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Catalase-negative *Staphylococcus aureus*: a rare isolate of human infection

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Staphylococcus aureus is by far the most important human pathogen among the staphylococci. It produces several enzymes that may contribute to its virulence, including catalase and coagulase, which are also widely used in the identification of this organism at both genus and species level [1]. Although it is well known that almost all strains of *S. aureus* have catalase activity, the strains that are not able to produce this enzyme have rarely been reported in human infections [2–7]. The case presented here of catalase-negative *S. aureus* (CNSA) as an etiologic agent of human infection is the first in Turkey and the ninth report in the literature.

A 15-year-old boy with high fever (38.4 °C), fluctuation, erythema and pain in his left knee attended the emergency department of our hospital. The patient was hospitalized with a preliminary diagnosis of osteomyelitis and/or soft tissue infection. However, osteomyelitis was ruled out by further investigation, and the patient was empirically treated with intravenous ampicillin–sulbactam (1 g 4 times a day) for his soft tissue infection. Three days later, despite the antibiotic therapy, an abscess formed in the infection area. After debridement of the abscess, the pus was submitted to the microbiology laboratory and the patient was followed up as an outpatient with oral antibiotic therapy. The physical examination of the patient revealed no symptoms of infection by day 14 of the oral antibiotic therapy.

Direct microscopic examination of the pus revealed leukocytes and Gram-positive cocci. After overnight incubation of culture media (5% sheep blood agar and chocolate agar) inoculated with pus, opaque, smooth creamy, and β-hemolytic colonies golden yellow in color were observed on blood agar. Although Gram staining of culture preparations showed clusters of Gram-positive cocci, raising the suspicion of staphylococci, the catalase test was repeatedly negative, with both the slide test with 3% H_2O_2 and in a nutrient broth tube with 30% H_2O_2 [1,3]. Despite the catalase negativity, we performed a coagulase test, since the microscopic and cultural characteristics correlated well with staphylococci. In addition to both clumping factor and free coagulase activity of the strain, the other tests used in the identification of staphylococci at species level were all in accord with *S. aureus* ATCC 29523 (Table 1). The Sceptor automated identification system verified the organism as *S. aureus* with a specificity rate of 99.87%. The strain was found to be susceptible to methicillin and most of the other antibiotics tested by using the standard disk diffusion method and the Sceptor Gram-positive MIC/ID panel [8].

Among the species of staphylococci, the members of only two species, *S. saccharolyticus* and *S. aureus* subsp. *anaerobius*, are not able to produce catalase. However, our strain differs from those species by its clumping factor, positive nitrate reduction, and acid production from trehalose, mannose and lactose (Table 1).

Only a few CNSA strains have been previously reported as infectious agents. It seems likely that there is no relationship between CNSA isolation and the characteristics listed in Table 2, such as geographic area, properties of patients (age,

Table 1 Comparison of catalase–negative *S. aureus* (CNSA) with related species of staphylococci and a standard strain of *S. aureus* (ATCC 29523)

Characteristic	CNSA	*S. aureus* (ATCC 29523)	*S. aureus* subsp. *anaerobius*	*S. saccharolyticus*
Catalase	–	+	–	–
Coagulase	+	+	+	+
Clumping factor	+	+	–	–
Nitrate reduction	+	+	–	+
β-Glucosidase	+	+	–	–
Mannitol fermentation	+	+	NA	–
Lactose fermentation	+	+	–	–
Mannose fermentation	+	+	–	+
Trehalose fermentation	+	+	–	–

NA, data not available.

Table 2 Certain characteristics of patients with CNSA infections

Case no.	Report date	Location	Isolation site	Age	Underlying condition
1 [3]	1955	?	Urine	?	?
2 [1]	1976	USA	Blood	24	Heroin addict
3 [4]	1981	?	Leg ulcer	?	Diabetes mellitus
4 [2]	1986	UK	Paronychia	67	None
5 [3]	1994	UK	Blood	49	Renal failure
6 [4]	1995	UK	Leg ulcer	80	None
7 [5]	1996	Saudi Arabia	Cellulitis	60	Diabetes mellitus
8 [6]	1996	Taiwan	Carbuncle	9	None
9 (present case)		Turkey	Abscess	15	None

underlying diseases), and the body sites. Although the organisms seem to be susceptible to the majority of antibiotics tested, it is difficult to link the sensitivity patterns of these strains to their catalase negativity.

Catalase production is a defense mechanism against destruction of the microorganism in phagocytic cells, and this may explain the lack of frequency of infections caused by non-catalase-producing *S. aureus* strains. However, the presence of such infectious agents in the literature indicates that catalase production is not essential for growth of *S. aureus* in vivo and in vitro.

In addition, although catalase production is still an important criterion with which to distinguish staphylococci and streptococci; colonial characteristics and microscopic appearance must be considered along with the catalase test results, keeping in mind the presence of catalase-negative strains of *S. aureus.*

This case report has been presented to encourage other clinical laboratories to identify such strains so that their incidence can be more accurately estimated.

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