



Yorkshire and Humber Neonatal ODN (South) Clinical Guideline

Title: Necrotising Enterocolitis (NEC)

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This clinical guideline has been developed to ensure appropriate evidence based standards of care throughout the Yorkshire and Humber Neonatal Operational Delivery Network(South). The appropriate use and interpretation of this guideline in providing clinical care remains the responsibility of the individual clinician. If there is any doubt discuss with a senior colleague.

Best practice recommendations represent widely used evidence-based practice and high quality standards that all Neonatal Units across the Network should implement. Subsequent suggested recommendations may be put into practice in local units. However, alternative appropriate local guidelines may also exist.

A. Summary page

Necrotising enterocolitis (NEC) is a disease with high mortality in the preterm neonate.

- Preventive measures should always be part of care:
 - Early trophic feeding with breast milk
 - Following an incremental feeding regime. See Y&H Neonatal ODN (South) Feeding the preterm infant).
 - Avoid prolonged use of early empirical antibiotics
 - Careful application of blood transfusion
 - Use of multi-strain probiotics in infants < 33 weeks or <1500g
- Early symptoms may be non-specific and there should be a low threshold to investigate for this condition.
- Sick infants may require urgent resuscitation, stabilization with ventilatory and inotropic support, including need of fluids/blood products.
- Monitor haematological, biochemical, inflammatory markers; obtain blood cultures and start broad spectrum antibiotics.
- Consider early discussion with surgical team.

Diagnosis and Treatment of NEC

	Signs and Symptoms	AXR findings	Management
Suspected NEC	<p>Abdominal Distension</p> <p>Feed intolerance</p> <p>Bilious Aspirates</p> <p>Unwell</p> <p>Increasing bradycardia and apnoea, desaturations</p> <p>Temperature instability</p> <p>Raised infection markers</p> <p>Decreasing neutrophil and platelet count</p>	<p>Normal</p> <p>Non-specific gaseous bowel loops.</p>	<p>Observe abdominal distension and feed intolerance closely</p> <p>Consider Nasogastric tube insertion to decompress bowel</p> <p>Holding feeds</p> <p>AXR</p> <p>Checking FBC, CRP and Capillary gas, Blood culture</p> <p>Consider broad spectrum antibiotics. To be reviewed at 36hrs with cultures and clinical assessment prior to re-administering feeds.</p>
Medical NEC	<p>Lactic acidosis</p> <p>Blood in stools</p>	<p>Distended bowels loops.</p> <p>Paucity of gas</p> <p>Pneumatosis</p> <p>Fixed dilated loops seen on serial AXR.</p> <p>Intramural gas</p>	<p>Stop feeds</p> <p>Nasogastric tube insertion to decompress bowel</p> <p>Serial AXR</p> <p>Close monitoring of inflammatory marker and examination of abdominal distension</p> <p>Broad spectrum Antibiotic 5-10 days</p> <p>Administration of parenteral nutrition via central access to maintain nutrition.</p>
<p>Failure of medical management (after 3-4 days) e.g. persistent ileus pattern, abdominal distension, AXR showing absence of bowel gas- consider elective discussion with surgical team</p>			
Surgical NEC	<p>Unwell</p> <p>Shocked</p> <p>Haemodynamically unstable</p> <p>Deteriorating clinical situation.</p> <p>Persistent abdominal distension with no improvement despite broad spectrum antibiotics.</p>	<p>Intraperitoneal gas</p> <p>Portal venous gas</p> <p>Ligamentum Flavum is visible</p>	<p>Stabilisation of haemodynamic status</p> <p>Referral to Surgical centre- laparotomy</p> <p>Early Intubation, ventilation, Inotropes, Fluids and Blood products maybe required</p>

B. Full guideline

1. Background

Necrotizing enterocolitis is one of the most common gastrointestinal emergencies in the newborn infant. It is disorder characterized by ischaemic necrosis of the intestinal mucosa, with associated inflammation, invasion of enteric gas forming organisms and dissection of the gas into muscularis and portal venous system. The excessive inflammatory process in the highly immune-reactive intestine in NEC extend the effects of the disease systematically, affecting distant organs such as the brain, increasing risk of neurodevelopmental problems. NEC is can stage through the Bell Staging criteria, please refer to Appendix 1.

Necrotizing enterocolitis occurs in 1 to 3 per 1000 births. The survival rate in UK is 75% but mortality is inversely related to gestation and birthweight, 10-44% in infants < 1500gram and 0-20% in infants over 2500grams.

Risk factors for NEC:

- Prematurity
- Intrauterine growth restriction
- Very low birthweight
- Patent ductus arteriosus
- Indomethacin treatment
- Blood transfusion
- Lack of enteral breast milk

2. Aim

To provide, as far as possible, an evidence-based guide in managing NEC in the neonatal unit, from early recognition to surgical referral.

