Neonatal Intensive Care Unit

Feeding and Surveillance Protocol for ELBW and VLBW Infants

Purpose
To state the guidelines for surveillance and feeding initiation and progression for ELBW and VLBW infants at risk for Necrotizing Enterocolitis (NEC).
To provide general guidelines for handling of all og/ng feeding for infants in the NICU.

Key Points
- Infants at greatest risk – born at less than 1500 grams, less than 32 weeks, or IUGR
- Early feeding (achieving full feeds by the second week of life) reduces the incidence of sepsis four-fold
- Not introducing at least some feedings to the gut (or stopping feeds for any length of time) results in GI atrophy, decreased motility, inflammation and bacterial translocation - increasing risk
- Bolus is preferred as it stimulates maturation of hormone secretion and motility of the GI tract.
- Routinely aspirating to check for gastric residual increases the contamination and growth of bacteria in the tube.
- Value of gastric residuals in predicting feeding intolerance or NEC was not supported – residual volume did not predict NEC, nor does it accurately reflect the volume of fluid in the stomach. Residuals also do not correlate with correct positioning of tube in the stomach.
- Hemocult testing for presence of occult blood in the stool also showed no predictive value for NEC – gross blood in stool was more frequent
- The strongest correlation found in all the research was that using BM resulted in significant decrease in the incidence of NEC – in all populations
- Early initiation (within 6 hours of birth) and adequate frequency of pumping are critical to establish an early milk supply, increase likelihood of adequate milk volumes and provide as much BM for the infant as possible.

(See Background and references for more in depth summary of the evidence)
Surveillance

1. Begin surveillance for all infants who are less than 1500 grams, less than 32 weeks GA (or as directed by the neonatologist) on day of life 7. Continue surveillance through 33 weeks cGA.

2. Monitor frequency of stools – note and report changes from baseline such as decreasing stools despite advancing feeds, or diarrhea/marked increase in stools, or grossly bloody stools.

3. Check glucose daily. (May be lab draw or glucometer)

4. Check electrolytes, CBC with differential, phosphorus and alkaline phosphatase every 2 weeks.

5. Monitor for and report increase in frequency or severity of apnea/bradycardia/desaturation events.

6. Monitor and report signs of lethargy, decreased perfusion, color change in baby or baby’s abdomen, temperature instability, or sustained tachycardia at rest.

Feeding

1. **Feedings for infants ≤ 1250 grams or < 30 weeks:**
   a. Infants less than or equal to 1250 grams at birth are **fed exclusively human milk (expressed maternal milk or human donor milk)**
   b. Begin trophic feedings at 10-20 ml/kg/day every three hours within the first 12 hours of life (if clinical condition allows)
   c. Trophic feedings may be continued in the follow clinical setting
      - Dopamine equal to or less than 5 mcg/kg/minute
      - Prophylactic Indomethicin
   d. Progressive enteral feedings may be initiated 24-72 hours after initiation of trophic feedings depending upon the clinical status of the infant
   e. Advance feedings by 20 ml/kg/day as tolerated (10 ml/kg/day every 12 hours or one advance of 20 ml/kg/day) Once 60-80 ml/kg/day feeding volume tolerated, start fortification with **Prolact +4**.
   f. Continue **Prolact +4 until 100 ml/kg/day** feeding volume tolerated, then fortify with **Prolact +6 and advance to goal of 165 ml/kg/day** (if using donor human milk, goal of 170-175 ml/kg/day)
   g. If growth rate less than optimal (15 gm/kg/day) once goal rate achieved, add Prolact CR **(ratio of 94 ml human milk to 6 ml Prolact CR)**.
   h. If growth rate continues to be less 15 gm/kg/day, can adjust the ratio of human milk to Prolact CR (maximum of 90 ml human milk to 10 ml Prolact CR).
   i. If feeding concentration increased to **Prolact +8, goal rate is 145-170 ml/kg/day** (adjustments prn for mother’s own milk vs donor human milk)
   j. **Once full volume feedings attained** (or approximately day of life 10), the following supplements should be ordered
      - Polyvisol without Iron: 0.5 ml twice daily
      - Ferinsol: 4 mg/kg/day (dose given as 2 mg/kg twice daily). If infant has been transfused, start supplementation 14 days after transfusion.
      - Vitamin K (oral): 8 mcg/kg/day—once daily
   k. **Continue fortification with Prolacta until 34 weeks corrected gestational age.**
      - Day 1: 2 feedings bovine HMF: 6 feedings Prolacta
      - Day 2: 4 feedings bovine HMF: 4 feedings Prolacta
      - Day 3: 6 feedings bovine HMF: 2 feedings Prolacta
      - Day 4: All bovine HMF (mother’s own milk or donor human milk)
1. Once transition completed, discontinue Polyvisol without Iron, Vitamin K and adjust Ferinsol dose to 2 mg/kg/day (or Polyvisol with Iron—0.5 ml daily if \( \geq 1800 \) grams).

