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CASE REPORT

First reported human case of meningitis by *Staphylococcus condimenti*

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Abstract
Staphylococcus condimenti (*S. condimenti*) is a coagulase-negative bacterium, generally regarded as not pathogenic. Indeed, *S. condimenti* owes its name to having been isolated from starter cultures of fermented sausage, as well as from fish and soy sauces. To the best of our knowledge, only two cases of human infection caused by this bacterium have been reported. Here, we present a case of meningitis by *S. condimenti* in a 65-year-old woman who was brought to hospital after having been found unconscious at home. At her arrival, she had a Glasgow coma scale = 3, fever, and hypoxic–normocapnic respiratory failure. Examination of her cerebrospinal fluid showed a slightly increased white blood cell count, normal glucose and protein concentrations. Paired cultures on blood and liquor samples yielded *S. condimenti*. Targeted antibiotic treatment with ceftriaxone led to a complete recovery. This unique case expands our knowledge on *S. condimenti* as a pathogenic bacterium.

Keywords *S. condimenti* · Coagulase-negative staphylococci · Meningitis · Contaminant

Introduction

Coagulase-negative staphylococci (CoNS) are a heterogeneous group of bacteria that play a key-role in the majority of food fermentation ecosystems, being easily demonstrable in fermented meat and dairy products. *Staphylococcus condimenti* is one of them, mainly isolated from starter cultures of fermented sausage, as well as from fish and soy sauces. As such, it has traditionally been considered nonpathogenic: indeed, to our knowledge, only two cases of human infections due to this bacterium have been reported to date. In the first, a catheter-related bacteremia developed in a 17-year-old female with dilated cardiomyopathy requiring support with a left ventricular assist device [1]. In the second, a severe soft tissue infection occurred in a 7-year-old girl with a knee laceration caused by a glass fragment [2]. Here, we add to this short list the first case of meningitis caused by *S. condimenti*.

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Case report

A 65-year-old woman arrived at the emergency room of an academic hospital in northern Italy in a coma, after having been found unconscious at home, lying on the ground, by her son. Based on the conditions in which she was discovered, loss of consciousness must have been preceded by vomiting and accompanied by loss of sphincter control. The length of time spent on the ground was unknown, because the patient lived alone and nobody has had contact with her in the previous 2 days.

The patient's past medical history included hypopituitarism due to Sheehan's syndrome, chronic paranoid psychosis, syphilis (diagnosed in 2015 and treated with benzylpenicillin), and hypertension. Two weeks before admission she was diagnosed a periodontitis.

At physical examination, her vitals were the following: temperature, 37.8 °C; blood pressure, 170/90 mmHg; heart rate, 102/min; SpO_2 85% while breathing in oxygen in a Venturi Mask (FiO_2 = 50%). The Glasgow coma scale (GCS) was 3, with muscular flaccidity and absence of meningeal signs. The remaining of the exam was normal except for scattered rhonchi on both lungs.

After having provided basic coma care, the patient was kept under observation in the Urgent care Department for 2 days. During the period of observation, a radiograph of the chest and a CT scan of the brain were performed,

but were noncontributory. In particular, the CT scan of the brain excluded intracranial hemorrhage and revealed prior ischemic lesions. Meanwhile, routine biochemistry tests revealed high creatine phosphokinase (CPK), lactate dehydrogenase (LDH), alanine aminotransferase (ALT), and aspartate aminotransferase (AST), consistent with rhabdomyolysis; blood glucose was 246 mg/dL and C-reactive protein 32.1 mg/dL (Table 1). Toxicological examination was negative for psychotropic drugs and narcotic substances.

A lumbar puncture was performed. Cerebrospinal fluid (CSF) examination demonstrated white blood cells 0011×10^3/μL, red blood cells 0.001×10^6/μL, glucose 61 mg/dL, protein 33.5 mg/dL, LDH 56 U/L. The ratio between CSF glucose and blood glucose was 0.23 [3].

