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Original Research Article

Nosocomial Infections in the Intensive Care Unit of Saint Louis Regional Hospital: Status Report and Prognostic Factors of Mortality

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Abstract: ***Introduction*:** Nosocomial infection or infection associated with care is a serious concern in intensive care units. It is a serious infection because of its frequency, incidence and additional cost. The objective of the study was to determine the epidemiological, clinical, therapeutic and evolutionary aspects of nosocomial infections in the intensive care unit of the regional hospital of Saint Louis. ***Materials and Methods*:** A one year retrospective, descriptive and analytical study of all cases of nosocomial infections found during the study period. We analyzed anamnestic, clinical, therapeutic, evolutionary and prognostic data. ***Results*:** 28 cases of nosocomial infections out of 243 hospitalized patients, an incidence of nosocomial infection of 11.5%. The mean age of the patients was 37.57 years with a standard deviation of 20.5 years. The reasons for admission were altered consciousness (28.5%), postoperative follow-up (21.4%), and acute respiratory failure (14.2%). Invasive procedures were represented by bladder catheterization (100%), central venous catheterization (64%), oro-tracheal intubation (39.2%), hemodynamic support (28.5%), extra-renal purification and parenteral nutritional support in respectively 10.7% and 7%. Pneumonia acquired under mechanical ventilation represented 28.5% of the infections identified, bacteremia 21%, urinary and neuro-meningeal infections 18% each and surgical site infections 14%. The germs identified were gram-negative bacilli (75%) (8 pseudomonas and 13 enterobacteria), gram-positive cocci in 25% of cases (5 staphylococci aureus Meti S and 2 staphylococci Meti R). The rate of microbial resistance was 35.7%. The average length of hospitalization was 16 days (Extreme = 60 -3 days). The mortality rate was 35%. ***Discussion/Conclusion*:** Nosocomial infections in the ICU are frequent and are associated with high morbidity and mortality. Effective preventive measures are the key to improve the prognosis.

Keywords: Nosocomial infection, bacterial resistance, prognostic factors.

INTRODUCTION

Nosocomial infection or infection associated with care is a serious concern in all hospitalization units and especially in intensive care. It is a serious infection because of its frequency, its potential impact on the prognosis of the initial condition and its additional cost. Nosocomial infection in intensive care is defined as an infection contracted in an intensive care unit, which was neither present nor incubating at admission. A period of at least 48 hours between the admission and the infectious state is retained. The surveillance of these infections is an essential prerequisite for the good management of patients in intensive care units.

We conducted this study, which had as objective to determine the epidemiological, clinical, therapeutic and evolutionary aspects of nosocomial infections in the intensive care unit of the regional hospital of Saint Louis.

MATERIALS AND METHODS

We conducted a one-year retrospective, descriptive and analytical study in the intensive care unit of the Saint Louis Regional hospital. The study focused on all cases of nosocomial infections found during the study period. We included all patients admitted to the department during the study period and whose hospital stay was at least 48 hours. We excluded

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all unusable records and infections occurring before 48 hours of hospitalization.

We analyzed the data from all hospitalization records involved in the study period. Anamnestic, clinical, therapeutic, evolutionary and prognostic data were collected on Microsoft Excel and analyzed with XLS STAT software. A correlation was significant as soon as the p value was lower than 0.05.

RESULTS

Out of a total of 243 patients hospitalized in the department during the study period, a total of 28 cases of nosocomial infections were identified, representing an 11.5% incidence of nosocomial infection. The average age of the patients was 37.57 years with a standard deviation of 20.5. Figure 1 is a box plot showing the distribution of age groups. The sex ratio was 1.15 men to 1 female. 28.5% of the patients with a nosocomial infection were admitted for management of consciousness disorders, 21.4% for postoperative management and 14.2% for management of acute respiratory failure. Figure 2 shows the distribution of our population according to the reasons for admission. The past history of our patients was represented by arterial hypertension in 14% of cases, diabetes in 7% of cases. Heart disease, asthma and psychiatric pathology were found in 1 patient each (4%). The quick sofa score on admission was positive in 6 patients (21.4%). During hospitalization, renal failure according to the KDIGO classification was observed in 7 patients, in 25% of cases. Invasive procedures were bladder catheterization in 100% of cases, central venous catheterization in 64% (n=18), oro-tracheal intubation in 39.2% of cases (n=11), hemodynamic support in 28.5% of cases (n=8), extra-renal purification and parenteral nutritional support in 10.7% (n=3) and 7% (n=2) respectively. The invasive procedures according to the number of patients are shown in figure 3.

