CASE REPORT

Life-threatening hypernatraemic dehydration in breastfed babies

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We describe five babies, who were exclusively breast fed, with life-threatening complications of hypernatraemic dehydration secondary to inadequate breast feeding. An increased awareness among health professionals is required so that this potentially devastating condition can be prevented.

Five babies presented with hypernatraemic dehydration secondary to inadequate breastfeeding. In all five neonates, the presentation and early clinical course were similar: they were the first children of healthy non-consanguineous parents, born after uncomplicated pregnancies and deliveries, and were exclusively breast fed. They were regularly assessed by their midwives and in neonates 1, 3 and 5 by their general practitioners, and all the mothers were reassured that their babies were feeding adequately and did not need to be weighed. When subsequently seen at their local hospitals, all the babies were profoundly dehydrated with cold peripheries, scaphoid abdomens and doughy skin, but normal fullness of the anterior fontanelle. Table 1 shows details of their presenting features and associated comorbidity. Neonates 3 and 5 were anuric at presentation, but the others continued to pass urine despite severe dehydration; in two of these, neonates 1 and 2, the fractional excretion of sodium $((U_{Na}\times P_{Cr})/(P_{Na}\times U_{Cr})\times 100)$ was calculated as 3.2% and 2.9%, respectively.

All the babies had severe hypernatraemic dehydration and acute renal failure (table 1). Neonates 3–5 required paediatric intensive care management, with ventilation for a median of 7 (range 3–12) days. Neonates 3 and 5 required haemofiltration (11 and 3 days, respectively). A detailed renal ultrasound scan with Doppler imaging of the renal vessels and the aorta and its main divisions was carried out in all the babies. Neonates 1, 3 and 5 had extensive vascular thrombosis at the time of referral (table 1), and received systemic thrombolysis with tissue plasminogen activator followed by continuous heparin infusion. In neonate 3, as there was no resolution of the aortic thrombus, local thrombolysis via a femoral arterial catheter was given.

To exclude a urinary concentrating defect, after rehydration and a period of stabilisation, all the babies underwent a water deprivation or 1-deamino-8-D-arginine vasopressin test with normal results in all (data not shown). Four had entirely normal thrombophilia screens, and one (neonate 5) was homozygotic for methylenetetrahydrofolate reductase C677T (the significance of this is uncertain, as this is a finding in 15% of the UK population). Residual renal function was evaluated after 1 year of age using chromium-51 EDTA glomerular filtration rate and Tc-99m dimercapto-succinic acid renal scans: four had normal renal function, neonate 5 had a glomerular filtration rate of 64 ml/min/1.73 m^2, and neonate 3 had a non-functioning left kidney. Prolonged heparin treatment was required in neonates 1, 3 and 5. None of the babies have had further thrombotic events. Cranial imaging (cranial ultrasound or magnetic

Table 1 Presenting features and associated morbidity

Case	Age (days)/ sex	Weight loss* (%)	Key features at presentation	Morbidity	Max plasma sodium (mmol/l)/serum osmolality (mOsm/kg)	Max plasma urea (mmol/l)/ creatinine (μmol/l)
1	9/M	30	Ischaemic right leg from mid-thigh downwards	Acute renal failure Vascular thrombosis with no flow on Doppler in the right external iliac, common femoral and popliteal arteries Seizures Arrhythmias (ventricular bigeminy) Necrotising enterocolitis	188/455	73/190
2	12/M	15	Poor feeding, drowsiness	Acute renal failure Apnoeas	172/NA	86/325
3	10/M	22	Anuria, circulatory collapse	Extensive aortic thrombus extending from the origin of the superior mesenteric artery to bifurcation of the aorta, affecting both renal arteries. Left kidney shrunken with no arterial flow and left renal venous thrombosis Ventilation Acute renal failure requiring dialysis Necrotising enterocolitis	161/329	47/260
4	6/F	18	Apnoeas, seizures	Multifocal clonic fits Ventilation	173/385	18/122
5	12/F	23	Anuria	Aortic thrombus extending from the superior mesenteric artery and affecting both renal arteries. No flow on Doppler renal ultrasound Acute renal failure requiring dialysis Ventilation	159/n/a	41/340

*% Weight loss = (birth weight − presenting weight)×100/birth weight; F, female; M, male; NA, not available.

resonance imaging) showed no major neurological insult, and all the babies have achieved normal growth and age-appropriate developmental milestones (follow-up at median 17 (range 11–30) months). Neonate 1 developed a dry gangrene and contraction deformity of the toes of the right foot.

