5minutes)
- Use bicarbonate 4.2 %
  (Use sodium bicarbonate 8.4% and make it 4.2% by diluting with the same amount of sterilized water)
- If you cannot check the actual level of Base Excess, use the estimated amount and calculate.
- Be aware of hypernatremia. **(**Sodium carbonate :7%MEYLON® contains Na :833mEq/L).

3. Electrolytes

Na *Sodium* (standard range: 135-145 mEq/L)

Hyponatremia

<Etiology> The treatment for hyponatremia varies depending on the underlying etiology.



< Causes >

Onset	Common causes
Early onset (First week of life)	• Free water excess (Increased maternal free water intake during labor or syndrome of inappropriate secretion of ADH (SIADH)) • Insufficient Na intake from oral feeding or intravenous fluids
Late onset	・Shortage of Na (This condition may occur from either inadequate sodium intake or excessive renal losses) ※This might happenfrequently to neonates of the followings ; preterm, perinatal asphyxia, respiratory distress, pneumothorax, interventricular hemorrhage

< Investigation >

Check the Water Balance, Body weight, Plasma/Urine Na concentration, Plasma/Urine osmolality

< Treatment >

- Pseudo-Hyponatremia type: Restriction of water
- Increased Na type: Restriction of water, Providing diuretic 0.5-1 mg/kg/dose IV
- Shortage of Na: Oral or intravenous feeding **0.5-4** mEq/kg/day

10%NaCl	1ml=1.7meq
Normal Saline (0.9%)	1ml=0.154mEq
Salt	1g=17mEq

Hypernatremia

<Etiology & Causes>

The treatment for hypernatremia varies depending on the underlying etiology

Etiology	Common causes
Excessed Na	Excessive administration of • 10%NaCl • Sodium Bicarbonate (7%MEYLON® contains Na :833mEq/L)

Increased water loss	• Inadequate TWI • Vomiting/Diarrhea • Diabetes insipidus

< Investigation >

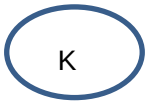
Check the Water Balance, Body weight, Plasma/Urine Na concentration, Plasma/Urine osmolality

< Treatment >

Excessed Na administration type: Change the infusion to Na-free fluid

※ Caution: Do not correct the Na concentration rapidly. It has a risk of leading the baby to cerebral edema.

Increased water loss type: Provide enough water intake.



Potassium (standard range: 3.5 - 5.5 mEq/L)

Hypokalemia

<Etiology & Causes>

Etiology	Common Causes
Shortage of K	Insufficient K intake from oral feeding or intravenous fluids
Redistribution of K	Alkalosis Hyper-Insulin
Increased K loss	By urine: Medicine induced (furosemide) By digestive tract: Vomiting/Diarrhea

<Treatment>

- Redistribution of K: Treat the causes
- Shortage of K: Provide K by Oral or intravenous, 0.5～2 mEq/kg/day

  1mmol KCL 1ml=1mEq

※ Caution: Do not correct the K concentration rapidly. It has a risk of leading the baby to arrhythmia. Usually, we mixed KCL with main infusion.

Hyperkalemia

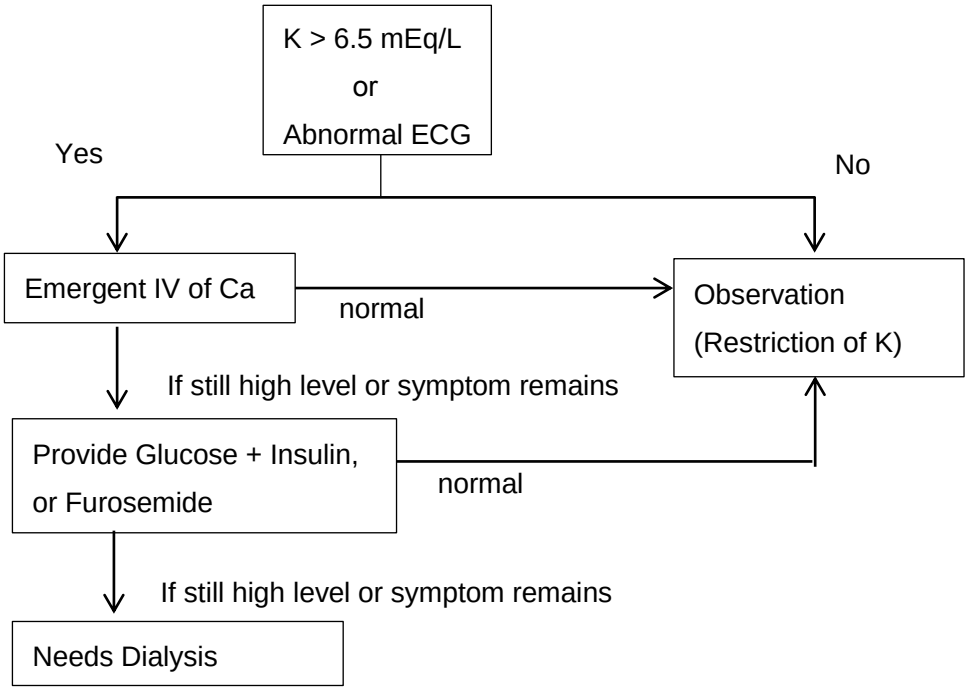
<Etiology & Causes>

Etiology	Common causes
Hemolysis	Often caused by blood collection procedures (squeezing too strong), Leaving the sample for longtime
Excessive administration of K	Blood transfusion (In particular, Old red blood cell transfusion)
Redistribution of K	Destruction of the tissues and cells (Hemorrhage, Under nutrition?) Hypo-Insulin Metabolic acidosis Medicine (Mannitol, β -blocker)
Excretory disorder of K	Severe dehydration Nonfunctional mineralocorticoid Adrenal insufficiency

<Treatment>

- Redistribution type: Treat the causes

- Excessive administration of K:



- Ca … Calcium gluconate (Calcicol) slowly IV (5 minutes)
  2ml/kg/dose diluted the amount twice with sterilized water

- Insulin … Glucose and insulin infusion

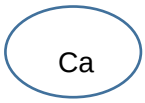
<One shot method>

Glucose (0.5g /kg) + Insulin (0.1 IU/kg): Slow IV (15-30 minutes)

<Continuous drip infusion method>

Glucose (0.5g /kg) + Insulin (0.1 IU/kg) DIV (0.8ml/kg/hr)

- Furosemide: 0.5-1 mg/kg/dose IV



iCa (low Ca level <0.75 mmol/L)

Hypocalcemia

It occurs more commonly in infants who are preterm or fetal growth restricted, born to mothers with diabetes, after perinatal asphyxia, or who have hypoparathyroidism.

<treatment>

・ One shot method

Calcium gluconate (Calcicol): Slow IV (over 5 min)

2ml/kg/dose diluted twice with sterilized water

・ Continuous drip infusion method

See Chapter7: Fluid management

Reference:

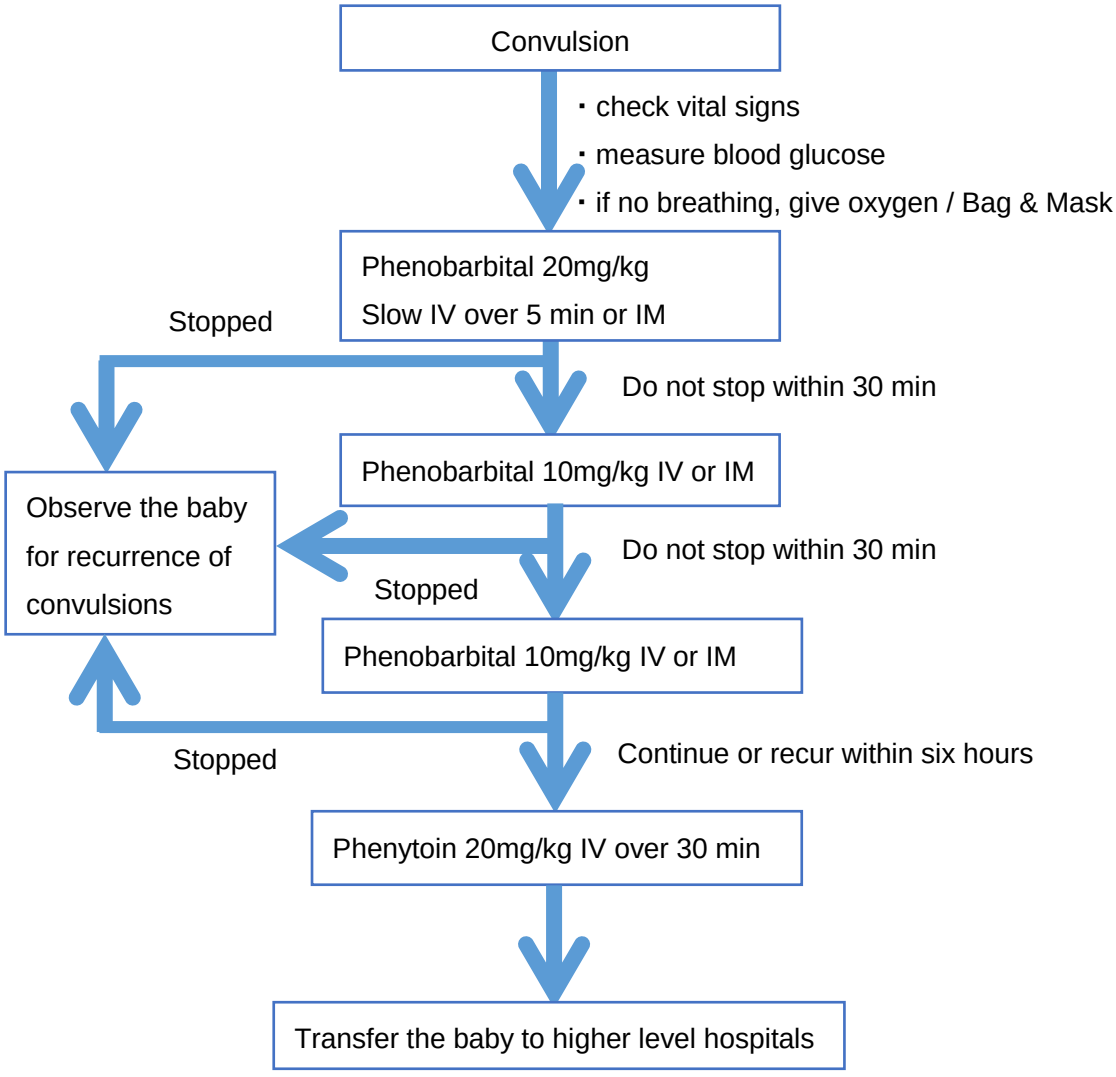
1) Cambodia MoH, Safe Motherhood Protocol for referral hospital. 2013
2) Kawai Masahiko. Electrolytes. Neonatal Care, 81-87, 2013.
3) Katherine MacRae Dell. Electrolytes, and Acid-Base Homeostasis. Neonatal-Perinatal Medicine 9th edition. 669-685
4) Chan SW. Neonatal hypoglycemia. UpToDate. Waltham,MA:2010. World Health Organization. Hypoglycemia of the Newborn, Review of the Literature :1997
5) Stanley, CA.Hypoglycemia in the neonate. Pediatr. Endocrinol. ReV4, 252-259, 2006
6) Green Baum LA. Acid-Base balance. Kliegman RM. Nelson Textbook of pediatrics. 19thPhiladelphia. Sauders, 229-242.2011
7) Yuki Hasegawa: Metabolic acidosis. SYOUNIKA-SINRYO, 65-69,2013

Chapter 9: Convulsion

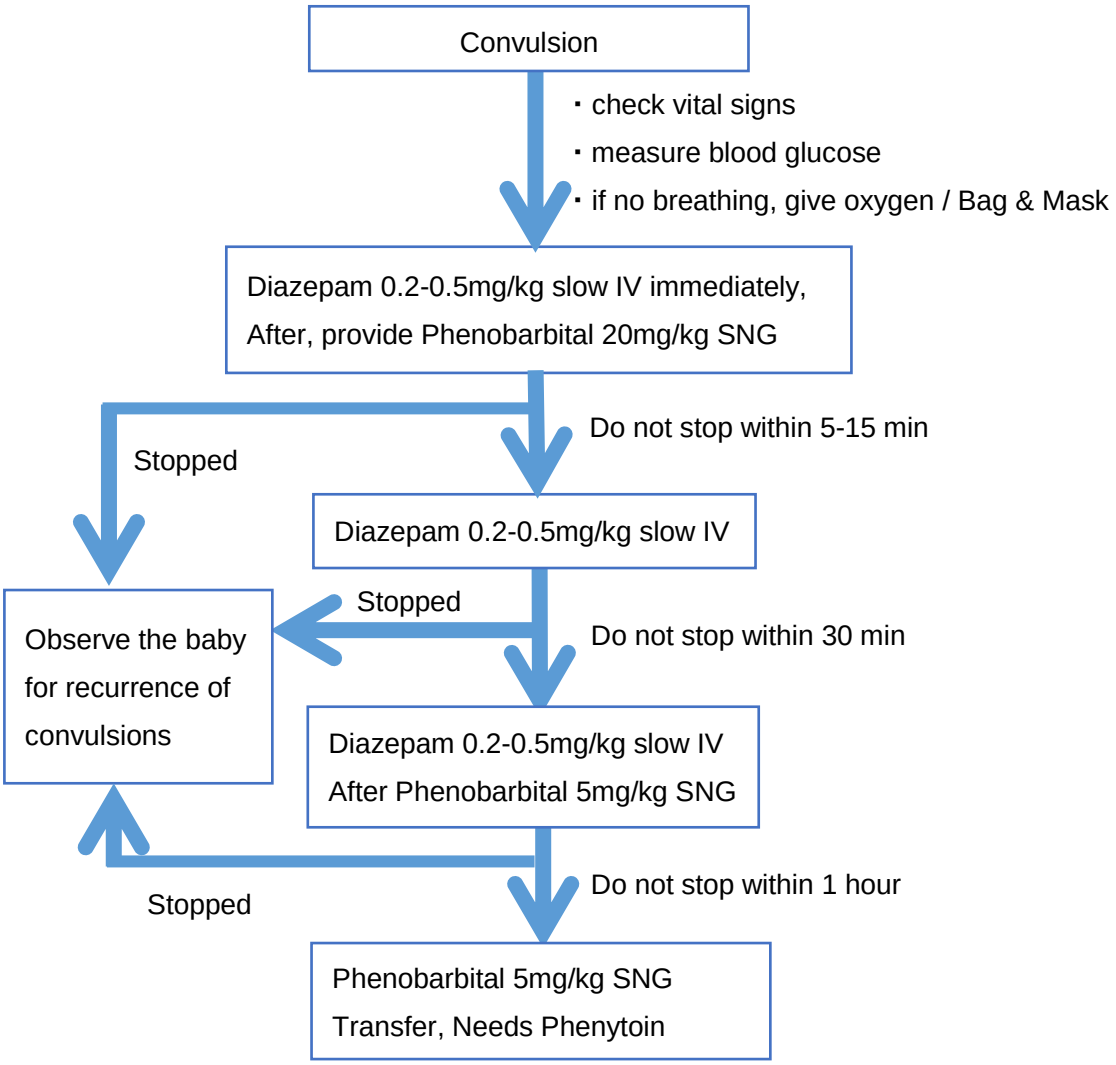
——Contents————————————————————————————

——

1-1. Flow charts of acute treatment (Recommended)



1-2. Flow charts of acute treatment (alternative)



- Be careful with circulatory collapse and respiratory failure!
- For diazepam, if IV line is not yet established, give IR.