Blood and CSF culture vials were incubated in an instrumented culture system (Bactec™, Becton Dickinson, New Jersey, USA). After turning positive, 10 μL of each fluid were sown on Columbia blood agar plates and chocolate agar plates to identify aerobic microorganisms as well as in Columbia blood agar plates, chocolate agar plates and Schaedler agar plates for anaerobic microorganisms. Plates were incubated at 37 °C for 24 h under aerobic and anaerobic conditions. The bacterium grew in both aerobic and anaerobic plates. Microbiological identification was made by matrix-assisted laser desorption ionization time-of-flight mass (MALDI-TOF) spectrometry, using the MALDI/TOF Biotyper (Bruker Italia, Milan, Italy) set at a quality measure (score) > 2, which confirmed the presence of *Staphylococcus condimenti* in both fluids (log score 2.3). Gene sequencing was not performed. Further testing showed that both isolates were susceptible to all antibiotics except fosfomycin.

A transthoracic echocardiogram excluded endocarditis.

Antibiotic treatment with ceftriaxone 2 g bid intravenously for 2 weeks led to a full recovery; the neurological status normalized within 5 days, accompanied by a progressive reduction of CRP in the peripheral blood (from 32 mg/dL on admission to 1.54 mg/dL). The following three blood cultures were negative. The patient was discharged home in good condition, after a total hospital stay of 25 days.

Table 1 xxxxxxx

		Normal values
Glucose	246 (mg/dL)	74–106
Proteins	6 (g/dL)	6.4–8.3
Aspartate aminotransferase (AST)	7890 (U/L)	0–40
Alanine aminotransferase (ALT)	2073 (U/L)	0–40
Creatine phosphokinase (CPK)	3440 (U/L)	26–140
Lactate dehydrogenase (LDH)	12,382 (U/L)	208–450
C-reactive protein (CRP)	32.13 (mg/dL)	0.00–1.00

Discussion

CoNS lack classical virulence factors of other staphylococci, and in everyday clinical practice are often simply regarded as contaminants. Nevertheless, they represent now a major source of healthcare-associated infections, especially those associated with foreign bodies, which are often characterized by a subacute course with a relatively mild clinical picture [4]. Meningitides due to CoNS are rare, with the exception of those related to placement of a ventriculo-peritoneal shunt, and have a good prognosis in comparison to other bacterial meningeal infections.

In this case, the findings at presentation, the elevation of inflammation indexes and the isolation of the same bacterium on blood and liquor samples appeared in stark contrast the hypothesis of contamination, prompting us to start antibiotics. It should be noted that in the case of *S. condimenti* a false-negative test result is more likely than a false-positive test. In fact, *S. condimenti* can be mistaken for *S. aureus* or other coagulase-positive staphylococci when rapid latex agglutination kits are used. However, *S. aureus* shows lipolytic activity on egg yolk agar including lecithinase and lipase, whereas *S. condimenti* exhibits a weak lecithinase reaction and no lipase reaction [1]. The recent advent of MALDI-TOF instruments in the microbiology lab has made identification of microorganisms faster, more accurate and cheaper than biochemical methods. Thus, identifying in clinical isolates germs previously thought as nonpathogenic—such as *S. condimenti*—may predictably become more frequent in the near future.

Potential virulence factors in *S. condimenti* have been described. Proteins with similarity to leucocidin have been identified by gene sequencing, and appear to be involved in immune evasion and to possess proinflammatory and cytolytic activity [5]. In a previous study of CoNS isolated from food and starter cultures, no toxin production was found in the two *S. condimenti* strains tested; however, one strain displayed moderate haemolytic activity on human blood agar [2]. Genome sequencing had not shown significant differences between pathogenic strains and the type of strains isolated from food.

The route by which our patient became infected is unclear. As mentioned above, she had psychiatric problems and lived alone, therefore details of her recent clinical history were scarce, and her last 2 days before admission had no witnesses at all. Our hypothesis is that the patient might have had an alimentary toxinfection followed by blood invasion and dissemination to the central nervous system. Alternatively, the infection may have originated from the

Fig. 1 Patient orthopantogram showing multiple foci of osteolysis

periodontitis, which was diagnosed in the preceding weeks and had the support of an orthopantogram confirming multiple foci of osteolysis [Fig. 1]. A few cases of meningitis in patients with dental infections have been described: all the reported cases were not caused by CoNs [6, 7].

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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