

Streptococcus thermophilus bacteraemia in a patient with transient bowel ischaemia secondary to polycythaemia

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Introduction: The ability of *Streptococcus thermophilus* to convert lactose into lactic acid has long been utilized by the dairy industry. A seemingly low-pathogenicity organism, to the best of our knowledge there have been no previously published reports linking the consumption of foodstuffs to bacteraemia caused by this bacterium.

Case presentation: Here we present a case of a regular consumer of Activia yoghurt who developed *S. thermophilus* bacteraemia, probably due to transient bowel ischaemia secondary to polycythaemia.

Conclusion: The isolation of this bacterium from blood cultures may indicate underlying large bowel pathology and should not necessarily be dismissed as contamination.

Keywords: bacteraemia; polycythaemia; *Streptococcus thermophilus*.

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Introduction

Infection secondary to the consumption of probiotic products is a safety concern, but despite the widespread consumption of these products, reports of infections by probiotic organisms are extremely rare. A previous literature review identified 15 reports of infection associated with the consumption of products containing probiotic organisms, none of which mention *Streptococcus thermophilus* as a cause.

S. thermophilus (previously known as *Streptococcus salivarius* subsp. *thermophilus*) is a Gram-positive, α -haemolytic bacterium that is ubiquitous in the dairy industry. Classified as a 'lactic acid bacterium', the organism's ability to convert lactose to lactic acid is harnessed in the manufacture of a number of dairy products such as yoghurts and cheeses. It is regarded as a low-pathogenicity organism, as genomic studies have shown that common streptococcal virulence genes are either absent or switched off in this species (Prajapati *et al.*, 2013). It also has 'Qualified Presumption of Safety' status in the European Union, as there is a long history of safe use in the food industry (Iyer *et al.*, 2010). In fact, it is thought that over 1×10^{21} live *S. thermophilus* bacteria are consumed every year around the world (Hols *et al.*, 2005).

The current case, an immunocompetent patient with intercurrent transient bowel ischaemia on a background of secondary polycythaemia, represents the first reported case, to the best of our knowledge, of bacteraemia due to *S. thermophilus*.

Case report

An 86-year-old lady presented to the Accident and Emergency Department at Nottingham University Hospitals NHS Trust, with a 4 h history of right-sided lower abdominal pain and anorexia. The pain was colicky in nature and rated as 8/10 on a pain scale. She had no nausea or vomiting, no urinary tract symptoms and her bowels were functioning normally. Her past medical history included early-onset Alzheimer's disease, polycythaemia secondary to ischaemic heart disease (JAC2 mutation negative), atrial fibrillation, hypertension and peripheral vascular disease. Her drug history included digoxin, bisoprolol, enalapril, co-amlofruse, simvastatin, aspirin and amitriptyline. She lived with her son who was her full-time carer. On examination, her temperature was 38.4 °C, heart rate was 88 beats min^{-1} and blood pressure was 135/84 mmHg. On chest auscultation, breath and heart sounds were normal and no murmurs were audible. Her abdomen was diffusely tender with more severe tenderness and guarding in the right iliac fossa. The differential diagnosis included acute appendicitis, diverticulitis and acute bowel ischaemia.

Investigations

An erect chest radiograph was performed, which showed no air under the diaphragm. An abdominal radiograph was also undertaken, which showed no signs of bowel obstruction. A full blood count showed a raised white cell count of $12.3 \times 10^9 \text{ l}^{-1}$ with a neutrophilia (9.8×10^9

l^{-1}) and haemoglobin of $179 \text{ g } l^{-1}$. Her lactate level was $1.8 \text{ mmol } l^{-1}$. Renal and liver function tests were unremarkable. A urine dipstick was negative for nitrites and leukocytes. Two sets of blood cultures were obtained and incubated in a BACTEC FX blood-culture system (BD Diagnostic Systems). She was referred to the surgical team and empirical therapy with piperacillin/tazobactam 4.5 g every 8 h intravenously was initiated. The following day, she underwent a computed tomography scan of the abdomen, which showed no radiological features of acute appendicitis or diverticulitis. Taken together, the clinical presentation and investigations suggested that bowel ischaemia was the most likely diagnosis. Her abdominal pain and fever resolved completely with conservative management, and she was discharged later the same day with a 5-day course of co-amoxiclav $250/125 \text{ mg}$ every 8 h orally.