<Caution> Diazepam is prohibited in the National guideline [*Safe Motherhood Clinical Management Protocols Referral hospital, June 2013*] published by the Ministry of Health. But in current situations, anticonvulsants that we have are only diazepam (ampoule) and phenobarbital (tablet). If you don't have a Phenobarbital ample, you can use Diazepam instead to stop convulsion. However, careful use and close monitoring is essential.

2. Causes of neonatal seizures

Perinatal asphyxia
Intracranial hemorrhage Subarachnoid hemorrhage / Periventricular or intraventricular hemorrhage / Subdual hemorrhage
Metabolic abnormalities Hypoglycemia/ Hypocalcemia / Hyponatremia/ Hypernatremia Amino acid disorders/ Pyridoxine dependency
Congenital malformations
Infections Meningitis/ Encephalitis/ Syphilis/Cytomegalovirus infections Toxoplasmosis, Herpes simplex/ Cerebral abscess
Drug withdrawal
Miscellaneous disorders Zellweger syndromes/ Tuberous sclerosis/Benign familial neonatal seizures etc

3. Management

< Investigation >

Complete blood cell count, blood gas, coagulation test,

Blood glucose should be checked to differentiate them.

Cerebral echogram and EEG, CT or MRI, and lumber puncture is useful to diagnosis meningitis.

< Treatment >

If hypoglycemia, other electrolyte imbalances or infection present, treat it before antiepileptic drug treatment is considered.

1. Phenobarbital (*Gardenal*)

Injection: IV, Tablet: by NG tube

Loading dose: 20mg/kg (injection: slow IV over 5 min)

Maintenance dose: 3-5mg/kg (first dose given 12hrs after loading, after given every 24 hrs)

<Caution> Phenobarbital is long-acting drug. Its half-life is greater in premature infants or infants with hypoxic-ischemic encephalopathy. The standard dose has a potential of high serum levels and resultant toxicity. Giving phenobarbital should be stopped when adverse reactions are suspected.

Example of adverse reactions: apnea, hypoventilation, respiratory depression, drowsiness, hyperkinesia, bradycardia

2. Diazepam(injection:10mg/2ml): 0.2-0.5mg/kg/dose, slow IV

: 0.3-0.5mg/kg/dose, IR

*total dose should not exceed 2mg/kg/day

3**.** Phenytoin: Loading dose: 15-20mg/kg over at least 30 min, IV

Maintenance dose: 4-5 mg/kg every12 hrs, IV / oral

How to provide loading dose: mix the total dose of phenytoin in 15ml of NS and infuse at the rate of 0.5 ml/min (30 ml/hr) over 30min

4.Fosphenytoin: Loading dose: 15-20mg/kg over at least 10min or IM,

Maintenance dose: 4-8mg/kg every 24hrs

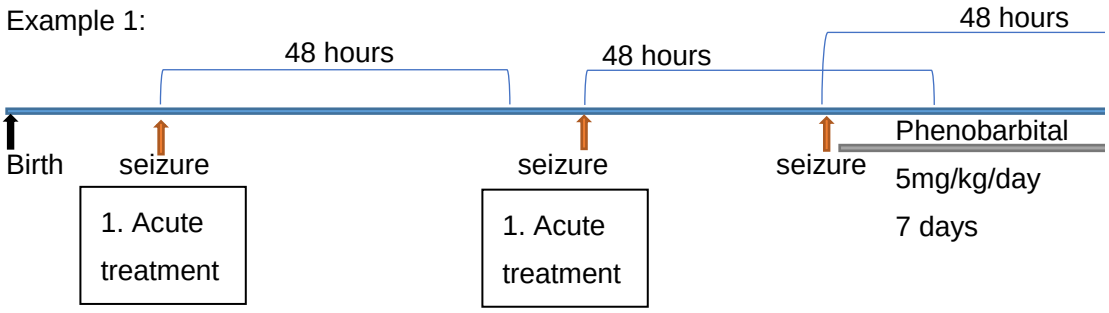
<After episodes of convulsion>

- If convulsion recur after two days without convulsions, go back to <1. Flow charts of acute treatment>
- If convulsions recur within two days, give Phenobarbital 3-5mg/kg, once daily from NG tube or by mouth until the baby has not had a convulsion for seven days.
- If the baby is receiving daily Phenobarbital:
  - Continue Phenobarbital for seven days after the last convulsion;
  - Once Phenobarbital is discontinued, observe the baby for an additional three days.

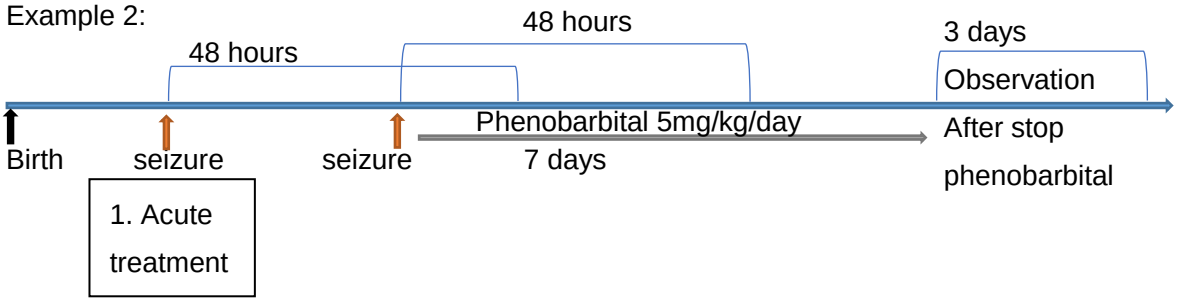
※ **In the absence of clinical seizures, neonates with hypoxic-ischemic encephalopathy need not to be given prophylactic treatment with phenobarbital.**

WHO recommendations on newborn health: guidelines approved by the WHO Guidelines Review Committee. Geneva: World Health Organization; 2017 (WHO/MCA/17.07). Licence: CC BY-NC-SA 3.0 IGO.

Example 1:



Example 2:



References;

1) Eli M Misrahi et al: Etiology and prognosis of the neonatal seizures, Up to date http://www.uptodate.com/ , Literature review current through: Dec 2013. | This topic last updated: 96, 2012.
2) Sandra L. Gardner et al: Merenstein & Gardner's Handbook of Neonatal Intensive Care Ed 7: 765-774, 2011.
3) Tricia Lacy Gomella et al: Lange, NEONATOLOGY Ed 7: 129 Seizures, 857-865, 2013.
4) Safe Motherhood Clinical Management Protocols, Referral Hospital: Ministry of Health, National Reproductive Health Program: 124, June 2013
5) Pocket Book of Hospital care for children, Guidelines for the management of common childhood illness: World Health Organization Ed 2: 54, 2013
6) Jeffrey L. Segar, MD, John M. Dagle, MD, PhD, and Sarah B. Tierney Pharm: Dosage Recommendations for Anticonvulsants, Iowa Neonatology Handbook: The University of Iowa: 2015
7) R. Shellhaas: Treatment of neonatal seizures. Up To Date: Accessed 24 Jan 2019.
8) WHO recommendations on newborn health: guidelines approved by the WHO Guidelines Review Committee. Geneva: World Health Organization; 2017 (WHO/MCA/17.07). Licence: CC BY-NC-SA 3.0 IGO.

Chapter10: Infection

— Contents ————————————————————————

————————————————————————————————

1. Neonatal sepsis

1. Definition

- Neonatal sepsis is a clinical syndrome of systemic illness accompanied by bacteremia (positive blood culture) occurring in the first 4 weeks of life (WHO 2010).
- Suspected sepsis becomes confirmed sepsis when the blood culture proved positive.
- Neonatal sepsis is characterized as early or late onset sepsis. Early onset sepsis occurs at 0-72 hours and late sepsis is more than 72 hours after birth.

< Germs responsible for neonatal sepsis >

Sepsis stage	Dominant germs
Early onset sepsis	E coli, GBS, Enterobacter, Enterococcus, and Listeria
Late onset sepsis	Pseudomonas spp, Salmonella, and Serratia
Both	Klebsiella, Acinetobacter, Coagulase negative staphylococci (CON), and Staphylococcus aureus

2. Risk factors of neonatal sepsis

< Well-newborns at risk for sepsis >

➢ Risk factors

- Maternal fever >38.5℃
- Maternal prolonged rupture of membranes >18 hours
- Foul-smelling, purulent appearing amniotic fluid

These babies can stay with the mother if there is no sign of infection.

< Laboratory investigation >

Blood specimen	**Timing of Blood Draw**			**Exact volume of blood**
	1-3 hours	24 hours	48 hours	
Blood culture and sensitivity	✓			1 ml
CRP		✓	✓	1 ml
White blood cell count and differential	✓	✓		

(Antibiotics should be given immediately for suspected sepsis after blood specimens are taken)

- Ampicillin IM/IV 50mg/kg every 12 hours,
  and
- Gentamicin IM/IV
  Body weight < 2500g: 3mg/kg once daily
  Body weight > 2500g: 5mg/kg once daily

< Interpretation of results >

Specimen source	**Laboratory result**	
	Positive	Negative
Blood culture sensitivity	Growth 48 hours incubation	No growth at 48 hours of incubation
CRP	> 10mg/dl	≦10mg/dl
WBC	<6000 or 30,000	6000-30,000
Immature/Total (I:T) WBC ration	≧ 0.2	< 0.2

- If all results are negative at 48 hours and the baby has no sign of sepsis: stop antibiotics.
- If any results are positive at any time, continue antibiotics for 10 days, except Gentamicin.
- If there is no laboratory capacity, while the newborn is well appearing; Continue antibiotics for 10 days, except Gentamicin.

※ Gentamycin is given for no more than seven days in all cases because of its toxicity. (especially, ototoxicity)

3. Signs of suspected sepsis

Clinical signs and symptoms of sepsis are nonspecific, and the differential diagnosis is broad. Some signs are subtle, and therefore high index of suspicion is required.

Clinical Presentation
1. Respiratory rate > 60 breaths (count for 1 minute)
2. Chest in-drawing
3. Continuous grunting after a period of skin-to skin contact
4. Hypothermia < 35.0℃ which does not respond to warming
5. Hyperthermia > 38.0℃
6. Temperature irregularity
7. Episodes of Apnea attack
8. Bradycardia (Heart Rate <100)
9. Episodes of cyanosis (blue) or pallor (white)
10. Convulsions
11. Bulging fontanel
12. Hypotonic
13. Any jaundice appears <24 hours or jaundice appears on the palms and soles at any time
14. Bleeding from the nasal-gastric tube, bloody stool
15. Abdominal distention
16. Pus from the umbilical cord
17. Moderate dehydration (dry mucous membranes, delayed capillary refill more than 3 seconds, sunken eyes or fontanel, or loss of skin elasticity)
18. Preterm <34 weeks gestational age delivered with thick meconium or meconium stained amniotic fluid (may indicate Listeria monocytogenes infection)

4. Clinical and laboratory findings

< Clinical investigation >

Clinical investigation is required at any time for newborns having any signs above. Following laboratory protocols, the specimens below should be taken:

Specimen	Timing of Blood/Cerebro- Spinal Fluid (CSF) Collection		Exact volume of blood/CSF
	Within 1 hour of onset of sign	24 hours	
Blood culture and sensitivity	✓		1 ml
CRP	✓	✓	1 ml
White blood cell count and differential	✓	✓	
Lumber puncture for CSF Culture, counts for WBCs, gulcose and protein level	✓		1 ml (0.5 ml/tube)

<Notes>

- Lumbar puncture should be done if meningitis is suspected or sepsis is confirmed by positive blood culture.
- Lumber puncture should not be done in case of coma, ongoi disturbance of consciousness, papilloedema, focal neurological signs, continuous convulsion, compromised cardio-respiratory status, bleeding disorder, or local infection at the lumbar area.