DISCUSSION

This case series describing five infants referred between 2002 and 2005 shows the rare but devastating consequences of hypernatraemic dehydration in breastfed babies, and the difficulties in its early recognition and management. Although hypernatraemic dehydration is rare in infants in the UK, in the past decade there have been several reports on hypernatraemic dehydration in breastfed newborns.[1 2] As our hospital is a tertiary referral centre, the cases that have been referred to us and that we report are likely to be the most severely affected.

As in previous reports,[1 2] the five babies in this report were first-born infants of motivated parents and were exclusively breast fed. In all cases, feeding had been difficult to establish and the volumes of milk ingested were likely to have been low. Although the babies had been under regular review by health professionals, the severity and consequences of their feeding difficulty had not been recognised until a very late stage.

Hypernatraemic dehydration is notoriously difficult to diagnose[1] on clinical examination alone, as skin turgor is preserved; the anterior fontanelle can retain its normal fullness, and urine output, although reduced, is maintained even in the face of severe dehydration. The clinical features are a spectrum, from an alert and hungry child who appears relatively well to a child who is lethargic, irritable and even moribund.[1 2] Investigations for urinary concentrating defects and haematological disorders showed no underlying cause for the hypernatraemia, renal failure or thrombotic events (except the possible effect of methylenetetrahydrofolate reductase (MTHFR) mutation in case 5).

In our series, extensive vascular thrombosis was seen at presentation in the three neonates who were the most severely dehydrated with a weight loss >20%. At presentation, neonates 1 and 3 had unrecordable femoral pulses with palpable but feeble pulses in the upper limbs, and neonate 1 also had an ischaemic lower limb with blackening of the toes, implying a critical impairment in arterial blood flow. Oliguria, gross haematuria or a presentation with necrotising enterocolitis may indicate impaired renal and mesenteric perfusion, respectively, but renal venous thrombosis or thrombosis of the mesenteric vessels requires a detailed ultrasound scan, with Doppler flows for diagnosis.

Assessing the adequacy of breast feeding includes a careful review of the feeding process, as well as an objective assessment of volume intake by weighing the baby and monitoring the urine output.[4]

In our cases, the underlying problem was one of water deficiency: the infant's plasma sodium concentration was raised predominantly as a result of low volume intake and a loss of extracellular water. We concluded that inadequate feeding led to hypernatraemic dehydration and the ensuing life-threatening sequelae. Although weighing has been recommended as a simple and reliable guide to the adequacy of feeding,[1–4] its accuracy, precision and potential psychological effects on the mother[5 6] need to be considered. ''Normal'' weight loss in breastfed babies has not been well understood. A prospective study showed that 11% of all healthy breastfed neonates had a weight loss of ⩾10%, whereas 5% lost >11.8% and 2.5% lost >12.8% of their birth weight.[3] Breastfed babies have been shown to lose a greater proportion of their birth weight (median weight loss 6.6% in breastfed babies, 3.5% in formula-fed babies), and take longer to recover their birth weight (median 8.3 days in the breastfed babies compared with 6.5 days in the formula-fed babies).[3] Thus, the infant's degree of weight loss must be interpreted against his age: centile charts using serial data on normal weight loss in breastfed babies allow a meaningful interpretation of weight loss.[2 3] To identify all ''at-risk'' cases, some authorities have recommended that all babies losing >10% of birth weight should be referred to a paediatrician for further assessment.[1] We believe that more research and discussion is needed on this topic before such a guideline is widely adopted.

CONCLUSION

Despite previous publicity of the risks of hypernatraemia,[1] we have seen severe, life-threatening complications because of an unrecognised inadequacy of breast feeding. We want to stimulate debate on whether, when and how breastfed babies should be monitored to improve recognition of feeding difficulties. This report supports a recent Cochrane review on breast feeding that emphasised the importance of trained professionals routinely offering adequate breastfeeding support to new mothers.[4] Failure to offer support may sometimes have devastating consequences.

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