Necrotising enterocolitis after cardiac catheterisation in infants

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SUMMARY Necrotising enterocolitis occurred in 3 infants after angiography at cardiac catheterisation. It is suggested that hypertonic contrast medium might have been responsible and that this complication could be avoided by the use of nonionic contrast media.

Necrotising enterocolitis (NEC) is a potentially lethal condition primarily seen in infants of low birthweights who have undergone hypoxia or similar stress. It is characterised by gastric retention, vomiting, abdominal distension, and blood-stained diarrhoea, or by frank rectal bleeding. The aetiology is obscure, but hypoxic damage to the mucosa of the gut followed by invasion of the gut wall by gas-forming organisms is usually postulated. The condition has been reported in term infants, but it is then usually slighter and carries a better prognosis. The association of NEC with cardiac catheterisation has not hitherto been reported. Within a 6-month period, there were 3 cases of NEC within 24 hours of diagnostic cardiac catheterisation in our department.

Case reports

Case 1. A term baby girl weighing 2670 g was admitted aged 2 days, deeply cyanosed, and with a presumptive diagnosis of transposition of the great vessels. Delivery had been normal. Clinical examination showed a cyanotic infant with an enlarged liver, normal heart sounds, tachypnoea (80/min), and blood pressure 70/50 mmHg. Arterial oxygen saturation (S_{aO_2}) was 58%, pH 7.35, and haematocrit 50%. A chest x-ray suggested D-transposition of the great vessels. Cardiac catheterisation on the day of admission confirmed the diagnosis. The catheter was introduced via the right femoral vein after percutaneous puncture. Contrast injections were made in the right and left ventricles using 5 and 4 ml respectively contrast medium. A balloon atrial septostomy was then performed and S_{aO_2} increased to 86%.

24 hours after catheterisation there was frank rectal bleeding on three occasions during a period of several hours.

The abdomen was not distended, and some bowel sounds were audible. Abdominal x-ray showed a distended colon and terminal ileum, but without fluid levels. A small area of intramural gas was visible in the colon. The x-ray appearances were normal 24 hours later. Oral feeds were stopped, and fluid with ampicillin and gentamicin given. Three days later, IV alimentation with Intralipid and Vamin was started. Eight days after bleeding, no further problems had been encountered and oral feeds were started. 19 days after catheterisation, S_{aO_2} had fallen to 27%, and a repeat balloon septostomy was carried out which improved S_{aO_2} to 60%. Further deterioration in S_{aO_2} and growth failure necessitated an early operative correction (Mustard procedure) at age 11 weeks. Subsequent progress is satisfactory.

Case 2. A term baby girl weighing 3 kg was admitted at age 8 days for investigation of cyanosis and a heart murmur. Delivery had been normal, but ampicillin and gentamicin had been given since birth because of prolonged rupture of amniotic membranes. Clinical examination showed a moderately cyanosed infant with tachypnoea (64/min), an enlarged liver, and a grade IV holosystolic murmur at the lower left sternal edge. ECG and chest x-ray were compatible with transposition of the great vessels. Two-dimensional echocardiography demonstrated D-transposition. S_{aO_2} was 68%, pH 7.20, and haematocrit 54%.

Cardiac catheterisation the next day demonstrated D-transposition with a muscular ventricular septum defect and patent ductus arteriosus. The catheter was introduced via the right femoral vein after percutaneous puncture, and a needle was placed in the opposite femoral artery to record arterial O_2 saturations and pressure.

Angiograms were made of the right and left ventricles after injection of 6 and 5 ml respectively contrast medium. A balloon atrial septostomy was then carried out, and S_{aO_2} was 87% after the procedure.

12 hours after catheterisation there was severe rectal bleeding and shock. Blood pressure was 50/0 mmHg. No peristaltic sounds were heard. Blood transfusion was carried out with rapid improvement.

X-ray showed extensive pneumatosis coli, but no involvement of the small bowel. The pneumatosis disappeared within 24 hours, but x-ray signs of ascitic fluid persisted for 2 days. Oral feeding was stopped and IV fluids with ampicillin and gentamicin was given, with IV alimentation (Intralipid and Vamin) from the 4th day. Oral feeds were gradually reintroduced from the 6th day, and IV fluids stopped on the 11th day.

