Combination of drainage and chemotherapy for treatment of a *Staphylococcus aureus* brain abscess in a pre-term infant

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**Introduction:** Neonatal brain abscess is an uncommon intracranial suppuration that usually occurs as a complication of bacterial meningitis or septicemia. *Staphylococcus aureus* rarely causes brain abscesses during the first months of life.

**Case presentation:** A case of a premature infant who developed cerebellar, left temporal and left occipital lobe abscesses after *S. aureus* sepsis is presented. The pus provided the same *S. aureus* strain of the sepsis. The patient was treated with vancomycin for 37 days, accompanied by extraction of the purulent material. The abscesses resolved and no sequelae remained.

**Conclusion:** It appears that long antibiotic treatment regimes, when associated with early pus drainage, are effective in resolving infection and abscesses caused by *S. aureus* in neonates.

**Keywords:** Brain abscess; hydrocephalus; neonatal sepsis; *S. aureus*; vancomycin.

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### Introduction

Neonatal brain abscess is an uncommon intracranial suppuration that usually occurs as a complication of bacterial meningitis or septicemia (Kao *et al.*, 2008; Krajewski & Stelmasiak, 1992). The most common aetiological agents are: *Citrobacter* spp., *Pseudomonas aeruginosa* and enterobacteria such as *Proteus mirabilis* and *Serratia marcescens* (Azrak *et al.*, 2009; Krajewski & Stelmasiak, 1992). In contrast, *Staphylococcus aureus* rarely causes brain abscesses during the first months of life (Arora *et al.*, 2012; de Oliveira *et al.*, 2007; Regev *et al.*, 1995; Vartzelis *et al.*, 2005). In this report, we present the clinical features, treatment and outcome of a premature infant with multiple brain abscesses caused by *S. aureus*.

### Case report

A 2-month-old male infant was admitted to the Neonatal Intensive Care Unit of the University Hospital of Asturias, Spain, with macrocephaly as the main clinical sign, which was accompanied by irritability, vomiting and inability to look upwards. He had, however, normal tone and primitive reflexes, as well as good connection with the environment.

The child was delivered pre-term in the 30th gestation week by an emergency Caesarean section. The Apgar scores were 5 and 8 at 1 and 5 min, respectively. Physical parameters were: birth weight, 1270 g [25th percentile (P25)]; length, 39.5 cm (P25–50) and head circumference, 28 cm (P50). Forty-eight hours after delivery, he became unstable with signs of sepsis. Empirical treatment with vancomycin (10 mg kg⁻¹ every 18 h) and amikacin (18 mg kg⁻¹ every 36 h) was started. The blood culture was positive for a coagulase-positive *S. aureus* strain, which was susceptible to penicillin G, oxacillin, vancomycin, co-trimoxazole, erythromycin and clindamycin. Given these data, the treatment with vancomycin was continued, the trough levels being 8 µg ml⁻¹. No cerebrospinal fluid culture was done at the time. The symptoms were relieved and C-reactive protein levels returned to normal 48 h after initiation of the monotherapy treatment, and for this reason the antibiotic was discontinued on day 8, in accordance with the recommendations of the Spanish Paediatric Association (Fernández *et al.*, 2009). A brain ultrasound test, performed on day 32 of life, was normal. Finally, the patient was discharged in excellent condition at 50 days of age. His physical parameters at that time were: weight, 2280 g (P3–10); length, 47 cm (P3) and head circumference, 35 cm (P75).

The macrocephaly observed at the time of admission to the paediatric emergency department (which occurred 11 days after the previous discharge) was accompanied by sutural

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diastasis and anterior fontanelle bulging. The physical parameters were: weight, 2450 g (P3); length, 48 cm (P30) and head circumference, 36.5 cm (P93). The blood biochemical evaluation revealed the following data: haemoglobin, 9.3 g l$^{-1}$; white blood cells, 26 400 mm$^{-3}$; platelets, 681 000 mm$^{-3}$; C-reactive protein, 2.7 mg dl$^{-1}$; procalcitonin, 0.1 ng ml$^{-1}$. The data obtained from examination of the cerebrospinal fluid were: leukocytes, 10 mm$^{-3}$, glucose, 33 mg dl$^{-1}$ and protein, 73.9 mg dl$^{-1}$.