<Interpretation of laboratory results>

Specimen source	Laboratory results	
	Positive	Negative
Blood culture	Growth at 48 hours incubation	No growth at 48 hours if incubation
CRP	> 10 mg/L	≦ 10 mg/L
White blood cell count and differential	< 6,000 > 30,000	6,000-30,000
Immature; Total (I;T) WBC ratio	≧ 0.2	< 0.2
CSF (1mL) **Culture or Gram Stain** **WBCs < 7 days old** **> 7days old** **Protein** **Gulcose**	 Positive ≧ 20 /mm ≧10 /mm > 0.4 g/L < 1.5 mmol/L	 Negative < 20 /mm < 10 /mm ≦0.4 g/L ≧ 1.5 mmol/L

<Notes>

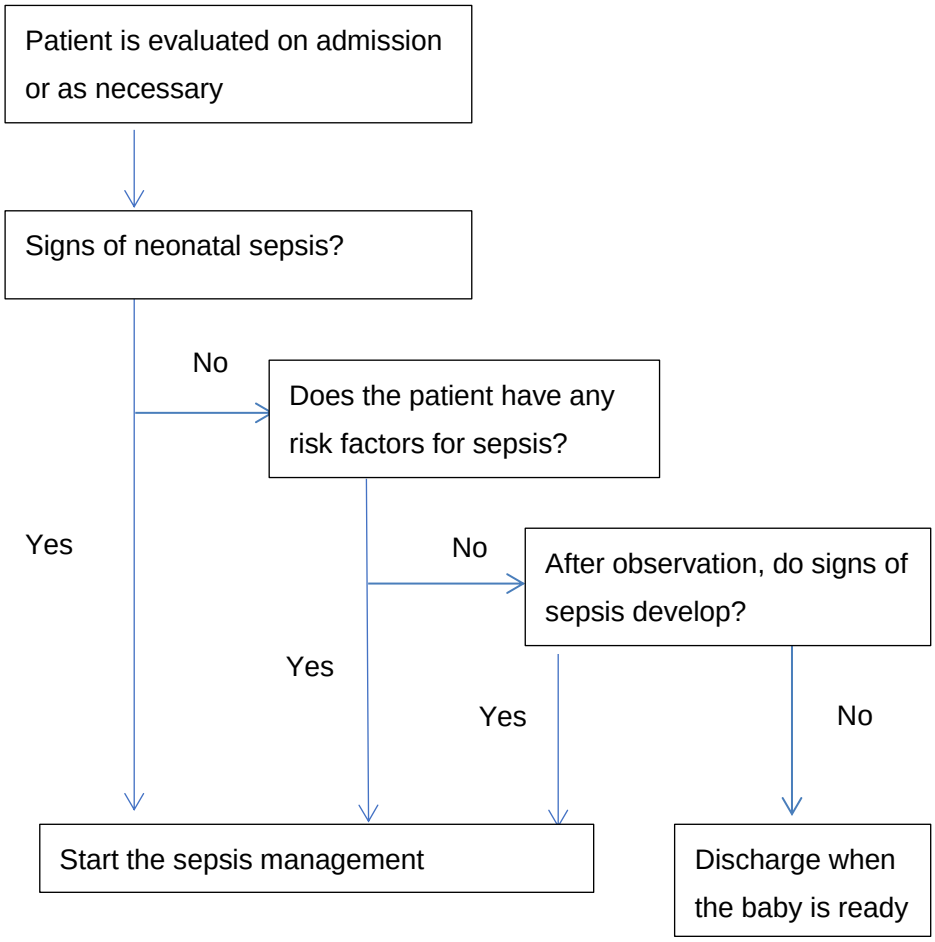
- Observe the baby carefully whether there is an additional signs of sepsis or not.
- Make assessments for every 2 hours up to 12 hours: If additional signs of sepsis are found during the observation period, go back to the septic protocols and start the appropriate treatment at any time.
- If any results are posotive , or signs of sepsis remain, or laboratory test has not done yet: continue antibiotics for 10 days. If there is a possibility of drug resistance for Ampicillin or Gentamicin, change the antibiotic to Ceftriaxone. Conitnue Ceftriaxone for 10 days.
- If all laboratory results(i.e.,blood culture taken 1hour after the first sign,and CRP,WBC/I:T taken both 1 hour and 24 hours after the first sign) are negative and has no signs of sepsis : stop antibiotics at 48 hours after the first dose.

5. Treatment

<table>
<tr><th></th><th>1st week of life</th><th>2-4 week of life</th></tr>
<tr><td>1st line AB</td><td>Ampicillin + Gentamicin
・ Ampicillin(IV) 50mg/kg every 12 hrs
・ Gentamicin (Slow IV):
BW< 2500 g 3mg/kg once daily
BW≧ 2500 g 5mg/kg once daily</td><td>Ampicillin + Gentamicin
・ Ampicillin(IV) 50mg/kg every 8 hrs
・ Gentamicin (Slow IV or IM):
7.5mg/kg once daily regardless of BW</td></tr>
<tr><td colspan="3">Change to Second-line therapy if newborn on first-line theraphy whose clinical signs have not started to improve after 48 hours of treatment, or whose blood culture results show resistance to 1stline AB.</td></tr>
<tr><td>2nd line AB</td><td colspan="2">Add Ceftriaxone(IV) : 50mg/kg every 12 hrs</td></tr>
<tr><td>Severe NNS with multiple organs involvement (respiratory distress, apnea, circulatory failure, convulsion, bulging fontanel…)</td><td>Ceftriaxone + Ampicillin + Gentamicin
・ Ceftriaxone(IV): 50mg/kg every 12hrs
・ Ampicillin(IV): 100mg/kg every 12hrs
・ Gentamicin(slow IV or IM)
BW<2500 g 3mg/kg once daily
BW≧2500 g 5mg/kg once daily</td><td>Ceftriaxone + Ampicillin + Gentamicin
・ Ceftriaxone(IV): 50mg/kg every 12hrs
・ Ampicillin(IV): 50mg/kg every 12hrs
・ Gentamicin(slow IV or IM)
7.5mg/kg once daily regardless of BW</td></tr>
</table>

Meningitis (Duration of treatment should be continue for 3 weeks)	Ceftriaxone + Ampicillin + Gentamicin ・ Ceftriaxone(IV): 50mg/kg every 12hrs ・ Ampicillin(IV): 100mg/kg every 12hrs ・ Gentamicin(slow IV or IM) BW<2500g 3mg/kg once daily BW≧2500g 5mg/kg once daily	Ceftriaxone + Ampicillin + Gentamicin ・ Ceftriaxone(IV): 50mg/kg every 12hrs ・ Ampicillin(IV): 50mg/kg every 12hrs ・ Gentamicin(slow IV or IM) 7.5mg/kg once daily regardless of BW
If > 10 skin pustules	Cloxacilin + Gentamicin ・ Cloxacillin(IV) : 50mg/kg every 8 hrs(10days) ・ Gentamicin(slow IV or IM) BW<2500g 3mg/kg once daily BW≧2500g 5mg/kg once daily	Cloxacilin + Gentamicin ・ Cloxacillin(IV) : 50mg/kg every 8 hrs(10days) ・ Gentamicin(slow IV or IM) 7.5mg/kg once daily regardless of BW
Necrotising Enterocolitis	Metronidazole + Ampicillin + Gentamicin ・ Ampicillin(IV) 50mg/kg every 12 hrs ・ Gentamicin (Slow IV): BW<2500g 3mg/kg once daily BW≧2500g 5mg/kg once daily ・ Metronidazole 7.5mg/kg every 8 hrs	Metronidazole + Ampicillin + Gentamicin ・ Ampicillin(IV) 50mg/kg every 8 hrs ・ Gentamicin (Slow IV or IM): 7.5mg/kg once daily regardless of BW ・ Metronidazole 7.5mg/kg every 8 hrs

6. Triaging Framework for newborn to exclude sepsis



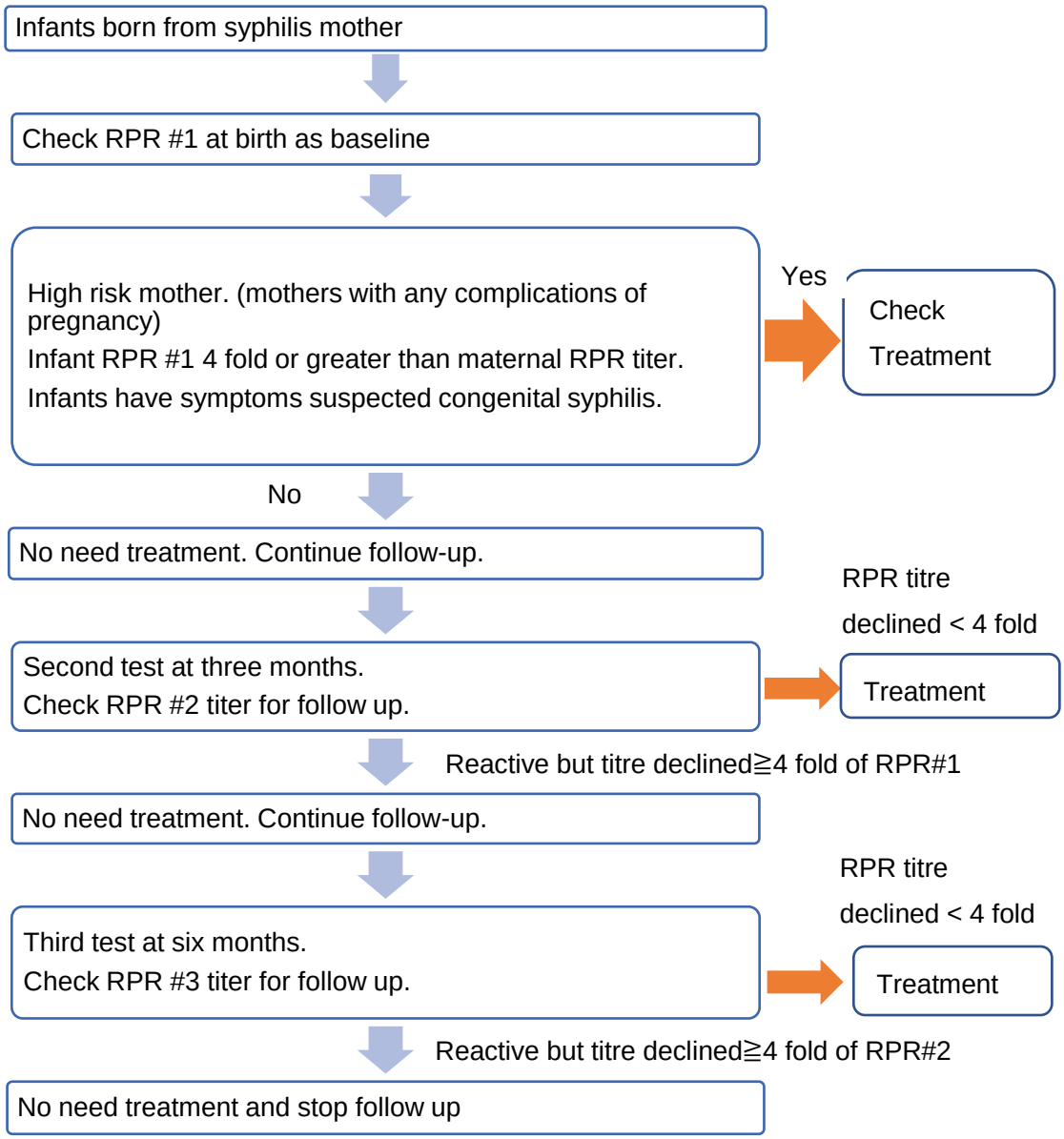
2. Syphilis

Syphilis is a sexually transmitted disease caused by Treponema pallidum.

- Early Congenital Syphilis is when clinical manifestations occur at > 2 years of age.
- Late Congenital Syphilis is when manifestations occur at > 2 years of age.

Treponemas appear able to cross the placenta at any time during pregnancy, thereby infecting the fetus. Syphilis can cause preterm delivery.

➢ Flow chart of management for infants with high risk of syphilis



<Clinical Presentation>

Generally, Neonates do not have sign of Primary Syphilis from in utero-acquired infection, 2/3 show no clinical signs of infection at birth and are identified by routine Perineal Screening.

Placentomegaly and congenital hydrops are clues to diagnose congenital syphilis.

Early congenital syphilis: Hepatosplenomegaly, jaundice, osteochondritis, lymphadenopathy, pneumonitis, myocarditis, nephrosis, pseudo paralysis (atypical Erb's palsy), rash (vesiculobullous especially on the palms and soles), hemolytic anemia (normocytic or normochromic), leukemoid reaction and hemorrhagic rhinitis (snuffles),

Late Congenital Syphilis: Hutchinson's teeth, healed retinitis, eighth nerve deafness, saddle nose, mental retardation, arrested hydrocephalus, saber shins.

<Treatment>

Need treatment:

- An infant with no clinical symptoms but the mother does not complete treatment for syphilis.
- A mother completes the treatment within 30 days of delivery.
- A mother treats syphilis with not penicillin. (e.g. erythromycin, ceftriaxone)
- An infant has clinical symptoms of syphilis
- An infant RPR’s titer not declined ≧ 4 folds of mother’s titer

Infants with no symptoms admit to the maternity ward.

Choose either treatment 1 or 2.

① Aqueous crystalline penicillin G 100,000 – 150,000 U/kg/day as 50,000 U/kg/dose IV every 12 hours during the first 7 days of life and every 8 hours thereafter for a total of 10 days

② Procaine penicillin G, 50,000 U/kg/day single dose intramuscularly for 10 days

If 24 or more hours of therapy is missed, the entire course must be restarted.

Infants receive treatment at national pediatric hospital or family health clinics, after mothers discharge from NMCHC. NCU staff should give referral sheets (include medication record) at discharge.

Reference:

1) Neonatal sepsis, National Clinical Practice Guideline, April 2013
2) T. Gomella, Neonatology seventh edition. McGraw-Hill Edition / Medical
3) Treatment of Congenital Syphilis (Cambodia National guideline)

Chapter 11: Nutrition

——Contents————————————————————————————

————————————————————————————————————

- Good nutrition is essential for survival, physical growth, mental development, performance, productivity, health and well-being across the entire life-span, especially for low birth weight babies.
- Insufficient nutrition increases the risk of communicable disease, and certain non-communicable disease in the future.

1. Benefit of breast milk and breastfeeding

Breastfeeding is the most effective way to ensure child health and survival. It provides many benefits for the baby as below.

- Increased gastrointestinal health
- Increased immunities
- Decreased allergies and eczema
- Decreased rates of diabetes in the future
- Decreased rates of respiratory illness
- Stimulates a good relation of mother-child attachment etc.

Using Formula milk has 6-10 times higher occurrence of NEC than breast milk in preterm infants.

