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Concordance Between the Germs of Hospital Surfaces and those Isolated Nosocomial Infections in Parturient in Public Hospitals in Lubumbashi

Mbutshu Lukuke Hendrick[1], Ntambue Mukengeshayi Abel[1], Makoutode Michel[2], Malonga Kaj Françoise[1]

[1]*School of Public Health, University of Lubumbashi, Democratic Republic of Congo.*

[2]*Regional Institute of Public Health, Republic of Benin.*

***Correspondence:**
Hendrick Mbutshu Lukuke, School of public health, University of Lubumbashi RD Congo, Tel: + 243 997 028 680.

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ABSTRACT

Introduction: *The objective of the study was to compare the germs found on hospital surfaces and those found in biological fluids of parturients hospitalized in public hospitals in Lubumbashi.*

Methods: *Data collection was performed on the surfaces by swabbing, by using ISO / DIS 14698-1. Similarly, samples of biological fluids were taken and all were analyzed in the laboratory of the university clinics in Lubumbashi to investigate the susceptibility and antibiotype. Kappa coefficient was used to study the correlation between the identified germs on hospital surfaces and those found in biological fluids of parturient at $p \leq 0.05$ significance.*

Results: *The antibiotype showed that the isolated germs on surfaces are the same strains as those isolated in pus, blood and urine of pregnant women. However, we noted a significant correlation of 0.02 between the surfaces germs and bacteria isolated in liquid surgical site.*

The probability of a woman in labor hospitalized in a public obstetric setting in Lubumbashi of contracting a nosocomial infection (NI) in a surface containing the same germs as that in question for this infection was 14.3% for Citrobacter freundi, 58.6%. for Escherichia coli, 19.2% for Klebsiella spp, 28.6% and this concordance was nevertheless negligible (0.10).

We noticed that as long as hospital hygiene conditions improved, that is, with a high score, the risk of nosocomial infections decreased.

Conclusion: The hospital environment contributes to the occurrence of (NI) in these public hospitals, however, note that there are several factors that influence the occurrence of these infections.

Keywords

Hospital surfaces, Concordance, Germs, Nosocomial infection.

Introduction

Nosocomial infection can be caused by the patient's germs, caregivers or the hospital environment. These infections increase morbidity, mortality, and the cost of hospital care and have a major impact on public health [1]. However, the application of simple hygiene measures such as hand hygiene through the awareness and participation of all can solve this problem [2].

The most affected services are intensive care units, in part because the rate of medical devices used in patients with severe conditions is higher than in the rest of the hospital. The use of these medical devices is frequently associated with the development of nosocomial infections, especially the use of invasive procedures [3,4].

Most of these infections are caused by bacteria that have patterns of antibiotic resistance and often complicate their care [5].

The purpose of this work was to determine the concordance between the germs of the environmental surfaces and the germs of nosocomial infections isolated among parturients in maternity wards of public hospitals in Lubumbashi.

Materials and Method

We conducted an ecological descriptive study; we were interested in the proportion of nosocomial urinary tract infections and operative sites in any woman who came for delivery and who did not have a urinary tract infection at admission. These germs were compared to the germs found on hospital surfaces of these hospitals.

The investigation covered the period from 1 October 2014 to 1 January 2015, a period of three months in each structure. Data collection was performed comprehensively in all women on admission until discharge. The parturients had left the study at the exit of the hospital. Was included in our study, any woman who came to this maternity due to childbirth and to whom we conducted the first analysis of urine before 12 hours of hospital stays. Those with urinary tract infection at admission were excluded directly from this group.

The samples of biological fluids were collected and analyzed in the laboratories of Lubumbashi University Clinics (CUL) to identify the germs involved and then study the antibiogram and the antibiotype.

For the surgical wound removal, we did it by rotating 360° and covering a surface of 1 cm^2. We used sterile swabs that we had wetted in sterile isotonic fluid. These swabs were passed over areas defined in close parallel streaks by rotating them slightly, then on the same areas in perpendicular streaks. These swabs were stored in their protective cases which carried all the identifications at the end and were sent to the laboratory within 15 minutes.

