Surgical strategies for necrotising enterocolitis: a survey of practice in the United Kingdom

C M Rees, N J Hall, S Eaton, A Pierro

Background: Strategies for the surgical management of necrotising enterocolitis are various and controversial.

Objective: To characterise variation in surgical management of this disease across the United Kingdom.

Methods: Postal survey of 104 consultant paediatric surgeons with a 77% response rate.

Results: Duration of antibiotic treatment (median 10 days, range 6–14), time until the start of enteral feeding (median 10 days, range 4–21), and absolute indications for surgery all vary between surgeons. Peritoneal drainage is used by 95% of surgeons. Forty two percent use it in neonates of all weights, whereas 36% restrict its use to those <1000 g. Peritoneal drainage is used for stabilisation by 95% and as definitive treatment by 58%. At laparotomy, operative procedures include diverting jejunostomy, resection and stoma, resection with primary anastomosis, and “clip and drop”. All procedures are used in infants of all weights except resection and primary anastomosis, which is used predominantly in larger infants (55% in <1000 g; 77% in >1000g; \(p = 0.005\)). Infants may be considered too unwell for peritoneal drainage by 11% of surgeons compared with 90% for laparotomy (\(p<0.0001\)).

Conclusions: There is considerable variation in surgical strategies for necrotising enterocolitis. Peritoneal drainage is used by most surgeons, with controversial indications and expectations. The use of resection and primary anastomosis is influenced by the weight of the neonate.
Indications for surgery (table 1)
The most common clinical indications for surgical intervention were: failure to improve with maximal medical treatment (71% consider this an indication for laparotomy compared with only 14% for peritoneal drainage), and the presence of an abdominal mass (36% for laparotomy compared with 1% for peritoneal drainage). A small number of surgeons consider thrombocytopenia and raised inflammatory markers absolute indications for surgical intervention.

Of the radiological features of NEC, free intraperitoneal gas is considered an absolute indication for laparotomy by 75% of surgeons and for drainage by 53%. A fixed intestinal loop is considered an absolute indication for laparotomy by 39% of surgeons compared with 6% for peritoneal drainage. Three percent of surgeons consider pneumatosis intestinalis an indication for laparotomy.

Role of peritoneal drainage
Ninety-five percent of surgeons use peritoneal drainage as an option in the management of patients with NEC. Forty-two percent of surgeons consider using peritoneal drainage in all patients; others restrict its use to infants weighing less than 1500 g (19%) or less than 1000 g (36%; table 2). Fifty-eight percent of surgeons consider using peritoneal drainage as a definitive treatment, 57% to stabilise neonates before transfer, and 95% to stabilise them before laparotomy. Those surgeons who responded always inserted peritoneal drains on the neonatal unit rather than in the operating theatre.

Most surgeons insert the drain into either iliac fossa, but the right side is used more commonly than the left (86% compared with 56% of surgeons). The right upper quadrant is used by 9% and the left upper quadrant by 5%. Twenty percent of surgeons use a single drain with two exit sites.

Delayed laparotomy after peritoneal drainage
Sixty-four percent of surgeons would perform a delayed laparotomy within 12 h, and 37% between 12 and 24 h after drainage. The most common indications for delayed laparotomy are clinical deterioration (87%), radiological evidence of bowel obstruction (61%), and palpable abdominal mass (32%). However, 8% of surgeons would never perform delayed laparotomy after primary peritoneal drainage.

Operative procedure at laparotomy
There is considerable variation in the procedures that individual surgeons perform at laparotomy. Approximately one third use "clip and drop" (a procedure in which non-viable bowel is resected, the remaining bowel ends being clipped or stapled and replaced in the abdomen with a planned second laparotomy performed 48–72 h after), whereas bowel resection and stoma formation is used by the majority (92%). Furthermore, some surgeons reserve resection and primary anastomosis for infants weighing more than 1000 g (77% in >1000 g v 55% in <1000 g; p = 0.005).

The laparotomy is usually performed in an operating theatre (62%) in an operating theatre in the same building, 38% in another building, and 3% in an operating area in the neonatal unit). Fourteen percent of surgeons operate on infants who are in their cot on the neonatal unit.

Too unwell for surgery
Eleven percent of surgeons sometimes consider neonates too unwell for peritoneal drain compared with 90% who may consider them too unwell for laparotomy (p<0.0001).

DISCUSSION
There is a lack of consensus on the surgical management of NEC and a need for ongoing clinical research to identify the most appropriate methods for managing this challenging group of patients. To identify precisely current techniques and opinions, we have performed a survey of neonatal surgeons practising within the United Kingdom and are able to discuss our findings in relation to evidence from the recent literature.

The response rate for this survey was high (77%), suggesting that it reflects current practice. It is striking that such a large variation exists in both conservative and operative management of NEC. This may be due in part to the variation in clinical presentations of NEC: infants may present at any stage of the disease with a variety of signs and symptoms. They may also have considerable co-morbidities which influence treatment decisions. We must also bear in mind that answers to questionnaires may imply artificial rigidity in clinical practice, as all scenarios cannot be covered in a simple questionnaire.

The decision of when to operate is often difficult but a number of indications have been evaluated in the literature. Kosloske found that clinical deterioration was only a poor indicator of the need for laparotomy yet it is used as an absolute indication for operation by 71% of surgeons. However, thrombocytopenia, also a poor indicator of the need for surgery, is regarded as an absolute indication by 3%, as is the presence of raised inflammatory markers (table 1). A number of papers have highlighted the difficulty of relying on radiological features to make a definitive diagnosis of NEC. Current evidence does support pneumatosis intestinalis as an absolute indication for operative intervention. Portal venous gas is only considered an absolute indication for laparotomy by 8% of surgeons, despite evidence that it is a marker for significant disease (with a mortality of up to 71% in some series).