3. Making a Diagnosis

3.1.1 Classic NEC in a preterm (usually after 10 days of age)

- Feed intolerance
- Abdominal distension (may be shiny +/- periumbilical erythema)
- Bloody stools

3.1.2 Symptoms may progress rapidly, often within hours.

- Abdominal discolouration
- Intestinal perforation
- Systemic hypotension

3.1.3 Early symptoms may be non-specific-

- Increased episodes of bradycardia and desaturations
- Mild abdominal distension
- Feed intolerance e.g. large bilious or large bloody aspirates, vomiting
- Tachycardia
- Increased crying

3.1.4 Early imaging signs

- Dilated loops of bowel
- Paucity of gas
- Gas-filled loops of bowel unaltered on repeated examinations (fixed loops)

3.1.5 More advance imaging signs

- Pneumatosis intestinalis
- Portal venous gas
- Pneumoperitoneum

3.2 *Presentation with any of the above early symptoms should prompt a thorough clinical examination of the infant with appropriate investigations – see below*

3.3 NEC-like symptoms also occur in term or late preterm infants, disease usually occurring in first week after birth, more often associated with other problems, e.g. maternal illicit drug use, intestinal anomalies, congenital heart disease and perinatal stress.^{4,5}

3.4 Spontaneous perforation in preterm infants probably represents a different disease entity with a different pathogenesis.^{6,7}

3.5 The more premature the infant, the later the disease occurs after birth.⁸

3.6 Diagnostic criteria using Bell's staging or Vermont-Oxford criteria both have similar shortcomings since severe NEC can develop without meeting the advance criteria.⁹

4. Investigation & Treatment 1

4.1 Factors conferring a predisposition to NEC include genetic factors and several immature characteristics of the foetal intestine, including altered microbiota, inadequate intestinal barrier function, and an excessive inflammatory response.^{1,10-17}

4.2 Management depends on clinical presentation (Table 1).

4.3 Investigations include abdominal radiograph (AP +/- left lateral decubitus)+/- radiological opinion.

4.4 Monitoring of white cells, differentials, platelet counts (sudden decreases suggest disease progression) and inflammatory markers; blood cultures; blood gases: electrolytes and lactate

4.5 Medical intervention includes abdominal decompression, bowel rest and parenteral nutrition.

4.5.1 Bowel rest, depending on degree of suspicion, severity of symptoms/signs may be a brief stopping of enteral feeds e.g. 24h (for unconfirmed NEC) or 7-10 days.

4.5.2 Nasogastric tube on free drainage

4.6 Start broad spectrum intravenous antibiotics – including anaerobic and gram-negative cover.

4.7 Intensive care monitoring

4.8 Appropriate resuscitation

4.9 Ventilatory support

4.9.1 Consider ventilation for infants on CPAP to avoid further abdominal distension.

4.10 Cardiovascular assessment (HR, Blood pressure, Lactate)

4.10.1 Low threshold for inotropic support

4.11 Fluid resuscitation

4.11.1 Strict fluid balance, monitor urine output, consider catheterization

4.11.2 Support with blood products as required

4.12 Early discussion with surgical team regarding on-going management, urgency of surgical assessment/intervention and the need for transfer – e.g. when not responding to/failure of medical management, where perforation /stricture is suspected.

4.12 Re-feeding after NEC

4.12.1 In a clinically stable infant with unconfirmed NEC, consider restarting feeding after 5 days of nil by mouth

4.12.2 In definitive NEC, consider restarting feeding after 10 days of nil by mouth

4.12.3 Rate of feed increment no more than 30ml/kg/day (refer to Y and H (South) Feeding the preterm infant guideline)

4.12.4 Use EBM or donor breast milk, if these unavailable, consider hydrolysed formula e.g. Pepti Junior

4.12.5 After resolution of clinical and radiological features in medically managed NEC, if feeds cannot be established i.e. recurrent/large aspirates with abdominal distension etc plus dilated loops on plain AXR, surgical opinion should be sought to exclude a post-NEC stricture

Recommendations:

- **Suspected NEC in a clinically stable infant should be investigated and treated as NEC until proven otherwise.**
- **Suspected NEC in an unwell/unstable infant OR confirmed NEC in a clinically stable infant should be resuscitated, stabilized, investigated, monitored and treated for 5-10 days. Consider discussion with surgical colleagues +/- early transfer in cases not responding to medical management.**
- **Confirmed NEC in a sick/clinically deteriorating infant requires urgent resuscitation and stabilization, close monitoring of clinical, haematological and biochemical status; urgent discussion with surgical and neonatal colleagues and transport team.**