To study the hospital environment, we have encoded the information by giving the value one (1) for designer yes or good and zero (0) for designer no or bad, when it is a question whose answer was two possibilities yes or no and bad or good. The summation of all these ratings on the hygiene conditions in each structure gave a score and structures that had a high score were considered as structures with good hospital hygiene conditions. We conducted an ecological descriptive study; we were interested in the proportion of nosocomial urinary tract infections and operative sites in any woman who came for delivery and who did not have a urinary tract infection at admission. These germs were compared to the germs found on hospital surfaces of these hospitals. From these scores, we sought a concordance between the level of environmental hygiene and the incidence of nosocomial infections.

The Kappa coefficient was used to study the correlation between germs identified on hospital surfaces and those found in the biological fluids of operative wounds in caesareans and episiotomies at the significance level $p \leq 0.05$. This comparison concerned not only the germs that were found both on the hospital surfaces and in the biological fluids of the operating sites of the parturients, but also the conditions of hospital hygiene and the occurrence of nosocomial infections.

The swabs were seeded on bromocresol purple lactose agar, Chapman medium, blood agar and chocolate agar, and incubated at 37°C for 24-48 hours. Colony abundance was noted and gram-negative bacilli colonies were subcultured on API 20E or API 20 NE labeling, whereas Positive Gram colonies were identified according to their catalase reaction, and agglutination on plate. Each sample was repeated and identified 3 times [6-8].

For the urine collection, the parturients made it themselves after a session of health education. Two samples were taken, one at the entrance and another at the exit for parturientes who had a short stay. The data was analyzed using the STATA 13 software and we used the usual statistics to describe the population and calculate the frequency measurements. Antibiotype analyzes were performed to compare strains of germs from environmental surfaces and those found in body fluids. The statistical correlation test was performed to study the concordance between the germs of surfaces and biological fluids.

To study the hospital environment, we have encoded the information by giving the value one (1) to designate yes or good and zero (0) to designate no or bad, when it is a question whose answer was two possibilities yes or no and bad or good.

The summation of all these ratings on the hygiene conditions in each structure gave a score and structures that had a high score were considered as structures with good hospital hygiene conditions. From these scores, we sought a concordance between the level of environmental hygiene and the incidence of nosocomial infections. The Kappa coefficient was used to study the correlation between germs identified on hospital surfaces and those found in the biological fluids of surgical wounds in caesarean sections and episiotomies at the significance level $p \leq 0.05$.

This comparison concerned not only the germs that were found both on the hospital surfaces and in the biological fluids of the surgical sites of the parturients, but also the conditions of hospital hygiene and the occurrence of nosocomial infections.

Results

Parturient profile

A total of 1240 women in labor were selected in this study. They were distributed in seven maternity wards of the public hospitals of the city of Lubumbashi, including: Lubumbashi University Clinics (20.3%), General Reference Hospital (HGR) of Kenya (19.6%), Kisanga General Referral Hospital (18.6%), 3%), Katuba Reference General Hospital (15.8%), Sendwe Reference General Hospital (12.4%), Lubumbashi National Railway Company Hospital (SNCC) (7.1%) and General Reference Hospital

Kampemba (6.5%).

Women in labor who were under 20 years of age were 11.5%, 71.5% were between the ages of 20 and 34, and 16.9% were older than or equal to 35 years and age average women in labor was 27.6 ± 6.5 years. Among women in labor, 39.4% had an individual history, including diabetes, immunodeficiency, and malaria.

Several women were married (90.7%). Compared to the level of study, 11.4% had a high level (university level), 50% an average level (secondary level) and 38.6% a low level (primary level). Women in labor who were mainly engaged in household work were in the majority (59.7%), 34.3% were involved in the liberal activities and the rest were in the public service and private enterprises.

As a place of accommodation for women in labor, 97.1% of women were hospitalized in a common ward room. The median parity was three children per woman (min and max = 0-12). The median gestational age was 38.5 weeks of amenorrhea (min and max = 39-44).

In the area dominated by *Pseudomonas Aeruginosa*, it was isolated in 6.8%. With regard to the surface containing *Enterococcus faecalus*, we found the same *Enterococcus faecalis* in 4.3%. And in the surface where we have more isolated *Staphylococcus aureus*, it is the same germ that in the majority *Escherichia coli* containing surface, *Escherichia coli* itself (21.8%) was the most isolated germ in operative wounds and urine.