Progress is satisfactory, and we expect to carry out corrective surgery in the first year of life.

Case 3. A 5-month-old boy weighing 3.8 kg was referred for investigation of a heart murmur and failure to thrive. He had been born at 32 weeks' gestation weighing 1290 g. He had received a course of ampicillin and kanamycin because of suspected neonatal infection, and had an exchange transfusion aged 2 days because of hyperbilirubinaemia, not associated with rhesus or ABO incompatibility. Further progress had been satisfactory with rapid weight gain, and he was discharged home aged 2 months, weighing 2800 g. At age 3 months a systolic heart murmur was first heard. At 5 months he was admitted to hospital in heart failure, and treated with digitalis and diuretics to good effect.

When referred, clinical examination showed a pale, dystrophic infant, with tachypnoea (84/min) and blood pressure 80/60 mmHg. There was no cyanosis. There was a loud first and second sound, with a grade IV holosystolic murmur at the lower left sternal edge.

ECG showed biventricular hypertrophy. S_aO_2 was 96%, pH 7.34, and haematocrit 31%. Three days after admission, cardiac catheterisation showed a large membranous ventricular septum defect, with a 5 to 1 left-to-right shunt. The catheter was introduced via the left femoral vein after percutaneous puncture. A needle was placed in the opposite femoral artery. Angiography of the right and left ventricles was carried out using 6 and 8 ml respectively contrast medium.

On the day after catheterisation, the infant began to have diarrhoea and fever; blood appeared in the stools 36 hours after catheterisation. Stool cultures were negative, and x-ray showed pneumatosis coli of almost the whole colon with a 'tram-line' appearance. This had diminished the next day and appearances were normal 48 hours later. Oral feeds were stopped, and IV fluids with ampicillin and gentamicin begun. Symptoms rapidly improved and IV alimentation with Intralipid and Vamin was started on the 5th day after bleeding had been seen. Later oral feeds were gradually reintroduced until full oral feeding was achieved on the 11th day. Subsequent progress has been uneventful and early

total correction was subsequently carried out successfully.

Discussion

The form of NEC seen in these 3 patients is similar to that described by Leonidas and Hall¹ in that it was characterised by x-ray changes confined to the colon, and followed a less severe course than is usually described. Although no pathological evidence for NEC was available, the degree of rectal bleeding suggested that it was necrotising enterocolitis that was responsible for these symptoms rather than pneumatosis coli.

Many reviews have attempted to analyse factors which may be responsible for NEC, mainly in preterm infants. Factors suggested have been birth asphyxia and the use and duration of umbilical catheterisation,²⁻³ hyperviscosity,⁴ primary invasion by Clostridia,⁵ and exchange transfusions.⁶

The infants reported here had not suffered birth asphyxia, although 2 had had slight hypoxia before catheterisation. The association of NEC with umbilical catheters (and probably hence with exchange transfusion), is generally attributed to haemodynamic disturbance produced by the catheter in the portal system, or in the mesenteric arteries.³ In the cardiac catheterisations of these 3 infants, the catheters were introduced only via the inferior vena cava, avoiding the umbilical vein and portal system. The duration of catheterisation was also short compared with that of an indwelling umbilical vessel catheter. No infant had a haematocrit of more than 60%, and so hyperviscosity was unlikely to be a cause, even though it is often seen in children with congenital heart disease. Although repeated routine stool cultures on all 3 infants grew no pathogenic organisms, a special search for fastidious anaerobes was not made.

The strong temporal associations of the condition with catheterisation and contrast injections, suggest that the latter may be contributory. The rapid recovery of the gut despite extensive involvement, and the lack of obstructive sequelae suggests mucosal rather than full thickness bowel wall involvement. The contrast media used in cardiac angiography have an extremely high osmolality, and can have profound effects on the haemostatic mechanisms of small infants.⁷ The contrast medium used in the patients described (sodium/meglumine amidotrizoate 76%) has an osmolality of 1770 mmol/l. In a small study of 5 infants, the injection of 1.7 ml/kg (mean) contrast at angiography resulted in an increase of the plasma osmolality from a mean of 279 mmol/l (range 258-285) to a mean of 305 mmol/l (range 293-316), a change over a few minutes

of 9%. These effects may be increased by dehydration, which is itself produced by the diuretic effect of the contrast medium. It is suggested that these 3 infants had a mild form of NEC after damage to the colonic mucosa by the hyperosmolar effects of contrast medium. Alternatively, arterial vasospasm, previously described during renal angiography,⁸ might have been responsible.

