

# *Staphylococcus lugdunensis* in several niches of the normal skin flora

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## Abstract

*Staphylococcus lugdunensis* is a coagulase-negative staphylococcus (CNS). Its pathogenicity and virulence are more similar to *Staphylococcus aureus* than to a CNS. It causes severe infections with high mortality, such as endocarditis, but more often painful and prolonged skin- and soft-tissue infections. Little is known of its normal habitat. Whether it is an integral part of the normal skin flora like many other CNS has been questioned, since it is rarely seen in blood cultures. This study was designed to determine whether *S. lugdunensis* has a niche in the normal skin flora and to compare *S. lugdunensis* and *S. aureus* in these niches. From 75 healthy subjects in Kronoberg County, Sweden, 525 swabs were obtained from the nose, axilla, perineum, groin, breast, toe and nail bed of the first toe. Significantly more of the 525 skin samples as well as of the 75 healthy subjects yielded *S. lugdunensis* (50/75) as opposed to *S. aureus* (16/75). Swabs from the nose frequently yielded *S. aureus*, but only rarely *S. lugdunensis*. Swabs from the groin and the lower extremities, especially the nail bed of the first toe, often yielded *S. lugdunensis* but rarely *S. aureus*. This study shows that *S. lugdunensis* is an integral part of the normal skin flora, primarily of the lower abdomen and extremities, and that the niches of this coagulase-negative staphylococcus are distinctly different from those of *S. aureus*. The predominant niches of *S. lugdunensis* explain why the bacterium is an uncommon contaminant of blood cultures.

**Keywords:** normal habit, *S. aureus*, *S. lugdunensis*, skin flora

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## Introduction

Taxonomically, *Staphylococcus lugdunensis* belongs to the coagulase-negative staphylococci (CNS), but in many other respects it behaves like *Staphylococcus aureus*.

Its clinical properties and susceptibility to antimicrobials are much more similar to those of *S. aureus*. Infections are similar in type and severity and, like *S. aureus*, it is considered a primary pathogen [1,2]. It is most often found in skin and soft tissue infections, but can also cause serious infections such as endocarditis with high mortality. The bacterium is more virulent than normally expected of a coagulase-negative staphylococcus (CNS). Because it is perceived as a CNS and therefore of doubtful significance, understanding its true significance in blood cultures is often delayed [3–11].

Over the last 10 years every isolate of CNS isolated from blood culture bottles (Bact Alert; Bio Merieux, Marcy l'Etoile, France) in our laboratory has been investigated to exclude *S. lugdunensis*. Only seven of the CNS in 1021 patients were *S. lugdunensis*. Three were from newborn boys, perhaps as a result of transmission from the perineal flora of the mother. Three were from elderly men, none of whom had endocarditis and in none of whom was the finding considered clinically significant. The last case was that of a 86-year-old woman with pneumonia in whom four of four bottles yielded *S. lugdunensis*.

These observations indicate that *S. lugdunensis* is not part of the normal flora of skin niches where blood cultures are normally obtained through puncture of the skin.

No detailed study has been carried out on the distribution of *S. lugdunensis* in healthy humans. It has been assumed to be part of the resident skin flora, but the fact that it is seldom seen as a contaminant of blood cultures indicates other niches than those common for CNS in general [3,11,12].

The aim of this study was to investigate whether there are skin niches that may be considered to be the normal habitat of *S. lugdunensis* and to relate the presence of *S. lugdunensis* to that of *S. aureus* in these niches.

## Material and Methods

Fifteen employees at the Clinical Microbiology Laboratory were asked to recruit non-hospital affiliated friends or relatives for the study.

The 75 participants delivered 525 samples from the nose (vestibulum nasii), axilla, from the fold under the male and female breast, groin, perineum, skin between the first and second toe, and from the nail bed of the first toe.

The study was anonymous. Participants completed a questionnaire declaring their age, gender, chronic illnesses (diabetes 2, psoriasis 1) and medication (none was on antibiotics). The questionnaire and the Copan vials were marked with the same study numbers.

### Identification

Samples were cultured on human blood agar plates for 48 h at 37°C under aerobic conditions. From each sample 3–6 colonies showing colony phenotypes characteristic of staphylococci were subcultured onto blood agar plates. All colonies were tested with Staphaurex (Remel Europe Ltd, Dartford, UK), tube coagulase (with horse plasma; Statens Serum Institut, Copenhagen, Denmark) and tested for ornithine decarboxylase, pyrrolidonyl aminopeptidase and resistance to deferroxamine (ROSCO; A/S Rosco, Taastrup, Denmark).

### Statistical methods

Statistical comparisons were made using a  $\chi^2$  test, and results were considered significant at values of  $p < 0.05$ .

## Results

Samples from 75 subjects, 33 male and 42 female, were cultured. Three were infants under the age of 1 year, seven were between 1 and 20 years, 56 were between 21 and

65 years and eight were  $> 65$  years of age; one subject did not reveal his age. Fifteen were healthcare employees.

Of 525 samples, we were unable to culture bacteria from 16 (3%). One swab yielded only *Enterobacteriaceae*, 65 swabs yielded a mixture of Gram-positive and Gram-negative bacteria, whereas the remaining 443 swabs yielded only Gram-positive bacteria (CNS including *S. lugdunensis*, *S. aureus*, miscellaneous streptococci and corynebacteria). Ninety of 94 swabs with *S. lugdunensis* and 20 of 21 swabs with *S. aureus* yielded only Gram-positive bacteria. With few exceptions (13 of 94 *S. lugdunensis*, two of 21 *S. aureus*), swabs gave a mixed flora.