2. Feeding methods

<Criteria for initiating feeding>

Term healthy infants	within the first hour
Premature babies	within 24 hours

If the clinical condition is not stable, you should refrain from feeding.
Ex) Vomiting, Distended abdomen, Respiratory distress, Apnea, Hemodynamic instability (including PDA)

<Feeding schedule>
Colostrum, the yellowish, sticky breast milk produced at the end of pregnancy, is recommended by WHO as the perfect food for the newborn, and feeding should be initiated **quickly after birth when the baby is clinically stable.**

Body weight	Initial volume	Daily increase of each volume
<1000g	0.5 - 1 ml	0.5 - 1 ml
1000-1500g	1 - 2 ml	1 - 2 ml
1500-2000g	3 - 4 ml	3 - 5 ml
2000-2500g	5 - 10 ml	5 - 10 ml
>2500g	10 - 15 ml	10 - 15 ml

<Frequency>
Every 3 hours
→If the baby can't maintain blood glucose level, and happens to vomit because of full stomach, or to have apnea many times, we should consider to change the feeding frequency to every 2 hours.

<Full feeding>

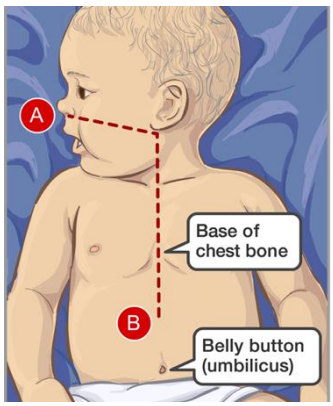
< 1000g	120 ml/kg/day
1000 – 1500g	120-140 ml/kg/day
> 1500g	140-160 ml/kg/day

This is because of avoiding abdominal distention, respiratory stress, vomiting, chronic lung disease, retinopathy of prematurity.

<feeding>

A. Gastric tube

- Estimate the required length of the tube:
  From the tip of nostil (A) to the lower tip of the ear lobe and to the middle of the base of chest bone and umbilicus (B).
- Insert a gastric tube via the nostril. When using Nasal prong for CPAP, insert it via the mouth.



To confirm proper placement:

- Inject air quickly with the 1ml syringe, and check the bubble sound with the stethoscope on the baby's stomach.
- Aspirate digestive fluids with the 1ml syringe.

B. Oral feeding

- Oral feeding should not be started until the baby becomes more than 34weeks of GA and body weight >1500g.
- DO NOT feed a baby with bottles. Use a cup (with a beak), spoon or NG tube.

How to cup feed a baby

■ Hold the baby sitting upright or semi-upright on your lap, wrap the baby with a cloth to provide some support and to stop his or her hands from knocking the cup.

■ Hold the cup of milk resting on the lower lip so that the Rim touches the baby's upper lip.

■ Tip the cup so that the milk just reaches the baby's lips.

■ A younger baby will start to take milk into his mouth with his tongue. A term or older baby will suck the milk, spilling some of it.

■ DO NOT POUR the milk into the baby's mouth. Just hold the Cup to the baby's lips and let him or her take it him- or herself.

■ When he or she has had enough , the baby closes his or her mouth and will not take any more. If the baby has not taken

The calculated amount, he or she may take more at the next feed, or you may need to give feeds more often.

■ Measure the intake over 24 hours = not just at each feed

<Milk preservation time>

Type of breastmilk	Preservation methods	Should be used within…
Fresh breastmilk (just expressed from a mother)	Room temperature	4 hours
	Refrigerator	2-4 days (should be put into refrigerator immediately after expression from a mother)
	Freezer (<= -20℃)	1 month
Defrost breastmilk	Room temperature (25-35℃)	4 hours
	Refrigerator	24 hours

(Nursing manual for Neonatal Care Unit. NMCHC Cambodia 2018)

3. Measurement of Calorie

The caloric value of dextrose (D-glucose): 4 kcal/g

Initial GIR to prevent hypoglycemia: Approximately 4 mg/kg/minutes. (For preterm: 4-8 mg/kg/min)

Increase GIR 1-2 mg/kg/minutes daily to a maximum of 11-12 mg/kg/min, by increasing infusion rate or glucose concentration.

Calories required for healthy growth and development: 120 kcal /kg /day

	Calorie (kcal/100ml)	Na (mEq/100ml)	K (mEq/100ml)	Ca (mg/100ml)	P (mg/100ml)	Protein (g/dL)	Fat (g/dL)
Breast-fed	65	0.65	1.23	27	14	1.3	4.0
Milk	76	1.39	2.46	68	37	1.7	3.5

< How to calculate the calorie >

If the milk is 10ml x 8 times…Body weight is 2 kg.

$$\frac{80 \text{ ml} \times 0.65}{2 \text{ kg}} = 26 \text{ kcal/kg/day}$$

4. Other nutrition

<Parenteral nutrition>

Indications for parenteral nutrition in neonates

Absolute Indications	• GA < 30 weeks • Birth weight < 1250 g • Failure to establish enteral nutrition* by day 5 of life (Enteral nutrition defined as ≧ 100 ml/kg/day, milk) • Any baby ≧ 5 days of age who becomes unable to tolerate enteral feeds for ≧ 24 hours.
Relative Indication	Any baby considered unlikely to establish enteral nutrition by day 5.

Newborn infants meeting an absolute criterion for PN should be started on intravenous (IV) glucose and amino acid (AA) solution as soon after birth as possible and IV lipid added within 24 hours.

< Lipid>

Lipids are an important component of parenteral nutrition for preterm infants. They are needed to be energy and provide essential fatty acid. Lipids should provide approximately 30 to 50 percent of nonprotein energy.

Lipofundin® MCT/LCT 10% (1000 ml = 1022 kcal)

Start from: 5ml/kg/day (0.5g/kg/day).

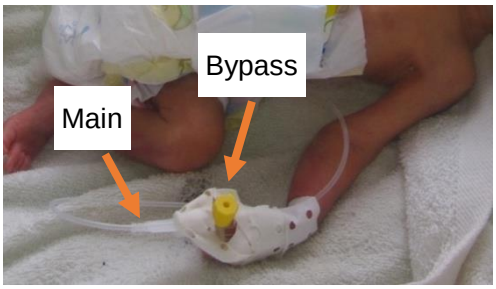
Increase: 5ml/kg/day daily, up to 20ml/kg/day (2g/kg/day).

※ Include lipid emulsion in calculations of total water intake.

※ Decrease the amount of lipid to 0.5 g/kg/day when adverse events occur.

- In principle, use single intravenous line. (One for main infusion, and the other for lipid)

- When lipids are to be simultaneously infused with carbohydrate solutions the Y- or the bypass connector should be placed as close to the patient as possible.



※ It should be made sure that solutions to be infused together with Lipofundin through the same tubing are compatible with the fat emulsion. (e.g. calcium gluconate cannot mix with lipofundin)

Example: Birth weight 1500g

Day	TWI	Total infusion speed	Main		Bypass	
			Contents*	Speed	Contents	Speed
0	60	3.8 ml/kg/hr	Dextrose + Ca	3.8 ml/kg/hr	-	0
1	70	4.4 ml/kg/hr	Dextrose	4.1 ml/kg/hr	Lipofundin	0.3 ml/kg/hr
2	80	5.0 ml/kg/hr	Dextrose + NS + Ca	5.0 ml/kg/hr	-	0
3	90	5.6 ml/kg/hr	Dextrose + NS	5.0 ml/kg/hr	Lipofundin	0.6 ml/kg/hr

* Refer Chapter 7: Fluid Management

- Syringes may be changed every 12 hours. Lipids emulsion increased the risk of catheter related blood stream infection.

- It should be infused continuously over 24 hours/day. Do not exceed 0.8 ml/kg/hr !
- If infusion speed is too slow and catheter gets clogged, consider to mixed Lipofundin with normal sarin or 5-10% Glucose.
- Stop Lipofundin when infants can achieve full enteral feeding (≧100 ml/kg/day)

Potential complications and risks:

- Hyperlipidemia
- Potential risk of kernicterus at low levels of unconjugated bilirubin because of displacement of bilirubin from albumin binding sites by free fatty acids.
- Potential increased risk or exacerbation of chronic lung disease
- Potential exacerbation of Persistent Pulmonary Hypertension (PPHN)
- Lipid overload syndrome with coagulopathy and liver failure
- Coagulation disorder

Monitor hemoglobin, platelet count, coagulation, liver function, triglyceride level.
At the first day (as baseline)

<Probiotic>

Probiotic supplementation significantly reduces all-cause mortality and definite necrotising enterocolitis without significant adverse effects in preterm neonates in many studies.

※ Practice in NCU
Enterogermina®
Half flacon, twice daily by oral or NG tube.
For premature infants born 30-34 GA.

<Vitamin>

The preterm infant has higher requirements for most vitamins.

※ Practice in NCU
Nutrigen Babytamin®:
10 drops daily directly to baby's mouth or mix with milk.
For premature, low birth weight, small for gestational age and weak infants.

NAME	AMOUNT	% EC NRV
Vitamin A	(1000 IU) 300 µg RE*	%38
Vitamin C	30 mg	%38
Vitamin D	(500 IU) 12,5 µg	%250
Vitamin E	4 mg α-TE	%33
Vitamin K	5 µg	%7
Vitamin B1	0,3 mg	%27
Vitamin B2	0,3 mg	%21
Vitamin B3	2 mg NE	%13
Vitamin B5	2 mg	%33
Vitamin B6	0,2 mg	%14
Vitamin B12	1 µg	%40
Folic Acid	40 µg (DFE 68 µg)**	%20
Biotin	5 µg	%10
Chromium	0,2 µg	%0.5
Copper	200 µg	%20
Manganese	0,003 mg	%0.2
Selenium	15 µg	%27
Zinc	2 mg	%20
Iodine	90 µg	%60

5. Management of gastric residual

・Gastric residual: Under 10 % → Next milk: full amount.
・Gastric residual: Over 10 % → Next milk: return the residual back and minus it from the full amount.

For example, if a baby is taken 10 ml milk by SNG tube,

Gastric residual: 0.5 ml (Under 10 %) → Next milk: 10 ml, 0.5 ml Residuum is back

Gastric residual: 4 ml (Over 10 %) → Next milk: 6 ml, 4 ml Residuum is back

* If the remaining is bloody or contain biles, do not return it back. Consider to skip one feeding depending on body's condition.

<Bleeding from the SNG>

Main Cause	Etiology
Gastric Bleeding	・ Stress induced (AGML: Acute Gastric Mucosal Lesion), especially premature or asphyxia ・ Tube injury

Deficiency of Vitamin K	・ Prematurity, ・ Antibiotics, ・ Insufficient amount of feeding ・ Diarrhea …etc.
Pseudo Melena	Swallowing the mother's blood

* If bleeding does not stop, we should check the CBC (complete blood cell count) because the baby has a risk of hematology disease.

Treatment

Management	Skip one feeding and recheck gastric residual.
Medicine	・ VitaminK1 1mg IM / oral, one time (If possible, continue 1mg/week until three months old) ・ H2 blocker (cimetidine) 1mg/kg × 2 /day for 3 days IV ・ (Tranexamic acid (NEXi) 10mg/kg IV)

When to restart milk: Start milk, as soon as possible, when after bleeding is stopped from the SNG. It will lead to good nutrition.

Reference:

1) Evidence for the Ten Steps to successful breastfeeding. Geneva,WHO. 1998 (WHO/CHD/98.9)
2) Infant and young child feeding Model Chapter textbooks for medical students and allied health professionals WHO
3) Optimal feeding of low birth-weight infants in low-and-middle-income-countries. 2011 WHO Breastfeeding supportive guidelines, Japan academy of Midfirery.2010
4) SickKids, AboutKidsHealth: https://www.aboutkidshealth.ca/Article?contentid=984&language=English. Accessed 28 Jan 2019.
5) J. Cloherty, Manual of Neonatal Care. Lippincott Williams & Wilkins
6) I. Griffin, Parenteral nutrition in premature infants. Up To Date. Accessed 29 Jan 2019
7) Neonatal Parenteral Nutrition, Intensive Care Nursery House Staff Manual, UCSF Children's hospital. https://www.ucsfbenioffchildrens.org/pdf/manuals/47_TPN.pdf

Chapter 12: Cerebral Management

— Contents ————————————————————————

————————————————————————————————

1. Perinatal Asphyxia

Perinatal asphyxia is a condition of impaired blood gas exchange that, if persistent, leads to progressive hypoxemia and hypercapnia.
Perinatal asphyxia can result in CNS (cerebral nerve system) injury alone (16% of cases), CNS and other end-organ damages (46%).

< Symptoms >

Birth -12 hours	・ Deep stupor or coma, ・ Respiratory failure or periodic breathing, ・ Subtle or focal clonic seizures in 6-12 hours in term infants. ・ Preterm infants can present with generalized tonic seizures.
12-24 hours	・ If the brain injury is not so severe, the consciousness level would be improved
24-72 hours	・ If there is an ongoing disturbance of consciousness, it would lead to deep stupor or coma, and respiratory failures. ・ Pupillary and oculomotor disturbance ・ Death due to HIE (hypoxic ischemic encephalopathy) mostly occurs at this period.
After -72hours	・ Diffuse hypotonia of muscles may persist or become evident. ・ Feeding difficulties become obvious due to abnormal sucking.

< Physical examination >

You can measure the intensity of HIE via the *Sarnat Grading* Scale.

Stage Ⅰ Mild	・ Hyper alertness, normal muscle tone, weak sucking, low threshold Moro, dilated and reactive pupils and no seizures.

Stage Ⅱ Moderate	・ Lethargic or obtunded, mild hypotonia, weak or absent sucking, weak Moro, miosis, and focal or multifocal seizures
Stage Ⅲ Severe	・ Stupor, flaccid muscle tone, intermittent decerebration, absent sucking, absent Moro, and poor pupillary light response

< Examination>

Blood gas	Check the degree of Hypoxemia. PH<7.0, Base excess (BE) <-15mmol/L is one of the indications of poor neurological prognosis.
Blood examination	Complete blood cell count, AST, ALT, BUN, Cr, CK, LDH, Ca, Na, K, Cl, NH_3, Coagulation system.
Head ultrasound	Bright brain (indicates cerebral edema) Increase of diastolic blood flow (Resistance index: RI < 0.55 indicates poor prognosis.)