The use of recently developed nonionic contrast media such as metrizamide, which have one-third the osmolality of conventional media, may help to avoid this complication in small infants undergoing cardiac angiography.

References

- ¹ Leonidas J C, Hall R T. Neonatal pneumatosis coli: a mild form of necrotizing enterocolitis. *J Pediatr* 1976; **89**: 456-9.
- ² Bunton G L, Durbin G M, McIntosh N, *et al.* Necrotizing enterocolitis. *Arch Dis Child* 1977; **52**: 772-7.
- ³ Frantz I D, III, L'Heureux P, Engel R R, Hunt C E. Necrotizing enterocolitis. *J Pediatr* 1975; **86**: 259-63.
- ⁴ Hakanson D O, Oh W. Necrotizing enterocolitis and hyperviscosity in the newborn infant. *J Pediatr* 1977; **90**: 458-61.
- ⁵ Howard F M, Flynn D M, Bradley J M, Noone P, Szawatkowski M. Outbreak of necrotising enterocolitis caused by *Clostridium butyricum*. *Lancet* 1977; **2**: 1099-102.
- ⁶ Touloukian R J, Kadar A, Spencer R P. The gastrointestinal complications of neonatal umbilical venous exchange transfusion—a clinical and experimental study. *Pediatrics* 1973; **51**: 36-43.
- ⁷ Standen J R, Nogrady M B, Dunbar J S, Goldbloom R B. Osmotic effects of methylglucamine diatrizoate (Renografin 60) in intravenous urography in infants. *AJR* 1965; **93**: 473-9.
- ⁸ Spriggs D W, Brantley R E. Recognition of renal arterial spasm during renal angiography. *Radiology* 1978; **127**: 363-6.

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Accidental administration of Syntometrine in adult dosage to the newborn

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SUMMARY The clinical course is described of an infant who accidentally received an adult dose of Syntometrine (synthetic oxytocin + ergometrine) at delivery. The infant soon became ill with convulsions and ventilatory failure, and later with water intoxication. Similar reported cases are reviewed and recommendations are given for the management of future cases.

Even in the best run labour units accidents can happen. This paper describes the effects on an infant of the accidental administration of an adult dose of Syntometrine, 1 ml of which contains Syntocinon (synthetic oxytocin) 5 units, and ergometrine maleate 0.5 mg.

Case report

The infant, a girl, the first child of a 23-year-old mother, was born by spontaneous vertex delivery at term weighing 3.2 kg. The pregnancy and labour had been uncomplicated, there was no evidence of fetal distress, and the baby was in good condition at birth.

During the 6 hours in labour the mother had received only 3.75 units Syntocinon in 2 litres 5% glucose IV.

The baby was accidentally given 1 ml Syntometrine IM immediately after delivery. 15 minutes later she was centrally cyanosed and had grunting respiration. One hour after the injection a fractional inspired oxygen (F_{IO_2}) of 0.5 was needed to abolish cyanosis and she had become hypopnoeic, 'mucously', and had generalised hypertonus tending to opisthotonus. This state appeared to be due to convulsions, and phenobarbitone 7.5 mg given 8-hourly IM was started. An umbilical arterial catheter was passed and at age 2½ hours the blood-gases in F_{IO_2} 0.5 were pH 7.06, P_{aCO_2} 88.7 mmHg (11.8 kPa), P_{aO_2} 38 mmHg (5 kPa), base excess 8.4 mmol/l. 90 min later the blood-gases had deteriorated to pH 6.9, P_{aCO_2} 102 mmHg (13.6 kPa), base excess 11 mmol/l. Intermittent positive pressure ventilation was given at 35/min, with F_{IO_2} 0.8, inspiratory/expiratory ratio 1:1, peak pressure 25 cmH₂O, and 5 cm positive end expiratory pressure. By 14 hours F_{IO_2} could be reduced to 0.3, and she was weaned from the ventilator at 42 hours.

Between 4 and 42 hours of age the baby had