The day after discharge, both the aerobic and anaerobic bottles from one of the two sets of blood cultures taken on admission signalled as positive (after 16 h of incubation) and Gram-stained smears from both bottles showed Gram-positive cocci in chains (Fig. 1). After 24 h of incubation in $5\% \text{ CO}_2$, small, grey, α -haemolytic colonies were visible on 5% horse blood agar (Fig. 2). A catalase test reaction and bile aesculin were negative, and the organism was presumptively identified as belonging to the 'viridans streptococci' group. The organism was further identified as *S. thermophilus* using a VITEK - system (bioMérieux), and this was subsequently confirmed by 16S rRNA gene sequencing (Molecular Identification Services Unit; Public Health England, UK). The organism was sensitive to amoxicillin using British Society for Antimicrobial Chemotherapy antimicrobial susceptibility methodology. Upon further questioning of the patient's son, it became apparent that she regularly consumed Activia yoghurt (The Danone Company).



Fig. 1. Gram stain of *S. thermophilus* from broth culture after 16 h incubation.



Fig. 2. Colonies of *S. thermophilus* on 5% horse blood agar after 24 h incubation in $5\% \text{ CO}_2$.

Outcome and follow-up

On review, following the identification of *S. thermophilus* in the blood culture, the patient remained asymptomatic. The 5-day course of co-amoxiclav was completed. No further blood cultures were obtained. On review 6 months following discharge, she had had no further episodes of abdominal pain or fever.

Discussion

For centuries, people have knowingly ingested dairy products containing bacteria due to perceived health benefits. A probiotic is defined as 'live micro-organisms that when ingested in large enough quantities confer a health benefit on the host' (Fuller, 1991). The most commonly used bacteria in probiotics are species from the genera *Streptococcus*, *Lactobacillus* and *Bifidobacterium*. The probiotic used by the patient in this case was the yoghurt Activia (The Danone Company), which contains *S. thermophilus*, *Lactobacillus bulgaricus* and *Bifidobacterium lactis*. A number of claims have been made concerning the benefits of probiotic products to the consumer's health, from promises of improved 'gastrointestinal health' to the lowering of serum cholesterol levels. Over recent years, the study of probiotics and their effect on health has been substantial. Although there has been much research, there is little evidence to show that probiotics do in fact confer significant health benefits. However, one area in which probiotics do appear to be beneficial is in the treatment of diarrhoea. A recent meta-analysis looked at the effect of probiotics on antibiotic-associated diarrhoea and found that they did have a protective effect (D'Souza *et al.*, 2002). The effect of probiotics on acute infectious diarrhoea has also been subjected to meta-analysis, which also demonstrated a beneficial effect (Sazawal *et al.*, 2006).

An obvious issue with ingestion of live micro-organisms is the assurance of safety. Probiotics should not cause infection in the consumer. This may be more of a risk in certain situations such as this case (transient ischaemia allowing translocation), those with damaged intestinal integrity secondary to chemotherapy or radiotherapy, infants with an immature intestinal barrier and those with an immunocompromised immune system. There have been a number of case reports of patients developing bacteraemia, which were thought to be secondary to probiotic consumption (Boyle *et al.*, 2006). To the best of our knowledge, there have been no previous reports of bacteraemia with *S. thermophilus* associated with probiotic consumption. As an α -haemolytic streptococcus, *S. thermophilus* in a single blood culture may easily be dismissed as a mere contaminant (and may not be identified to the species level in all cases), particularly if the patient is not displaying overt signs of sepsis. There are also reports of difficulty confirming the identification of *S. thermophilus* by 16S rRNA gene sequencing alone (Wilck *et al.*, 2001) or matrix-assisted laser desorption/ionization time-of-flight mass spectrometry fingerprinting (Christner *et al.*, 2010). We hypothesize that consuming Activia yoghurt on a regular basis caused *S. thermophilus* to become part of this patient's large intestinal microbiota. Transient bowel ischaemia, which was likely to be secondary to polycythaemia, probably permitted the organism to translocate and enter the bloodstream.

When one considers the sheer volume of probiotic products consumed around the world, and the possibility of large intestinal colonization, transient bacteraemia with various probiotic organisms is likely to occur on occasion due to intercurrent pathology of the large intestine. We would like to emphasize that this case does not signify safety issues with probiotic products containing *S. thermophilus*; indeed, colonization of the large intestine with *S. thermophilus* (and other probiotic organisms) might protect against translocation-related bacteraemia due to more pathogenic organisms (Sahin *et al.*, 2012). Clinical microbiologists should, however, be aware of this organism and consider the possibility of large bowel pathology rather than contamination if it is identified in blood-culture specimens.

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