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CLINICAL AND EPIDEMIOLOGICAL STUDY

Abscesses and wound infections due to *Staphylococcus lugdunensis*: report of 16 cases

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Abstract
Purpose *Staphylococcus lugdunensis* has emerged as a major human pathogen, capable of causing significant infections at many sites. It should never be dismissed as a contaminant without careful review. We report 16 cases of wound infections and skin and soft tissue abscesses caused by *S. lugdunensis* during a period of 3.5 years (January 2008–June 2011). These cases were isolated from clinical specimens in a tertiary hospital (250 beds) in Athens, Greece.
Methods The identification of *S. lugdunensis* was based on Gram staining, catalase and coagulase test results, and 26 biochemical reactions that were included in the database of the MicroScan Walkaway 96 commercial system. The susceptibility pattern was performed with the same commercial system according to CLSI recommendations.
Results Twenty-five isolates were classified as *S. lugdunensis*, of which 16 were considered to be clinically significant. The age distribution of the patients ranged from 29 to 65 years. Patient outcome after treatment was good with no long-term sequel. All isolated *S. lugdunensis* were methicillin sensitive (cefoxitin screen negative), while five isolates were β-lactamase producers. The isolates were susceptible to most of the antibiotics tested except for a few cases that were resistant to erythromycin, tetracycline, and clindamycin.
Conclusions Coagulase-negative staphylococci isolated from traumatic and surgical wound infections should be identified by microbiological laboratories to the species level, and susceptibility testing should be performed on these isolates so as not to underrate the virulence of staphylococci resembling *S. aureus*.

Keywords *Staphylococcus lugdunensis* · Wound infections · Antibiotic susceptibility · Infection

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Introduction

Staphylococcus lugdunensis is a coagulate negative staphylococcus (CoNS) first described by Freney et al. [1] isolated from human clinical specimens. The new species was named from Lyon, the French city where the organism was first isolated (lugdunum, the Latin name for Lyon). This unusual virulent CoNS causes severe infections including endocarditis in prosthetic and native valves, bacteremia, abscesses and surgical wound infections, osteomyelitis, intravascular catheter infection, prosthetic joint infection and rarely urinary tract and ear infections [2–6]. Although it causes severe infections similar to *S. aureus* infections, clinicians and every microbiologist are not acquainted with this bacteria or they consider this staphylococcus as part of the normal skin flora reporting it as contaminant. The clinical results of Arias et al. [7] support the fact that *S. lugdunensis* predominantly causes abscesses and would infections. Wound infections due to the above microorganisms have also been reported by other researchers [2, 8].

At our hospital, *S. lugdunensis* is recognized as a significant pathogen, and methods for its identification have been optimized. The laboratory routinely identifies CoNS to the species level and performs antibiotic susceptibility testing. Here, we describe the microbiological and clinical characteristics of clinically significant *S. lugdunensis* isolated from soft tissue abscesses and infections of hospitalized patients and outpatients of the hospital clinics from January 2008 to June 2011.

Materials and methods

Strains

Of the 25 *S. lugdunensis* strains identified during the study period, 16 were the sole organisms isolated from the abscesses and surgical wounds of patient/outpatients tested in our laboratory and therefore considered to be clinically significant. Specimens were cultured on blood agar and mannitol salt agar and incubated for 48 h at 35 °C. The reference *S. lugdunensis* strain ATCC 6343 was used as the control strain. The characteristics of the colony count of the cases due to *S. lugdunensis* are listed in Table 1.

Identification

The bacteria were identified as *S. lugdunensis* on the basis of their colony morphology and Gram-straining characteristics. The coagulase test was performed with the slide test for bound coagulase "clumping factor" (Slidex Staph Plus; Biomerieux, Marcy l' Etoile, France) and with the tube test for free coagulase results. The commercial identification system Microscan Walkaway 96 (Siemens Healthcare Diagnostics, West Sacramento, CA) for Gram-positive cocci was used for the phenotypic characterization of CoNS isolated from the clinical specimens.

Susceptibility tests

Antibiotic susceptibility studies were carried out using MicroScan panels according to the Clinical and Laboratory

Table 1 Characteristics of all patients

Case	Age (years)	Sex	Risk factors	Clinical presentation	Location	Treatment	Outcome
1	62	Male	Diabetes, Hepatitis	Abscess	Left arm	Surgical drainage, amoxicillin, clavulanic acid	Cure
2	39	Male	None	Abscess	Perineal	Flagyl–amoxicilin	Cure
3	29	Female	None	Abscess	Perineal	Flagyl–amoxicilin	Cure
4	30	Female	None	Abscess	Perineal	Flagyl–amoxicilin	Cure
5	38	Male	Chololithiasis	Abscess	Perineal	Surgical drainage, amoxicillin, clavulanic acid	Cure
6	62	Female	Encephalopathy	Pressure ulcer	Right buttock	Ceftazidime	Cure
7	65	Male	Chololithiasis	Wound infection	Abdomen	Ciprofloxacin	Cure
8	50	Female	Diabetus melitus	Abscess	Right knee	Ciprofloxacin	Cure
9	45	Male	None	Wound infection	Left leg	Amoxicillin	Cure
10	58	Male	Mammary hyperectomy	Wound infection	Right breast	Ciprofloxacin	Cure
11	59	Female	Breast cancer	Wound infection	Left breast	Ciprofloxacin	Cure
12	42	Female	None	Abscess	Left breast	Surgical drainage, amoxicillin, clavulanic acid	Cure
13	50	Male	None	Abscess	Thorax	Ciprofloxacin	Cure
14	35	Female	Lupus erythromatosus	Wound infection	Left leg	Amoxicillin–clavulanic acid	Cure
15	65	Male	None	Wound infection	Right arm	Ciprofloxacin	Cure
16	48	Male	None	Wound infection	Right hand	Amoxicillin	Cure

Standards Institute's (CLSI, Wayne, PA) [9] interpretative breakpoints for minimum inhibitory concentrations (MICs). The presence of the mecA gene was determined by the cefoxitin method. At a cefoxitin MIC of <4 g/ml or > 4 g/ml, the strain is considered to have a negative or positive mecA gene status, respectively.

