A staphylococcal cerebral abscess in a preterm infant

This report considers the case of a rare presentation of a premature infant with post-haemorrhagic hydrocephalus who developed a cerebral brain abscess. Although cerebral abscesses are rare in this patient population, they are associated with significant mortality and morbidity. This report highlights the diagnostic difficulties and the importance of multidisciplinary team input.

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Key points

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1. Cerebral abscesses are rare in neonates, present insidiously and can be difficult to diagnose.
2. Laboratory testing is not sensitive until the abscess has ruptured into the cerebrospinal fluid.
3. Cranial ultrasound scans are a useful screening tool, but further evaluation using magnetic resonance imaging can provide invaluable information in differentiating between abscesses and other causes.
4. Multidisciplinary team input is important in the diagnosis and management of neonates with cerebral abscesses.

Case presentation and investigations

A female infant was born at 27^{+4} weeks' gestation via an emergency caesarian section following an antepartum haemorrhage. Her birthweight was 1,165g. She was intubated for three days and received two doses of surfactant. She was initially commenced on intravenous benzylpenicillin and gentamicin but these were stopped after 48 hours following negative blood cultures.

On day 6 of life she was noted to have a left-sided grade II intraventricular haemorrhage (IVH). She then developed post-haemorrhagic hydrocephalus with an increasing head circumference. As she was asymptomatic at the time, this was managed conservatively with weekly monitoring.

On day 70 of life (corrected gestational age 37^{+3} weeks) she had a profound apnoeic episode. Her anterior fontanelle was full and her sutures were splayed. She was recommenced on second line antibiotics (flucloxacillin and gentamicin) for possible sepsis, but her inflammatory markers remained unremarkable. A repeat cranial ultrasound scan (**FIGURE 1**) showed increasing ventricular indices with a new lesion in the left thalamic area. A lumbar puncture was performed which yielded clear cerebrospinal fluid (CSF) with a normal cell count and negative cultures. Her antibiotics were stopped after 36 hours, prior to an initial magnetic resonance imaging (MRI) scan on day 73. The MRI scan showed a strikingly abnormal central diffusion of the lesion in the left thalamus that was surrounded by a well-demarcated margin of higher signal on T1 weighted imaging (**FIGURE 2**). The variable signal was not consistent with haemorrhage. With hindsight, this could have represented an abscess and the patient should have been kept on antibiotics; however, this did not seem to correlate with her clinical picture.

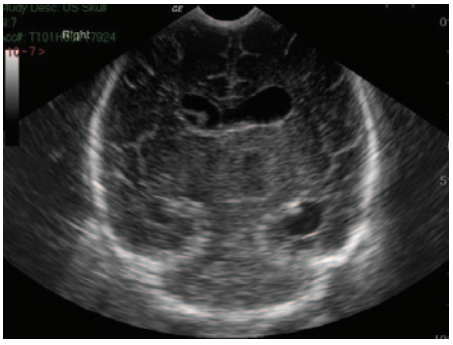

FIGURE 1 A cranial ultrasound scan carried out on day 70 showing a hypoechogenic lesion in the left thalamic area.

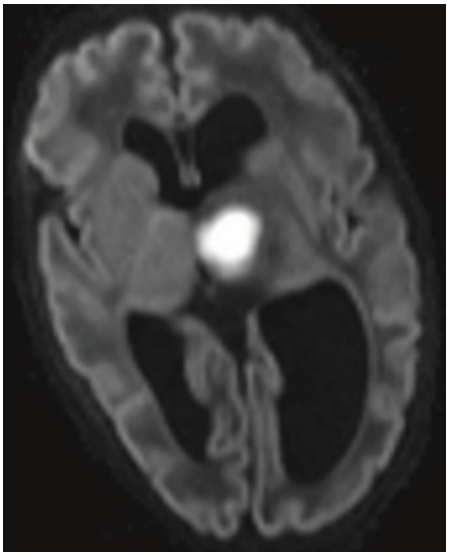

FIGURE 2 Diffusion weighted imaging on day 73 of life showing a lesion with central diffusion.