In the area where the predominance of sprouts was *Klebsiella spp*, the same germ was isolated in has been identified in the urine and the biological fluids of operative wounds. The probability of a woman hospitalized in a public obstetric setting in Lubumbashi of contracting a nosocomial infection in a surface containing the same organism as that in question for this infection was 14.3% for Citrobacter freundi, 58.6% for *Escherichia coli.*, 19.2% for *Klebsiella spp.*, 28.6% for Pseudomonas aeruginosa and 15.5% for Enterococcus faecalus, and this concordance was negligible, however (0.10).

From figure 1, we noticed that as long as hospital hygiene conditions improved, ie. by having a high score, the risk of the onset of IN decreased. This risk was higher when the score was ≥ 5, it was 50% at the score of 4 and more than 25% at the score of 5.

It appears from table 2 that the germs isolated on the surfaces are of the same strains as those isolated in the pus, blood and urines of the parturients.

Hospital environment	Isolated germs in hospitalized parturients								Kappa	p
	Total	None	CF	EC	Ksp	PA	EF	SA		
All women	1240								0,022	<0,001
Citrobacter freundii (CF)	210	83,3	2,4	5,7	2,9	3,8	1,9	0,0		
Escherichia coli (EC)	78	60,3	3,9	21,8	2,6	9,0	0,0	2,6		
Klebsiella spp (Ksp)	251	81,3	1,2	10,0	3,6	3,2	0,8	0,0		
Pseudomonas aeruginosa (PA)	88	75,0	1,1	14,8	0,0	6,8	1,1	1,1		
Enterococcus faecalus (EF)	397	72,0	0,8	11,6	2,0	9,1	4,3	0,3		
Staphylococcus aureus (SA)	216	98,1	0,0	0,0	0,0	0,0	0,0	1,9		
Women with Nosocomial Infections	246								0,102	<0,001
Citrobacter freundii (CF)	35	‡	14,3	34,3	17,1	22,9	11,4	0,0		
Escherichia coli (EC)	29	‡	10,3	58,6	6,9	24,1	0,0	0,0		
Klebsiella spp (Ksp)	47	‡	6,4	53,2	19,2	17,0	4,3	0,0		
Pseudomonas aeruginosa (PA)	21	‡	4,8	61,9	0,0	28,6	4,8	0,0		
Enterococcus faecalis (EF)	110	‡	2,7	41,8	7,3	32,7	15,5	0,0		
Staphylococcus aureus (SA)	4	‡	0,0	0,0	0,0	0,0	0,0	100,0		

Table 1: Concordance between germs of environmental surfaces and isolated germs in parturients.
From this table, we have noted that there is a negligible agreement of 0.02 between the surface germs and the isolated germs in the operating site liquids.

		Germs	Gentamicin	Augmentin	Ciprofloxacin	Ceftaxim	Ampicillin	Norfloxacin	Clindamycin
Parturient	Pus	*Pseudomonas aeruginosa*	S	R	R	S	R	S	S
	Pus	*Klebeiella oxytoca*	S	R	R	S	R	S	S
	Urine	*Escherichia coli*	S	R	R	S	R	S	S
Surfaces	Incubators	*Pseudomonas aeruginosa*	S	R	R	S	R	S	S
	Dakin S.OP solutions	*Klebsiella oxytoca*	S	R	R	S	R	S	S
	Door knobs Delivery room	*Escherichia coli*	S	R	R	S	R	S	S

Table 2: The antibiotype study of germs isolated in the biological fluid compared to those of the hospital surface.

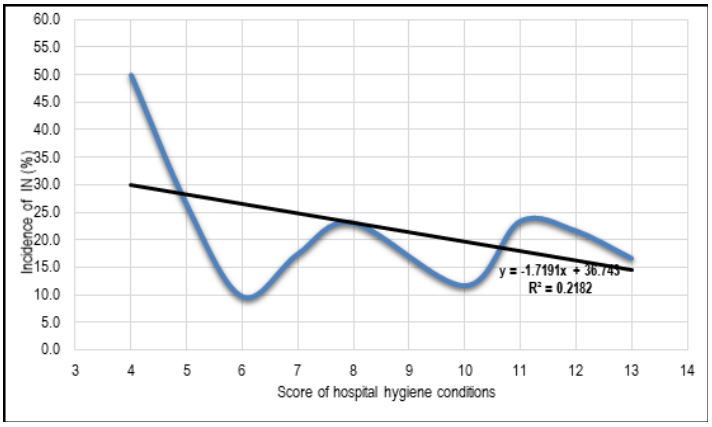

Figure 1: Correlation curve between the incidence of urinary Nosocomial Infections (NI) and Surgical Site Infections (SSI) and the score of hospital hygiene conditions.