Results

During the study period, 1,100 CoNS strains were isolated by the biopathology laboratory from clinical specimens received, of which 25 (2.27 %) were identified as *S. lugdunensis*. From these latter 25 strains, 16 (64 %) were isolated from abscesses and wound infections and were considered to be true pathogens. The remaining nine isolates were considered to be contaminants according to clinical and microbiological standards [10] and were derived from perinea (4), neck (3), and mastoiditis (2).

The age of the patients ranged from 29 to 65 (mean 48.5) years. Seven were female (43.8 %). Risk factors associated or not with surgical drainage, clinical characteristics (8 abscesses and 8 wound infections), location of wound or abscess (perinea, breast, abdomen, lower limbs), and treatment outcome are listed in Table 1. All patients were considered to be cured after therapy. The duration of therapy was 7 days in all cases.

Of the 16 *S. lugdunensis* strains that were considered to be true pathogens, three tested weakly positive for bound coagulase (clumping factor); however, 16 strains tested negative for free coagulase when tested by tube method. In all cultures from the above-mentioned system strains, *S. lugdunensis* was the sole bacterium isolated at a density of $>10^4$, and the patients from whom the specimens were isolated had a clinically significant infection according to guidelines.

All 16 strains were oxacillin sensitive with a breakpoint MIC of <2 μg/ml and a negative cefoxitin screen (MIC <4 μg/ml). Five were β-lactamase producers with penicillin and ampicillin MIC of >8 μg/ml. From the penicillin-resistant strains one was also resistant to erythromycin, clindamycin, and tetracycline. All stains were sensitive to all other tested antibiotics.

Discussion

During recent years we have identified all CoNS isolated from clinical specimens at the species level and conducted susceptibility testing. *S. lugdunensis* has been the focus of much attention in a plethora of reports. This usually virulent CoNS has predominantly been associated with skin abscesses and wound infections [2, 7, 8, 11–14] which are clinically similar to those caused by *S. aureus*. As such, they should be considered as serious as *S. aureus* infections.

The number of *S. lugdunensis* strains isolated from different parts of the body during the study period is 25 out of a total of 1,100 CoNS (2.2 %), which is close to the 3 % accepted rate. Knowing that *S. lugdunensis* is a common skin commensal and commonly regarded as a contaminant, we differentiated the contaminants isolated from different parts of the body (urine, external otitis, rhinitis, urethral, intravascular catheter etc.) from the real pathogens based on laboratory results (Gram-positive cocci, isolation of the cocci in monoculture at a density of usually $>10^4$, and clinical criteria) [10]. If these conditions did not exist the *S. lugdunensis* isolate was considered to be a simple contaminant.

In an effort to identify correctly documented infections caused by *S. lugdunensis* in our hospital during the study period (3.5 years), we isolated 16 strains of *S. lugdunensis*. Of these 16 strains, ten were from pus exudate specimens of skin abscesses of patients visiting our outpatient clinics and six were from wound exudates of operated patients in our hospital. All of the above strains were considered to be pathogens.

We avoided the misidentification of *S. lugdunensis* as *S. aureus* by checking all *Staphylococcus* isolates for free coagulase with the tube method because the positive reaction for clumping factor (bound coagulase) is not unusual in *S. lugdunensis* [15].

Commercial systems are currently available that include biochemical reactions in their database for the correct identification of CoNS. The automatic commercial system used in our laboratory (MicroScan Walkaway 96) includes 26 biochemical reactions. During many of the years following its initial identification, *S. lugdunensis* remained susceptible to many antimicrobial agents [16]. Nowadays a number of studies refer to its resistance to different classes of antibiotics, such as β-lactams [17, 18], macrolides [19], and tetracycline [20]. There are also some reports which describe *S. lugdunensis* isolates as being resistant to multiple antimicrobial agents [21].

The differences between the frequency of *S. lugdunensis* β-lactamase producers in different countries and among the laboratories of the same country likely depends on the methods used in each laboratory for the identification and susceptibility of CoNS. The range of frequency of β-lactamase producers of *S. lugdunensis* varies between 7 and 40 % [11, 15, 17, 18, 22]. In our study, the rate of *S. lugdunesis* β-lactamase producers was 30.2 %.

The procedure used to identify different CoNS species includes biochemical reactions, of which the most significant are those for the presence of pyrrolidonyl, azylamidase, ornithine, decarboxylase, and mannose utilization

[17, 18]. The gold standard is screening for the mecA gene by PCR. As molecular methods are unsuitable for routine testing, the presence of mecA based on another method, such as cefoxitin MIC, can also differentiate mecH-positive strains of *S. lugdunensis*.

According to CLSI, when the cefoxitin MIC is >4 μg/ml and the oxacillin MIC >2 μg/ml, *S. lugdunensis* carries the mecA gene and is resistant to methicillin. Only very few cases of *S. lugdunensis* carrying the mecA gene have been reported in the literature [4, 17, 23]. The MIC of oxacillin for *S. lugdunensis* strains without the mecA gene has been reported to be in the range of 0.5–2 μg/ml as in our study [24].

In conclusion, *S. lugdunensis* is a CoNS that causes abscesses and surgical infections and should be considered to be a true pathogen when it is correctly identified from the examined clinical specimens.

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Conflict of interest None.

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