< Management >

As many cases of perinatal asphyxia are unpredictable and unpreventable, clinical care mostly focuses on providing supportive care to prevent further exacerbation of injury.

Resuscitation	See Chapter 3.
Ventilation	Assisted ventilation may be required to maintain PCO_2 within the physiologic range.
Fluid status	・ Fluid restriction (10 -20 %) is recommended. ・ The avoidance of volume overload helps averting cerebral edema. ・ Furosemide 1-2mg/kg IV 2-4times a day
Acid-base status	Acidosis normalizes in the majority of infants within 4 hours of life, regardless of using bicarbonates.
Blood glucose	Initial hypoglycemia (< 40 mg/dl) in the context of HIE amplifies the risk of progression from moderate to severe encephalopathy.
Seizures	See Chapter 9: Convulsion

- Dexamethasone is not proved to be effective preventing cerebral damage. Nowadays, it is not recommended to use.

2. Intraventricular hemorrhage: IVH

20% of <1500g babies have a risk of IVH.
90% of IVH occur within 72 hr.

< Symptoms >

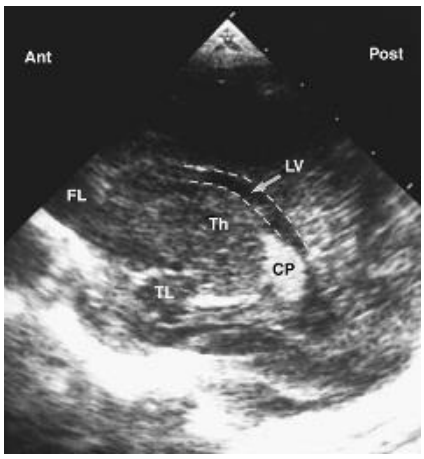
Apnea, irritability, abnormal movement of eyes and limbs, seizure, bulging of the anterior fontanelle, changes in muscle tone, changes in level of consciousnessss.

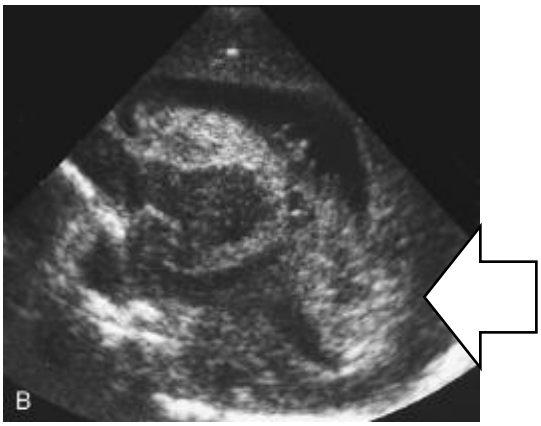
< Diagnosis >

Ultrasonography is the most simple and assured way of diagnosis.

Papile classification

Grade Ⅰ	Germinal matrix hemorrhage
Grade Ⅱ	Intraventricular hemorrhage without ventricular dilation
Grade Ⅲ	Intraventricular hemorrhage and with acute ventricular dilation
GradeⅣ	Intraparenchymal hemorrhage





A. B.

A. Normal lateral ventricle. A sagittal view obtained through an open fontanelle clearly shows the frontal lobe *(FL),* lateral ventricle *(LV),* thalamus *(Th),* temporal lobe *(TL),* and choroid plexus *(CP). Ant,* Anterior; *Post,* posterior.

B. Grade III intraventricular hemorrhage. Longitudinal view through the left lateral ventricle shows intraventricular hemorrhage and ventriculomegaly.

< Management>

There is no fundamental treatment. Supportive care is the main management.

See <1. Management of perinatal asphyxia >

< Complication >
Hemorrhagic cerebral infarction / Bleeding after hydrocephalus / Cerebral Palsy / Mental retardation / Epilepsy

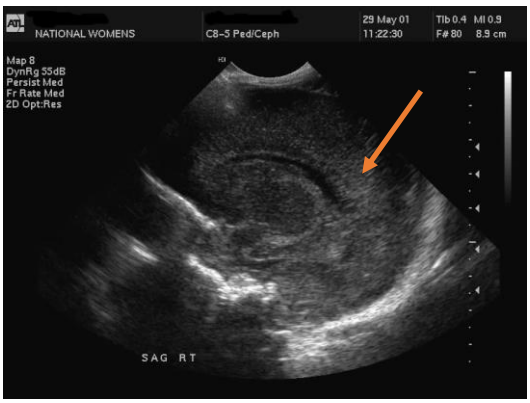
3. Periventricular leukomalacia: PVL

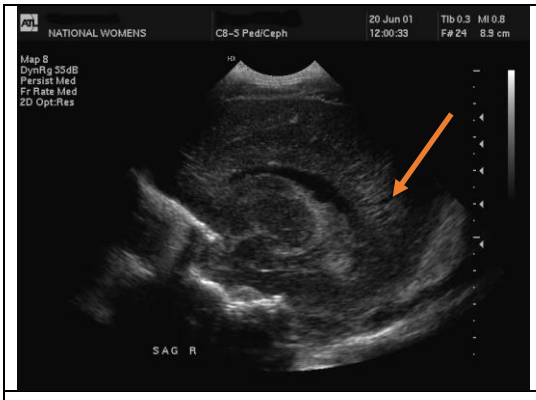
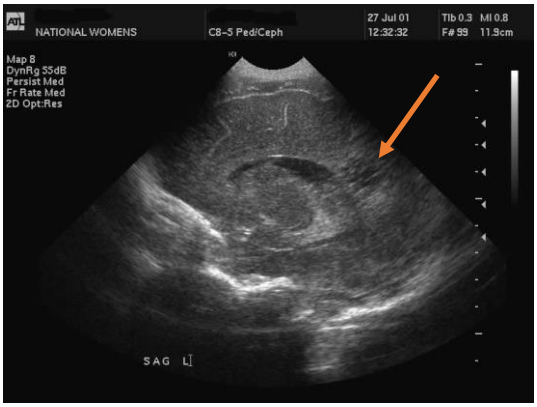
Ischemic brain injury typically seen in preterm infants. PVL is the principal cause of the cognitive, behavioral, motor and sensory impairments found in children born at <32 weeks GA.

<Symptoms>
It often has no outward clinical sign. It is evolving over days to weeks. A spasticity is first detected weeks to months later, or at an even later age. It is high risk of neurodevelopment impairment, such as cerebral palsy.

<Diagnosis>
It usually finds at routine head ultrasound. PVL is characterized by symmetric bilateral lesions that result from coagulation necrosis. The lesions are located adjacent to the external angles of the lateral ventricle, with or without cavitation.

<Example of views of PVL>

	**1 week** Hyperechogenicity of periventricular white matter

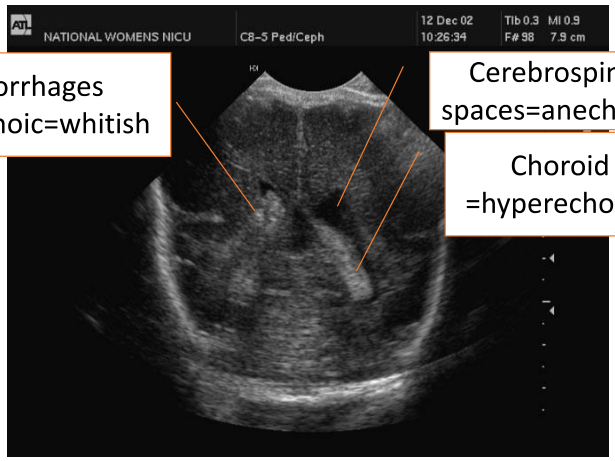
	**<u>1 month later</u>** Hyperechogenicity + cystic lesion
	**<u>2 months later</u>** Cystic lesion

< Management>

There is no specific medications or treatments. Careful management of blood pressure, intravascular volume, oxygenation or ventilation could maintain normal cerebral perfusion for prevention. Avoidance and treatment of infection may also minimize PVL.

Appendix: Normal brain view of Neonatal Ultrasound

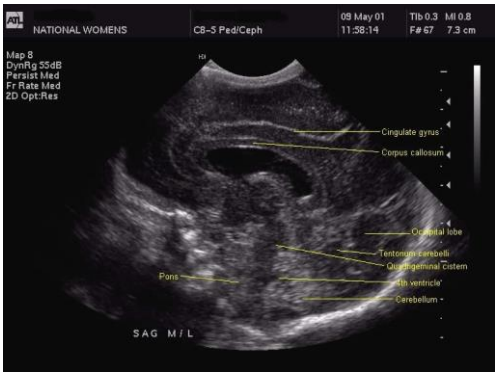
<General principle for image>



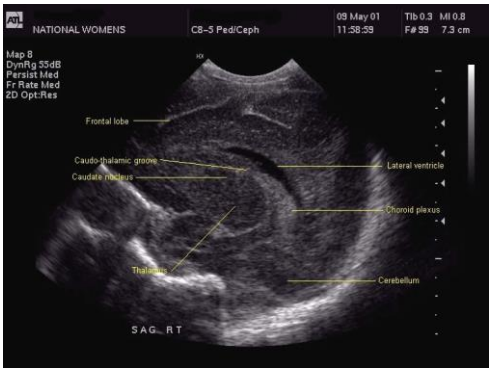
If the brain is not nearly symmetric, something may be wrong.

Sagittal view

Sagittal view (midline)

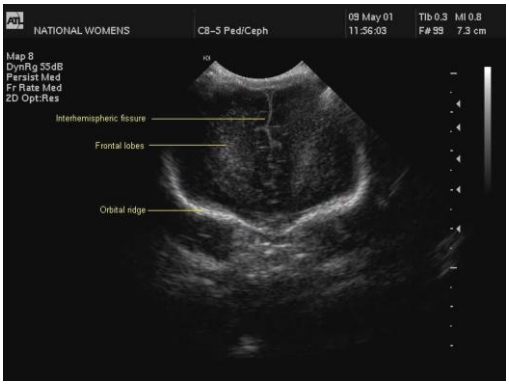


Sagittal view (parasagittal)

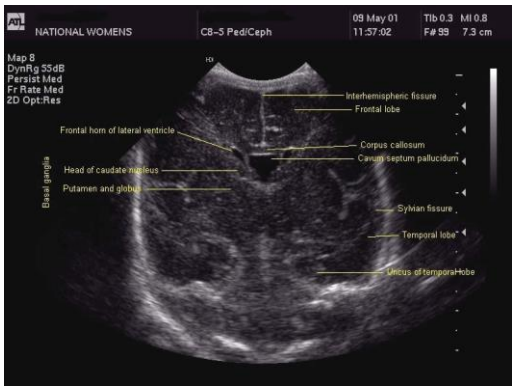


Coronal view

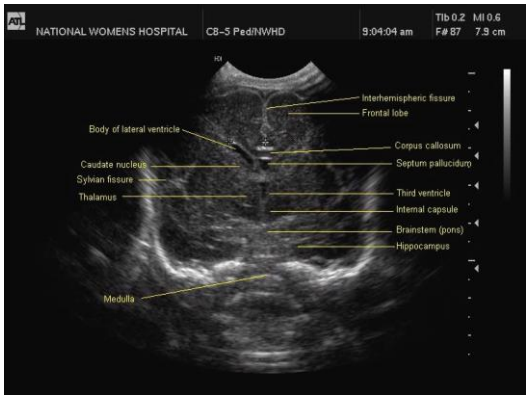
Coronal view (frontal lobes)



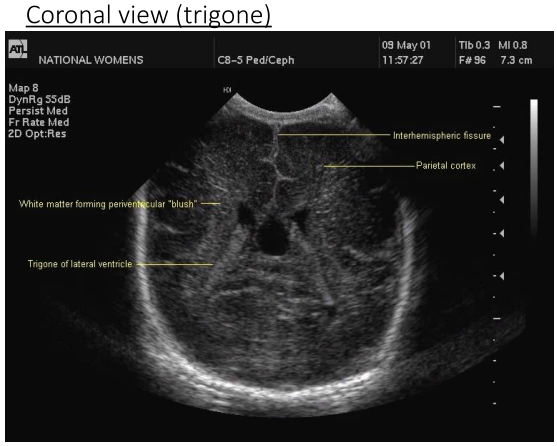
Coronal view (anterior horn of the lateral ventricles)



Coronal view (the third ventricle)



Coronal view (trigone)



References

1) Fanaroff & Martin's Neonatal-Perinatal Medicine 9th edition Chapter 36 :669, 2011
2) H Nishida: Introductory guide for Neonatalogy, 3rd edition 2009; Igaku shoin
3) Jonnasan M:Klaus and Fanaroff's Care of the High-Risk Neonate
4) http://www.adhb.govt.nz/newborn/TeachingResources/Radiology/HUSS/NeonatalHUSSViews.htm
5) Gupta P, Sodhi KS, Saxena AK, Khandelwal N, Singhi P. Neonatal cranial sonography: A concise review for clinicians. J Pediatr Neurosci. 2016;11(1):7-13.
6) Fox TB. Sonography of the neonatal brain2009 2017/7/16. Available from: http://jdc.jefferson.edu/rsfp/2.
7) Y Inotani: KCMC Manual of Neonatal Care, 6th edition 2015; Tokyo Igakusha

Chapter 13: Jaundice

— Contents ————————————————————————

1. Symptoms & Cause of jaundice
2. Diagnosis
3. Treatment

————————————————————————————————

1. Symptoms & Cause of jaundice

Jaundice is the yellow color seen in the skin of many newborns. When severe jaundice goes untreated for too long, it can cause a brain damage called kernicterus.