m. If using donor human milk, continue fortification with bovine HMF until 35 weeks corrected gestational age.
   - Day 1: 2 feedings preterm formula: 6 feedings donor human milk with bovine HMF
   - Day 2: 4 feedings preterm formula: 4 feedings donor human milk with bovine HMF
   - Day 3: 6 feedings preterm formula: 2 feedings donor human milk with bovine HMF
   - Day 4: All preterm formula

2. Feedings for infants >1250 and < 1500 grams or \( \geq 30 \) weeks but < 34 weeks:
   a. Use only mother’s own milk or donor human milk
   b. Begin feedings within the first 12 hours of life at 20 ml/kg/day
   c. Advance by 20 ml/kg/day as tolerated to goal of 150-160 ml/kg/day
   d. Add bovine HMF to breast milk to provide 22 kcal/oz once tolerance to 50 ml/kg/day established
   e. Increase fortification to 24 kcal/oz once tolerance to 100 ml/kg/day established.
   f. At day of life 14, if tolerating full volume feedings, start supplementation with Ferinsol: 2 mg/kg/day. If infant has been transfused, start supplementation 14 days after transfusion.
   g. Transition off donor human milk at 34 weeks corrected gestational age
      - Day 1: 2 feedings preterm formula: 6 feedings donor human milk with bovine HMF
      - Day 2: 4 feedings preterm formula: 4 feedings donor human milk with bovine HMF
      - Day 3: 6 feedings preterm formula: 2 feedings donor human milk with bovine HMF
      - Day 4: All feedings preterm formula

3. Feedings for infants > 1500 grams and > 34 weeks
   a. Begin feedings within the first 12 hours of life at 20-30 ml/kg/day
   b. Advance by 20-40 ml/kg/day to goal rate of 150-160 ml/kg/day
   c. If mother’s own milk available, add bovine HMF to breast milk to provide 22 kcal/oz once tolerance to 50 ml/kg/day established
   d. Increase fortification to 24 kcal/oz once tolerance to 100 ml/kg/day established
   e. At day of life 14, if tolerating full volume feedings, start supplementation with Ferinsol: 2 mg/kg/day. If infant weighs 1800 grams or more, can supplement with Polyvisol with Fe: 0.5 ml daily (instead of Ferinsol). If infant has been transfused, start supplementation 14 days after transfusion.

4. Mothers should be encouraged to start pumping as early as possible. If both breast milk and formula are given at a feeding, document the exact amount of each that is given.
5. Give liquid glycerin via rectum if no stool in 24 hours until spontaneous stool frequency has been accomplished during advancing feedings, then consider liquid glycerin after full feedings established if no stool for greater than 72 hours. Discontinue routine glycerin once infant reaches cGA of 33 weeks.
6. Consider infusion pump when feeding volume exceeds 10 mls to control rate of feeding.
7. Non-nutritive sucking is to be offered during og/ng feeds whenever possible.
8. Considerations to delay/stop feeds may include any conditions thought to decrease gut blood flow. Discontinue feedings for significant abdominal distension or discoloration, signs of perforation, bloody stools, or bilious emesis. Clinical change in the status of the infant, including changes in activity level, pattern of A/Bs, perfusion and vital signs may be an indication to hold feedings until the baby’s clinical status is clarified. Low feeding volumes (1-2 ml q 3-6 hours) can be maintained in some instances.

**General infection prevention activities for all NICU Infants**

1. Attempt to place OG/NG tube prior to obtaining CXR so placement can be confirmed on x-ray. To insert OG/NG tubes, measure from nose (or mouth) to ear to xyphoid and add 1 cm, and insert tube to this depth. Pull back to check for residuals only enough to see in the tube and then return. Document centimeter marking on care plan and flowsheet. If OG/NG tube needs to be vented to prevent abdominal distension, consider placement of a second tube for venting purposes only.

2. Do not routinely check residuals prior to feedings. Check placement by auscultating for air in the stomach, and by checking cm markings at the nose or lip. Monitor at start of feeding for signs of choking or respiratory distress.

3. Pour BM or formula into capped syringe with plunger removed, then replace plunger and turn up to remove air. Do not put syringe down into BM container.

4. When feeding via OG/NG tube, use a clean syringe for each feeding and replace extension tubing every 8 hours.

5. Disconnect from OG/NG tube and flush extension tubing with sterile water between feedings

6. Keep end of extension tubing capped between feedings

7. Wipe ends of extension tubing and end of OG/NG tube with alcohol and allow to dry prior to reconnecting for the next feeding

8. Good hand hygiene is essential prior to contact with infant, after diaper changes, prn for soiling of hands and after completion of care for infant. Parents should be instructed on proper handwashing as well.