Fifty subjects (66.7%) were colonized with *S. lugdunensis* and 16 (21.3%) with *S. aureus* ( $p < 0.001$ ). Ten subjects (13.3%) yielded both *S. lugdunensis* and *S. aureus* in one or more swabs.

Twenty-five male (75.8%) and 25 female participants (59.5%) were colonized with *S. lugdunensis*, compared with nine male (28.1%) and seven female (16.7%) with *S. aureus*. None of the differences between male and female participants was statistically significant ( $p > 0.05$ ). *S. lugdunensis* was found in all sampled body sites, but most often in samples from groin, toes and axilla, whereas *S. aureus* was rarely found in other sites than the nose (Table 1). Subjects colonized with *S. lugdunensis* were significantly more often colonized in more than one site than those colonized with *S. aureus* ( $p < 0.05$ ) (Table 2).

**TABLE 2.** Healthy subjects colonized in one or several niches

No. of niches	<i>S. lugdunensis</i>				<i>S. aureus</i>			
	Males	Females	Total	%	Males	Females	Total	%
1	5	16	21	42	7	5	12	75
2	11	7	18	36	2	1	3	19
3	6	1	7	14	0	1	1	6
4	3	1	4	8	0	0	0	0
Total	25	25	50	100	9	7	16	100

**TABLE 1.** Healthy subjects with swabs positive for *Staphylococcus lugdunensis* and/or *Staphylococcus aureus*

Location <sup>a</sup>	<i>S. lugdunensis</i>			<i>S. aureus</i>		
	Males (n = 33)	Females (n = 42)	Total (%)	Males (n = 33)	Females (n = 42)	Total (%)
Nose	6	1	7 (9.3)	8	6	14 (18.7)
Axilla	9	6	15 (20)	1	1	2 (2.7)
Perineum	9	2	11 (14.7)	0	1	1 (1.3)
Groin	13	11	24 (32)	0	0	0 (0)
Breast	3	1	4 (5.3)	1	1	2 (2.7)
Toe	1	3	4 (5.3)	0	0	0 (0)
Nail 1st toe	10	8	18 (24)	0	1	1 (1.3)
Unspecified	6	5	11 (14.7)	1	0	1 (1.3)
Total	57	37	94	11	10	21

<sup>a</sup>One swab per location from each of the 75 subjects.

## Discussion

In our department, *S. aureus* is 50 times more common than *S. lugdunensis* in clinical samples (based on cultures from wound secretions, abscesses, etc).

*Staphylococcus lugdunensis* has been suspected to be part of the normal skin flora, especially in the pelvic region. Herchline and Ayers [13] described the occurrence of *S. lugdunensis* in consecutive clinical specimens and commented on the presence of the bacterium in various niches. These authors suggest that *S. lugdunensis* can be found over the entire human skin surface, whereas Vandenesch *et al.* [14], based on a prospective, nationwide survey of skin and post-surgical wound infections, propose that the preferred site of carriage of *S. lugdunensis* is the perineum rather than the entire skin surface.

Over a period of 12 months, Bellamy and Barkham [3] investigated all clinical cultures where CNS was the dominant or only finding. Samples from 17 patients were positive for *S. lugdunensis*, and in 14 the finding was considered clinically relevant. Nine patients had an abscess in the pelvic girdle region. van der Mee-Marquet *et al.* cultured samples from the inguinal folds of 140 consecutive patients evaluated at the accident and emergency unit over a 3-month period. Twenty-two percent of patients carried *S. lugdunensis* in this area, and in 68% results were positive with samples from both inguinal folds [12]. In the same study it was argued that in several published cases *S. lugdunensis* endocarditis was preceded by surgical procedures in or near the pelvic girdle region, e.g. vasectomy [15], scrotal wounds, renal transplantation, femoral arterial catheterization, total-knee arthroplasty [8], continuous ambulatory peritoneal dialysis [16], prostatic cancer [17] and inguinal furuncle [18,19]. Despite numerous studies of *S. lugdunensis* in patients, we have not seen a previous detailed study on the distribution in various skin niches of *S. lugdunensis* in healthy volunteers.

Our results confirm the hypothesis that *S. lugdunensis* is an integral part of the normal skin flora but that it is more common in the lower than the upper part of the body; 32% and 15% of investigated individuals were positive in the inguinal and perineal areas, respectively, and 28% were positive in the nail bed of the first toe and/or between the first and second toe.

In this study, exploring seven niches, *S. lugdunensis* was more commonly encountered as part of the normal skin flora than *S. aureus*. The only niche dominated by *S. aureus* was the nose. Of the 75 volunteers, 18.7% were nasal carriers of *S. aureus* vs. 9.3% for *S. lugdunensis*. Only 15 volunteers were healthcare workers, which would explain the lower nasal

carriage. The niches from which *S. lugdunensis* was most frequently isolated as part of the normal flora were the same as those from which clinical samples most often yield *S. lugdunensis*. We have >10 years' experience encompassing 40–60 clinical cases of primarily skin and soft tissue infections with *S. lugdunensis* per year. These often occur in the pelvic region, in the lower extremities including the feet and, occasionally, manifest as small mammary abscesses. We have registered several patients with recurrent, often painful, infections, sometimes lasting for several years.

To anyone interested in improving the diagnosis of *S. lugdunensis* in clinical samples, our advice would be to incubate samples for at least 36 h and to investigate closely pure cultures of CNS (typical smell and creamy white appearance with a small zone of haemolysis) from skin- and soft-tissue infections, especially abscesses from the pelvic region, the lower extremities and the female breast region.

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## Transparency Declaration

The authors declare no commercial or conflict of interest in this work.

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