CASE REPORT

Atypical presentation of acute fulminant neonatal necrotising enterocolitis: diagnostic superiority of sonographic evaluation over plain radiography of abdomen

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SUMMARY

A female preterm infant was born to a non-consanguineous couple at 35 weeks of gestation. On day 8 of life, while on full feeds, she developed prolonged apnoea and bradycardia, requiring respiratory support. Her abdomen was soft with unremarkable serial abdominal X-rays. Her septic screen was negative. Metabolic acidosis was worsening despite treatment. Echocardiography showed evidence of high pulmonary pressures. With further deterioration, an ultrasound scan of the abdomen was requested in view of the rising suspicion of abdominal pathology in the absence of sepsis and metabolic disorders. Mural oedema, pneumatosis and portal venous gas, consistent with diagnosis of necrotising enterocolitis, were noted in the ultrasound images. An emergency laparotomy showed extensive small bowel necrosis. Despite maximal medical support, the infant died. This case highlights the importance of imaging using an ultrasound scanner in the diagnosis of necrotising enterocolitis in preterm infants having intractable metabolic acidosis, subtle abdominal signs and unremarkable abdominal X-rays.

BACKGROUND

Necrotising enterocolitis (NEC) is a neonatal emergency, affecting preterm infants with an incidence of 12% in infants born <27 weeks of gestational age with a mortality of 26%.¹ Most of these infants develop symptoms and signs compatible with NEC, but they may have atypical radiographical evidence. This can result in delayed, inappropriate or unnecessary therapy. In this reported case, the major clinical presentation was sudden clinical deterioration in an otherwise healthy infant with severe metabolic acidosis; no gastrointestinal symptoms/signs while on full feeds and the abdominal X-rays were inconsistent with a diagnosis of NEC. Hence, an abdominal ultrasound (US) scan was requested, leading to findings consistent with NEC. An emergency laparotomy confirmed acute fulminant NEC.

CASE PRESENTATION

A female preterm infant (35 weeks) weighing 1700 g (<3rd centile) was born to a 23-year-old gravida 2 mother by emergency caesarean section with an Apgar score of 9 and 9 at 1 and 5 min of life, respectively. The mother had a history of a

termination of pregnancy for multiple fetal anomalies. Antenatal scans raised a suspicion of agenesis of corpus callosum with dilation of lateral ventricles and intrauterine growth restriction. Maternal serology was positive for cytomegalovirus (CMV). Infant's urine for CMV was negative on day 7 of life. Karyotype was normal 46 XX and MRI of the brain confirmed agenesis of corpus callosum with lateral ventricular dilation and bilateral periventricular white matter cystic changes. Eye examination was normal. Placental histopathology revealed high-grade chronic lymphohistiocytic villitis with associated obliterative vasculopathy.

Feeding was initiated with preterm formula milk on day 2 of life and was graded up to full feeds by day 6 of life as per the department guidelines. Her bowel patterns were normal with no gastrointestinal concerns. On day 8 of life, the baby had recurrent desaturation and bradycardia needing intubation and ventilation. There was no history of feed intolerance or haematochezia prior to this episode. On examination, the abdomen was soft and no oragnomegaly was noted. She had progressively increasing metabolic acidosis with hyperlactatemia. Feeds were terminated and gastric contents with partially digested milk were aspirated. She was resuscitated with fluid boluses and broad-spectrum antibiotics were started. The clinical course was complicated by hypotension needing inotropes and severe pulmonary hypertension.

INVESTIGATIONS

Septic and metabolic work up was carried out. Blood counts were within normal limits. Liver function test showed mild prolongation of prothrombin time and hypoalbuminaemia. Renal function was normal. Blood culture was negative and urine microscopy was normal. Plasma glucose and serum ammonia levels were normal, with raised lactate levels. Inborn error of metabolism screen on day 3 of life using Tandem mass spectrometry (TMS) was negative. Serum amino acid levels and urine organic acid profiles were normal. X-ray of the chest was unremarkable. Echocardiography revealed severe pulmonary hypertension. During the course of illness serial abdominal X-rays were reported as unremarkable except for mild bowel dilation. An X-ray of the abdomen performed 10 hours since the onset of symptoms showed

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Figure 1 X-ray of the abdomen carried out 10 hours since the onset of symptoms noted to have suspicious mottled lucencies on both sides with no free air.

suspected mottled lucencies on both sides of the abdomen (figure 1). So an urgent abdominal US scan was carried out which showed multiple echogenic foci in the bowel wall consistent with pneumatosis intestinalis, portal venous gas and ascites (figure 2A–C) and a diagnosis of NEC was made.

