MICROBIOLOGICAL SURVEILLANCE AS A SUPPORT TO THE INFECTION CONTROL PROGRAM IN THE INTENSIVE CARE UNIT

VIGILÂNCIA MICROBIOLÓGICA COMO APOIO AO PROGRAMA DE CONTROLE DE INFECCÕES NA UNIDADE DE TERAPIA INTENSIVA

VIGILANCIA MICROBIOLÓGICA COMO APOYO AL PROGRAMA DE CONTROL DE INFECCIONES EN LA UNIDAD DE CUIDADOS INTENSIVOS

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ABSTRACT

Objectives: delineating the density of the incidence of colonization/infection with multidrug-resistant microorganisms in an intensive care unit and the average time to investigating the occurrence of colonization/infection with these germs. Method: cohort study with patients in a general hospital between August 2009 and July 2010. Data were the results of microbiological tests, hospitalization time and the occurrence of infection/colonization. The research project was approved by the Research Ethics Committee, Protocol 12/09. Results: there was a predominance of Acinetobacter baumannii, being identified two outbreaks referring to germs Acinetobacter baumannii and Klebsiella pneumoniae. Regarding the time of colonization and infection, the shortest time to spread was that of the Enterococcus vancomycin-resistant and Acinetobacter baumannii was the largest. Conclusion: it was possible monitoring the microbiological profile of the intensive care unit as part of the infection prevention program at the institution. Descriptors: Drug Resistance; Hospital Infection/Epidemiology; Epidemiological Surveillance; Intensive Care; Inpatients.

RESUMO

Objetivos: delinear a densidade de incidência de colonização/infeção por micro-organismos multirresistentes em uma unidade de terapia intensiva e estudar o tempo médio para a ocorrência da colonização/infeção por esses germes. Método: estudo de coorte, com pacientes em um hospital geral entre agosto de 2009 e julho de 2010. Os dados foram os resultados de exames microbiológicos, o tempo de internação e a ocorrência de colonização/infeção. O projeto de pesquisa foi aprovado pelo Comitê de Ética em Pesquisa, Protocolo 12/09. Resultados: houve predominio de Acinetobacter baumannii, sendo identificados dois surtos, referentes aos germes Acinetobacter baumannii e Klebsiella pneumoniae. Em relação ao tempo de colonização e infeção, o menor tempo para disseminação foi o do Enterococcus resistente a vancomicina e o maior foi o Acinetobacter baumannii. Conclusão: foi possível acompanhar o perfil microbiológico da unidade de terapia intensiva como parte do programa de prevenção de infeções na instituição. Descriptores: Resistência a Medicamentos; Infeção hospitalar/epidemiologia; Vigilância Epidemiológica; Terapia Intensiva; Pacientes Internados.

RESUMEN

Objetivos: delinear la densidad de incidencia de colonización/infección por microorganismos resistentes a múltiples fármacos en una unidad de cuidados intensivos y el promedio de tiempo para investigar la ocurrance de la infección/colonización por estos gérmenes. Método: un estudio de cohorte con pacientes en un hospital general entre agosto de 2009 y julio de 2010. Los datos fueron resultados de las pruebas microbiológicas, el tiempo de hospitalización y la aparición de la infección/colonización. El proyecto de investigación fue aprobado por el Comité de Ética de la Investigación, el Protocolo de 9.12. Resultados: se observó un predominio de Acinetobacter baumannii, dos brotes, en referencia a los gérmenes se identificaron Acinetobacter baumannii y Klebsiella pneumoniae. En cuanto a la época de la colonización y la infección por el menor tiempo para difundir fue la de Enterococcus resistente a vancomicina y Acinetobacter baumannii fue el más grande. Conclusión: es posible controlar el perfil microbiológico de la unidad de cuidados intensivos como parte del programa de prevención de la infección en la institución. Descriptores: Farmacorresistencia; La infección hospitalaria/epidemiología; La vigilancia epidemiológica; Cuidados Intensivos; Los Pacientes Hospitalizados.