All of our patients received basic hydroelectrolytic resuscitation (40 ml/kg of fluid intake). Enteral nutrition of 30kg/calorie/day was appropriate in 92% of cases (n=26) and parenteral nutrition was introduced in 7% of cases (n=2). Nosocomial pneumonia acquired under mechanical ventilation represented 28.5% of the infections identified (n=8), bacteremia 21% of the cases, urinary and neuro-meningeal infections 18% each and surgical site infections 14%. The germs identified were represented by gram-negative bacilli in 75% of cases (8 pseudomonas and 13 enterobacteria), gram-positive cocci in 25% of cases (5 Meti S staphylococci aureus and 2 Meti R staphylococci). In our study, the microbial resistance rate was 35.7% (n=10). The mechanism of microbial resistance was represented by extended spectrum beta-lactamase secretory germs (ESBL) secretors in 80% (n=8) of the cases, and methicillin resistance was incriminated in 20% (n=2). Probabilistic antibiotic therapy was readapted in 60% (n=17) and not adapted in 40% of cases (n=11). The reasons for non-adaptation were delays in obtaining laboratory results in 45% of cases and financial difficulties in purchasing broad spectrum antibiotics in 55% of cases. The average length of hospitalization was 16 days with a maximum of 60 days and a minimum of 3 days. The outcome was favorable in 64% of cases (n=18), while 10 patients had an unfavorable outcome leading to death. We had a mortality rate of 35%.

In correlational analysis, the mortality rate for patients with resistant germs was 60% (6 patients/10) and the mortality rate for infections with sensitive germs was 22% (4 patients/18). Microbial resistance and inadequate antibiotic therapy were the prognostic factors for mortality in our series ($p < 0.05$).

Table 1: Distribution of identified germs and their resistance/sensitivity profile

Family of Identified Germs	**Types of germs identified**	**Number (Percentage)**	**Mecanisme of Resistance**	**Resistance ratio**
Gram negative bacilli N=21 (75%)	Enterobacteria : Echerichia coli Klebsiella pneumonia Proteus mirabilis	N=13 (46,5%)	Extended spectrum betalactamase secretion	N=8 (28,5%)
	Pseudomonas aéruginosa	N=8 (28,5%)		
Gram positive cocci N=7 (25%)	Methicillin sensitive Staphylococcus aureus	N=5 (18%)	Methicillin-resistance	N=2 (7%)
	Methicillin resistant Staphylococcus aureus	N=2 (7%)		
Total		**N=28 (100%)**		**N=10 (35, 5%)**