Discussion

The most common infections are urinary tract infections in surveyed patients, surgical site infections after cesarean section, endometritis and episiotomy infections; [9,10] according to our findings that approved urinary tract infections (65.5%), operative sites (22%).

Another study found that lung infections were the most common (31.9%), followed by urinary tract infections (24.6%), followed by surgical site infections (11.6%) and bacteremia-septicemia (10.6%). 2%) [11]. While in our study, we did not take into account the pulmonary infections, from where we affirm that the frequency of nosocomial urinary infections is identical to that of our study.

The germs isolated in the urine and the operative sites were *Escherichia coli* 45.9%, followed by *Pseudomonas aeruginosa* (26.4%), *Klebsiella oxytoca* (10.2%), *Enterobacter cloacae* (5%), (3%), *Citrobacter freundii* (4.9%), *Enterococcus faecalis* (4.5%), *Staphylococcus aureus* (1.6%) and *Acinotobacter baumannii* (1.2%).

Malavaud S. et al found *Streptococcus pyogenes*, *Escherichia coli*, coagulase-negative *Staphylococcus*, *Staphyloccus aureus*, *Proteus mirabillis*, *Enterococcus faecalis*, *Enterobacter aerogenes* and *Klebsiella oxytoca* [23,24]. Another study found that isolated germs were Gram-negative bacilli at the head (86.58%) with the predominance of *Pseudomonas aeruginosa* (28.0%). Gram-positive *Cocci* accounted for 13.4%, *Staphylococci* accounted for 9.7% [5].

The nosocomial infection-related bacteria in the Njall and allied study were predominantly *Echerichia coli*, *Pseudomonas aeruginosa*, *Acinetobacter baumanii*, *Staphylococcus aureus* [12]. In Nigeria, germs such as *E. Coli* (28.0%) and *S. aureus* (19.0%) were the most isolated [13,14].

These results are similar to those found in our study since hospital hygiene conditions are similar in several African countries. In the study conducted in 2010 in two hospitals in Lubumbashi, the authors found five germs responsible for a nosocomial infection including *Escherichia coli* (11.9%), *Staphylococcus aureus* (6.8%), *Pseudomonas aeruginosa* (5.1%), *Shigella spp*. (5.1%) and *Salmonella typhi* (1.7%). These results show that the bacterial ecology of hospital surfaces in Lubumbashi has remained the same since 2010, as the results are the same as those of our study [15].

Antibiotic profile

Talking about the sensitivity-resistance profile of antibiotic-isolated bacteria. 83.95% of infected parturients received an antibiotic, amoxycillin, ampicillin and gentamicin, and ampicillin. None of the operative wounds were sensitive to ampicillin and amoxicillin, only *Staphylococcus aureus* was 100% sensitive to ciprofloxacin. Citrobacter freundiietle *Pseudomonas aeruginosa* were not susceptible to gentamicin however all the organisms were sensitive to Ceftaxime. As with the operating sites, the urine germs were not as sensitive to ampicillin and amoxicillin. *Escherichia coli* and *Pseudomonas aeruginosa* were not sensitive to ciprofloxacin

In the Ayoub study, ceftazidime, imipenem, ciprofloxacin and amikacin resistance rates were 34%, 37.1%, 27.1% and 29.6%, respectively [16-18]. While in the study of Fki and allies, amoxicillin was the most prescribed antibiotic in first intention (28.3%) and resistance was noted in 21.6% of all prescriptions [32] in contrast to our study which found a strong resistance to 100% of certain antibiotics, including amoxicillin and ampicillin [16]. This situation is explained not only by self-medication, but also by non-compliance with the policy of use of antibacterials, particularly antibiotics.

Our results are similar to those of Mchich in Morocco who found that Pseudomonas aeruginosa had a resistance of 88.8% to Cefotaxime, 84.2% to gentamycin and 43.7% to Ciprofloxacin; *Escherichia coli* 100% resistant to the combination of Amoxicillin-Clavulanic acid; Klebsiella spp had 45.4% resistance to gentamycin and 58.5% to the combination of Amoxicillin-Clavulanic acid, 23% to Ciprofloxacin and Staphylococcus aureus was 62.5% to gentamycin, 58.5% to the combination of Amoxicillin-Clavulanic acid and 23% to Ciprofloxacin [18].

