

## Research Article



## Investigation of *Staphylococcus aureus* Nasal Carriers in Hemodialysis Patients and Its Role in the Infection in Al-Assad Hospital

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### ABSTRACT

The Nasal carriage of *Staphylococcus aureus* may be responsible for some serious infections among hemodialyzed patients, therefore, our study investigated the nasal carriage of *Staphylococcus aureus* and evaluated its role as a risk factor for the occurrence of infections especially bacteremia in hemodialysis patients in kidney department in Al-Assad Hospital. This study included 110 patients, with mean ages of (50.77 ± 15) years, containing 60 males and 50 females, all patients had undergone 3-4 hours hemodialysis sessions twice weekly, with a mean hemodialysis duration of (25.50 ± 21) months, the study was established from June 2010 till May 2011, and three nasal screens per patients were gathered. The rate of three screens was respectively (38.7%, 40.3%, 46.8%), the Permanent carriage recorded the highest ratio compared to the negative and intermittent carriage rate were respectively (17.7%, 38.7%, 43.5%) (P. C. A.) showed that the Permanent nasal carriage of *Staphylococcus aureus* and the center catheter infection has a major role in the occurrence of bacteremia in these patients, followed by an arterio venal bypass infection. This study allowed us to identify the hemodialyzed patients who carried *S. aureus* as a high risk group to bacteremia, which appear to begin from endogenous origin in the nasal mucosa. Thus its necessary to implement the individual and collective hygiene guidelines, and to extend the Mupirocin antibiotic prophylaxis in our hemodialysis unit, and to spread widely this in the important centers in the Syrian hospitals.

**Keywords:** Nasal Carriage, *Staphylococcus aureus*, Hemodialysis, Infection, Bacteremia

### INTRODUCTION

*Staphylococcus aureus* is one of the most common causes of both endemic and epidemic infections acquired in hospitals, which results in a substantial morbidity and mortality<sup>1</sup>.

Patients which are at the End-Stage of Renal Disease (ESRD) and submitted to Hemodialysis subject, have a high mortality rate compared with the general population<sup>2</sup>, whereas the complications of septic infection are the main reason for the pathogenesis of morbidity and the second reason of mortality after cardiovascular diseases (CVD) in these patients.<sup>3</sup>

The Nasal carriage of *S. aureus* plays an important role in the pathogenesis of these infections.<sup>4,5</sup> Approximately 30% of the normal population will have prolonged carriage of *S. aureus*, and 50% will be intermittent carriers, whereas 20% will never be colonized<sup>6</sup>.

The underlying mechanisms for these differences are presently unknown.

The adherence of *S. aureus* to nasal epithelial cells seems to be mediated, to a certain extent, by the lipoteichoic acid moiety in the cell wall.<sup>7</sup> The Increased rates of nasal carriage are founded among groups of patients in whom the skin often is punctured, eg, by needles or intravascular devices, especially in patients with insulin-dependent diabetes mellitus<sup>8,9</sup>, and in patients with

chronic hemodialysis<sup>8,10</sup>, and in patients with intravenous drug addicts<sup>8,11</sup>.

The Nasal carriage of *Staphylococcus aureus* has been associated with an increased risk of infections in patients after surgery<sup>12</sup>, and in patients on continuous ambulatory peritoneal dialysis<sup>13</sup>, and in patients on hemodialysis<sup>5,14</sup>. In the addition to their increased colonization by *Staphylococcus aureus*, patients on chronic hemodialysis are more prone to infections because of their suppressed immunity and the presence of a vascular access site<sup>14</sup>.

The used catheters and bypasses used in Hemodialysis represent the most important executor of infection sepsis<sup>15</sup> due to match *Staphylococcus aureus* isolated strains nasally and bloody<sup>16</sup>, It has been proven that the nasal carriage of *Staphylococcus aureus* raise the risk of blood sepsis in patients with renal failure<sup>17,18</sup>.

### MATERIALS AND METHODS

#### Methods

The study specimen included 110 patients undergoing to Hemodialysis at Lattakia Al-Assad University Hospital, between June 2010 till May 2011; patients were submitted to two dialysis sessions weekly for 3-4 hours.

#### Screening Methods

Three nasal swabs has been collected for all patients at the study, Sampling was performed by introducing a sterile swab at least 2cm into each nostril, followed by five successive rotations on the nostril wall.



**First swab**

At the first and second month of the study.

**Second one**

At the fifth and sixth month from the beginning of the study.

**Third one**

At the eleventh and twelfth month from the beginning of the study.

