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Research Article

Nasal colonization by Staphylococcus lugdunensis in surgical service personnel at the Saturnino Lora Provincial Hospital

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Abstract

Introduction: The identification of *Staphylococcus lugdunensis* in the nasal mucosa of healthcare personnel is becoming a necessity. Its presence at this level constitutes a risk for both healthcare-associated and community-acquired infections.

Objective: To determine the frequency of nasal colonization by *Staphylococcus lugdunensis* in healthcare personnel at the Saturnino Lora Provincial Hospital in Santiago de Cuba.

Method: An observational, descriptive, and cross-sectional study was conducted among healthcare personnel from the general surgery, orthopedics, and surgical departments of the Saturnino Lora Provincial Hospital in Santiago de Cuba, from August to September 2024. The sample collection consisted of 123 nasal secretion samples diagnosed in the microbiology department of the aforementioned hospital, which were processed according to microbiological standards.

Results: A total of 11 *Staphylococcus lugdunensis* isolates were found, representing 8,9%. By occupational category, physicians were found to be the most colonized, with the department with the most isolates being general surgery, at 8,1% and 4,1% respectively, while Staphylococcus aureus was isolated in 9,7%. Antimicrobial susceptibility testing showed high sensitivity of *Staphylococcus lugdunensis* isolates to most antibiotics.

Conclusions: The highest number of positive isolates was from surgery and orthopedics departments. The isolated strains showed high sensitivity to the antimicrobials tested, and the isolation frequency was low.

Key words: ***S****taphylococcus lugdunensis*, Nasal colonization, Healthcare

Introduction

Healthcare-associated infections are a public health problem in the country due to their frequency, severity, and high cost. [1] Their prevalence worldwide is high, and a wide variety of bacteria with high pathogenic potential stand out. From an epidemiological standpoint, staphylococcus, which inhabits the nasal passages, pharynx, and skin of asymptomatic carriers, constitutes the main substrate for transmission to patients, whether through direct contact with nasal secretions, sneezing, conversation between physician and patient (airborne transmission), or inadequate handwashing contaminated with the bacteria. [2]

The involvement of coagulase-negative staphylococci in human diseases is a major problem, particularly in hospital settings where these species often act as opportunistic pathogens. Furthermore, some coagulase-negative staphylococci, such as Staphylococcus lugdunensis, have emerged as

pathogenic bacteria, implicated in serious infections. The risk is increased in patients with diabetes mellitus, renal failure, immunosuppressive treatment and neoplasia. [23]

Consequently, this bacterium, which is part of the normal flora of human skin and mucous membranes, is capable of colonizing parts of the body based on the characteristics of the anatomical site where it establishes itself. It can be transmitted to patients and cause healthcare-associated infections, as well as spread in the community, even causing serious infections if the bacteria have developed resistance to antimicrobials. [3,4]

Thus, several risk factors are associated with nasal colonization, such as living with people who work in healthcare institutions, recent hospitalization, upper respiratory tract infections, infrequent handwashing by healthcare personnel, and being a carrier, which increases the risk of developing an internal and healthcare-associated infection among healthcare personnel. [3,4]

Considering that the nasal microbiota is organized into ecological niches that interact with the host and pathogens, it is worth highlighting the importance of nasal carriers of Staphylococcus strains in their transmission, particularly in hospitals, as they are crucial in the genesis of infections caused by this agent. Therefore, nasal colonization of healthcare workers normally precedes hospital-acquired infection with this bacterium. [1,2]

There are insufficient studies to demonstrate the true magnitude of the problem in other countries, including Cuba and especially in the province of Santiago de Cuba. Considering this microorganism as a real danger worldwide for the development of infectious clinical conditions in surgical patients, as well as the risk factors associated with nasal colonization, the purpose of this study is to determine the frequency of nasalcolonization by Staphylococcus lugdunensis in healthcare personnel in the aforementioned services at the Saturnino Lora Provincial Hospital in Santiago de Cuba.

Method

An observational, descriptive, and cross-sectional study was conducted among healthcare personnel from the general surgery, orthopedics, and surgical units of the "Saturnino Lora" Provincial Hospital in Santiago de Cuba, from August to September 2024. The sample consisted of 123 nasal secretion samples diagnosed in the microbiology department of the aforementioned hospital, which were processed according to microbiological standards.

To address the research objective, the following variables were operationalized: Microbiological procedures to identify isolates: determinations for the diagnosis of the microorganism through enzymatic and biochemical tests.

Positivity: related to the positive or negative result of the tests performed to identify the isolates.

Bacterial isolation: corresponded to the bacterial microorganisms obtained from the seeding, processing, and identification of the samples according to the technical procedures established for microbiological diagnosis in the laboratory. Healthcare personnel: These were medical and nursing staff, as they were directly involved in technical procedures for post-surgical patients.

