

# Neonatal meningitis and septicaemia caused by *Salmonella agama*

## Introduction

Bacterial meningitis affecting newborn or very young infants occurs when the meninges are infected by bacteria which have usually spread via the haematogenous route (National Institute for Health and Care Excellence, 2010). A prospective, enhanced, national population-based active surveillance study to determine the incidence, aetiology and outcome of bacterial meningitis in infants aged <90 days in the UK and Ireland undertaken by the British Paediatric Surveillance Unit reported an annual incidence of 0.38/1000 live-births; the most commonly identified causative organisms were *Streptococcus agalactiae* (group B streptococcus), *Escherichia coli*, *Strep. pneumoniae*, *Neisseria meningitidis* and *Listeria monocytogenes* (National Institute for Health and Care Excellence, 2010; Okike et al, 2014).

*Salmonella* spp. are rarely encountered as the infectious cause of meningitis, particularly during the neonatal period.

Non-typhoidal *Salmonella* spp. are increasingly being recognized as an important causative organism in invasive salmonellosis, a significant proportion of which have been transmitted through contact with exotic reptile pets including snakes, turtles and lizards (Editorial team et al, 2008). Farm animals are a recognized reservoir of *Salmonella* spp. (Davison et al, 2005). This article describes a case of neonatal meningitis with sepsis caused by non-typhoidal *Salmonella* in a neonate, probably contracted from farm animals.

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## Discussion

This case of *Salmonella agama*-associated meningitis is possibly the first documented case in the UK. The authors are aware of only one previous reported case of salmonellosis caused by the same organism (Appas et al, 1966). A systematic review of neonatal meningitis in England and Wales between 1975 and 1991 identified *Salmonella* spp. as the causative organism in only 0.9% of cases of bacterial meningitis affecting newborn babies (Synnott, 1994) and 0.2% of cases of bacterial meningitis at other ages. In the last 5 years Public Health England has documented only one or two cases per year of meningitis in infancy caused by non-typhoidal *Salmonella* spp. (Public Health England, personal communication, 2014).

In 1956, isolated from the faeces of agama lizards (*Agama agama*) in Nigeria, *S. agama* was characterized as a new serotype of *Salmonella enterica* (Collard and Montefiore 1957). The organism has been associated with human illness, notably as a cause of traveller's diarrhoea in tropical African countries where exposed foodstuffs may be contaminated by lizards and other small reptiles (Bélar et al, 2007). Subsequent to its initial microbiological identification *S. agama* had been recovered from a wide variety of reptilian, avian and mammalian sources (Otokunefor et al, 2003; Wilson et al, 2003; Orji et al, 2005).

A study of randomly selected dairy cattle farms in England and Wales between October 1999 and February 2001 found that the prevalence of all *Salmonella* serov-

## Case Report

A 3-week-old girl presented with a 6-hour history of fever, irritability and poor feeding. She was born at term by normal vaginal delivery with no risk factors for sepsis identified. Clinical assessment revealed a temperature of 38°C, heart rate 180/min, respiratory rate 54/min and a central capillary refill time of 3–4 seconds. She was alert but irritable. A bulging anterior fontanelle was noted but the systemic examination was otherwise unremarkable. A diagnosis of meningitis with sepsis was suspected and she was admitted. Blood, CSF and urine samples were obtained, a fluid bolus of 10 ml/kg with 0.9% saline was given, then intravenous cefotaxime was started. She was monitored for temperature, neurological status, activity and fluid balance.

Laboratory investigations showed C-reactive protein of 220 mg/litre, CSF white cell count of 900x10<sup>9</sup>/litre (90% were polymorphs, 10% lymphocytes); CSF protein 13.2 g/litre and glucose 0.1 mmol/litre (blood glucose was 3.2 mmol/litre). Gram stain of the CSF revealed no organisms, and there was no bacterial growth at 48 hours or subsequently; however, the CSF sample was obtained after antibiotics were administered. Following microbiology discussion and advice, and in view of the patient's age, initial presentation and CSF results, amoxicillin and gentamicin were added to the antibiotic therapy to cover for *Escherichia coli* and *Listeria monocytogenes* infections.