**Patient Features**

The study included 110 patients with varied ages between 16 and 85 years with a mean age of (50.77 ± 15) years, and a mean hemodialysis duration of (25.50 ± 21) months. The data related to the patient characteristics were collected, Table 1, included age, sex, duration of Hemodialysis period and the presence of the diabetes.

**Table 1:** Showing the patient characteristics covered to the study

Characteristics		Patient Numbers	Percentage
Age	≤ 65	8	7.37%
	> 65	102	92.7%
Sex	Male	60	54.5%
	Female	50	45.5%
<b>Total</b>		<b>110</b>	<b>100%</b>
Dialysis period	≤ 37	91	83%
	> 37	19	17%
Diabetes	Yes	50	45%
	No	60	55%
<b>Total</b>		<b>110</b>	<b>100%</b>

Patient files have been reviewed and the medical information about their registered infections have been collected.

**Bacterial Infections in the Patients Under Hemodialysis**

Infections are considered the main reason for the pathogenesis and the second reason of mortality in patients with hemodialysis<sup>1</sup>, where infections and death occur in patients at the End-Stage of Renal Disease (ESRD) by 12-20%, and most important of these infections, the most common:

1. Central Catheter-associate infection and arterial venous bypass
2. Urinary tract infection
3. Pneumonia
4. Respiratory infection
5. Septicemia

6. Skin, soft tissue and bone infection
7. Inflammation and bone marrow
8. Endocarditis

Thereof, the most important infection of our study caused by *Staphylococcus aureus* have been categorized and the results have been put inside the Table 2.

**Table 2:** Showing the registered infections of the patients subjected to the study

Infections		Patients Number	Percentage
Central Catheter-associate infection	Yes	43	39.1%
	No	67	60.9%
Venal Arterial Bypass Infection	Yes	16	14.5%
	No	94	85.5%
Septicemia	Yes	14	12.7%
	No	96	87.2%
Urinary tract infection	Yes	21	18.6%
	No	89	81.4%
Pneumonia	Yes	7	5.6%
	No	103	94.4%
<b>Total</b>		<b>110</b>	<b>100%</b>

**Microbiology**

Three hundred and thirty (330) nasal traces have been collected and were immediately implanted during less than one hour in a blood agar through spreading by using plastic plantation loops to be incubated at 37 C° in an aerial atmosphere for 24 - 48 hours.

*Staphylococci* sex has been distinguished by remarking their colonies, gram stain and catalase test.

The *Staphylococcus aureus* type has been determined by both tests: Coagulase and Manitol fermentation in a Chapman milieu.<sup>19</sup> All the analysis have been done in Lattakia Al-Assad University Hospital.

**Analytical Analysis**

Results have been ordered and some other statistical studies have been done as follows:

- Determination of the obtained results percentages according to every one of the factors according to the three traces results and to septicemia.
- Calculation of the correlation Coefficient (R) as per Spearman in order to know the correlation coefficient degree between the nasal carriage of *Staphylococcus aureus* and infections, and septicemia.
- A statistical study showing the relationship between infections in the results of three samplings (Spearman) and their classification as per the importance of their causing of sepsis in Hemodialysis patients according to the Principal Component Analysis (PCA), SPSS.11.



**RESULTS AND DISCUSSION**

**Investigation of *Staphylococcus aureus***

The percentages of the first, second and third sampling results have been studied, as per the Table 3, that the spreading rates of *Staphylococcus aureus* among the patients at the study have been remarked. We noticed too through the patient control, during 12 months (Study term), the transformation of many of them to the intermittent or permanent carriage situation, emphasized the role that patient pregnant *Staphylococcus aureus* plays as a repository for the transfer and diffusion in the Section and among the other ones. Consequently to the three sampling results, three kinds of nasal carriage have been distinguished as follows:

**Non carriers**

when all taken samples were negative.

**Intermittent carriers**

While they are at least one of the positive sampling or less than 66 % of all the positive nasal traces, i.e. 1 from 3.

**Permanent carriers**

When more than 66 % were positive (2 from 3) and their percentages were as shown in the following Table 3:

**Table 3:** showing the rates of the *Staphylococcus aureus* spreading among the patients at the study

Sampling Results	%	Carriage Type	%
First	38.7%	Permanent	43.5%
Second	40.3%	Intermittent	17.7%
Third	46.8%	Non-Carriers	38.7%

The permanent carriage rate of *Staphylococcus aureus* object of our study reached 43.5%, so we compared this ratio with a number of international studies in which the permanent carriage evaluation criteria are similar.