Concordance between the hospital environment and the occurrence of nosocomial infections

The causative germs of nosocomial infections were the same strains found in the environment after the antibiotic analysis. Although we found a negligible 0.02 concordance between the surface germs and the isolated germs in the operating site fluids. Only in the surface mainly containing *Escherichia coli* where we isolated *Escherichia Coli* itself (21.8%) as the most isolated germ in operative wounds, followed by Pseudomonas aeruginosa and Citrobacter freundii respectively 9, 0% and 3.9%. And in the surface where we have more isolated *Staphylococcus aureus*, it is the same germ that has been identified in the biological fluids of operative wounds.

In other surfaces containing Citrobacter freundii, *Klebsiella spp*,

Pseudomonas aeruginosa and *Enterococcus faecalis*, *Escherichia coli* was the most isolated organism in body fluids, followed by *Pseudomonas aeruginosa*. Nevertheless, there are certain identified germs on the surfaces that have not been found in operative wounds, in particular *Candida albicans*, as well as some isolated germs in the surgical sites that have not been isolated on hospital surfaces, such as *Klebsiella oxytoca*.

Since *Candida albicans* is difficult to identify in our environment, it is likely that this is the reason why it was not isolated because the identification of strains is a stimulating work that may require the use of molecular techniques [19-20].

Several publications, in particular those of Boyce and Talon, have found multi-resistant antibiotic-resistant bacteria on the surfaces in soils, bedding and furniture close to the patient. These bacteria, commonly found in the environment, have been found in colonized or infected patients in urinary sites or in wounds caused by *enterococci*, *S. aureus* and *Clostridium difficile*. One study found that 80% of infectious diseases are transmitted by contact: to the naked eye, stainless steel or aluminum door handles and trolleys, commonly used in hospitals today, seem clean ... but they can harbor deadly pathogens. Among the micro organisms most frequently identified in the occurrence of nosocomial infections, mention may be made of methicillin-resistant *staphylococcus aureus* (MRSA), coliforms such as *Escherichia coli, Klebsiella pneumoniae*, and *Clostridium* [21-22].

The incidence of nosocomial infections was very high in our study, but as for the characteristics of the causative germs, they are almost identical for all studies in Africa [15].

This negligible concordance can be explained by the fact that it has not analyzed all the surfaces, whereas generally the hospitalized women in labor are in contact with several hospital surfaces. This is the reason why the women in labor found in the structures where the surfaces were known contaminated by any germ did not develop the infection of the same germ, because the other surfaces not analyzed will have other germs than those identified. In addition, several factors intervene in the occurrence of nosocomial infections. Nevertheless, the germs that were isolated both on the surfaces and on the biological fluids of the parturient victims of the IN were revealed of the same strain, it allows us to confirm that the germs of the hospital surfaces of the public hospitals of Lubumbashi are really the germs cause of these nosocomial urinary infections and operative sites.

Conclusion

Escherichia coli, *Pseudomonas aeruginosa*, *Citrobacter freudii*, *Enterococcus aureus*, *Acinebacter baumannii*, and *Staphylococcus aureus* were isolated from urines and body fluids at the sites of operation. The surface germs were the same as those found in the urine and the operative sites. The total involvement of the entire hospital community and allies in the respect of hospital hygiene measures, especially in personnel hygiene, hygiene of equipment, hygiene of the hospital environment and the best policy of use of antibacterials is essential for prevent the occurrence of these infections.

What is known about this subject?

- The scarcity of research on the microbial ecology of hospital surfaces and nosocomial infections in our environment in particular;
- The germs of nosocomial infections are mostly bacteria that often have patterns of antibiotic resistance;
- The hospital environmental conditions, medical practice and individual factors are causing the occurrence of these infections.

What does your study bring again?

- Knowledge of more germ-positive surfaces and their concordance of nosocomial infection germs in maternity wards of public hospitals in Lubumbashi;
- Identification of their susceptibility profile for antibiotics used in clinical practice in Lubumbashi.

Contributions of The Authors

- Lukuke Hendrick Mbutshu: study design, protocol writing, data collection, data analysis, document writing.
- Michel Makoutode: validation of the protocol and drafting of the document.
- Mukengeshayi Abel Ntambue: protocol validation, data analysis, document writing.
- Malonga Françoise Kaj: validation of the protocol and drafting of the document.

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