9. Diaper wipes are to be kept at the bottom of the isoclette or bed or stored separately from feeding supplies and are to be considered dirty.

10. Change bulb syringes weekly and prn. Wash with hot water after each use. Keep above the infant’s waist at all times.

11. Change pacifier weekly and prn. Ensure that pacifier remains at the top of the bed and is discarded if found below infant’s waist.

12. Keep IV tubing away from the diaper area.

13. Wipe down all work areas and equipment every shift and prn with hospital approved cleansing wipes.

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Background

1. Infants at greatest risk for Necrotizing Enterocolitis (NEC) are those born at less than 1500 grams, and less than 32 weeks gestational age. For infants <30 weeks gestation, the mean age at diagnosis is approximately 20 days\(^1\). The more immature the neonate the later the onset of NEC with a centering of occurrence at a median of 31 weeks post-conceptual age\(^2\).

2. NEC affects up to 10% of children with placental circulatory insufficiency and IUGR\(^3\). IUGR is one of the strongest risk factors associated with NEC\(^4\).

3. Bell’s Staging criteria:
   a. Stage 1 – Suggestive, nonspecific, with feeding intolerance, sepsis, GI hemorrhage, and radiographic abdominal distention and ileus.
   b. Stage 2 – Pneumatosis intestinalis and portal venous gas present on radiographic films. However, these classic signs are not always seen, especially in more preterm infants. (75% will have pneumatosis; infants born at 23-26 weeks GA will have pneumatosis only 29% of the time. This group more commonly presents with ileus [77%] and abdominal distension [71%]). If unable to distinguish stool from pneumatosis, hold feedings and repeat film in 4 hours.
   c. Stage 3 – Pneumoperitoneum. This may be very subtle. After first AP and lateral x-ray, all subsequent x-rays should be lateral only to avoid missing the pneumoperitoneum.

4. Feeding rationale and evidence:
   a. The fetus swallows amniotic fluid composed of nutrients, growth factors, and immunoglobulins\(^5\) Following premature birth, an active in utero gut becomes inactive when enteral feeding is delayed\(^6\). Early establishment of feeding is the most influential factor for the reduction of sepsis. Nearly four-fold reduction in late-onset sepsis is noted if full feedings are established in the second week of life. Not introducing at least small amounts of food to the GI tract results in atrophy and predisposes the intestine to inflammation and likely translocation of bacteria. Poor motility increases the opportunity for antigens to injure mucosal surfaces and for bacteria to translocate. As few as 3 days NPO is associated with significant gut atrophy in animal models.
   b. Bolus vs continuous feedings stimulate maturation of hormone secretion and motility in the premature GI tract. Slowly administered boluses increase intestinal motor activity\(^7\).
   c. In a meta-analysis of 4 trials (N=496), slow (15=20 ml/kg/day versus fast advance (30-35 ml/kg/day) of feedings was evaluated. No statistically significant difference was found between the 2 on the risk of NEC (RR=1.43, 95%CI:0.78-2.61\(^8\).

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4 Transfusion Associated Necrotizing Enterocolitis: A Meta-analysis of Observational Data, Pediatrics 129(3), March 2012

5 Noerr. Current Controversies in the Understanding of Necrotizing Enterocolitis. Advances in Neonatal Care 3(3), June, 2003;107-120


8 Morgan et al. Slow advancement of enteral feed volumes to prevent necrotizing enterocolitis in very low birth weight infants. Cochrane Database Syst Rev.2011;(3):CD001241
d. Feeding intolerance and NEC may result from contaminated enteral feeding tube. Investigators have shown that more than 54% of intensive care patients on continuous enteral feeding for more than 3 days developed pneumonia and most of these episodes of pneumonia were caused by Gram negative organisms previously cultured in the stomach.\textsuperscript{9} Retrograde movement of organisms can and does occur in the clinical situation even with continuous infusion of diet administered nasogastrically.\textsuperscript{9} Infants treated with H2 antagonists are more likely to have contaminated tubes, because they reduce the acidity of the stomach and potentiate the growth of bacteria.\textsuperscript{10} The NIH recommends careful evaluation of giving H2 blockers to premature infants, given the high morbidity and mortality from NEC.\textsuperscript{11}

e. Breast milk feedings should be encouraged whenever possible. Enteral feedings of at least 50% mother’s own milk in the first 14 days of life resulted in a six-fold decrease in the incidence of NEC.\textsuperscript{12} Early pumping is critical in establishing an early milk supply, which increases the likelihood that the mother will be able to produce adequate volumes of breast milk over the long term. In a meta-analysis of 7 RCTs (n=471), donor milk decreased an infant’s risk for NEC by nearly 80% compared with formula.\textsuperscript{13} At least 50 ml/kg/day human milk has been shown to protect against late onset sepsis.\textsuperscript{14}