**Table 4:** The rates of the nasal permanent carriage of a certain number of studies

Study	Year	Permanent Carriage Rate %	Country
Boelaert	1995	58%	Belgium
Koziol-Montewka	2001	57.1%	Poland
Pena	2004	55%	Spain
Our study	2011	43.5%	Syria
Ternois	1993	31.4%	France
Muro	1991	30%	Belgium
Koziol-Montewka	2006	27.9%	Poland
Edoh	2003	21.4%	Ivory Coast
Souly	2011	18.52%	Morocco
Montagnac	1995	11.25%	France

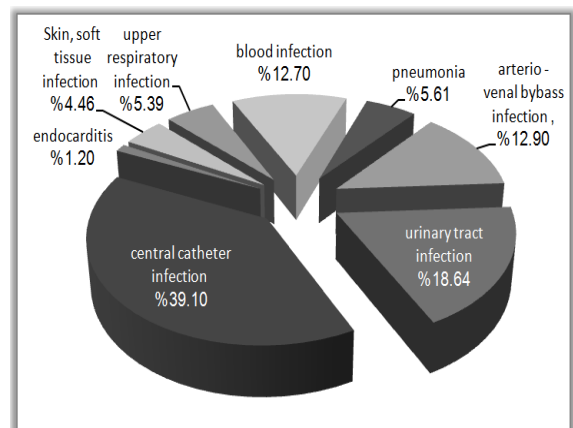
These studies were done on Hemodialysis patients and their registered carriage rates were more or less than those of our study. Results are represented in the Table 4.

From the above table we could establish specifically from the Polish study for the searcher: Koziol-Montewka and al., a difference in the nasal permanent carriage rate before the therapy in 2001 and after it in 2006 when this study has been processed on the same patient group. This fact confirms the importance of therapy for the nasal permanent carriage *Staphylococcus aureus* of Hemodialysis patients.

**Investigation of Infection**

The most frequent infection classification of the Hemodialysis patients participated in the study has been done, and from which we could notice that the highest rate is the central catheter infection (39.10%) in comparison with the other infections (Figure 1).

The blood infection rate (12.7%) formed a great importance too in the study that might be taken into consideration, while the other infection rates were dissimilar and the lowest one (1.2%) was that of the endocarditis.



**Figure 1:** Infection classification of the Hemodialysis patients participated in the study

Consequently, it's necessary to seriously deal with such cases by knowing their reasons and treat them to avoid the patient life from the infection which causes the contamination in the hospital.

By comparing our results with the results of the researcher Von Eiff study 2001, of which, he recognized the possible infections for the *Staphylococcus aureus* Bacteraemia, as follows:

1. Catheter related infection 46%
2. Skin, Soft tissue and bone infection 27%
3. Urinary tract infection 10%
4. Pneumonia 11%
5. Endocaditis 5%
6. Other 1%

### The Central Catheterization Infection

The central catheterization infection forms one of the vascular inlets leading to the infection in Hemodialysis patients.

It is clear through this study, that it is an infection caused by *Staphylococcus aureus* and it is the most infections that happened for our study patients; this rate reached (39.1%) (Figure 1); considering that *Staphylococcus*

*aureus* nasal carriage is an additional danger factor to the injury with this infection, the highest rate of the injury with the central catheter-associate infection in our study for the permanent carriers of *Staphylococcus aureus* and with a rate of (69.8%), while the rates converged in both intermittent carriers and the non-carriers, i.e. successively: 16.3% and 14%, Table 6. Concerning the hemo-infection it was accompanied to 78.6% of patients injured with central Catheter-associate infection.

**Table 5:** Showing the central catheter-associate infection (%) and the nasal carriage and the hemo-infection as per the central catheterization one.

Central catheter-associate infection	Rate without the Staff		Injured with Hemo-infection patient number = 14	Percentage of the Hemo-infection injured
	Patient number	Percentage		
None	67	60.9 %	11	78.6 %
Present	43	39.1 %		
<b>Total</b>	<b>110</b>	<b>100 %</b>		

**Table 7:** Clarify the hemo-infection in dialysis patients comparatively with *Staphylococcus aureus* nasal carriers.

	Patients with hemo-infection + Permanent nasal Carriage	Patients with Hemo-infection number + Intermittent Nasal Carriage	Patients with Hemo-infection non carriers + negative carriage
the total number of patients with Hemo-infection 14	12	1	1
Percentage	85.7 %	7.1 %	7.1 %

**Table 8:** Clarifying the results of the correlation study results as per Spearman

Infections	Results of the three samplings	Septicemia
	P Value	P Value
Central Catheterization Infection	0.001***	0.001***
Arterio-Venal Bypass Infections	0.007**	0.001***
Pneumonia	(NS)	0.001***
Urinary tract infection	(NS)	(NS)
Nasal Carriage of <i>Staphylococcus aureus</i>	-	0.001***

Note: Spearman test NS, Not significant.