Nasal carriers: These were healthcare personnel without clinical symptoms, where results of Staphylococcus lugdunensis isolations were obtained from nasal secretion samples.

Antimicrobial susceptibility: This was determined according to the Clinical Laboratory Standards Institute (CLSI) sensitivity and resistance criteria, using the standardized disk diffusion method (Bauer-Kirby) on the surface of a Mueller-Hinton agar plate.

The collected information was used to create a database using SPSS version 22.0 for Windows, which allowed for all statistical processing. A synthetic, inductive, and deductive analysis was performed to obtain frequency distributions and prepare the tables. Furthermore, comparisons with national and international studies were made from the reviewed literature, allowing for conclusions to be drawn.

Ethical Principles

For the conduct of this research, approval was obtained from the Scientific Council of the Provincial Center for Hygiene, Epidemiology, and Microbiology (CPHEM) of Santiago de Cuba, following a presentation and discussion of the research. Coordination was established with the management of the "Saturnino Lora" Provincial Hospital, and the objectives and importance of the work were explained to them, as well as the benefits that the results would bring to the institution. The confidentiality of the information collected was guaranteed, and the consent of the individuals to participate in the research was obtained.

Results

The involvement of coagulase-negative staphylococci in human disease is a significant problem, especially in hospital settings, where these species often act as opportunistic pathogens. During the study period, 123 nasal swabs were performed among medical and nursing staff working in surgical departments, from which 11 Staphylococcus lugdunensis were isolated, representing 8,9%.

Table 1 shows the results of the physiological, biochemical, and metabolic tests performed, and their interpretation after growth on blood agar and staining reactions. A total of 123 *Staphylococcus* isolates were obtained. Within this group, 11 strains of *Staphylococcus lugdunensis* were identified, which were capable of producing the enzyme catalase, decarboxylating ornithine, the main characteristic always present in this species, as well as the fermentation of carbohydrates, glucose, mannose, trehalose and mannitol, and the grouping factor test, where 100% was positive.

Table 1: Microbiological results of the tests performed. Microbiology Laboratory, Saturnino Lora Provincial Hospital. August – september 2024

Microbiological determinations	Completed	Positives		Negatives	
		No.	%	No	%
Growth on Blood Agar	123	123	100	0	0
Gram stain	123	123	100	0	0
Oxidase production	123	0	0	123	100
Catalase production	123	123	100	0	0

Coagulase Test	123	12	9,7	111	90,2
Ornithine decarboxylation	123	11	8,9	112	91,0
Mucus test	11	11	100	0	0
Glucose fermentation	11	11	100	0	0
Mannitol fermentation	11	0	0	11	100
Mannose	11	11	100	0	0
Trehalose	11	11	100	0	0
Aggregation factor	11	11	100	0	0
Production of β-lactamase	123	112	91	11	8,9

Source: Microbiology Laboratory Logbook

Regarding the frequency of isolations according to occupational category (Table 2), 8,1% of physicians were infected with *Staphylococcus lugdunensis*, while 7,3% were infected with *Staphylococcus aureus*. *Staphylococcus lugdunensis* was isolated in one nurse (0,8%) and *Staphylococcus aureus* was identified in three of them (2,4%).personal se obtuvo otros aislamientos bacterianos propios de la microbiota normal (81,4%).

Table 2: Bacterial isolates according to healthcare personnel

Bacterial isolates	Health personnel					
	Doctors		Nursing		Total	
	No.	%	No.	%	No.	%
Staphylococcus lugdunensis	10	8,1	1	0,8	11	8,9
Staphylococcus aureus	9	7,3	3	2,4	12	9,7
Other coagulase negative staphylococci	74	60,2	26	21,2	100	81,4
Total	93	75,6	30	24,4	123	100

Source: Microbiology Laboratory Logbook

When determining the frequency and carrier ratio by nasal swab according to the work service, the highest percentage corresponded to carriers from the surgery service with 5 isolations for 4,1%, preceded by orthopedics with 4 which represents (3,2%), and the surgical unit 1,6%. (Table 3)

Table 3: Isolation of *Staphylococcus lugdunensis* related to nasal swabs performed in surgical services.

Medical services	Nasal swabs performed		*Staphylococcus lugdunensis* isolates	
	No.	%	No.	%
Surgery	55	44,7	5	4,1
Orthopedics	43	34,9	4	3,2
Surgical unit	25	20,4	2	1,6

Total	123	100	11	8,9

Source: Microbiology Laboratory Logbook

Regarding antimicrobial susceptibility, *Staphylococcus lugdunensis* only showed 18% resistance to Azithromycin (Table 4).

Table 4: Antimicrobial susceptibility of *Staphylococcus lugdunensis* n=11.

