Research Article

Determining the Distribution rate of Staphylococcus Aureus in Hemodialysis Patients in Al-Assad Hospital

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ABSTRACT

Our study aimed to investigate about the nasal carriage of *Staphylococcus aureus* and its prevalence between hemodialysis patients and medical staff and its role as a risk factor in the occurrence of bacteremia in hemodialysis department in Al-assad Hospital. This study included 124 participants, with mean age of (50.77 ± 15) years, containing 60 male and 64 female, hundred and ten of them were patients and fourteen of them were members of the medical staff, all patients had undergone 3-4 hours hemodialysis secessions twice weekly, with mean hemodialysis duration of (25.50 ± 21) months, the study was established from June 2010 till May 2011, and three nasal screen per participant where gathered. The rate of three screen was respectively (38.7%, 40.3%, 46.8%), the Permanent carriage recorded the highest ratio compared to the negative and intermittent witch rate were respectively (17.7%, 38.7%, 43.5%), (P.C.A.) showed that the Permanent nasal carriage of *Staphylococcus aureus* and center catheter infection has a major role in the occurrence of bacteremia in these patients. This study allowed us to identify hemodialyzed patients who carry *S.aureus* as a high risk group to bacteremia, which appears to begin from endogenous origin in the nasal mucosa. Thus it's necessary to implement individual and collective hygiene guidelines, and expand the treatment and preventing in hemodialysis unit and wide spread this to the important centers in Syrian hospitals.

Keywords: Nasal carriage, *Staphylococcus aureus*, Hemodialysis, Bacteremia.

INTRODUCTION

Patients suffering of End-Stage Renal Disease (ESRD) and submitted to Hemodialysis subject, those with a high mortality rate compared with the general population[1], whereas the complications of septic infection is the main reason for the pathogenesis of morbidity and the second reason of mortality after cardiovascular diseases (CVD) in these patients.[2]

Up to date, the *Staphylococcus aureus* are considered as the most causing of such infections being one of the important and principal morbid factors that cause the blood infections.[3]

Many studies indicated the mortality rate linked with blood infection caused by the *Staphylococcus aureus Bacteraemia (SAB)* that reached 17-25 %[4], while the relapse one is 18%.[5]

The nasal invasion of *Staphylococcus aureus,* which named the main internal origin repository, played the key role in such infectious[6], due to the presence of genetically specific affinity among the nasal mucous cells and some microbes such as *Staphylococcus aureus*.[7]

The used catheters and bypasses used in Hemodialysis represent the most important executor of infection sepsis[8], due to demonstrate match *Staphylococcus aureus* isolated strains nasally and bloody[9].

It has been proven that the nasal carriage of *Staphylococcus aureus* raise the risk of blood sepsis in patients with renal failure.[10]

MARERIALS AND METHODS

Methods

The study specimen included 124 participant distributed into two groups:

1. Patients undergoing to Hemodialysis (110 patients).
2. Medical staff working in the artificial kidney service at Lattakia Al-assad University Hospital (i.e. 14 members), during June 2010 till May 2011; patient were submitted to two dialysis sessions weekly for 3-4 hours.

Screening Methods

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

- First swab: The first and second months of the study.
- Second one: the fifth and sixth month of the start of the study.
- Third one: the eleventh and twelfth month of the study beginning.

Patient Features

The study included 124 participants ages varied among 16 and 85 years with an age mean (50.77 ± 15) years, and mean hemodialysis duration of 25.50 ± 21 months. 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		Patients Number	Percentage
Age	≤ 65	22	18%
	> 65	102	82%
Sex	Male	60	48.4%
	Female	64	51.6%
Total		**124**	**100%**
dialysis period	≤ 37	91	83%
	> 37	19	17%
Diabetes	Yes	50	45%
	No	60	55%
Total		**110**	**100%**

Patient filers have been reviewed and the medical information about their registered infections have been collected. Thereof, the most important infections of our study, and that cause 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 subject 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%
Total		**110**	**100%**