\*  $\alpha = 0.05$ , \*\*  $\alpha = 0.01$ , \*\*\*  $\alpha = 0.001$

From the Table 8, we established a clear relation between the central catheterization infection and the three sampling results (i.e. with *Staphylococcus aureus* nasal carriage) and the hemo-infection, so that these results are conform with the researcher study Von Eiff, 2001 in the summary of which, he registered that the most common infection of endogenous *Staphylococcus aureus* Bacteraemia (SAB) is the catheters one used in different therapy that the most important are the Central one that leads in its turn to SAB and that the rate was 46 %.<sup>1</sup>

### The *Staphylococcus Aureus* Nasal Carriage Vs *Staphylococcus aureus* Bacteraemia (SAB)

This factor represents the goal of our study, where he was investigating for sepsis in patients, so as the recognizing of a certain number of *Staphylococcus aureus* nasal carriage conform with the hemo-infection after every sampling.

Having compared the three sampling results, results were

as in Table 7.

Patient number injured by the hemo-infection being 14 ones; the permanent nasal carriers of *Staphylococcus aureus* was 85.7 % of the hemo-infection ones, a result very important to our study, while the rate reached 7.1 % for the intermittent carriers and the negative ones.

It may be mentioned that the hemo-infection in the patient study is caused by *Staphylococcus aureus*.

*Staphylococcus aureus* nasal carriage has a moral linking relation with sepsis (Table 8).

Our study results are conform with the researcher Von Eiff, (2001) study ones in the summary of which, he confirmed that a great rate of *Staphylococcus aureus* Bacteraemia in the Dialysis patients begins from endogenous *Staphylococcus aureus*. i.e. Internally carried, consequently, *Staphylococcus aureus* nasal carriers are mostly exposed to endogenous Bacteraemia.<sup>1</sup>



## Statistical Study

### Study of the Correlation Spearman of the three Sampling Results with Infections

Relationship between infections and results of the three samplings were studied statistically as per Spearman test. Correlation coefficient Spearman had been studied among all the variables in view to statistically evaluate the presence or absence of an indicative correlation among these variables and evaluate its energy, if any. Results are shown in the Table 8:

From the previous table we notice that:

1. Each of *Staphylococcus aureus* nasal carriage and the central catheterization, arterio-venal bypass infections has a moral relation and a statistically moral indication with septicemia.
2. *Staphylococcus aureus* nasal carriage correlated by a moral relation and a statistically indication with the central catheterization infection.
3. Pneumonia nor urinary tract infection have no relation with a statistical indication with *Staphylococcus aureus* nasal carriage or septicemia.

### Study of the Principal Component Analysis (P.C.A.) of a certain number of Factors

Factors were divided as per their importance into three groups, Results were as follows:

#### First Group

consecrated to the variable *Staphylococcus aureus* nasal carriers followed by the central catheterization infection.

#### Second Group

the variable arterio venal bypass infection.

#### Third Group

consecrated to the variable of Pneumonia and Urinary tract infection.

i.e. each of the Permanent *Staphylococcus aureus* nasal carriers and the central catheterization infection formed the most danger factor of the injury by septicemia in our study, followed by variable arterio venal bypass infection, the last factor was Pneumonia.

## CONCLUSION

1. This study allowed screening hemodialyzed patients for risk of *S. aureus* infections, so as to implement individual and collective hygiene guidelines, as well as clinical and bacteriological surveillance of long-term nasal carriage in our hemodialysis unit.
2. The current study was performed to determine the efficacy of elimination of nasal carriage of *Staphylococcus aureus*, the nose considered as an important store for *Staphylococcus aureus*, we recommend the necessity to find strategies aiming to limit and prevent its infections through the

examinations and the quick getting rid of this organism nasal colonies by applying antibiotics. An antibiotic called rifampin has been the most consistently effective medication, although the emergence of strains of staph aureus that are resistant to rifampin is a potential problem. It is necessary to research other medications which can be applied topically or taken orally. Promising antibiotics include topical mupirocin, the oral quinolones and clindamycin.

3. The need to mainstreaming these recommendations not only on the artificial kidney service patients but also on the other service in the University Hospital Al-assad, together with the possibility to generalize this step on all the other hospitals in Syria, that would be bring economical and social benefits for the patients, the that hospital and the society.

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