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Life-threatening hypernatraemic dehydration in breast-fed babies

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ABSTRACT
We describe 5 babies who were exclusively breast-fed with life-threatening complications of hypernatraemic dehydration secondary to inadequate breast-feeding. An increased awareness amongst health professionals is required so that this potentially devastating condition can be prevented.

CASES
In all 5 neonates the presentation and early clinical course was similar: they were the first children of healthy non-consanguineous parents, born after uncomplicated pregnancies and deliveries and exclusively breast-fed. They were regularly assessed by their midwives, and in cases 1,3 & 5 by their GPs, 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. Details of their presenting features and associated co-morbidity are shown in Table I. Cases 3 and 5 were anuric at presentation, but the others continued to pass urine despite severe dehydration, in two of these, cases 1 & 2, the fractional excretion of sodium (\(\frac{(U_{Na} \times P_{Cr})}{(P_{Na} \times U_{Cr})} \times 100\)) was calculated as 3.2 and 2.9% respectively.

All the babies had severe hypernatraemic dehydration and acute renal failure (Table I). Cases 3 to 5 required Paediatric Intensive Care management with ventilation for a median of 7 (range 3 – 12) days. Cases 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 performed in all the cases. Cases 1, 3 and 5 had extensive vascular thrombosis at the time of referral (Table I) and received systemic thrombolysis with tissue Plasminogen Activator (tPA) followed by continuous heparin infusion. In case 3, as there was no resolution of the aortic thrombus, local thrombolysis via a femoral arterial catheter was given.

In order to exclude a urinary concentrating defect, after rehydration and a period of stabilisation all underwent a water deprivation or DDAVP test with normal results in all (data not shown). Four had entirely normal thrombophilia screens, one (case 5) was homozygous for MTHFR (methylene tetrahydrofolate reductase) C677T (the significance of which 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 GFR (Glomerular Filtration Rate) and Tc-99m DMSA (dimercaptosuccinic acid) renal scans: 4 have normal renal function, case 5 has a GFR of 64ml/min/1.73m\(^2\), and case 3 has a non-functioning left kidney. Prolonged heparin treatment was required in cases 1, 3 and 5. None of the babies have had further thrombotic events. Cranial imaging (cranial ultrasound or MRI) showed no significant neurological insult and all the babies have achieved normal growth and age appropriate developmental milestones (follow-up at median 17 [range 11 to 30] months). Case 1 developed a dry gangrene and contraction deformity of the right toes.
DISCUSSION

This case series describing 5 infants referred between 2002-2005 illustrates rare but devastating consequences of hypernatraemic dehydration in breast-fed babies and the difficulties in its early recognition and management. Although hypernatraemic dehydration is rare in infants in the UK, in the last decade there have been a number of reports in breast-fed newborns. As a tertiary referral centre, the cases we have been referred and report are likely to be the most severely affected.

As in previous reports, the 5 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 likely to be 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 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. Investigations for urinary concentrating defects and haematological disorders revealed no underlying cause for their hypernatraemia, renal failure or thrombotic events (except the possible effect of MTHFR mutation in case 5).

In our series extensive vascular thrombosis was seen at presentation in the 3 infants who were the most severely dehydrated with a weight loss >20%. At presentation cases 1 and 3 had unrecordable femoral pulses with palpable but feeble pulses in the upper limbs, and case 1 also had an ischaemic lower limb with blackening of the toes, implying a critical impairment in arterial blood flow. Oliguria, gross hematuria 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. 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 loss of extracellular water. We conclude 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, its accuracy, precision and potential psychological effects on the mother need to be considered. ‘Normal’ weight loss in breast-fed babies has not been well understood. A prospective study showed that 11% of all healthy breast-fed neonates had a weight loss of ≥ 10% while 5% lost >11.8% and 2.5% >12.8% of their birth weight. Breast-fed babies have been shown to lose a greater proportion of their birth weight (median weight loss 6.6% in breast-fed babies, 3.5% in formula-fed babies), and take longer to recover their birth weight (median 8.3 days compared to 6.5 days in the formula-fed). Thus the infant’s degree of weight loss must be interpreted against his age: centile charts using serial data on normal weight loss in breast-fed babies allow meaningful interpretation of weight loss.
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 assessment¹. We
believe more research and discussion is needed on this topic before such a guideline is
widely adopted.

Despite previous publicity of the risks of hypernatraemia¹, we have seen severe, life-
threatening complications due to an unrecognised inadequacy of breast-feeding. We
want to stimulate debate on whether, when and how breast-fed babies should be
monitored in order to improve recognition of feeding difficulties. This report supports
a recent Cochrane review on breast-feeding that emphasised the importance of
offering adequate breastfeeding support routinely to new mothers by trained
professionals⁴. Failure to support may sometimes have devastating consequences.

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### Table I – Presenting features and associated morbidity

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (days) /sex</th>
<th>Weight loss * (%)</th>
<th>Key features at presentation</th>
<th>Morbidity</th>
<th>Max plasma sodium (mmol/l) / Serum Osmolality (mOsm/kg)</th>
<th>Max plasma urea (mmol/l) / creatinine (µmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>12 / M</td>
<td>15</td>
<td>Poor feeding, drowsiness</td>
<td>1. Acute renal failure &lt;br&gt;2. Apnoeas</td>
<td>172 / n/a</td>
<td>86 / 325</td>
</tr>
<tr>
<td>5</td>
<td>12 / F</td>
<td>23</td>
<td>Anuria</td>
<td>1. Aortic thrombus extending from superior mesenteric artery and involving both renal arteries. No flow on doppler renal ultrasound. &lt;br&gt;2. Acute renal failure requiring dialysis &lt;br&gt;3. Ventilation</td>
<td>159 / n/a</td>
<td>41 / 340</td>
</tr>
</tbody>
</table>

*Key*: %Weight loss = (birth weight – presenting weight) x 100 / birth weight

n/a – not available
REFERENCES