Three thousand seventy two (372) nasal traces have been collected and were immediately implanted during less than one hour in a blood agar through spreading first then by using plastic plantation loops to be incubated at 37 °C in an aerial atmosphere for 24 to 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.[12] All 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 follow:

- 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 among the studied factors with the nasal carriage of *Staphylococcus aureus* and septicemia.
- The Principal Component Analysis (P.C.A.) has been done to be sure of the danger factor effect and their reaction each with others through showing the participation degree in the interpreted difference among them by using SPSS[11] program.

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 participant 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 Section and among the other ones.

The medical staff worker department has also in turn form a reservoir and always a source for the dissemination of Staphylococcus aureus among patients result of direct contact with them.

Consequently to the three sampling results, three kinds of nasal carriage have been distinguished as follows:

1. Non carriers: when all taken samples were negative.
2. 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.
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 participants 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 % were compared this ratio with a number of international studies in which the permanent carriage evaluation criteria are similar.

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 following Table (4).

Table 4: 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
Soudy	2011	18.52%	Morocco
Montagnac	1995	11.25%	France

From the above table we could establish and specifically in the Polish study of the searcher: Koziol-Montewka and al., a difference in the nasal permanent nasal rate before the patient therapy in 2001 and after it in 2006 when this study has been processed on the same patient group.

This fact confirms the important therapy of the nasal permanent carriage *Staphylococcus aureus* of Hemodialysis patients.

Through the result questionnaire, the most frequent infection classification of Hemodialysis patients participant at the study has been done and from which we could notice that the highest rate is that of the central catheter infection (39.10%) in comparison with the other infections.

The blood infection rate (12.7%) formed to a great importance 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.

Consequently, it's necessary to seriously deal with such cases in view to know their reasons and treat them avoiding them to be a danger for the patient life or one of the infection causes contaminated in the hospital.

Risk Factors for Sepsis Injury

Some auxiliary and most common factors of the injury by sepsis have been determined in the kidney deficiency patients. The result agree with the danger criteria fixed in the universal studies[11,13,14] the most important being:

1. sex
2. age
3. Both central kinds and arterio-venal bypass catheters used in the blood vessels entries.
4. Diabetes
5. Dialysis period
6. *Staphylococcus aureus* nasal carriage

These factors studied in terms of:

- Distribution of the three sampling results and sepsis as per the danger factors.
- A statistical study showing the relation of these factors with those of the 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).

Study of the three samplings results and sepsis according to danger factors:

Sex

Results of the three samplings have been divided as per the sex, due to its important role sepsis injury possibility and some studies confirmed the increased danger possibility in males in comparison with females, while other studies confirmed the absence of difference between both sexes, to find out the nature of the relationship between gender (male and female) as a constant with the results of the three samplings and septicemia.

Through the study it's established the approach of *Staphylococcus aureus* nasal carriage rate in males, i.e. (46.7%) with that in females (40.6%).The distribution of septicemia according to sex, it was noted that the proportion of infected males sepsis has reached (11.7%) either when they are (14%) in females Table (5).

Table 5: showing the nasal carriage distribution and sepsis as per the sex

Sex	*Total Number*	*Nasal carrier No.*	*Nasal Carriage rate*	sepsis *number*	sepsis *injured Rate*
Male	60	28	46.7%	7	11.7%
Female	64	26	40.6%	7	14%

In our present study the sex has no statistical relation with the three sampling results as shown in the Table (8) (i.e.: with the nasal carriage of *Staphylococcus aureus*) and sepsis. This may be imputed to a random sample of the study, where these results were conform with those of the researcher universal studies ones[9,15], and weren't conform with the researcher study results (Souly, 2011) that took place on 54 dialysis patients and where *Staphylococcus aureus* re carriage in females rate was greater than that of males and the injury by sepsis was accompanied in females[11].