On day 86 of life (corrected gestational age 39+5 weeks) she went on to have further apnoeas with unusual posturing of back arching and arms pushing into an extended posture – a possible seizure. She was recommenced on antibiotics (flucloxacillin, gentamicin and cefotaxime) and had a repeat lumbar puncture. The CSF tests revealed:

- high white blood cell count at 153x10^6/L with 77% lymphocytes
- high red blood cell count at 47,680x10^6/L (in keeping with a traumatic lumbar puncture in which peripheral blood contaminated the CSF)
- high protein count at 3.05g/L
- a low CSF to plasma glucose ratio of 0.23.

These results are in keeping with a bacterial infection. Gram staining revealed no organisms but a CSF culture yielded light growth of *Staphylococcus aureus*.

A repeat MRI with diffusion weighted imaging was carried out on day 87 (**FIGURE 3**). The images showed progression in size of the lesion involving the thalamus and midbrain. The lesion was now causing increasing mass effect with distortion of the third ventricle, however the ventricular system was not more dilated than previously. The central component of the lesion showed marked restricted water diffusion, suggestive of a cerebral abscess.

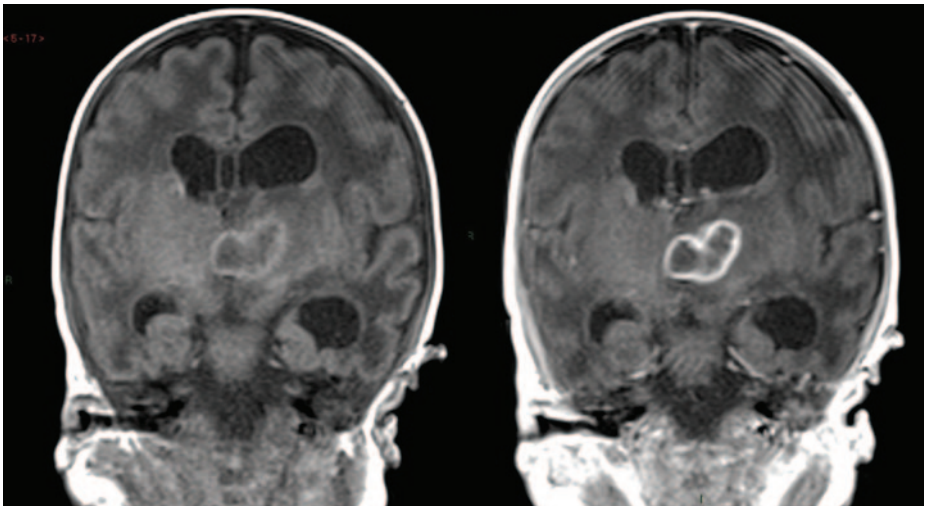

FIGURE 3 Pre- and post-contrast images of T1 weighted studies on day 87 showing enlargement of the lesion with increasing mass effect.

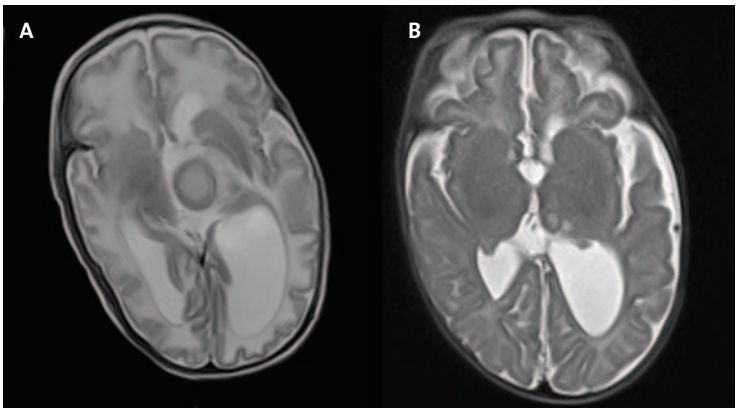

FIGURE 4 A comparison of T2 weighted images. (A) Initial MRI on day 70, (B) resolution of the lesion after treatment.

Outcomes and follow-up

Neurology and neurosurgical colleagues were consulted regarding the management of this patient. Due to the location of the lesion and the increased risk of ventriculitis with abscess drainage, the child was treated conservatively with six weeks of intravenous flucloxacillin. At the end of treatment, the lesion had reduced significantly in size and her CSF yielded no further growth (**FIGURE 4**). She is being seen in the clinic regularly for monitoring and at 20 months of age she has normal tone and normal development.