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INTRODUCTION

There is great concern regarding the ability of microorganisms to acquire resistance to antibiotics as well as the speed how they disseminate. As an example, we can refer to methicillin-resistant (MRSA) *Staphylococcus aureus*.\(^1\)\(^2\) Such phenomenon is ratified by the National Health Surveillance Agency (ANVISA) to the point that infections by multiresistant bacteria are commonly caused by MRSA, *Enterobacteriaceae* and *Pseudomonas*.\(^3\)

Among the several factors that increase bacterial resistance is the inappropriate use of antimicrobials, which exerts selective pressure on these germs. In this context, it would be interesting defining the time required for the patient to the intensive care unit (ICU) of adults colonize or infect by microorganisms multidrug-resistant (MDR) and thus establish, in advance, increasingly selective in the antimicrobial therapy. Currently, a major challenge in the control of nosocomial infection (NI) is to recognize health care associated infections and implement effective interventions to reduce and limit the rate of infection and spread of bacterial resistance.\(^4\)\(^6\)

In 2008, the Centers for Disease Control and Prevention (CDC), through the National Healthcare Safety Network (NHSN), published a document that changed some concepts and definitions of diagnostic criteria. The term “hospital infection/nosocomial” was changed to “related to health care (IRAS) infections”; criteria for sepsis and the definition of implant surgical site for diagnosis and clinical sepsis in patients less than 1 year old also had changes.\(^5\)

The Clinical and Laboratory Standards Institute (CLSI) manual is updated annually and divided into five modules; it measures the sensitivity of micro-organisms to different antibiotics: qualitative assessment, by disk diffusion and quantitative evaluation by minimum inhibitory concentration (MIC).\(^5\)\(^6\) It is recognized that the antibiogram, the disk diffusion method, can induce error and may produce false results because it has three variables to control: concentration of active drug in the disk, the thickness of the agar plate and inoculum concentration. CIM is a more accurate, though more expensive method. Evaluates the minimum serum concentration able to inhibit microbial growth for each antimicrobial agent that inhibits growth of the germ.\(^6\)

In the hospital setting, the ICUs are considered reservoirs and sources of multiresistant bacteria dissemination.\(^3\) There are examples of multidrug-resistant nosocomial microorganisms the vancomycin-resistant *Enterococcus* (VRE), MRSA, Gram-negative glucose non-fermentative bacteria (*Acinetobacter baumannii* and *Pseudomonas aeruginosa*) and Gram-negative bacteria ferment glucose (*Enterobacteriaceae* family).\(^3\)\(^7\)

It is of the responsibility of CCIH control of IH (Hospital Infection), which is “(…) An advisory body to the ultimate authority of the institution and execution of the actions of hospital infection control”.\(^8\) However, it is known that the problem of nosocomial infection in institutions is multidisciplinary character; for its effective control is important to all professional responsibility of the institution involved in the care process and simultaneous actions, including measures aimed at the control of nosocomial infection, because none alone was effective.\(^5\)

The Guidelines 2006 published by the CDC, reinforced by national recommendations in 2007 and 2010, emphasizes interventions for the control of multidrug-resistant bacteria include improvements in hand hygiene and use of barrier precautions (contact precautions, active surveillance cultures, education, forced environmental cleanup and improvements in communications about patients within the health units).\(^3\)\(^8\)\(^9\)

Given the above, this study aims to:

- Outlining the incidence density of colonization/infection with multidrug-resistant micro-organisms in an intensive care unit.
- Investigating the mean time to the occurrence of colonization/infection with these germs.

METHOD

Cohort study with patients admitted to the ICU of a general hospital in the city of Rio de Janeiro (RJ), which has ten beds, from August 2009 to July 2010 inpatients were considered research subjects in period had positive microbiological result for multidrug-resistant organisms after 48 hours of hospitalization in the industry.

In this ICU, following the guidelines of literature, which recommends control of multidrug-resistant organisms in healthcare institutions as well as local microbiological data, there are performed by the nursing team tracings with nasal and rectal swabs.
collected at the time of admission of patients included in risk group for colonization by MDR, and weekly in all hospitalized in the unit.1,10

It was used a form of data collection especially prepared for the research in consultation with the staff of the hospital was used CCIH. In the period studied, the results of microbiological tests on ICU patients, delivered daily by the microbiology laboratory, were analyzed to identify positive outcomes for multidrug-resistant organisms, following the criterion of multi-resistance of the CLSI ratified by ANVISA.3,9

Microbiological tests for analysis included the screening surveys of multiresistant microorganisms from clinical samples and materials, such as blood culture, urine culture, culture of catheter tip, tracheal aspirates, and wound secretion, collected according to the patient’s condition.