Age

Results of the three samplings have been divided as per the age, due to its important role in sepsis injury possibility, specifically for the advanced age.

Through the study of the relation nature between the age as a constant factor with the three samplings results and sepsis, it was established that the highest rate of the age permanent carriage (65-66) reached 29.6% while there were no great difference between the nasal carriage rate among the other age categories. The hemo-infections

cases were accompanied too in the same age category, i.e. 56- 65 and were nearly the same for the other age categories.

Consequently, in our study the advanced age has no statistical indices with the three sampling ones (i.e. *Staphylococcus aureus* nasal carriage and sepsis), when our study result were conform with the researcher study results (Souly, 2011) who confirmed that there is no relation between *Staphylococcus aureus* nasal carriage and sepsis, where the category age 56-65 registered the highest rate between the nasal carriage and the hemo-infection.

This may be imputed to the relatively low mean ages of the participant at our study (50.77 ± 15) and similarly to the morocco study where mean age is (44.16 ± 14) years.

While our study results weren't conform with the researcher study ones (Saxena, 2004) that took place on 205 patients injured with Hemodialysis in Saudi Arabia where the mean age of the patients participating to the study was relatively high and reached (73.44 ± 17) years, and the age category 75-84 years registered the highest rate in both cases. Briefly, this study showed that the advanced age plays an important role in *Staphylococcus aureus* nasal carriage and consequently the hemo-infection for these patients[11].

Central Catheter-Associate Infection

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

It was shown through this study that it's an infection causing by *Staphylococcus aureus* and it's the most infection that happened for our study patients; this rate reached 39.1 % if the patients, Table (6); 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%. Concerning the hemo-infection it was accompanied to 78.6% of patients injured with central Catheter-associate infection.

Table 6: 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 %		
Present	43	39.1 %		
Total	110	100 %	11	78.6 %

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 %

From the Table (7), 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 %[22].

Diabetes

We studied the diabetes as an additional factor taking part at the infection injury probability in kidney deficiency patients submitted to dialysis, so, the three sampling results and the hemo-infection were divided as per the diabetes. The SA permanent carriage was accompanied for 60 % of these diabetics, the highest rate if compared with the intermittent carries and the non carriers; it was established too that 85.7 % of the hemo-infection patients were diabetic.

The diabetes registered in our study a statistically acceptable relation with the results of the three samplings and the hemo-infection. This may be imputed to the deficiency of immunity that accompanies the diabetics, Table (8).

Dialysis period

The dialysis period plays a role in the hemo-infection injury. Many studies have confirmed that as long is the dialysis period as the possibility of injury by the hemo-infection increases due to the repeated use of catheters. At its turn, *Staphylococcus aureus* nasal carriage helps to the occurrence of such injury. Therefore, we acted to divide the dialysis periods as per months. By the above previous steps, we studied the distribution of the three sampling results as per the dialysis nasal carriage

registered the highest rate for the category that spent the left temporal period in the dialysis (i.,e. less than 13 months) and reached 40.8 % while the hemo-infection registered the highest rate for the category treated for more than 37 months and was 50 %.

Consequently to the statistical relation, Table (8), we found that the dialysis period has a statistically acceptable relation with only the hemo-infection, taking into account in months the mean dialysis period (25.50 ± 21).

Our study results were compatible with Souly search one although the dialysis mean period in his study was (118.77 ± 67).

This fact confirms the presence of a moral relation between the dialysis period and the hemo-infection disregarding the mean dialysis period and the important role of the dialysis in the possibility of injury with the hemo-infection.[11,23]

Staphylococcus aureus nasal carriage

This factor represents the goal of our study, where he was investigating for sepsis in patients participants, 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.[22]

Statistical Study

Study of the Correlation Spearman of the Three Sampling Results with Risk Factors

Every risk factors relation with the 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).