Discussion

This article considers a rare presentation of a premature female infant with post-haemorrhagic hydrocephalus who developed a cerebral abscess. There were several diagnostic dilemmas that made management decisions challenging. In brief, the female was born at 27 weeks' gestation and was diagnosed with grade II IVH on day 6 of life. She continued to have an increasing head circumference and on day 70 she deteriorated with apnoeic episodes and a possible seizure on day 86. She never had raised inflammatory markers or positive blood cultures. Imaging helped determine that her symptoms were due to a new thalamic lesion and not purely from her expanding hydrocephalus. Serial diffusion weighted MRI scans suggested that the lesion was consistent with a cerebral abscess and not a further infarct. This was confirmed with a positive CSF culture that grew *S. aureus*. She was treated with six weeks of antibiotics and the abscess cleared. At 20 months of age she appears to be reaching developmental milestones appropriately.

Cerebral abscesses are a rare finding in neonates and usually occur as a complication of bacterial meningitis or bacteraemia.[1] Spread of infectious organisms can occur via the haematogenous route or directly into the CSF, secondary to traumatic injury or post-operatively.[1] Extension of infection from otitis media has also been described.[1] Gram-negative organisms such as Proteus and Citrobacter have been identified as having a higher propensity for causing brain abscesses in neonates.[1] Pathogens such as *S. aureus* are rarely implicated, with only a handful of cases reported. These include staphylococcal brain abscesses secondary to bacteraemia, mastitis and of unknown origin. In the case presented here, it was difficult to determine the source of infection. The abscess was noted on scans prior to any lumbar puncture attempts, making it unlikely to be direct spread via the CSF.

Brain abscesses in neonates are often diagnosed late due to the insidious onset of symptoms. The signs of raised intracranial pressure are not as apparent due to their open fontanelles and cranial sutures. Instead, neonates present with seizures, signs of infection, respiratory symptoms, poor feeding, vomiting, increased head circumference and bulging fontanelles.[1]

This patient did demonstrate signs of increased intracranial pressure that were initially attributed to her post-haemorrhagic hydrocephalus. It was not until further radiological information was obtained that the possibility of an intracranial abscess was considered.

The literature shows that laboratory tests are not sensitive in infants with brain

abscesses, with only 10% of blood cultures being positive and the majority of CSF cultures being sterile unless the abscess has ruptured into the CSF.[2] Cranial ultrasound scanning in infants with an open fontanelle is still regarded as a useful first-line investigation[3] although it is widely accepted that ultrasound alone is not sensitive enough to detect an abscess and MRI is necessary. Differentiation between early phase abscess and other pathologies can be difficult on ultrasound.[4]

For further evaluation, MRI scanning is superior to CT as it gives better differentiation of oedema from liquefactive necrosis, greater sensitivities for early satellite lesions and the detection of early cerebrates.[5] Additional information obtained from diffusion weighted imaging was shown to be useful.[5]

Medical versus surgical management of brain abscesses has been largely debated, and is influenced by the:

- location of the abscesses
- child's neurological status
- number and size of the abscesses
- stage of abscess formation.[2,5]

Patients should receive a prolonged course of intravenous broad-spectrum antibiotics, which can later be rationalised if a pathogen is identified.[5] Stereotactic aspiration may be used to obtain cultures and relieve mass effect[5] and there has been some suggestion that infants who received early aspiration of their abscesses had better outcomes.[1] However, this procedure is not without risk and should only be carried out in conjunction with a neurosurgical team. For our patient, the risks outweighed the benefits due to the location of her abscess. Other surgical procedures include drainage via craniotomy or neuroendoscopically.[5]

Conclusion

Although mortality has decreased due to advancing imaging technology and antibiotic treatment, morbidity associated with cerebral abscesses remains significant. Neonatologists should therefore be aware that cerebral abscesses do occur, albeit rarely, in this patient population. This case highlights the importance of screening using ultrasound imaging in patients with an increasing occipitofrontal circumference as well as the need to involve a multidisciplinary team, eg radiologists and neurosurgeons, in the diagnosis and management.

Parental consent

The authors received written consent to publish this report from the patient's mother.

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