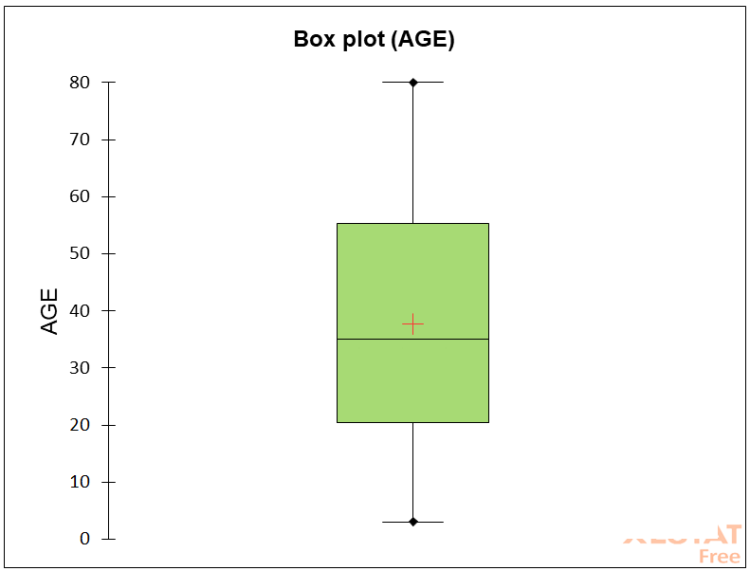
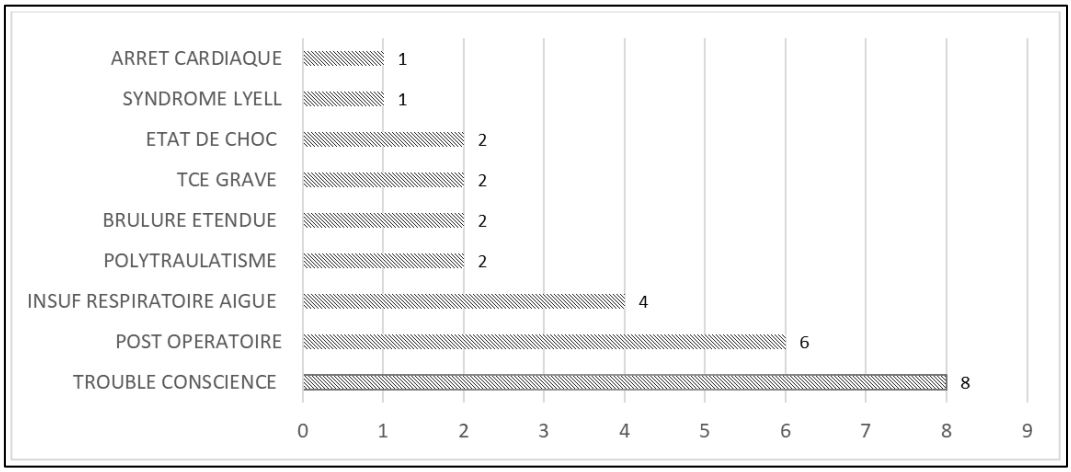
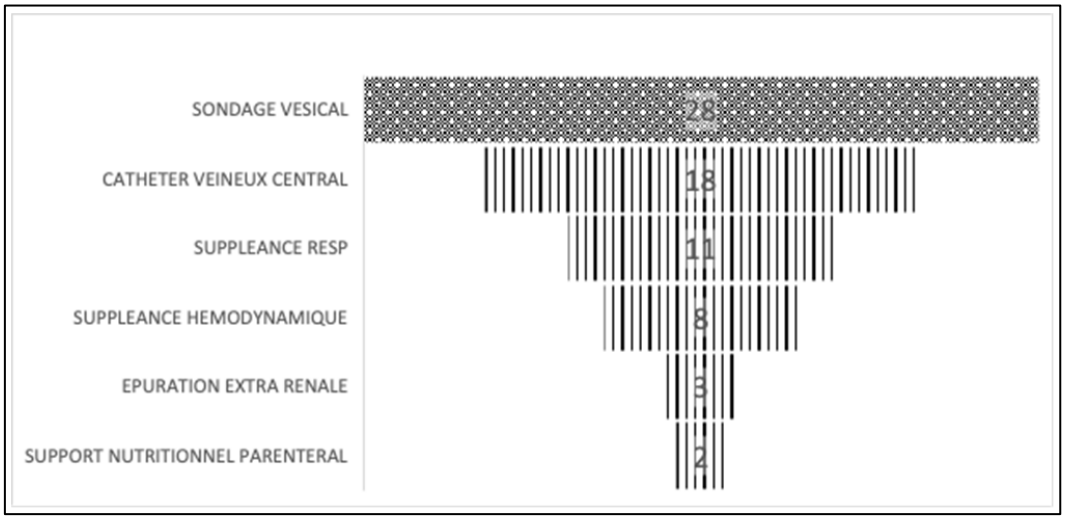


Figure 1: Distribution of age groups by size



Legend from top to bottom: Cardiac arrest -Lyell syndrome - Shock state -severe brain trauma-severe burns - polytrauma - acute respiratory failure - post operatory - altered consciousnness

Figure 2: Distribution of patients according to reason of admission



Legend from top to bottom: bladder catheterization - central venous catheterization - oro-tracheal intubation - hemodynamic support - extra-renal purification - parenteral nutritional support