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

Danger Factors	Results of the three samplings	septicemia
	P Value	*P Value*
Sex	(NS)	(NS)
Age	(NS)	(NS)
Central Catheterization Infection	0.001***	0.001***
Diabetes	0.007**	0.001***
Dialysis Period	(NS)	0.001***
Nasal Carriage of *Staphylococcus aureus*	-	0.001***

Note: Spearman test NS, Not significant.

** α = 0.05, * * α= 0.01, *** α= 0.001*

From the previous table we notice that:

- Each of *Staphylococcus aureus* nasal carriage and the central catheterization, arterio-venal bypass infections, diabetes and the dialysis period has a moral relation and a statistically moral indication with septicemia.
- Staphylococcus aureus nasal carriage correlated by a moral relation and a statistically indication with the central catheterization infection and the diabetes.
- Age nor sex 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 Risk Factors

Risk 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 age and diabetics

- ***Third Group***

consecrated to the variable of dialysis period and the arterio venal bypass 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 both factors, Age and diabetes the last factor was the dialysis period and the arterio venal bypass infection.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The nose constituted an important store for *Staphylococcus aureus*; therefore, these carrier microbe patients may have a role in its transmission and spreading inside the service and among the other patients. The medical staff working at the service has too an important role in spreading *Staphylococcus aureus* among the patients due to their direct contact with them. That was established by noticing the conversion of many patients, during the study period, into the intermittent/permanent carriage so that the highest rate of the permanent carriage *Staphylococcus aureus* reached 43.5% comparatively with the intermittent/negative ones.
2. Nor age or sex and the dialysis period have in our study a statically indicative relation with the nasal carriage of *Staphylococcus aureus*, while there was a relation between the nasal carriage and the central catheterization infection.
3. The nasal carriage of *Staphylococcus aureus* played a fundamental role among the danger factors of the injury by the septicemia and registered a moral correlation with this infection where sepsis of the permanent carriers of *Staphylococcus aureus* was clearly and importantly accompanied inside the rate of 85.7 % of the patients.
4. The nasal carriage of *Staphylococcus aureus* rate was evaluated as highest in diabetics patients submitted to the dialysis comparatively with the other patients, where *Staphylococcus aureus* nasal carriage correlated statistically with a moral relation in the presence of the diabetes disease, consequently the diabetics were much more exposed to sepsis they caused. Thereof, the preventive therapy by the antibiotics may decrease among them the mortality caused by the infection.
5. in our study, the permanent nasal of *Staphylococcus aureus* and the central catheterization infections constituted the most dangerous factor to the injury with septicemia, through the result of analysis P.C.A. Thereof, it's necessary to treat the nasal carriage problem through diagnosis and the quick getting rid of these colonies organism in view to avoid the infection complications caused by it such as septicemia.

Recommendations

Our study recommendations were abstracted on the importance of finding new means to deal with the hospital epidemic problem with *Staphylococcus aureus* and on the insistence on the preventive method importance through the following:

1. The follow up of the study by other researchers or by the hospital itself so that it would include all the other hospital services as: the intensive care, surgery that represent at their turn a store of the hospitably acquired infections by *Staphylococcus aureus* and apply the long term clinic control of the nasal carriage patients in the various services in view to reach an effective, automatic and prophylactic strategy to limit it, strategy that in its turn would bring economical and social benefits for the patients, the hospital and the society.
2. Perform genotyping to demonstrate match *Staphylococcus aureus* strains isolated nasally and bloody, and To make sure that the septicemia in patients with dialysis starts from Staphylococcus aureus nasally carried, and to achieve this step with allergy test against the wrong therapeutic antibiotics MRSA and MSSA, in view to avoid creation of new microbe lineages all these steps included inside the support program of therapy and prevention.
3. The nose considered as an important store for *Staphylococcus aureus*, being a principal transmission way, 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 of the artificial kidney service patients and the other service in the University Hospital Al-assad, together with the possibility to generalize this step on all the other hospitals in Syria.

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