After analyzing the results and seeking to highlight cases of colonization or infection and identify the patient, started the collection of variables in records. Each identified patient was followed from admission to the ICU until his departure from it, being due to death or transfer to another unit. Among the variables collected, there were length of hospital stay, occurrence of infection/colonization, and the time between admission and the first positive microbiological result. The material was typed in Microsoft Office Excel 2003 program and analyzed using Statistical Package for Social Sciences (SPSS) version 14.

At the end of each month, a new analysis was performed to identify possible errors during data collection, confirming the colonization and infections for patients in the sector. The number of patients/day was used as denominator for the calculation of the density of incidence. For purposes of calculating the rate of incidence of colonization in the ICU was only considered the first appearance of each microorganism in each of the investigated patients, regardless of quantitative microbiological research conducted. In calculating the incidence rate of infection, the first criterion considered MDR infection, including patients previously colonized by the same micro-organism, since they are different incidences. However, for the density calculations of total incidence (colonization and infection) has been considered only the first positive result for each microorganism for each patient.

It was calculated the expected maximum limit (LME) of colonization/infection by averaging the first six months (moving average) added to the standard deviation of the same period multiplied by 1.96 eliminating surges for calculating the moving average was calculated. Thus, it was considered evidence of an outbreak whenever the monthly incidence exceeded the LME.

The project was approved with waiver of signing the Instrument of Consent by the Hospital Ethics and Research Committee 12/09 the record, after approval of the coordination of CCIH, the Research and Education Division and the overall direction of the hospital.

RESULTS

The analysis did not perform hypothesis testing, merely describing the data. The number of patients in which there was some kind of colonization or infection with MDR it totaled 82, from which 44 (53.6%) male. From this total, 35 (42.7%) died and 47 (57.4%) remained in ICU or were transferred to other medical institution. Of the 35 deaths, four (11.4%) could be associated with infection by MDR.

In Figure 1, it can be observed that the incidence density of colonization remains above 25 cases per 1.000 patients per day, with the highest incidence density in June 2010, with 62,26 cases per 1.000 patients per day and the lowest in October last year, with 26,62 cases per 1.000 patients per day. However, this data is difficult to assess due to changes occurring in the information system of the microbiology laboratory in the month in question, which may suggest an underreporting. It can be observed that in some months in which there was an increase in the rate of colonization occurred an increase in the rate of infection, as in the months of November and December 2009 and January 2010, however, increased rates of colonization in the months of April, May and June 2010 did not follow the same rate of growth of infection rate; however, the rates remained equivalent to the other aforementioned previous months.
Considering the LME for incidence density rates for infection, it can be observed in Figure 2 that in all months, the values remained below this limit; however, it is notable that in this study period, two peaks occurred in infection rates: in January and April 2010.

Figure 3 shows the values of the LME incidence density for colonization and we note that in June 2010 an outbreak occurred. This graph allows us to observe that despite the fluctuation in the rate of colonization, there is an increasing trend in these values when comparing the entire study period.
Figure 3. Incidence density and expected maximum limit of multidrug-resistant microorganisms in the occurrence of colonization.

It is worth noting that the LME chart indicates the possibility of outbreaks. Both charts above (Figures 2 and 3) allow for the possibility of identifying an outbreak of MDR, being more explicit in colonization chart for the month of June 2010. However, the peak of infection, in January 2010, can be considered the beginning of the event in the industry.

When analyzing the colonization data for each MDR, the predominant micro-organisms in the samples were *Klebsiella pneumoniae* and VRE present in all months, ranging from 3.58 to 15.94 and 4.03 to 14.39 cases, respectively, per 1,000 patients per day. With respect to VRE, it is noted that this germ was endemic in this sector. *A. baumannii* was also present in most months, excluding October and November. From December 2009, the rate of this micro-organism grew, reaching a peak in June 2010, with the highest rate of incidence density of all MDRs, 19.46 per 1,000 patients per day.

The colonization by MRSA was present in 8 of the 12 months studied, although its rates are lowering than those of Gram-negative already addressed. Other MDRs, such as *P. aeruginosa*, had a strong presence in the first half analyzed between August and December 2009, with the highest rate of incidence density, with 16.13 per 1,000 patients per day in November of that year.