Microorganism		Antimicrobials						
		P	FOX	FOS	MRP	AK	CIP	AZM
		%	%	%	%	%	%	%
Staphylococcus lugdunensis	S	100	100	100	100	100	100	72
	I	0	0	0	0	0	0	0
	R	0	0	0	0	0	0	18

Source: Microbiology Laboratory Logbook

Legend: P-Penicillin, FOX-Cefoxitin, MRP-Meropenen, AK-Amikacin, CIP-Ciprofloxacin, AZM, Azithromycin.

Discussion

In the study conducted by Argemi X et al, [5] they state that, although this microorganism is part of the skin microbiota and is a rare human pathogen, it has been described with increasing frequency both in patients with underlying diseases after receiving immunosuppressive therapies, as well as in healthy individuals with superficial or deep infections, and is the cause of healthcare-associated and community-acquired infections that can develop aggressively and severely.

In this sense, since its initial description, this microorganism has gone from being an occasional finding as a causative agent of human disease to becoming increasingly common. [10] This may be due to both a better understanding of its microbiological characteristics and a higher level of clinical suspicion. However, its incidence may still be underestimated if an active search for it is not carried out, since the identification of coagulase-negative staphylococci at the species level is not a common practice in microbiology laboratories. [5] To this we must add that it can be confused with Staphylococcus aureus, [9] in some Occasionally due to the production of fibrinogen affinity factor or clumping factor.

However, the highly virulent and destructive nature of *Staphylococcus lugdunensis* should be emphasized; [10,11] this is sufficient reason for the rapid identification of this microorganism to the species level when its presence is suspected in an infection, especially if it is isolated from a sterile site.

Regarding the antimicrobial susceptibility tests performed on Staphylococcus lugdunensis strains, they showed high sensitivity to the antibiotics analyzed. This is another indirect indicator that may lead to the suspicion of *Staphylococcus lugdunensis*, along with the type of sample analyzed and the microbiological tests performed, consistent with what has been reported by various authors. [9-12]

Although this microorganism does not possess free coagulase [1] (negative tube coagulase test), it should be noted that between 60 and 80% of strains produce a membrane-bound form of the enzyme (called clumping factor) that gives a positive result in both the human plasma slide coagulase test and commercial rapid latex agglutination tests; this can lead to identification errors in the laboratory. However, according to Fernández et al [4] and Liu et al, [6], it should be noted that the reaction produced by Staphylococcus lugdunensis is slower and weaker than that produced by *Staphylococcus aureus*.

Staphylococcus lugdunensis [11] causes infection primarily in the hospital setting and in patients who usually have an underlying disease, but it is premature to define the predisposing factors. However, diabetes mellitus, immunosuppression, neoplasia, chronic kidney failure, trauma, and previous surgery are the most frequently described risk factors. [10-11]

In the study conducted by Aties López et al., [10] they stated that skin and skin abrasions are the most common portal of entry, with nasal carriers, specifically healthcare personnel in hospitals, playing a significant role in the transmission of the microorganism. It should be noted that no growth was observed in some of the samples, leading the authors to infer that it could be related to the action of the enzyme lugdunin, produced by Staphylococcus lugdunensis. which is capable of inhibiting the growth of *Staphylococcus aureus* and other species that are part of the indigenous nasal flora.

In a study conducted by García Revilla, [1] he highlights that Zipperer et al. [13] referred to the discovery of strain IVK28, which demonstrated that it was a cyclic peptide containing thiazolidine, which possesses potent antimicrobial activity against a wide range of Gram-positive bacteria, including opportunistic pathogens such as difficult-to-treat methicillin-resistant Staphylococcus aureus and vancomycin-resistant enterococci, among others.

From this perspective, Zipperer et al. [13] demonstrate that *Staphylococcus lugdunensis* and its antimicrobial product lugdunin

play a crucial role by sensitizing epithelial cells to increase their defenses, resulting in effective protection against S. aureus colonization.

It is worth noting that one of the limitations of the study was the lack of methods to detect the aforementioned enzyme, which prevented the demonstration of this hypothesis. Furthermore, during the study period, the authors found no updated national or international references related to the frequency of nasal carriage of *Staphylococcus lugdunensis* in healthcare facilities that would allow for comparison of results.

According to Karakullukçu et al, [11] *Staphylococcus lugdunensis* is an atypical coagulase-negative staphylococcus compared to other coagulase-negative staphylococci due to its special virulence characteristics and sensitivity to multiple antimicrobials, including penicillin in many cases.

Conclusions

The highest number of positive isolates was from the surgery and orthopedic departments. The isolated strains showed high sensitivity to the antimicrobials tested. Although the frequency of *Staphylococcus lugdunensis* isolations from nasal carriers was low, this microorganism should not be underestimated due to its relevance, as it is more virulent than other coagulase-negative staphylococci.

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