<Symptoms>

Early period (～2, 3days)	Yellow eye, Yellow skin, Hypotonia Poor sucking, Lethargy
Middle period (～1 week)	Stupor, Irritable, Hypertonia, Opisthotonus, Fever  [Opisthotonus]
Progress period (1week～)	Coma, Seizure

< Causes >

Etiology	Common causes
Increased bilirubin	Isoimmune-mediated hemolysis (eg ABO or Rh(D) incompatibility Inherited red blood cell membrane defects (eg hereditary spherocytosis and elliptocytosis). Cephalohematoma Macrosomic infants born from diabetic mothers
Decreased clearance	Hypothyroidism Crigler-Najjar syndrome Gilbert syndrome
Other causes	Breast-feeding (early onset) or breast milk (late onset) jaundice,

	Physiologic, Intrauterine infection (eg. Congenital syphilis) Severe bacterial infection / sepsis Asphyxia/hypoxia Intestinal obstruction(rare)

2. Diagnosis

① Check medical history and do physical examination

General condition, gestation and weight, sign of sepsis, hydration status

Signs of abnormal jaundice:

- Started on the first day of life
- Jaundice lasting longer than 14 days in term, 21 days in preterm infants,
- Jaundice with fever,
- Deep jaundice: palms and soles of the baby deep yellow

② Laboratory test

The clinical impression of jaundice should be confirmed by a serum bilirubin measurement.

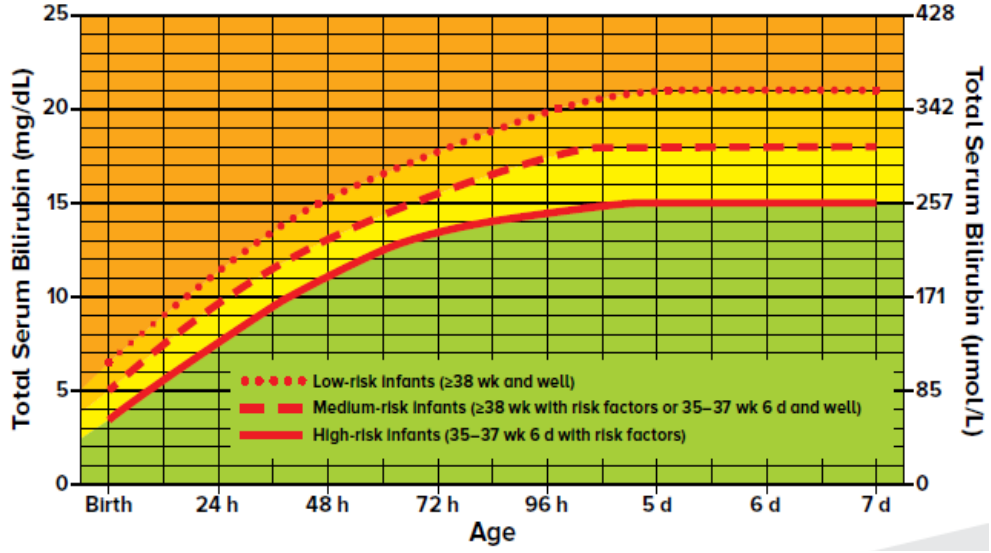
- Total serum bilirubin (TSB)
- Full blood count to look for signs of serious bacterial infection, and to look for signs of hemolysis
- Blood type of baby and mother

<Bilirubin sheet>

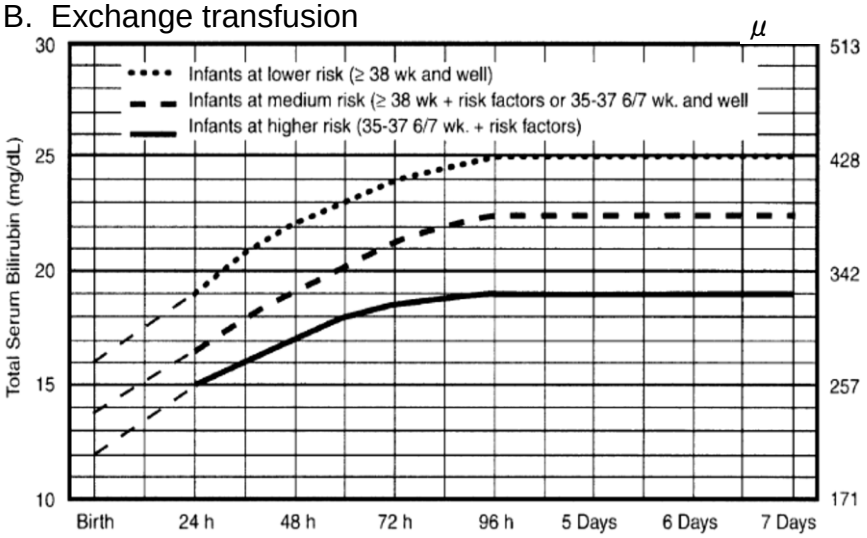
- Check the TSB, birth weight, gestational age and age.
- Plot on the sheet. Start A. phototherapy or B. exchange transfusion when the total serum bilirubin level excess the reference value.

➢ For a baby with 35 or more gestation weeks

A. Phototherapy



B. Exchange transfusion



The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of

➢ For a baby less than 35 gestation weeks

	TSB (mg/dl)	
Gestational Age	**A. Phototherapy**	**B. Exchange transfusion**
<28	>5	11-14
28-29	6-8	12-14
30-31	8-10	13-16
32-33	10-12	15-18
>34	12-14	17-19

Source: Maisels MJ, McDonagh AF. Phototherapy for neonatal jaundice. *N Engl J Med.* 2008;358:920–928

< Treatment >

- Phototherapy
  - Start phototherapy when the TSB level excess the reference value.
  - Check the TSB level 12-24 hourly, but if the TSB level is greater than 2 mg/dl above the line, then check the TSB level 4-6 hourly
  - Stop phototherapy if the TSB level is greater than 3mg/dl below the line. Consider rechecking the TSB in 12-24 hours.

<Management during phototherapy>

Do one of the following methods to avoid dehydration

- Increase the amount of breast milk. If a baby breastfed directly from a mother, increase the frequency of breastfeeding.
- If a baby can't absorb milk, consider increasing TWI by 10-20 % more.

- Guidelines for exchange transfusion
  - If the TSB is at a level of exchange transfusion, it is a medical emergency.
  - Immediate exchange transfusion is recommended when:
    - an infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry)
    - his/her TSB is ≧5mg/dL (85μmol/L) above the reference value.
  - Start phototherapy and consider transferring the baby to hospitals where provide blood transfusion to neonates.

* Special concern of preterm infants

Preterm infants, compared with term infants, appear to be more vulnerable to bilirubin. Bilirubin Induced Neurologic Dysfunction (BIND) is more likely to happen at even lower level of TSB.

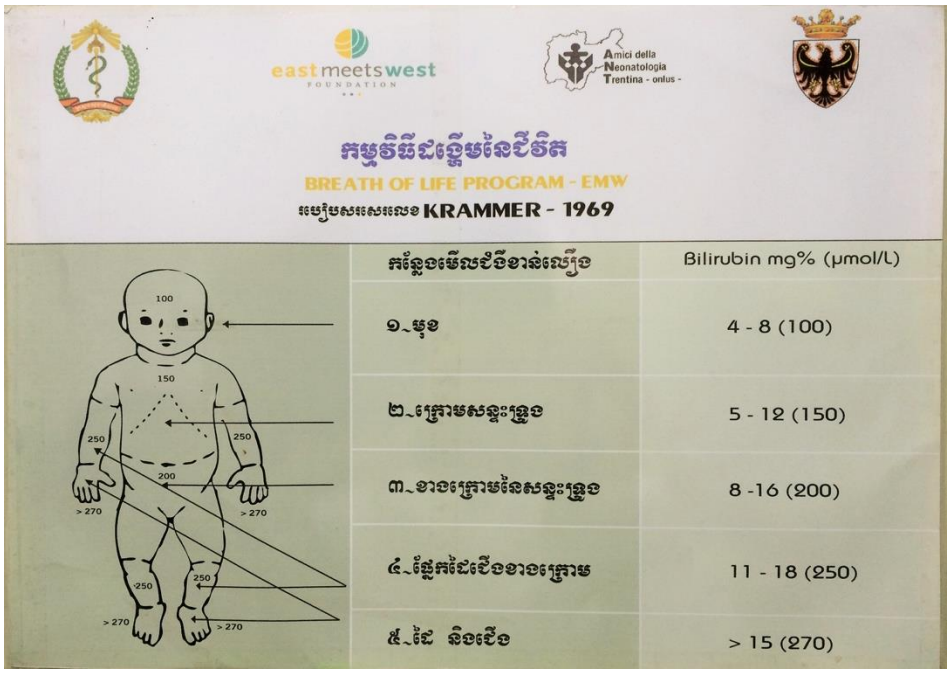
References:

1) Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation. Pediatrics 2004;114;297
2) An approach to the management of hyperbilirubinemia in the preterm infants less than 35 weeks of gestation. MJ Maisels, Journal of Perinatology 2012, 32. 660-664
3) Clinical Practice Guidelines for Paediatric, Ministry of Health Cambodia, April 2013

<Other Standards>

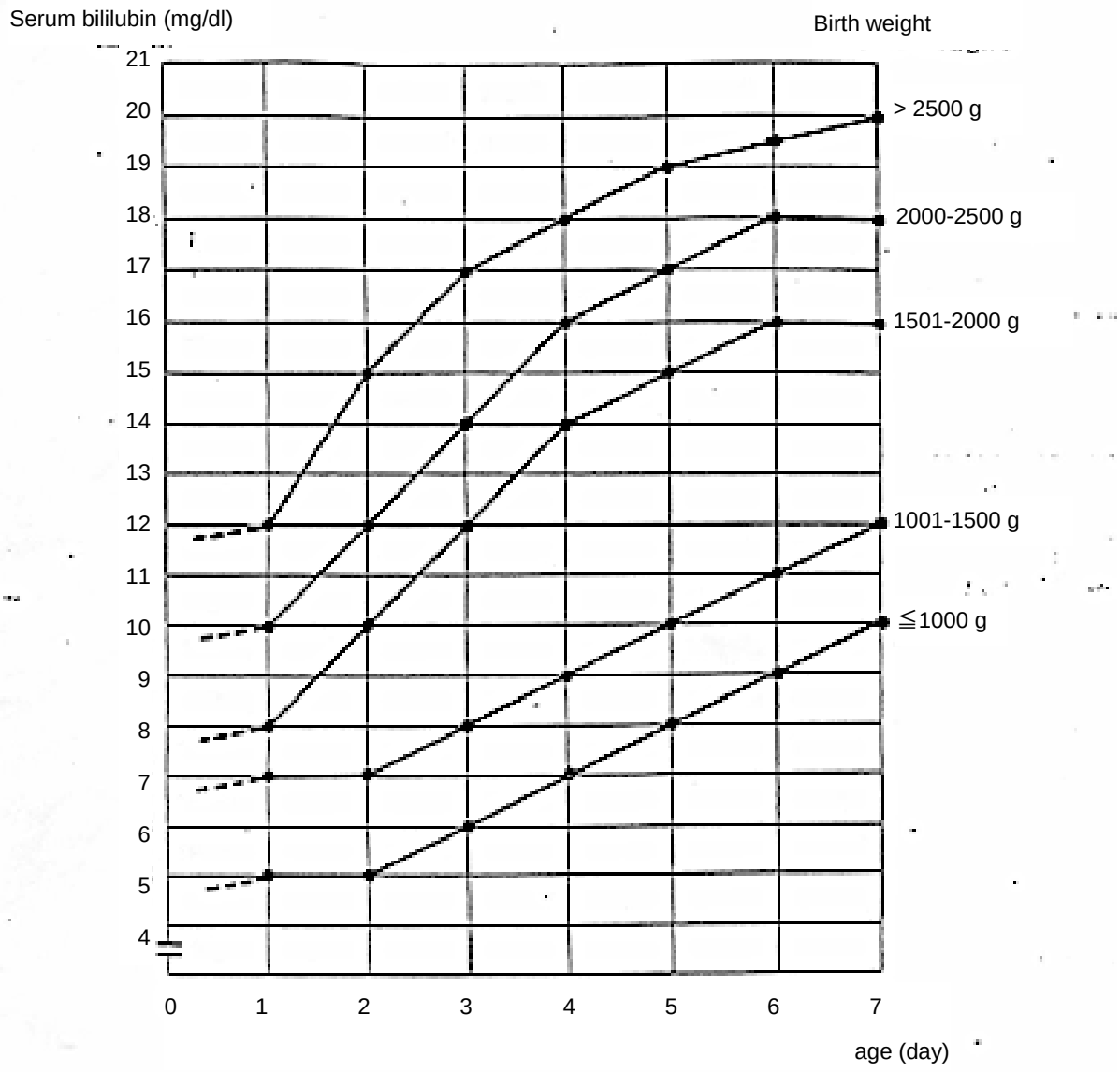
A. Krammer score
B. Murata's Standards for phototherapy: based on birth weight and age
C. Bilirubin sheets from "Clinical Practice Guidelines for Paediatric, Cambodia"

A. Krammer score: based on visible jaundice



※ The clinical impression of jaundice should be confirmed by a serum bilirubin measurement.