The micro-organisms present in infections were MRSA, *A. baumannii*, *K. pneumoniae*, *P. aeruginosa*, *E. coli*, *Morganella morgannii* and *Stenotrophomonas maltophilia*. Regarding the incidence density of monthly infection, we observe two distinct moments for analysis: the period between August 2009 and January 2010, and the period between February and July 2010. At first, the rates have little variation, keeping the values between 2.72 and 4.03 per 1,000 patients per day in most months except for October, when there was no notification of infection with multidrug-resistant germ. During this period, despite the low rate of infection, there was a predominance of *A. baumannii*, *K. pneumoniae* and *P. aeruginosa*.

In the second period, it makes plain the increased rates of infection density of every germ, predominantly *A. baumannii* and then the germ of a higher incidence in the sector for the whole period analyzed. Another micro-organism of importance for this period was the *K. pneumoniae*, which achieved its highest rate during the study: 7.97 per 1,000 patients per day.

Table 1 refers to time in days, a patient in the ICU led to colonize or infect, respectively, by a multidrug-resistant micro-organism. They not interquartile range, but the mean, standard deviation, median, maximum and minimum value was presented. The reason for all these parameters based on the high variation for the time of colonization/infection. As these times are critical for professionals involved in the care of critically ill patients, we chose to provide measures of central tendency and dispersion.
Only the most common germs served in the last three
nii showed similar times, 7, f germs by
,E. faecalis
Staphylococcus aureus methicillin resistant
Pseudomonas aeruginosa
Klebsiella pneumoniae
Acinetobacter baumannii
Escherichia coli

Table 1. Time in days to colonization and infection by multidrug-resistant microorganisms (MDR)

<table>
<thead>
<tr>
<th>MDR</th>
<th>Colonization</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patient/day (n)</td>
<td>Average ±</td>
</tr>
<tr>
<td>Enterococcus faecalis and</td>
<td>13</td>
<td>8 ± 5</td>
</tr>
<tr>
<td>E. faecalis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>11</td>
<td>11 ± 10</td>
</tr>
<tr>
<td>methicillin resistant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>11</td>
<td>13 ± 6</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>34</td>
<td>13 ± 11</td>
</tr>
<tr>
<td>Acinetobacter baumannii</td>
<td>21</td>
<td>16 ± 14</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>-</td>
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</tr>
</tbody>
</table>

Considering only the most common germs in the unit, the VRE colonized patients earlier, as average is 8 days, with a standard deviation of 5 days. The germ that was later colonized A. baumannii, with an average of 16 days and a standard deviation of 14 days. The time for the occurrence of infection, unlike colonization, with respect to the minimum and the maximum was 3 days and 37 days, respectively, after admission. Despite the early VRE colonized patients in the unit, he was not responsible for any infection, whereas the MDR K. pneumoniae was responsible for the infection at an earlier time, with an average of 11 days and a standard deviation of 9 days. The MDR in time later infection with P. aeruginosa was 24 days and mean standard deviation of 10 days. The A. baumannii showed similar times to colonize and infect the patient: average of 16 and 17 days, respectively.

With respect to frequency of occurrence of hospital infections, according to the germs, there were observed the following values: A. baumannii (40%), K. pneumoniae (20%), P. aeruginosa (13,3%), E. coli (10%), others (16,7%).

It is important emphasizing the existence of protocol for empiric treatment, evaluated every six months by infectologists of CCIH and modified according to the profile of circulating micro-organisms in the unit, which was observed in the last three protocols, respectively in the first and second half of 2009 and first half of 2010, showing changes in the indication of the use of antimicrobials.

There was a total of 27 nosocomial infections by multidrug-resistant bacteria, and the most frequent site of infection corresponded to the respiratory tract, with 15 cases (55,5%), and 7 (25,9%) infections associated pneumonia mechanical ventilation (VAP), 7 (25,9%) by tracheobronchitis and 1 (3,7%) for pneumonia not associated with mechanical ventilation. The second major site was the bloodstream, 10 (37,1%) cases, followed by surgical infection, with 2 patients (7,4%). There were no cases of infection with multidrug-resistant bacteria in the urinary tract.