Figure 3: Distribution of patients according to invasive procedures performed

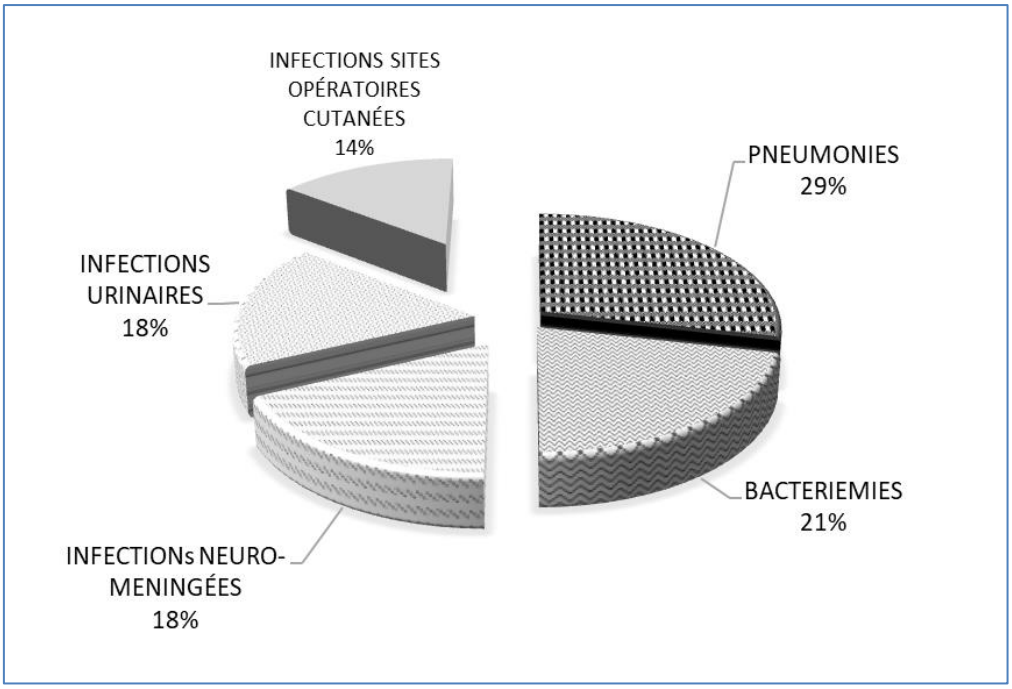


Figure 4: Distribution of patients according to types of hospital-acquired infections

DISCUSSION

Nosocomial infection is defined as an infection contracted in an intensive care unit which was neither present nor incubating on admission. A period of at least 48 hours between the admission and the infectious state is retained. All types of infections should be monitored (pulmonary, urinary, catheter-related, bacteremia, surgical site infections, gastrointestinal, sinus, skin and eye infections). However, this monitoring is tailored most often to infections related to an invasive device (catheter, urinary or endotracheal tube) and bacteremia. The objective of our study is to monitor nosocomial infections in our centre in order to determine the prognostic factors of morbidity and mortality and to develop a prevention strategy.

The routes of contamination of a patient in the intensive care unit are endogenous or exogenous. The endogenous route is the major source of hospital infections. This means that normally sterile sites are contaminated and then colonized by the flora carried by the patient himself, as a result of a breakdown in the defense barriers. The exogenous route is associated with the colonization, followed by infection, of the patient by external bacteria, coming from other patients or from the environment (for example: legionellosis), transmitted indirectly (aerosols, handling, materials). This route is relatively more important in the ICU than in other sectors, due to the density of care and the frequency of procedures, increasing the risk of exposure of patients to the transmission of bacteria from one patient to another (cross-transmission) [2]. Microbiological sampling of the environment of hospital wards allows us to determine the microbial reservoir at the origin of hospital-acquired infections [3, 4]. These microbial reservoirs are a key indicator of poor hospital hygiene [5].