5. Some association between transfusion and the development of NEC has been noted. The infant at highest risk to develop transfusion related NEC is also very premature and has a history of being acutely ill, significantly more anemic, lower birth weight, and has a higher prevalence of treated PDA, that is, at overall higher risk of NEC. It is also feasible that the early stages of NEC may have preceded transfusion. Subtle early symptoms of NEC, such as apnea and bradycardia, may have influenced the clinical decision to administer transfusion to infants before more fulminant clinical signs of NEC developed. Preterm infants receiving a blood transfusion in the presence of a significant PDA show a reduction in mesenteric flow 4 hours after transfusion, an effect proportional to the proportion of PDA.

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\textsuperscript{13} Boyd et al. Donor breast milk versus infant formula for preterm infants: systematic review and meta-analysis. Arch Dis Child Fetal Neonatal Ed. 2007;92(3:F169-F175

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to the volume of packed cell transfusate\textsuperscript{2}. The issue of whether to feed during PRBC transfusion is unresolved

6. Antibiotic therapy early in the clinical course prevents bacterial colonization with potentially beneficial microbes and predisposes the colonization of antibiotic-resistant bacteria. Prolonged duration of initial empirical antibiotic treatment is associated with increased rates of necrotizing enterocolitis and death for extremely low birth weight infants\textsuperscript{16}.

7. In a meta-analysis of 15 studies (n=865) comparing ibuprofen with indomethacin to close a PDA, the risk for NEC decreased with ibuprofen (RR =0.68, 95% CI:0.47-0.99)\textsuperscript{17}

8. Early growth failure has long-term negative effects on childhood growth and neurodevelopment and these effects probably persist into adulthood\textsuperscript{18}. The NICHD reported that although IUGR was present in 22% of VLBW newborns at birth, 91% of newborns demonstrated postnatal growth restriction by 36 weeks PMSA\textsuperscript{19}. Initial weight loss is expected for all newborns, but up to 50% of the initial weight loss for VLBW newborns may be attributable to the loss of endogenous glycogen and lipid stores and lean tissue mass that have been used to meet metabolic energy demands in the absence of adequate nutrition\textsuperscript{18}. The longer it takes to regain birth weight, the more difficult it is to regain an optimal growth pattern based on genetic growth potential\textsuperscript{18}. If improved head circumference measurements, reflecting brain growth in the absence of CNS abnormalities, do not occur within the first 3 to 8 months of postnatal life, there is not likely to be further “catch-up” head circumference growth\textsuperscript{18}. AGA VLBW newborns who remain on the same growth curve through to discharge have better neurodevelopmental outcome at 24 months of age than do VLBW newborns who reach AGA at birth but drop to lower than the 10\textsuperscript{th} percentile growth curve (SGA) at discharge\textsuperscript{18}.

9. There is little published evidence to support the predictive value of gastric residuals\textsuperscript{5}. A randomized, controlled multicenter trial assessed GR in 99 infants with birth weights <1000 g (mean gestation 26 weeks, mean birth weight 820 g), of whom 5 developed NEC. The mean GR was 1.2 ml and did not predict NEC\textsuperscript{20}. Using a syringe to withdraw

\begin{thebibliography}{9}
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\bibitem{5} Noerr. Current Controversies in the Understanding of Necrotizing Enterocolitis. Advances in Neonatal Care 3(3), June, 2003;107-120
\bibitem{20} Mihatsh, et al. The Significance of Gastric Residuals in the Early Enteral Feeding Advancement of Extremely Low Birth Weight Infants. Pediatrics 2002; 109; 457
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gastric contents will not consistently result in aspiration of the total volume of fluid present in the stomach\textsuperscript{21}.

10. In a prospective blinded study evaluating the association of occult hematochezia and NEC, daily Hemoccult testing of stools in 95 LBW neonates who were being fed revealed no relationship between the development of NEC and preceding occult blood in the stools. Of the 6 neonates who developed NEC\textless 5 had stools tested in one or both days preceding the disease; none contained occult blood\textsuperscript{22}. In infants with NEC, gross hematochezia occur more frequently than isolated occult hematochezia, and detection of occult blood has marginal value when added to gross hematochezia\textsuperscript{23}.

References


3/2010; Revised 12/2012
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28) Jatinder Bhatia, MD, Southeastern Association of Neonatologists Meeting 2008; Killer NEC: New Face for an Old Name.
29) Feeding Guidelines – University of Virginia NICU; 2009.
32) Bombell et al. Delayed introduction of progressive enteral feeds to prevent necrotizing enterocolitis in very low birth weight infants. Cochrane Database Syst. Rev. 2009;(3)CD000504