Regarding the distribution of germs by site of infection, have been, in respiratory tract infections, A. baumannii corresponding to 8 (50%) instances, K. pneumoniae 3 (18,75%), E. coli and M. morganii 2 (12,5%) and P. aeruginosa occurrences each case 1 (6,25%). In bloodstream infection associated with catheter were recorded A. baumannii and P. aeruginosa in 3 (30%) episodes each and K. pneumoniae and MRSA in two (20%) each. For surgical site infection, the germs were identified in samples A. baumannii in one case and in another case, M. morganii and K. pneumoniae were present in the samples.

**DISCUSSION**

The percentage of deaths recorded in this study were below another study, which showed results above 50%, however the percentage of genera remained similar, with slightly higher percentages for men.7

Regarding the incidence density rates, the higher prevalence of multidrug-resistant germ unit in A. baumannii was the fact that research confirms that claim to treat yourself to a germ of high incidence in ICU patients.11-14 It can identify the occurrence of an outbreak by this germ through the LME data rates of incidence density, it was observed that this tool is useful in order to anticipate the occurrence of the event in the unit.

Another study, also conducted in ICU, obtained results similar to this, although the statistical analysis be different. The most representative MDR identified in 90% of samples were A. baumannii (36,3%), P.
K. pneumoniae (21.9%), MRSA (14.7%), K. pneumoniae (11%) and E. coli (7.8%).

By analyzing the average time to occurrence of colonization and infection in prevalent bacteria in the unit of study, there was less than the average for colonization time of infection, indicating previous colonization of the germ to the occurrence of infection. The two microorganisms that predominate in the infection in the second reporting period, A. baumannii and K. pneumoniae are also prevalent in colonization rates for the same period and for the first period of the study, but it is important to differentiate that a reversal occurs profile, which prevailed before the K. pneumoniae passes in the second period, the prevalent A. baumannii.

This assessment allows us stating that, despite the diversity of bacteria colonizing the sector, there is a change in the profile of the unit, through which evidenced the occurrence of an outbreak of A. baumannii between the months of February and July 2010 on a study general hospital in Fortaleza (CE) identified K. pneumoniae and P. aeruginosa bacteria acting as major nosocomial infections in the ICU, and the A. baumannii as ascending germ.

When analyzing the changes in the protocol of empirical antibiotic therapy and the frequency of germs at the site of infection most prevalent, it can make an association with regard to the change in the profile of the drive strains. Antibiotics suggested for late nosocomial pneumonia, most frequent site of infection, and highlighting the incidence of A. baumannii were as follows: in the first half of 2009 the orientation of the first option was to meropenem/imipenem associated with antimicrobial and amikacin, as second option, vancomycin associated with meropenem/imipenem. In the second half of 2009, the scheme was changed to a first option with piperacillin + tazobactam, and associated with gentamicin and, as a second option, polymyxin B associated with meropenem/imipenem. It was further directed that in case of a second episode, be added trimoxazole.

This change in antibiotics throughout the semesters was encouraged by the change of susceptibility of strains to antibiotics used in the unit. Fact that in the first half of 2010, during the outbreak of A. baumannii and K. pneumoniae occurred, stressed that the first option of empirical treatment for pneumonia were polymyxin B is the antibiotic indicated for the treatment of pan-resistant germs especially to carbapenems, with the only therapeutic option polymyxin B. However, it is noteworthy that the introduction of antimicrobial sulfamethoxazole + trimethoprim to empirical treatment for pneumonia took into account the occurrence of germ S. maltophilia.

An important fact to be emphasized is the importance of epidemiological surveillance by the CCIH through rigorous monitoring of multidrug-resistant organisms in the ICU, and teamwork among professionals providers of patient care in the health sector. The occurrence rates of both colonization as infection are high, and closely monitored for tracking, identification cultures, implantation of antibiotic therapy protocols, handwashing, rigor in the established precautions, when combined, can result in a control greater the spread of multidrug-resistant organisms.

The study objectives were achieved even though the moments of outbreak may have influenced the reduction of time for colonization of patients, greater environmental microbial load. The strategy has enabled the monitoring of the microbiological profile of the intensive care unit as part of the infection prevention program at the institution. Underlies the development of action plans to control the incidence of germs with greater relevance in the assistance unit.

The diagnosis based on those rates the condition of colonization and infection of hospitalized patients, calculated from the LME monitoring, allows the CCIH monitor and anticipate, in a timely manner, the possible adverse conditions to be faced. Finally, it is believed to be providing data that may reflect an important specificity to the historical of infection control in the country.

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