Nosocomial infection is the most frequent adverse event in an intensive care unit, representing 20 to 30% of serious avoidable complications [6]. Epidemiological surveillance of healthcare-associated infections (HAIs) in the ICU is the first step in the fight against this scourge. This surveillance makes it possible to orient and better target prevention programs and facilitate the evaluation of control actions [7]. In our study, the incidence of nosocomial infection is 11.5% of cases. This incidence rate is low compared to the data in the literature. In Tunisia, Chaouch *et al.*, showed an incidence rate of 29.3% [8]. In Morocco, Quassimi *et al.*, found an incidence rate of 38.4% [8]. For Western countries, the rates are lower. In the United States, the national nosocomial surveillance system (NNIS) reports an incidence of infection of 9.2% in 196 intensive care units [9]. In France, the REA RASIN network found an incidence of 14.1% in 2004 and 15% in 2012 [10, 11]. This low rate of nosocomial infections in our study is probably not related to a better prevention policy but mainly to the difficulty of performing and accessing bacteriological examinations in our centre. Infections associated with care observed in the ICU are directly or indirectly associated with the techniques used and those particularly requiring the use of invasive devices (vascular catheter, bladder probe, tracheal intubation, etc.). Indeed, invasive devices allow germs that are resistant to break through the defense barriers of the organism already weakened by the underlying pathology. All studies, show a high frequency of pneumopathies acquired under mechanical ventilation, urinary tract infections and bacteremia on vascular catheters [12]. In fact, the preferred sites for infections

associated with medical devices are VAP (ventilator-associated pneumonia), which are predominant in most countries such as Turkey [13], China [14] and India [15], where the frequencies are around 33%, 68.4% and 59.7%, respectively, followed by urinary tract infections and primary bacteremia. In our study, we find the same frequency of distribution of infections associated with medical devices.

Microbial resistance and inappropriate antibiotic therapy were the two factors associated with mortality that were found in our study. Indeed, bacterial resistance to antibiotics has been considered since 2014 by WHO as a public health priority [16]. The prevalence of multidrug-resistant bacteria infections is high, 35.5% in our study. and it is between 10.3 to 32.9% in the USA, 13% in Europe, and 29.26% in the Maghreb [17-19]. In the ICU, as in the majority of long-stay hospitalization services, the prescription of antibiotics is strongly elevated, all studies recognize in a convergent way a decisive role to the previous antibiotic therapy as a major factor of the appearance of a hospital flora comprising resistant bacteria: either an antibiotic therapy of more than 24 hours in the preceding days, or a less recent but prolonged antibiotic therapy [20]. In line with the literature, our study showed a significant relationship between the use of inappropriate probabilistic antibiotic therapy and mortality. The mechanisms of resistance identified in our study were methicillin resistance by staphylococcus (MRSA) and extended-spectrum beta-lactamase production by enterobacteria (ESBL). These bacteria include primarily MRSA (methicillin-resistant staphylococcus), extended-spectrum beta- lactamase (ESBL)-producing enterobacteria. The density of incidence varies according to location and time. MRSA colonization seems to vary from 5% to 20% according to the studies [20], that with ESBL-producing enterobacteria (E- BLSE) is 3.9% for E. coli and 14.3% for Klebsiella, the presence of carbapenem-resistant P. aeruginosa 22.5% [20]. Some risk factors have been associated with MRSA infection: the hospital origin of the patient, the length of hospitalization, readmission to the intensive care unit, the patient's terrain, the presence of a skin or mucous lesion, the presence of a urinary catheter, the need for mechanical ventilation or extrarenal purification and, more generally, the severity of the patient and the need to use an invasive device for resuscitation, or the use of antibiotics, both in quantity and duration [21-23] . Colonization by enterobacteria or other multi-resistant germs is governed by the same risk factors of healthcare-associated infections (lack of hygiene, cross-transmission, handling). The crude mortality of patients with PAVM varies between one quarter and more than three quarters of patients [24, 25]. PAVM is recognized as a poor prognostic factor in patients in ICU [26]. Bacteriuria in catheterized patients and bacteremia in vascular catheters are associated with an increase in the length of hospitalization [27], and even in the duration of mechanical ventilation. Nosocomial urinary tract infection is also associated with an increased risk of mortality [28], most often secondary to bacteremia complicating the urinary tract infection [29]. Primary bacteremia and bacteremia complicating catheter infections are also associated with increased severity and mortality of patients [30, 31]. Finally, these nosocomial infections, especially in their most severe forms, are associated with a significant additional cost, both financial and in terms of workload for caregivers [32, 33].

CONCLUSION

Nosocomial infections in the ICU are frequent and can be serious. They are associated with high morbidity and mortality. The factors favoring the occurrence of nosocomial infections are numerous and are linked to the use of medical devices and the alteration of defense mechanisms in patients in ICU. Prevention, although partial, must be initiated by the use of simple measures, based on rigorous asepsis, the reasonable use of antibiotics, the regular evaluation of the use of medical devices.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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