East of England Neonatal ODN
(Hosted by Cambridge University Hospitals)

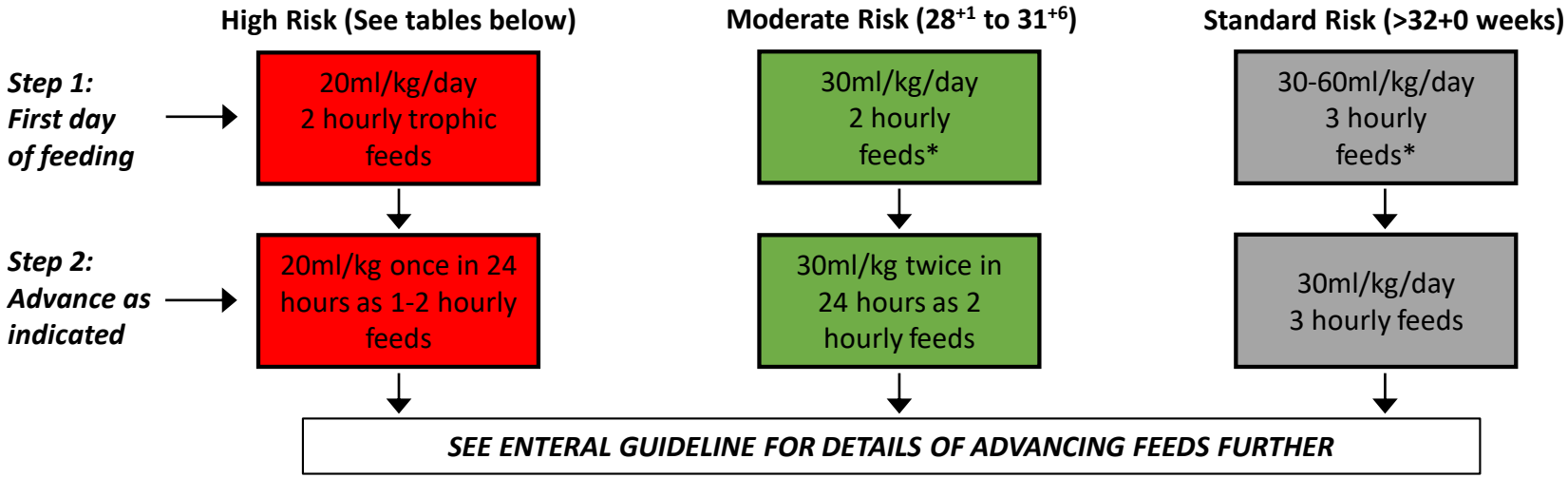
Ongoing Care

East of England Neonatal Operational Delivery Network
Collaborative working to deliver high quality care to our babies and their families

Initiating & Advancing Enteral Feeds:

Trophic feeds encourage intestinal adaptation, enhance gut motility, decrease incidence of PN-induced cholestasis and bacterial translocation. Trophic feeds should be considered early in infants receiving Parenteral Nutrition (PN) (where clinically indicated) in order to utilise maternal colostrum & stimulate gut trophic hormones.

- ***Evidence supports early enteral feeding - Trophic feeds should be commenced as soon as clinically indicated in the infant receiving PN***
- ***EBM Breast milk, freshly expressed by an infant's own mother is the first feed of choice for preterm infants***



- *Commence feeding as close to birth as possible following individual clinical assessment. Maintain trophic feeds in high risk infants as long as clinically indicated. Infants can move between risk categories following individual clinical assessment.*
- *Undigested milk residuals should be re-fed if: Volumes are <50% of previous 4 hours feeds, OR Residual volumes are present during low volume/trophic feeds*

High Risk

- <28 weeks gestation **OR** < 1000g birth weight
- Preterm SGA infant (<2nd percentile and <34 weeks gestation)
- Absent or reversed end diastolic flow in infants <34 weeks
- Unstable /hypotensive ventilated neonates
- Re-establishment of feeds following NEC
- Perinatal hypoxia-ischaemia with significant organ dysfunction
- Congenital gut malformations (eg gastroschisis)

Caution*

- Severe SGA infants (<0.4th percentile and >34 weeks)
- Preterm SGA infants (<2nd percentile and <34 weeks)
- Indomethacin or Ibuprofen for PDA
- Complex congenital cardiac disease
- Dexamethasone treatment
- Polycythaemic infants

**Caution should be taken initiating feeds in the following subgroups. The decision to manage as "high risk" is at clinician's discretion.*

Parenteral Nutrition (PN):

WHEN TO START PARENTERAL NUTRITION

- 100% of infants meeting the absolute indicators should commence parenteral nutrition within 24 hours of birth. Gold standard is within 6 hours – **ideally as soon as central venous line placement (UVC/Long Line) is confirmed**
- Any neonate who has not made sufficient progress with enteral feeds within the first 3 days after birth should also be considered for PN

Absolute Indications

- Premature infants < 30 weeks gestation or <1.25kg birth weight
- Intestinal Failure (i.e. short gut, pseudo-obstruction)
- Gastrointestinal Surgery
- Necrotising Enterocolitis (NEC)
- Congenital gastrointestinal defects (i.e.gastroschisis, intestinal atresia)

Relative Indications

- Any infant ≥ 30 weeks gestation or ≥ 1.25kg who has not made sufficient progress with enteral feeds within the first 3-5 days after birth.