Table 1 Absolute indications for surgical intervention

<table>
<thead>
<tr>
<th>Absolute indication</th>
<th>Percentage of surgeons using indication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical findings</strong></td>
<td></td>
</tr>
<tr>
<td>Failure of medical therapy</td>
<td>71%</td>
</tr>
<tr>
<td>Abdominal mass</td>
<td>36%</td>
</tr>
<tr>
<td>Thrombocytopenia</td>
<td>3%</td>
</tr>
<tr>
<td>Raised inflammatory markers</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Radiological findings</strong></td>
<td></td>
</tr>
<tr>
<td>Pneumatosis intestinalis</td>
<td>75%</td>
</tr>
<tr>
<td>Fixed intestinal loop</td>
<td>39%</td>
</tr>
<tr>
<td>Portal venous gas</td>
<td>8%</td>
</tr>
<tr>
<td>Pneumatisis intestinalis</td>
<td>3%</td>
</tr>
</tbody>
</table>

Question asked: In which of these weight categories of infants would you use peritoneal drainage? (tick one only): All; <2000 g; <1500 g; <1000 g.

Table 2 Use of peritoneal drainage and weight of patient

<table>
<thead>
<tr>
<th>Weight category</th>
<th>Number of surgeons (n = 74)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All weights</td>
<td>31</td>
<td>42</td>
</tr>
<tr>
<td>&lt;1000 g</td>
<td>27</td>
<td>36</td>
</tr>
<tr>
<td>&lt;1500 g</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>&lt;2000 g</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Question asked: In which of these weight categories of infants would you use peritoneal drainage? (tick one only): All; <2000 g; <1500 g; <1000 g.
Since it was first described by Marshall in 1975, peritoneal drainage has become a useful tool in the armamentarium of the paediatric surgeon, but surgeons’ expectations seem to vary considerably. This survey highlights that the role of peritoneal drainage in perforated NEC is becoming established, as 53% of surgeons would consider pneumoperitoneum an absolute indication for its use. (In the extremely low birthweight (ELBW) infant, pneumoperitoneum may sometimes result from spontaneous gastrointestinal perforation, which may also be treated by peritoneal drainage.)

Ein et al reported that peritoneal drainage should only be used in the presence of free air and should always be followed by a laparotomy if there is no improvement. These authors also recommended that it be restricted to infants weighing less than 1500 g. Azarow et al showed a clear survival benefit of laparotomy over peritoneal drain in all infants over 1000 g, but improved survival in the ELBW infants treated with a peritoneal drain. This survey found that 42% of surgeons would consider a drain in all weights of infants (table 2), despite this not being supported by current evidence. This response may reflect the use of peritoneal drainage as a stabilising procedure, for example to allow transfer for operation. The role of peritoneal drainage as a definitive procedure or method of stabilisation is also controversial. There is published literature to suggest that peritoneal drainage can be a satisfactory definitive procedure, particularly in the ELBW infant, but other authors recommend its use as a method of stabilising unstable infants before definitive laparotomy. This controversy is reflected in the finding that only 58% of surgeons in this survey use peritoneal drainage as a definitive procedure. In a meta-analysis of peritoneal drainage versus laparotomy for perforated NEC, Moss et al concluded that the only way to answer this question conclusively is by conducting a randomised trial. Two randomised trials are in progress to address this issue: NECSTEPS (http://necesteps.stanford.edu) and the NET trial (http://www.netttrial.net). The latter is an international trial which we are coordinating.

The preferred site of insertion of peritoneal drains has usually been described as the right or left iliac fossa, and the original descriptions of the procedure usually refer to the right lower quadrant as the preferred site for insertion. However, 9% of surgeons would place a drain in the right upper quadrant of the abdomen, a manoeuvre that could cause bleeding from the liver. The concept of peritoneal drainage is linked to that of delayed laparotomy, but the timing and indications for this have always been controversial. Most advocates of peritoneal drainage caution against the risk of waiting too long before performing a delayed laparotomy. Dimmitt et al suggest that death may be avoided by performing a timely laparotomy. Interestingly, some surgeons (8%) would never perform a delayed laparotomy after drain insertion.

It is not within the scope of this paper to debate the concept of surgery in the neonatal unit, but our findings suggest that this practice is becoming widespread. The beneficial effect on neonatal morbidity and mortality is increasingly being recognised. However, very few units have a specialised operating area on the neonatal unit for this purpose. When laparotomies are performed on the neonatal unit, they are undertaken in the cot.

The procedure performed at laparotomy varies between surgeons, reflecting the clinical condition of the infant and the extent of disease (localised, diffuse, or pan-intestinal NEC). This also highlights the controversies surrounding the concept of resection of the diseased area—some surgeons consider this the key to recovery—and whether to perform a stoma or primary anastomosis. We found that the weight of the infant significantly influences the surgical options, many surgeons reserving primary anastomosis for infants weighing more than 1000 g, even though current evidence (from retrospective series) does not support this. As many as 90% of surgeons feel that there are occasionally patients who are too unstable for a laparotomy, and 11% of surgeons may consider patients too unwell even for peritoneal drain. This may be because in some cases it is felt appropriate to withdraw active care because of co-morbidities.

Our survey shows variation in current surgical management of NEC and inconsistencies between surgical practice and current evidence. The reasons for this variation are not known, but we hypothesise that the lack of clear guidance from the existing literature may be contributory. A number of surgical techniques are available, but none have been shown unequivocally to be superior. Most of the published literature in this field represents retrospective data based on clinical case series, and not prospective data from randomised trials, so it is difficult for the surgeon to make informed decisions about best practice. These findings emphasise the need for randomised trials and guidelines in this field.

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REFERENCES

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