The cerebral ultrasound test showed a triventricular hydrocephalus, while the cerebral magnetic resonance revealed cerebellar, left temporal and left occipital lobe abscesses (Fig. 1). A surgical approach was taken for diagnosis and treatment. During the surgery, the largest abscess (located in the occipital lobe) was drained and an Ommaya reservoir was placed in the ventricular brain space. Culturing of the abscess aspirate produced S. aureus, which turned out to be phenotypically identical to the strain isolated during the previous sepsis episode suffered by the patient.

Given the success of the previous treatment and in accordance with the Infectious Diseases Society of America recommendations for treatment of meningitis (Tunkel et al., 2004) an intravenous vancomycin treatment was prescribed that lasted 37 days, after which it was substituted by oral administration of co-trimoxazole for another week. During the first 15 days of admission, repeated punctures of the Ommaya reservoir were needed to relieve the hydrocephalus signs. All cerebrospinal fluid cultures were negative. Serial imaging tests performed throughout the admission time showed a gradual decrease of the abscesses, ending with their resolution and stabilization of the ventricular size. Cardiac ultrasonography did not reveal congenital abnormalities and no signs of endocarditis were observed. The baby was discharged after 46 days.

**Outcome and follow-up**

At the 15-month follow-up visit, the child appeared to be healthy and was not showing any neurological or

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**Fig. 1.** Cerebral magnetic resonance images. (a, b) Sagital T1 without (a) and with (b) contrast: a high ventriculomegalia with two ring-shaped lesions showing a peripheral hyperintense signal in the posterior fossa and a small abscess in the occipital lobe can be distinguished. (c) Axial T2 showing the liquid-filled lesions and their peripheral hypointense rings. (d) Axial diffusion: hyperintense signal due to diffusion restriction.
developmental sequelae: he walked without help, asked for objects by finger pointing, said ‘hello’ and ‘bye’, kissed, played with other children and made two-cube towers.

**Discussion**

Brain abscesses in neonates or young infants are uncommon central nervous system infections and have different characteristics from those in older children and adults. Thus, in older children they are often recognized by the presence of a higher intracranial pressure, while in neonates the fontanelles and the cranial sutures are still open and an intracranial mass lesion can grow without raising the intracranial pressure (de Oliveira et al., 2007). Of these infections, staphylococcal brain abscesses are rare entities in young infants and, to the best of our knowledge, only three have been reported previously as secondary to sepsis (Vartzelis et al., 2005; Regev et al., 1995; Arora et al., 2012). In these cases, it appears that the brain became infected through the haematogenous route during the sepsis, because culture of the cerebrospinal fluid remained negative in all cases, while identical strains were obtained from the blood during sepsis and from the brain abscess drainages. The main difference between the case described by Vartzelis et al. (2005) and the others (Regev et al., 1995; Arora et al., 2012), including our own, is that in the first instance the treatment of the previous sepsis was performed empirically with ampicillin plus gentamicin, while in the others vancomycin was used. It turned out that the causative staphylococcal strain of the first report was resistant to this β-lactam antibiotic, whereas the strains isolated from the other cases were susceptible to the glycopeptide. This did not prevent abscess formation, in spite of the facilitated diffusion of vancomycin through the inflamed haematoencephalic barrier (Tunkel et al., 2004; Garcia-Sanchez et al., 1993), thus indicating that the physiological immaturity of the immune system makes pre-term neonates especially susceptible to infection, even when treated adequately. However, our patient and the one described by Vartzelis et al. (2005) were subjected to early abscess drainage to lower intracranial pressure, while it seems that drainage in the case reported in Regev et al. (1995) was done later as a consequence of antibiotic treatment failure, while no indication on whether this was performed at all was provided by Arora et al. (2012). Interestingly, no neurological or developmental sequelae were observed in the two first children (Vartzelis et al., 2005 and this study), which contrasts with the psychomotor retardation reported in the third case (Regev et al., 1995) and the lack of reference to the outcome for the fourth child (Arora et al., 2012).

Based on the literature available and this work, it can be concluded that the long antibiotic treatment regimes used, when associated with early pus drainage, are effective in resolving infection and abscesses caused by S. aureus in neonates, as well as in elimination of any sequelae derived from this encephalopathy.

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**References**