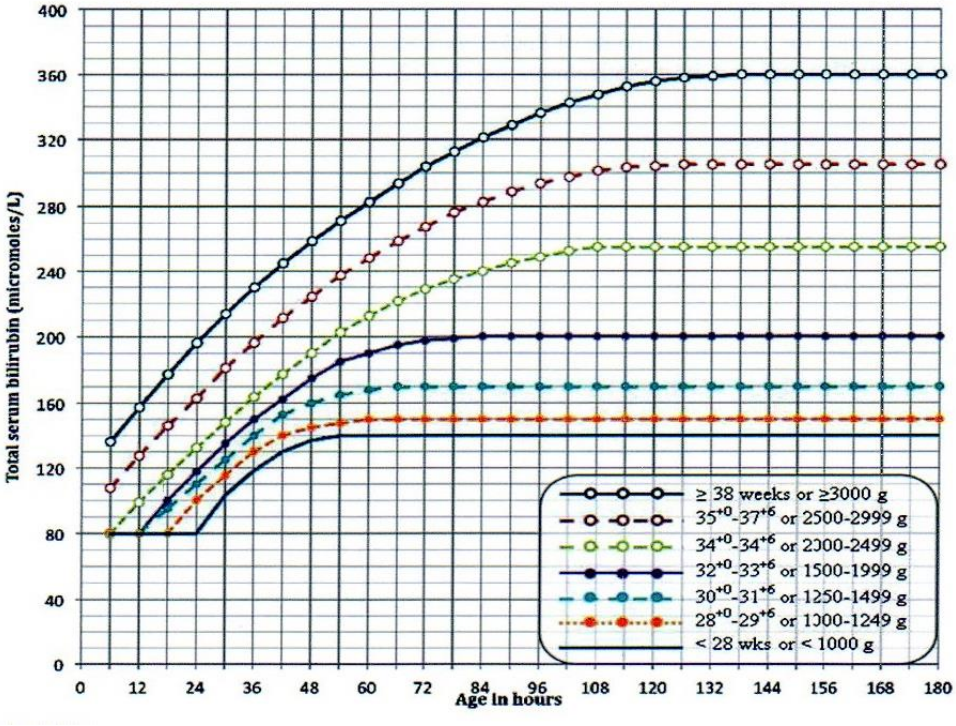
B. Murata's Standards for phototherapy: based on birth weight and age



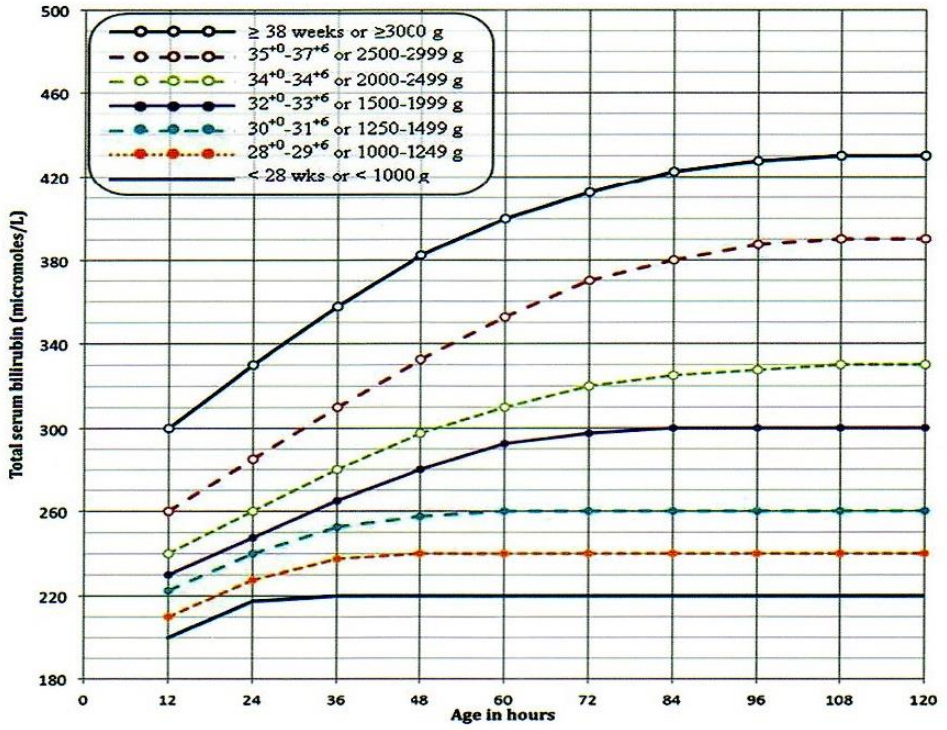
1) Birthday : 0 day
2) Take down the standard when there is one of followings
    1. Newborn hemolytic disease
    2. Asphyxia
    3. Acidosis (pH ≦ 7.25)
    4. Respiratory distress
    5. Hypothermia (≦ 35.0℃)
    6. Hypoproteinemia (serum protein ≦ 5.0 g/100ml)
    7. Hypoglycemia
    8. infection

C. Clinical Practice Guidelines for Paediatric, Cambodia

1. Phototherapy



2. Exchange transfusion



*Serum bilirubin: 10 micromoles/L = 0.585 mg/dL

Chapter 14: Anemia

——Contents————————————————————————

————————————————————————————————

1. Definition of anemia

Anemia is defined as a hemoglobin level below reference value.

	Normal range for newborn
Hemoglobin	16.5mg/dl (mean)
MCV	90-120

Hemoglobin Nadir in Babies in the First Year of Life

Birth weight	Hemoglobin level at nadir (g/dl)	Time of nadir (weeks)
> 2500g	9.5-11.0	6-12
1200g-2500g	8.0-10.0	5-10
< 1200g	6.5-9.0	4-8

Common causes of pathologic anemia in newborns:
blood loss, immune hemolytic disease (ie, Rh or ABO incompatibility), congenital infection, twin-twin transfusion, and congenital hemolytic anemia (eg, hereditary spherocytosis, glucose-6-phosphate dehydrogenase [G6PD] deficiency), anemia of prematurity

Simple diagnosis of anemia

	MCV	Bilirubin
Iron deficiency	Low	Normal
Hemolytic anemia	Normal	High
Hemorrhage	Normal	Normal

2. Anemia of prematurity

Premature infants often suffer from anemia because of impaired erythropoietin production, reduced red blood cell life span, iron deficiency and blood loss from tests in NCU. Typically occurs at 3 to 12 weeks after birth in infants less than 32 weeks gestation.

Risk factors of anemia of prematurity

- Maternal iron deficiency
- Prematurity
- Administration of erythropoietin for anemia of prematurity
- Perinatal hemorrhagic events (e.g. twin-twin transfusion or fetal-maternal hemorrhage)

3. Management of anemia

Iron supplement during the neonatal period (every preterm infant):

- Iron 2mg/kg, 3 times a day, for three months

Consider blood transfusion when infants with Hematocrit (Hct) < 20% and Hemoglobin≦7 mg/dl have at least one of the following condition

- ≥24 hours of tachycardia (heart rate >180 beats per minute) or tachypnea (RR >60 breaths per minute)
- Doubling of the oxygen requirement from the previous 48 hours
- Weight gain <10 g/kg/day over the previous four days while receiving ≥120 kcal/kg/day
- If the infant will undergo major surgery within 72 hours

<After discharge>

All preterm infants who are breastfed should receive iron supplementation through the first year of life, because breast milk contains less iron compared to formula.

Birth weight	Once daily, Oral
> 1.5kg	2mg/kg/day
1.0-1.5kg	3mg/kg/day
< 1kg	4mg/kg/day

Risk factors of iron deficiency anemia in infancy

- Lack of iron supplements for breastfed infants*
- Use of low-iron infant formula
- Feeding of unmodified (non-formula) cow's milk, goat's milk, or soy milk
- Insufficient iron-rich complementary foods

Reference:

1) Gilbert Huault, Bernard Labrune. Pédiatrie d'urgence
2) Tricia Lacy Gomella: Neonatology sixth edition
3) Joseph A Garcia-Prats. Anemia of Prematurity. Up To Date. Accessed 28 Jan 2019.
4) Safe Motherhood
5) J. Cloherty et al. Manual of Neonatal Care. seventh edition: Lippincott William & Wilkins.

Chapter 15: Kangaroo Mother Care

— Contents ————————————————————————

————————————————————————————————

1. Definition and Benefits of KMC

Kangaroo mother care (KMC) refers to the care of preterm or low-birth weight (LBW) infants through skin-to-skin contact with the mother.

< Benefits>

- Breastfeeding

Increases both the prevalence and duration of breastfeeding.

- Keeping warm

Skin-to-skin contact between the mother and her LBW infants provides effective thermal control. Other family members can do as well.

- Growth and Development

Optimize infant growth and development

- Mental support

Both infants and parents experience less stress. Parents report an increased confidence, self-esteem, and feeling of fulfilment.

2. How to start KMC at the NCU in NMCHC

< When to start KMC >

KMC should be used for preterm (<37weeks of GA) or LBW 1800g to <2500g newborns.

・ The baby should breathe spontaneously without apnea.
・ The baby has no life-threating conditions.

Notes

・ KMC can be started with stable newborns on IV fluid or oxygen.

・The ability to coordinate sucking and swallowing is NOT an essential requirement for KMC. Other methods of feeding by gastric tube can be used until the baby can be breastfed.

< Physicians Responsibility >

- When newborns meet the criteria of starting KMC, physicians order [Start KMC] in their medical charts.
- Before starting KMC, physicians explain about effectiveness of KMC, danger signs of newborn etc. > to families.

Danger signs

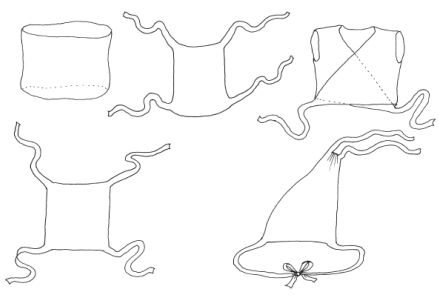
- Breathing difficulties, chest indrawing, grunting
- Breathing very fast or very slow
- Frequent and long spells of apnea
- Suspected cold body temperature
- Feeding difficulties: too sleepy to breastfeed or vomiting
- Convulsions
- Diarrhea
- Floppy
- Jaundice, pallor

< Nurses Responsibility >

- Nurses provide support binder to the mothers.
- Nurses counsel how to implement KMC to the mothers, including: skin-to-skin contact with mother, holding position, breastfeeding, attachment, Continued daily activity).
- Nurses help and observe the mothers and babies during KMC.
- Nurses write down on the nursing record <KMC duration> and <Vital sign before and after KMC>.

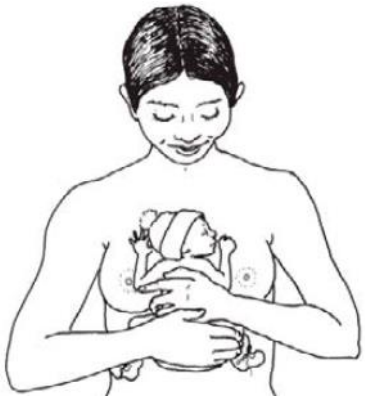
3. Implementation of KMC to the mother and family

➢ Preparing a ‘support binder’



- Positioning the baby;

- Place the baby upright position between the mother's breasts, chest-to-chest;
- Position the baby's hips in a 'flog-leg' position with arms also flexed;
- The baby's abdomen should be somewhere at the level of the mother's stomach, but should not be constricted. The mother's breathing helps stimulate the baby to breathe;
- Turn the baby's head to one side, slightly extended to keep the airway open and allow eye contact with the mother; and
- Cover the baby's buttocks and feet with binder with the top of the binder just beneath the baby's ear.
- Keep baby in place; have mother wear open-front shirt; holding buttocks and feet tightly enough to secure baby without letting him/her fall out.

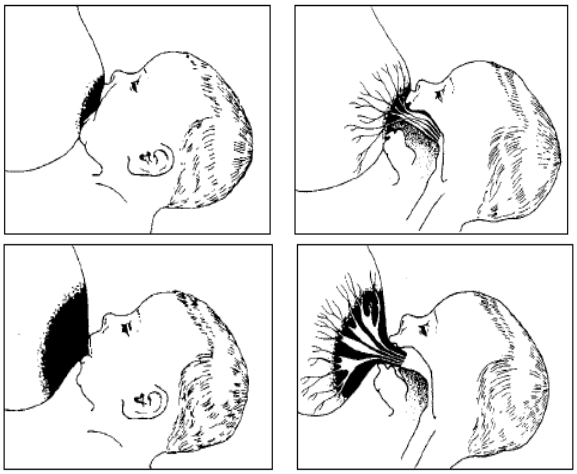


Note

- KMC should last for as long as possible each day.
- If the room temperature is below 22℃, put a sleeveless cotton sheet on the baby.

- Attaching her baby for breastfeeding;

- Clean their hands with alcohol hand rub before loosening or turning the KMC binder to position the baby for breastfeeding.
- Hold the baby in skin-to-skin contact, the mouth close to the nipple.
- Observe for feeding cues.
- Attach the baby to the breast with the lower lip below the nipple, If the infant still closes his/her mouth, bring him/her onto the breast, aiming lower lip well below nipple and wait until the baby opens his/her mouth.
- Identify effective suckling – slow; deep; and strong sucks, sometimes pausing;
- Reposition the baby in KMC position and wash hands after the procedure



Good attachment

Bad attachment

If baby is unable to suckle, use alternative feeding methods. (Check chapter 11)

4. Duration of continued KMC

- KMC should be used as long as possible every day.
- KMC should be continued at home.
- KMC can be continued until the infant gain weight to 2500g or 40 weeks post-conceptual age, meaning the date that they were expected to have been born. It may be continued as a mother wishes or until the baby does not want to be in KMC.

< Discharge Criteria >

Would be considered when meet the following conditions.

- Baby is breastfed well and gaining weight at least 15g/kg/day on three consecutive days.
- Baby's body temperature is stable between 36.5-37.5℃ on three consecutive days;
- Mother and family feel confident in KMC for infants at home.
- Mother and family recognize danger signs that require bringing the babay to a health facility.

References:

1) National Protocol on Kangaroo Mother Care Training, Cambodia MoH
2) WHO Library Cataloguing-in-Publication Data Early essential newborn care; clinical practice pocket guide.
3) WHO Library Cataloguing-in-Publication Data Kangaroo mother care

Chapter 16: Follow-up examination at the maternity ward

<Date> From Monday to Friday at 10:00am-

<Babies to be examined> All babies who were born the day before the examination date.

※ If the baby is born on Friday night or Saturday, we check on Monday.

<Schedule>

1	Registration	Nurse takes Yellow card of the baby and checks the ID.
2	Check Temperature	Nurse checks the baby's temperature and write down on the document
3	Check baby's condition after delivery	Before Physical Examination, a duty physician should ask the family whether the baby feeds well or has urine or stool after birth.
4	Physical Examination	Physician checks the baby using the document.
5	Information of Vaccination	After finishing physical examination, Physician tells the family about the vaccination schedule.

<Management of common problems >

Check "chapter 2: Proposed Admission and Discharge Criteria"

If a baby meets at least one of the criteria of admission, refer to NCU.

Risk of infection	The baby needs to start treatment (See chap10 Infection).
Minor Anomaly	If the baby's condition is good, the physician introduces the family to go to specialized hospitals for consultation after discharge.
Vomiting	If the baby continues to vomit over 24 hrs, and has the symptoms of dehydration, the baby should be admitted to NCU to receive DIV.
Poor Sucking	First confirm how a mother breastfed a baby including positioning and latching. If the baby cannot suck well after checking or has the symptom of dehydration; We need to admit the baby to NCU and provide DIV.