5. Prevention

5.1 Because of the fulminating nature of NEC, preventive approaches are extremely important:

5.1.1 Rapid increases in feeding increases the likelihood of NEC.²⁰

5.1.2 However, complete withholding of feeds leads to prolonged use of parenteral nutrition, intestinal atrophy, parenteral nutrition associated cholestasis, increased permeability and inflammation, and late onset sepsis.²¹

5.1.3 Exclusive use of human milk enterally may lower the incidence of NEC.²²⁻²⁴

5.3.1 Prolonged empirical use of intravenous antibiotics increases the incidence of NEC.²⁵

5.3.2 Evidence has amassed that demonstrates the use of probiotics can prevent the incidence of severe NEC RR 0.57 (0.47-0.7), mortality RR 0.77 (0.65-0.92) and late onset sepsis 0.88 (0.8-0.97)³². Equivocal results from large studies such as PIPS study³⁴ which utilised Bifidobacterium contrasted with positive results from many other studies prompting assessment of type of probiotic used. Meta-analysis of strain-types demonstrates that multiple strains are more effective than single strains in reducing NEC (OR 0.36 (0.24-0.53)) and mortality (OR 0.58 (0.43-0.79)) supporting their use³³.

Multi-strain probiotics should be used routinely for babies born below 33 weeks' gestation or 1500g once infant is on a minimal feed volume of 1ml. Omit if the baby is nil by mouth or being treated for NEC. Discontinue at 34 weeks gestational age, unless feeds are poorly tolerated, and consultant decision is made to continue beyond this gestational age.

5.3.3 Prebiotics enhance the proliferation of endogenous flora such as bifidobacterial and appear to alter the consistency and frequency of stools, but their efficacy in prevention of NEC is unclear.

Recommendations

- **Early initiation of minimal enteral feeds of expressed human milk avoiding rapid increments: refer to Y&H Neonatal ODN "Feeding the Preterm Infant" guideline**
- **Avoid early prolonged use of antibiotics.**
- **Use of multi-strain probiotics to prevent severe NEC in infants < 33/40 or < 1500g**

6.0 Areas outside remit

6.1 Surgical management of NEC.

7.0 Audit criteria

- 7.1 numbers of suspected and confirmed NEC
- 7.2 yearly figures
- 7.3 preventive measures
 - 7.3.1 type of feed
 - 7.3.2 rate of feed increment
 - 7.3.3 use of empirical antibiotics
- 7.4 imaging
- 7.5 medical management
 - 7.5.1 bowel rest (days)
 - 7.5.2 parenteral nutrition
 - 7.5.3 antibiotics used (which and duration)
 - 7.5.4 monitoring of haematological, biochemical and inflammatory markers
 - 7.5.5 support of other systems
 - 7.5.6 surgical referral
 - 7.6.7 outcome

8.0 References

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Sources

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- Probiotics guideline. Ashford and St Peter's Hospital. Dr P Reynolds.

C Appendices

- 1) Bell's staging for NEC
- 2) Grading recommendation

Appendix 1

Modified Bell staging criteria for necrotizing enterocolitis (NEC) in neonates

Stage	Classification of NEC	Systemic signs	Abdominal signs	Radiographic signs
IA	Suspected	Temperature instability, apnea, bradycardia, lethargy	Gastric retention, abdominal distention, emesis, heme-positive stool	Normal or intestinal dilation, mild ileus
IB	Suspected	Same as above	Grossly bloody stool	Same as above
IIA	Definite, mildly ill	Same as above	Same as above, plus absent bowel sounds with or without abdominal tenderness	Intestinal dilation, ileus, pneumatosis intestinalis
IIB	Definite, moderately ill	Same as above, plus mild metabolic acidosis and thrombocytopenia	Same as above, plus absent bowel sounds, definite tenderness, with or without abdominal cellulitis or right lower quadrant mass	Same as IIA, plus ascites
IIIA	Advanced, severely ill, intact bowel	Same as IIB, plus hypotension, bradycardia, severe apnea, combined respiratory and metabolic acidosis, Disseminated intravascular coagulopathy, and neutropenia	Same as above, plus signs of peritonitis, marked tenderness, and abdominal distention	Same as IIA, plus ascites
IIIB	Advanced, severely ill, perforated bowel	Same as IIIA	Same as IIIA	Same as above, plus pneumoperitoneum

Appendix 2

Grades of Recommendation

Grade	
A	Requires at least one meta analysis, systematic review or RCT rated as 1++, and directly applicable to the target population, and demonstrating overall consistency of results
B	Requires a body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
C	Requires a body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+