WHAT TO START

- Standardised PN solutions should be used where ever possible (EoE standardised bags as opposed to bespoke PN) in order to maximise nutrient delivery and to minimise the risk of errors. PN prescription should be guided by senior clinicians and the pharmacist or dietician
- Where electrolyte manipulation is clinically indicated patient specific electrolytes should be prescribed in the "non standard" column

AQUEOUS PN

- Preterm infants should commence **'Preterm Concentrate PN'** in order to maximize nutrient delivery
  - If their final PN volume is likely to be <->120ml/kg/day then change to **'Standard bag'**
- Term or near term infants (>35 weeks) should commence **'Term Standard PN'**
  - If their final PN volume is likely to be <150ml/kg/day then a **'Preterm Standard'** or bespoke PN bag may be considered

LIPID PN

- Lipid PN should commence as soon as possible on the 1st day of life
- Incremental introduction may reduce the risks of high triglycerides
- Minimum essential fatty acid requirement is met by:
  - 0.5g[2.5ml]/kg/day Intralipid **OR** 1.5g[7.5ml]/kg/day SMOF Lipid
- Maximum provision: 3-4g/kg/day or 25-450% of non protein calories
- **SMOF Lipid should be used:** in infants at high risk of needing PN for >28 days or if significant liver dysfunction occurs before 28 days on PN [conjugated bilirubin >50micromol/l, ultrasound evidence of hepatomegaly, or clinical cholestasis (pale stools, dark urine)]

Cerebral Function Monitoring (CFM)/ Amplitude integrated Electroencephalogram (aEEG):

- The amplitude-integrated EEG (aEEG) is a single or dual channel time-compressed and filtered EEG which is recorded on a cerebral function monitor (CFM). The aEEG provides useful information on overall global or hemispheric electrical activity

WHICH INFANTS SHOULD BE MONITORED?

i) CFM should routinely be used for all infants of gestational age ≥ 36 weeks that meet criteria A & B.

a) Evidence of perinatal distress suggestive of possible hypoxic-ischaemic encephalopathy (HIE):

- fetal/neonatal academia with cord pH or arterial pH within 1 hour of birth showing pH <7.0 or Base Deficit of ≥16
- APGAR score of <5 at 10 mins after birth
- continued need for resuscitation, including endotracheal or mask ventilation, at 10 minutes after birth

b) Evidence of moderate or severe encephalopathy consisting of altered state of consciousness (lethargy, stupor or coma) with at least one of the following:

- hypotonia, abnormal reflexes (including oculomotor or pupillary abnormalities), absent or weak suck, clinical seizures

ii) CFM may also provide useful information in:

- Meningitis (requiring intensive care)
- Evidence of extensive structural brain injury or serious congenital brain anomalies (e.g. cerebral infarction, haemorrhage/ tumour, hydrocephalus)

iii) Preterm Infants (CFM monitoring should be at discretion of attending consultant)

The CFM may be less easy to interpret in preterm infants. Nevertheless it can provide very useful information and so may be considered in some infants of ≤36 weeks gestation, e.g.:

- Clinical or suspected seizures
- Moderate to severe encephalopathy
- Grade 3 or 4 intraventricular haemorrhage

Apply CFM as soon as possible following admission to the NICU of any infant with suspected hypoxic-ischaemic encephalopathy.

Infants who meet at least one A criteria but on initial examination are neurologically normal require frequent neurological assessment during the first 6hours of life. These examinations should be carried out by someone competent in performing a neonatal neurological examination. The findings of the neurological examination must be clearly documented. The first examination should take place as soon as the infant is clinically stable (e.g. gas normalising, respiratory and cardiovascularly stable). Further examinations will inform the neurological progression and guide further neuroprotective interventions.

FOR HOW LONG SHOULD aEEG MONITORING BE CONTINUED?