DIFFERENTIAL DIAGNOSIS

Gram-negative septicaemia was ruled out with normal haematological parameters and negative blood cultures. Inborn error of metabolism screen using TMS was unremarkable on day 3 of life and a negative extended screening later was making it unlikely to be a cause. Duct-dependant cardiac lesion was excluded by echocardiography. NEC diagnosis arose from US imaging.

TREATMENT

A multidisciplinary team comprising of neonatologists, surgical and metabolic specialists were involved in the management. The infant was resuscitated and ventilated following the acute deterioration on day 8 of life. She required inotropes, high-frequency oscillatory ventilation and inhaled nitric oxide for the management of severe pulmonary hypertension. She was started on flucloxacillin and gentamicin, but with increasing concern of sepsis, the antibiotics were escalated to broad-spectrum carbapenem. Coagulopathy was corrected with vitamin K and fresh frozen plasma. Following advice by the metabolic team, work up was initiated. The metabolic acidosis did not respond to infusion of acetate and bicarbonate. Following the US scan diagnosis an emergency laparotomy was planned. Owing to severe cardiorespiratory instability, surgical intervention was delayed by 4 hours during which abdominal distension was noted. Intraoperative findings included 15 cm of unhealthy necrotic bowel and two areas of impending perforation, which were resected and stoma was created (figure 3).

OUTCOME AND FOLLOW-UP

Postoperatively, metabolic acidosis worsened despite maximal support and pulmonary hypertension worsened. The infant

Figure 2 (A) High-resolution ultrasound image of the bowel in the right upper quadrant of the abdomen showing the presence of multiple echogenic foci seen in the bowel wall consistent with pneumatosis intestinalis (arrows). (B) Grey-scale ultrasound scan image showing the presence of thickened small bowel loops (thick arrow) with thickened echogenic valvulae giving a zebra or herring bone appearance (thin arrow). Ascites is noted (*). (C) Multiple echogenic foci are noted in the liver consistent with air in the portal venous system within the liver (arrow).

succumbed following an acute cardiorespiratory collapse 8 hours postoperatively despite extensive resuscitation.

DISCUSSION

This preterm infant, on full feeds, had an acute deterioration on day 8 of life. Clinical examination was unremarkable and the medical team's consensus was more in favour of sepsis or a metabolic disorder in the early phase of this infant's critical illness. Serial abdominal X-rays did not show any evidence of NEC, which resulted in delayed intervention. NEC is a disease of prematurity, more so in small for gestational age infants, occurring more often in formula-fed infants, and is characterised by variable degree of enteral mucosal damage, ranging from mucosal injury to pneumatosis and perforation. Symptoms of NEC vary from vomiting, abdominal distension, increasing gastric aspirate, abdominal wall erythema and haematochezia. Apnoea, lethargy, acidosis and sudden collapse can be the systemic signs.² Sudden collapse, while on full feeds in a previously healthy infant could be a feature of inborn error of metabolism or closure of ductus arteriosus in a duct-dependant congenital heart disease. Serial abdominal radiography remains the main diagnostic tool for NEC, supported by severe metabolic acidosis,

Figure 3 Small bowel with multiple patches of ischaemia and impending perforation.

hyponatremia and coagulopathy. However, radiographical and haematological picture of sepsis may mask NEC, delaying the diagnosis.