Improvement in clinical condition was noted within 48 hours of commencing antibiotics and her feeding improved. The blood culture results at 48 hours showed growth of gram-negative bacilli which were initially considered to be indicative of *E. coli* infection. Amoxicillin and gentamicin were discontinued after discussion with the microbiology service, but by the third week of treatment the organism was identified definitively by the Public Health England reference laboratory as *Salmonella agama* Serotype 14,12:i:1,6, susceptible to cefotaxime and ceftazidime. Intravenous cefotaxime was given for a total of 6 weeks. Stool and urine cultures showed no bacterial growth. Discussions with the family identified the only potential reptilian source of infection to be a tortoise kept as a pet by the patient's maternal grandmother, but there had been no direct contact of the child or her family with the animal. Further history revealed that the patient's father worked in a farm which involved regularly handling of cattle and this was judged to be the most likely source of the bacterium. The girl had recovered completely by discharge and at 1 year showed normal growth and developmental progress.

ars in faecal samples of the domestic livestock ranged from 12.1 to 24.7%. This increased in late summer, with the prevalence of *S. agama* being 1.8–7.6% (Davison et al, 2005). The organism is considered to be endemic among cattle in south-west England, the region where this patient lived.

In the UK *S. agama* has also been recovered from faeces sampled from the latrines of wild badgers. It has been suggested that wildlife, including badgers, may act as a reservoir of infection for domestic livestock (Wilson et al, 2003).

The other well-recognized source of non-typhoidal *Salmonella* spp. transmission is from exotic animals, in particular reptiles including snakes, lizards, tortoises and terrapins which are commonly kept as pets in European countries. In many cases, owners remain unaware of the actual risk of pathogens carried by their reptilian pets (Editorial team et al, 2008). Salmonellosis associated with exotic pets is a public health problem, and safe cleaning and handling advice needs to be emphasized.

Intravenous administration of antibiotics is recommended in infants younger than 3 months of age who are treated for serious bacterial infections (National Institute for Health and Care Excellence, 2013). Intravenous ceftriaxone is preferred for treatment of *Salmonella* meningitis in infants, although it is not recommended in jaundiced, hypoalbuminaemic or acidotic neonates. Where cefotaxime is used instead of ceftriaxone, a very high daily dose of 200–300 mg/kg/day is recommended, although neonates were not specifically considered by Soe and Overturf (1987) in the review. Although there is a lack of data on the optimal duration of antibiotics therapy in *Salmonella* meningitis, continuation of therapy for a minimum of 3 weeks after the first sterile CSF sample has been

suggested (Price et al, 2000). Price et al (2000) suggested that the repeat CSF specimen should be taken no earlier than day 4 after commencing antibiotic treatment as CSF cultures from patients with *Salmonella* meningitis have been reported to remain positive for prolonged periods in some cases.

## Conclusions

Neonatal meningitis is a serious infection; early identification and appropriate treatment is usually associated with an improved outcome. *Salmonella* is a rare cause of meningitis in the UK, and enquiries into the potential source should be made especially where non-typhoidal *Salmonella* spp. are identified. Longer duration of antibiotic therapy is usually necessary and an interval lumbar puncture may be useful to guide the total duration of antibiotic therapy. Strict import restrictions on exotic pets and public awareness campaigns about dangers from such pets may be effective public health measures. **BJHM**

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## LEARNING POINTS

- Invasive salmonellosis caused by non-typhoidal *Salmonella* spp. is often transmitted by a reptilian contact.
- Enquire about exotic pets and parental occupation when taking a history.
- Prolonged course of antibiotics are necessary in comparison with other bacterial causes of meningitis.
- Salmonellosis associated with reptiles is a continuing public health concern.
- Increased public awareness is the key to prevention.

## Forthcoming case reports

Inverse takotsubo cardiomyopathy in a young woman investigated by non-invasive coronary CT angiogram

Lower limb lymphoedema and obesity: a much neglected association

Visual hallucinations: I can't believe what's happening in front of my eyes

Muscle wasting, bone pain, and cognitive decline: a unifying diagnosis