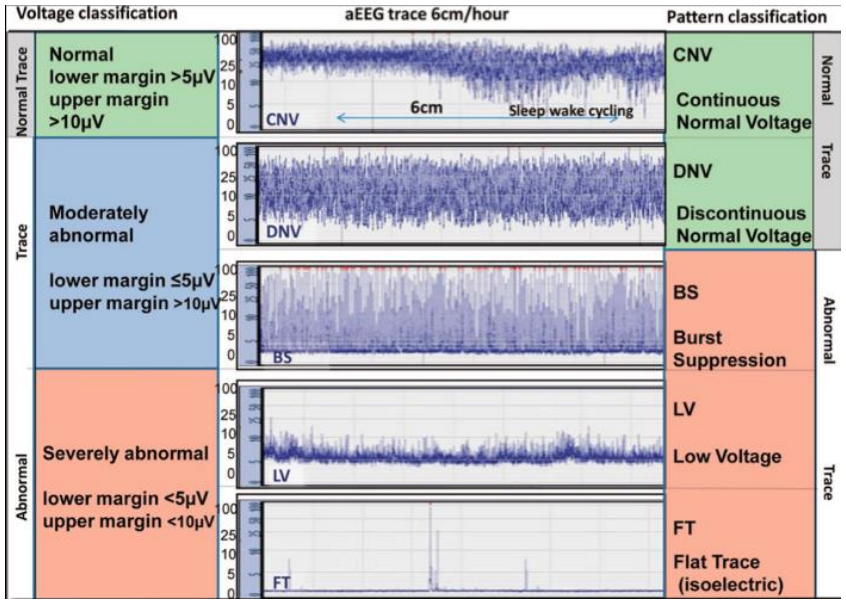
Generally continue monitoring until the patient has clinically stabilised with no risk of further cerebral insult, and at least until:

The background recording has become stable for 24 hours / there have been no seizures for 12–24 hours

This will often necessitate continuous monitoring for the first 4 days of clinical encephalopathy.

aEEG monitoring should be continued during rewarming as this is a period associated with re-emergence of seizures

Cerebral Function Monitoring: Interpretation



SEIZURES: *usually seen in the aEEG as high voltage and reduced amplitude (narrowing of the trace) – correlate with the raw EEG trace which should show simultaneous seizure activity*

SLEEP-WAKE CYCLING: *A normal finding in the aEEG. Characterized by smooth sinusoidal variations, mostly in the minimum amplitude. Broader bandwidth represents discontinuous background activity during quiet sleep, and narrower bandwidth corresponds to the more continuous activity during wakefulness and active sleep*

Neurological Examination (BAPM, 2020)

Domain	Stage1	Stage2	Stage3
Seizures	None	Common focal or multifocal seizures	Uncommon (excluding decerebration) Or frequent seizures
Level of consciousness	Normal hyper alert	Lethargic Decreased activity in an infant who is aroused and responsive Can be irritable to external stimuli	Stuperose/ comatose Not able to rouse and unresponsive to external stimuli
Spontaneous activity when awake or aroused	Active Vigorous does not stay in one position	Less than active Not vigorous	No activity whatsoever
posture	Moving around and does not maintain only one position	Distal flexion, complete extension or frog – legged position	Decerebrate with or without stimulation (all extremities extended)
tone	Normal – resists passive motion Hypertonic, jittery	Hypotonic or floppy, either focal or general	Completely flaccid like a rag doll
Primitive reflexes	Suck: vigorously sucks finger or ET tube Moro – Normal extension of limbs followed by flexion	Suck: weak Moro: incomplete	suck: completely absent Moro: completely absent
Autonomic system	Pupil – normal size Reactive to light Heart rate normal >100 Respirations - normal	Pupils – constricted <3mm but react to light Heart rate: bradycardia (<100 variable up to 120) Respirations: periodic irregular breathing effort	Pupils: fixed dilated, skew gaze not reactive to light Heart rate: variable inconsistent rate, irregular, may be bradycardic Respirations: completely apnoeic requiring positive pressure ventilation

-British Association of Perinatal Medicine(2020) Therapeutic Hypothermia for Neonatal Encephalopathy: A Framework for Practice. BAPM (ONLINE). Available: https://www.bapm.org/resources/237-therapeutic-hypothermia-for-neonatal-encephalopathy:

- Sarnat HB, Sarnat MS. Neonatal encephalopathy following fetal distress. A clinical and electroencephalographic study. Arch Neurol. 1976;33:696-705

Hypoxic Ischaemic Encephalopathy & Therapeutic Hypothermia

Starting Therapeutic Hypothermia:

- Cooling should be started as soon as eligibility is confirmed
- Maximum benefit can be derived from cooling when it is commenced within 6 hours of birth
- PaNDR should be contacted for advice regarding cooling outside of trial criteria
- When an infant has been identified as suitable for cooling, the PaNDR team should be contacted as soon as possible to locate a cot and provide advice regarding cooling - ***PANDR – 01223-274274***

Temperature Monitoring:

- Monitor rectal temperature continuously
  - Record every 15 minutes
- Target rectal temperature: 33.5°C
  - Range: 33-34°C (do not allow it to drop below this)
- Target of 33.5°C should be reached in a controlled manner
  - Plot on Neuroprotection Care Pathway 1 (NCP1) to guide rate of cooling

Ensure correctable causes of encephalopathy are excluded
Consider wider investigation of encephalopathy, including:

- LP / Metabolic screen (e.g. ammonia, amino acids, urine organic acids, ketones, reducing substances, genetics)