Although abdominal US scan can identify changes in the bowel wall in NEC, it is not widely practised due to lack of expertise and high procedure cost. The expertise for an US scan diagnosis of NEC remains with the experienced sonologist. In a prospective trial by Kim *et al*, echogenic dots or dense granular echogenicity in the bowel wall was seen in patients with early stage of NEC. None of these infants showed evidence of pneumatosis intestinalis in abdominal X-ray.² US scan findings in NEC includes augmented echogenicity of the bowel wall, with intestinal wall thickness either over 2 mm or thinning below 1 mm, pneumatosis intestinalis, portal venous gas, pneumoperitoneum, echogenic ascitic fluid and reduced peristalsis.³ Doppler US imaging may reveal altered/reduced intestinal wall perfusion.³ Dilli *et al*⁴ suggested abdominal US scan to be superior to plain radiography for early detection of intestinal perforation. Abdominal US scan has many advantages over radiography including direct visualisation of intraperitoneal fluid, visualisation of bowel wall thickness, peristalsis and assessment of the arterial perfusion of the bowel wall.⁵

There are reports that support the use of US imaging when abdominal radiographical findings are negative in the face of a strong clinical suspicion of NEC. A review by Bohnhorst suggests that due to the high acoustic impedance nature of US, portal venous gas can be easily identified, which is pathognomonic of NEC.⁶ Dördelmann *et al*⁷ did a prospective assessment of abdominal US scanning for suspected/definite NEC and found that portal venous gas had 100% specificity for NEC. A prospective study by Bohnhorst *et al*⁸ confirmed that the sensitivity and specificity of radiological evidence for NEC was lower (75% and 91%), but with the combined imaging of portal venous gas using an US, the sensitivity increased to 89%.

Ultrasonographic findings have been used as a prognosticating measure in addition to diagnosis. Muchantef *et al*⁹ described four abdominal US scan findings that are of greatest clinical

importance: pneumoperitoneum and focal fluid collections can indicate perforation, and bowel wall thinning and avascularity may indicate impending perforation and necrosis. Silva *et al*³ showed that adverse clinical outcome was associated with the sonographic findings of free gas, focal fluid collections or three or more of the findings such as increased bowel wall echogenicity, portal venous gas, absent bowel perfusion, pneumatosis, free fluid with echoes and bowel wall thinning/thickening.

More supportive evidence for use of abdominal US scan in the decision of surgical intervention came from more recent literature. Staryszak *et al*¹⁰ in their study showed that pneumatosis intestinalis was more frequently noted in US scan than in plain abdominal X-ray; most children were treated by surgical intervention; and in more than half of the cases, location of changes identified during surgery was concordant with US scan findings. Miller *et al*¹¹ have described in their series of five neonates with gasless abdomen diagnosed to have NEC, four of them demonstrated intraperitoneal fluid–debris levels and ascites in the US scan, and all had surgical proof of perforation. A recent prospective study by Yikilmaz *et al*¹² confirmed 100% sensitivity, 95.4% specificity, 80% positive predictive value and 100% negative predictive value of abdominal US scan for the detection of bowel necrosis prior to the development of perforation or medical deterioration.

In conclusion, abdominal US scan is a useful bedside diagnostic tool when challenged with an infant with subtle abdominal symptoms and signs and unremarkable radiographical images. Our case also reinforces the importance of early US imaging in suspected NEC, which could guide the surgeon on timing the intervention and thereby preventing the catastrophic gastrointestinal morbidities and mortality associated with NEC.

Learning points

- ▶ A strong suspicion of necrotising enterocolitis (NEC) should arise when a preterm infant becomes sick while on formula feeds with persistent severe lactic acidosis, even in the absence of gastrointestinal symptoms and/or positive abdominal X-ray findings.
- ▶ Abdominal radiographs can be normal in early stages of NEC.
- ▶ Ultrasonographic diagnosis of NEC should be initiated on strong clinical suspicion with atypical symptomatology in an infant at-risk for NEC, especially sick preterm infants having negative abdominal radiographic findings.
- ▶ Early diagnosis of NEC using abdominal US scan may alter the clinical course and prognosis.

Contributors VR wrote the case report. HT reported the images. VSR edited the case report. SC wrote the discussion and finalised the case report.

Competing interests None declared.

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