Fever / high body temperature (> 38.0 ℃)	・ If the hyperthermia is due to an exposure to high room temperature or sun; - Place the baby in a normal temperature environment - Undress the baby partially or fully for 10 minutes, then check the temperature again. If it is normal, counsel the family how to dress the baby - Feed the baby frequently ・ If the baby's temperature is still abnormal after two hrs, provide initial treatment for sepsis and refer the baby urgently to NCU. ・ Do not give antipyretic drugs to reduce the baby's temperature.
Pustules	Usually, skin rashes and neonatal acne is not a problem. But if the baby has >10 pustules and baby's condition is not good, we should manage it (see Chapter 10 Infection).

※ Epithelial pearl and erythema toxic are not dangerous signs. We should inform and explain to the family.

References

1) Tricia Lacy Gomella, Neonatology 7th Edition
2) Early Essential Newborn Care, WHO
3) Safe Motherhood Clinical Management Protocols for referral hospital, Ministry of health Cambodia. 2013

Chapter 17: Vital signs / temperature control

— Contents ————————————————————————

————————————————————————————————

1. Measurement of vital signs

Purpose:

- To observe baby's general condition.
- To assess after treatment.
- To identify acute medical issues.

When to take vital signs?

- Routine schedule: every 3 hours
- Before and after; treatment
- Before and after; nursing interventions
- Change in physical condition

A) Measurement of Heart rate

Purposes: To monitor cardiovascular conditions.

Equipment: Stethoscope, Watch or clock, SpO_2monitor

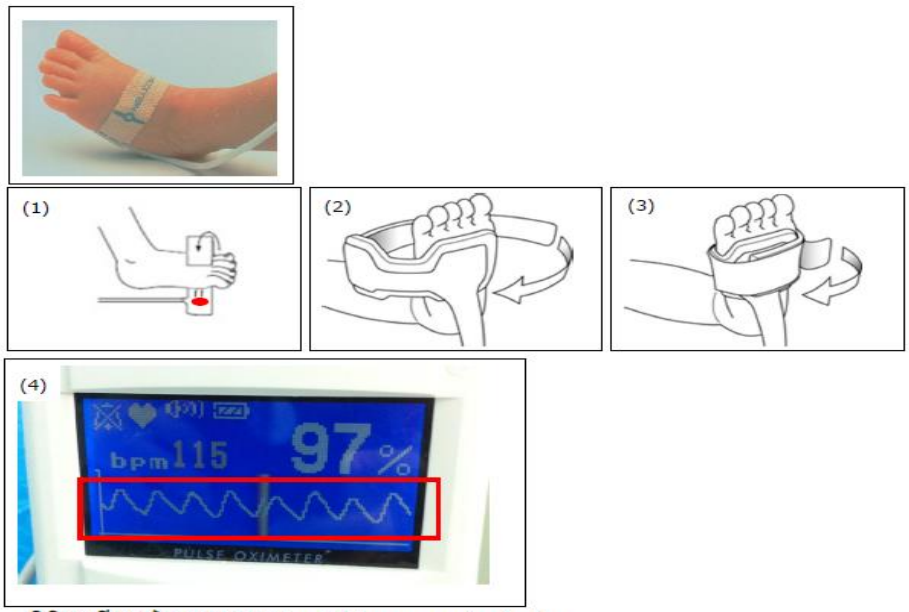
<Methods>

Using Stethoscope, Watch or clock

- Clean hands with alcohol-based hand rub.
- Clean stethoscope with ethanol cotton.
- Make sure that the baby is at rest.
- Place a stethoscope softly over the apex of heart.
- Measure the Heart Rate for 1 minute. (= This is the HR /min)
- Clean hands with alcohol-based hand rubs.
- Write down on the documents.

Using SpO_2 monitor

- Make sure the probe is attached correctly (1-3) and waveform is stable(4).



- ពិនិត្យមើលតម្លៃជាតួលេខ Read the numerical values.

< Check point>

- Normal range: 110-160 bpm/min
- Influence factor

Position, Drugs, Activities level, Temperature

B) Measurement of respiratory rate

Purposes: To monitor respiratory function.

Equipment: Stethoscope

<Method>

- Clean hands with alcohol-based hand rubs.
- Make sure that the baby is at rest.
- Measure the Respiration rate for 1 minute (inhale + exhale = 1 breath)
- Clean hands with alcohol-based hand rubs.
- Write down respiratory rate (RR) on the document.

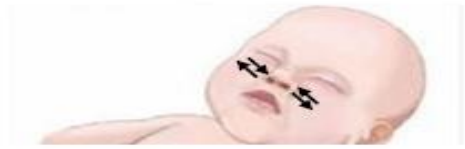
<Check points>

- Normal range: breathing rate 30-60 per minute

- Influence factor
  - ➢ Position, Drugs, Temperature
- Abnormal signs (Early treatment is needed)

ដង្ហើមធីតធត Seesaw Respiration

ដង្ហើមដង្ហក់ Retractive breathing



រន្ធច្រមុះរីករួម Nares dilation

ដង្ហើមថ្ងូរ Expiatory grunt

C) Measurement of body temperature

Purpose:

- To monitor the potential presence of infection
- To monitor the physiological response to treatment or nursing care

Method:

- When the baby is at rest.
- Make sure that there is nothing near the measuring site to affect the measurement value. (e.g. warm water bottle, wet gauze)

<Digital thermometer>

- Clean hands with alcohol-based hand rubs. Press the button to set the thermometer.
- Make sure ’Lo’ appears in the display.
- Place the thermometer on the center of axilla.
- Hold the arm continually against the baby until the thermometer beeps.
- Remove the thermometer and read the temperature.
- Clean your hand.

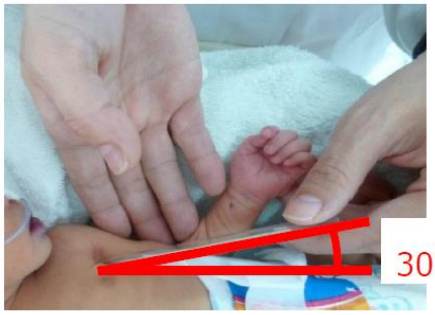
<Glass thermometer>

- Clean hands with alcohol-based hand rubs.

- Shake the thermometer down to below the lowest number (at least below 35.0 degrees) before placing it.
- Place the thermometer on the center of axilla for 5-10 minutes.
- Observe lines on scale at the upper side of the column of liquid in the glass.
- Remove the thermometer
- Read at the point where the liquids end.
- Clean your hands

<Note>

There is an axillary artery in the underarms. Measuring axillary temperature has the advantage of being able to measure the temperature near internal body temperature.



- Put your hand on baby's arm.
- Hold thermometer until the thermometer beeps.
- Remove thermometer.
- Read the temperature in the display.

<Check point>

- Abnormal sign　> 37.5℃, < 35.5℃
- Influence factor

Exercise, Time of day, Medications, Infection, Hydration, Clothing, Environmental temperature, air movement

2. Management of body temperature

Check "Nursing manual for Neonatal Care Unit 2018", chapter 5 for the further details

- Check their body temperature every hour until their temperature is stable within the normal range.
- Be careful not to change the incubator air temperature quickly. (0.5℃ / time)
- If the baby can keep body temperature adequately even with the incubator setting 32 ℃, the baby can get out of the incubator.

Incubator setting (After admission)

Body weight	< 1000g	1000-1500g	1500-2000g	2000-2500g
Incubator temperature	35℃	34℃	33℃	32℃

Temperature setting of Incubator (AAP: American Academy of Pediatrics. 1977)

Within 24 hours		More than 24 hours			
Birth weight (g)	℃ (media±range)		1500g ≧	1500～2500g	36 weeks ≦ 2500g ≦
	35.5±0.5	age	℃	℃	℃
500	35.5±0.5	1 day	34.3±0.4	33.4±0.6	33.0±1.0
	35.0±0.5	2	33.7±0.5	32.7±0.9	32.4±1.3
1000	34.9±0.5	3	33.5±0.5	32.4±0.9	31.9±1.3
	34.2±0.5	4	33.5±0.5	32.3±0.9	31.5±1.3
1500	34.0±0.5	5	33.5±0.5	32.2±0.9	31.2±1.3
	33.7±0.5	6	33.5±0.5	32.1±0.9	30.9±1.3
2000	33.5±0.5	7	33.5±0.5	32.1±0.9	30.8±1.4
	33.3±0.7	8	33.5±0.5	32.1±0.9	30.6±1.4
2500	33.2±0.8	9	33.5±0.5	32.1±0.9	30.4±1.4
	33.1±0.9	10 day	33.5±0.5	32.1±0.9	30.2±1.5
3000	33.0±1.0	11	33.5±0.5	32.1±0.9	29.9±1.5
	32.9±1.1	12	33.5±0.5	32.1±0.9	29.5±1.6
3500	32.8±1.2	13	33.5±0.5	32.1±0.9	29.2±1.6
	32.8±1.3	14	33.4±0.6	32.1±0.9	
4000	32.6±1.4	15	33.3±0.7	32.0±0.9	
	32.5±1.4	4 week	32.9±0.8	31.7±1.1	
		5	32.1±0.7	31.1±1.1	
		6	31.8±0.6	30.6±1.1	
		7	31.1±0.6	30.1±1.1	

3. Hypothermia / Hyperthermia

<Hypothermia>

Hypothermia cause anaerobic metabolism and metabolic acidosis, and leads to further hypoxemia. It occurs more often in home deliveries or emergency deliveries.

- ✓ Premature infants have a high risk of heat loss.
- ✓ Important to minimize heat loss, and maintain the body temperature within the normal range.

Check “Nursing manual for Neonatal Care Unit 2018”, chapter 5 for the further details of management to prevent heat loss

Body temperature < 36 ℃

- Remove cold or wet clothes, if present.
- The mother should rewarm the baby using direct skin to skin contact, or dress the baby in warm cloths and a hat, and cover with a warm blanket.
- If the temperature is not rising after 2 hrs reassess the baby as for severe hypothermia.

Body temperature < 34.9 ℃

- Warm the baby immediately using a pre-warmed radiant- warmer.
- Provide initial treatment for sepsis.

<Hyperthermia>

It may be caused by a relatively hot environment, infection, dehydration, CNS dysfunction, or medication

Do not give antipyretic drugs to reduce the baby's temperature

Body temperature > 38 ℃

Firstly, observe for signs of sepsis (e.g. poor feeding, vomiting, breathing difficulty). If there are no signs of sepsis, check the following condition.

✓ Overwarming under a radiant warmer or in an incubator;

- Reduce the temperature setting of the warming device. If the baby is in an incubator, reduce the incubator air temperature (every 0.2-0.5 ℃) until baby's temperature is within the normal range.

✓ Expose to a high ambient temperature or sun exposure;

- Place the baby in a normal temperature environment (25 ℃ to 28 ℃)
- Undress the baby partially or fully for 10 minutes, then dress and cover the baby;

Measure the baby's temperature every hour until it is within the normal range.

Body temperature > 39 ℃

- Sponge the baby for 10 to 15 minutes in water that is about 4 ℃ lower than the baby's current temperature.

- Do not use cold water or water that is more than 4 ℃ lower than the baby's temperature;
- Measure the baby's temperature every hour.

If the baby's temperature is still abnormal after 2 hrs, provide initial treatment for sepsis and call the physician.

References

1) Early Essential Newborn Care, WHO
2) Safe Motherhood Clinical Management Protocols 2013
3) Kumiko Nakata; Method of measurement of vital signs, Neonatal care, vpl20 2007

Editor's Note

I feel proud and very happy in making this manual under the cooperation between Japanese and Cambodian physicians.

The difficulty facing us during making this manual was that we tried to compare our previous manual to the national and international guidelines. Based on these manual and the guideline, we made adjustment and combined the ideas to make it suitable for our current situation.

I hope that this manual will be the guide for us in providing treatment and care for neonate in NCU at NMCHC. I believe that the manual will contribute to a decrease in neonatal mortality rate and an increase in survival rate for Cambodian newborns.

SEANG Sody
Neonatology
National Maternal and Child Health Center
Phnom Penh, Cambodia

On February 26th in 1994, Cambodia-Japan Friendship Bridge had been constructed across the Tonle Sap River in Phnom Penh with the cooperation of Japan. At the same period, the project for improvement of maternal and child health in Cambodia has been started through the Japanese Cooperation Agency (JICA).

Since then, indeed four projects of maternal and child health has been continued with the collaboration between the National Maternal and Child Health Center (NMCHC) in Cambodia and the National Center for Global Health and Medicine (NCGM) in Japan. During this time, the two have been build a strong relationship, cooperating and supporting each other's activity.

This time, the new Neonatal Care Unit (NCU) clinical manual has been made by updating from the old manual that been used by the NCU staff from the beginning of their activities. In the process of creation, there was a support from many people. The NCU doctors and nurses needed to reflect on their activities until now, to review and to organize them. The NCGM young pediatricians need to provide and update information, and explore the standard and realistic way for NMCHC-NCU in Cambodia during a collaborative work. As led by Dr. Takeji Matsushita, many attending doctors gave us many advices. Then, finally, in spring season of cherry blossoms blooming in Japan, this new manual has been completed.

This manual is not as big & expensive as the Cambodia-Japan Friendship Bridge. However, many people involved and made it as the same way. Also this is readily accessible to everybody to use every day. The most important thing is the medical staff of both Japan and Cambodia has created this manual in cooperation with the same position and passion. Because of this, the new manual would be a "Bridge" for neonates can reach to the place called happiness.

The origin of this new manual has been created by Dr. Takako Yamada, the first leader of the JICA project. In the end of this sentence, we would like to show our greatest appreciation for her contribution. And I would like to mention that all of its principle, accuracy, and the ease-of-use of this new manual benefits significantly for her work.

Shinichi Hosokawa
Pediatrics (Neonatology)
National Center for Global Health and Medicine
Tokyo, Japan

April 2015

The NCU Clinical Manual

2019

English version

National Maternal and Child Health Center

JICA IINeoC (Improving Continuum of Care with focus on Intrapartum and Neonatal Care) Project

Cambodia