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NOSOCOMIAL INFECTIONS IN A SECONDARY HOSPITAL SERVICE IN THE COVID ERA

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Abstract*: Healthcare-associated infections have an increased incidence, due to the antibiotic medication introduced without indication. Multiple infections with bacteria resistant to existing antibiotic medication occur, and the mortality rate given by these infections exponentially increases. Due to the increase in longevity of life, institutionalized which increases the incidence of HAI. The conduct developed in the programs to combat these infections must include activities for the prevention, surveillance, and training of medical staff in this regard. Several elaborate studies demonstrate the importance of staff education in terms of protection methods and show an exponential decrease in the occurrence of HAI. Continuous surveillance associated with infection control programs contributes to a better approach, to reducing healthcare costs, and the effort to improve the system. Specific activities need to be organized and supported at both regional and national levels, with extensive programs to prevent and combat the occurrence of resistant multi-drug infections.*

INTRODUCTION

Nosocomial infections are an important public health problem due to significant morbidity and mortality, increased hospital costs, increased hospital days, costs for home care (increased). Nosocomial infections, otherwise called healthcare associated infections (HAI), encompass those infections, which are due to healthcare, the patient being asymptomatic from an infectious point of view at the time of hospitalization. These infections begin more than 48 hours after hospitalization or 30 days after contact with the medical system. They can come from other organizations that provide medical care, such as care institutions for the elderly, numerous presentations in outpatient medical services, palliative care institutions. The highest incidence is described in intensive care units. (1),(2),(3) Countries with low economic income and status and countries with increased social resources are struggling with the burden of HAI. These infections are closely monitored by the Public Health Directorate, in order to develop preventive behaviors and increase the safety of patients in health institutions. Most hospitals consider it a common problem, with multiple negative consequences, and work on developing behaviors for the protection of both patients and staff. It is considered a public danger due to infections with resistant multi-drug agents, which associate increased mortality and a decrease in quality of life. HAIs are also included in occupational diseases, which can affect medical staff in various ways. HAI occurs when a potentially infectious pathogen is confined to a susceptible patient / staff. (4),(5),(6) Invasive procedures, multiple surgeries, implantation of permanent or temporary devices, implantation of various prostheses, act due to modern medicine, can be sources of propagation and maintenance of these infections.

Etiology depends on the type of medical procedures performed and the infectious source, can be bacterial, viral and fungal infections.

HAIs are divided, after the starting point into several categories, such as infections associated with central venous catheters, urethro-vesical probes, infections from surgery, pneumonia with intrashital pathogens, pneumonia associated with mechanical fan support and enterocolitis with Clostridium difficile. (7),(8)

PURPOSE

Increased mortality from healthcare associated infections due to unjustified use of antibiotics and poor hygiene of both healthcare professionals, as well as instutations dealing with the treatment of patients with multiple risk factors for the development of infections with prognosis and negative evolution. Intention to highlight the importance of monitoring compliance with the conditions imposed for patient protection at the institutional level, with the introduction of the screening obligation for both patients and staff to protect both parties from unwanted and difficult to treat infections, with a bad prognosis. Highlighting the importance of prevention methods against HAI. Early notification of risk factors and their removal to avoid HAI training. Establishing major correlations, which negatively influence the prognosis and evolution of infections, as well as developing stricter and specific behaviors in order to prevent nosocomial infections.

MATERIALS AND METHODS

98 patients were included in this retrospective descriptive study, for a period of 2 years (01.01.2020-31.12.2022) hospitalized in the Medical Clinic I of the Târgu Mureș County Emergency Clinical Hospital.

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The necessary information was extracted from the observation sheets of the patients of the department, patients hospitalized by presentation in the emergency service within the hospital, who presented different types of symptoms specific to the competencies of the department.

Inclusion criteria: patients confirmed with HAI, the presence of necessary paraclinical investigations. Exclusion criteria: patients with inpatient infections, without HAI confirmation, patients not properly investigated.

In order to develop this work and to perform the appropriate statistics, it was necessary to persevere in collecting data related to: age; sex; the day of the infectious symptoms; the number of days of

hospitalization; patient admission departments (their presence or absence on the intensive care unit); infectious or non-infectious diagnosis from hospitalization; diagnoses on (pulmonary systems - such as asthma, COPD, pulmonary fibrosis, community pneumonia, bronchopulmonary tumors; cardiac – heart failure, ischemic heart disease, essential hypertension, valvulopathy, chronic venous insufficiency, peripheral arterial disease; abdominal – hiatal hernias, esophagitis, gastric ulcers, gallstones, gastrointestinal tumors; urination – urinary tract tumors, kidney stones, nephropathy, chronic kidney disease, acute kidney failure; skin – limb ulcers, ulcers). We collected data on antibiotic treatment, gastroprotector or the association of these two at home before hospitalization; antibiotic treatment, antibiotic combined with IPP, antibiotic in combination with IPP and probiotic during hospitalization; the day of the occurrence of specific infectious symptoms divided by systems (dysuria, pyuria, dyspnea, cough, fever, superinfection of skin continuity lesions). We recorded the types of infectious agents (Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter baumanni, Staphylococci, Escherichia coli, Enterococci, Enterobacteria, Streptococci, Proteus mirabilis, Corynebacteria, Providencii, Serratia), the presence of antibiotic resistance type (MDR, XDR, CPE, CRE, MRSA, BLSE). Description of the infected organ (respiratory tract, ruinous tract, cutaneous or unspecified in cases of unspecified sepsis); the number of days under antibiotic treatment, whether or not the patient receives the combined antibiotic therapy; antibiotic treatment at home after continuous discharge or not; evolution (ameliorated, stationary, cured or deceased). All data is entered into a Microsoft Excel database, with subsequent statistical analysis with SPSS 17, Graphpad and Microsoft Excel. The statistical protocol includes correlations, comparisons of environments, unifactorial models of linear regression. The significance threshold is $p = 0.05$.

RESULTS

Analyzing the study group from the point of view of the predominant age group 70-80 years with 26% (27 cases), closely followed by the 60-70 age group with a percentage of 25% (25 cases), with extreme ages > 95 years (4 cases) and < 30 years (3 cases), with approximately equal ratio of women / men. From the analysis of the study group on sex dispersion we can emphasize the presence of a percentage of 47% represented by the female and 53% by the male. From the perspective of the number of days of hospitalization of patients with these pathologies we can highlight a number of 16 patients, with hospitalization between 5 and 10 days; 15 patients, who were hospitalized for 10-15 days, and most of the study group is represented by patients with hospitalization for over 15 days in a number of 64. Analyzing the hospitalization departments of patients we can present a percentage of 45% (44 patients) hospitalized exclusively in Medical Clinic I, 21% (21 patients) from patients were transferred to the Intensive Care Unit (ICU), and the remaining 34% (33 patients) were admitted to the intensive care unit with an internal medicine observation sheet. As a number of days on antibiotic treatment most, ie 40% (39 patients) required antibiotic treatment for 10-14 days, followed by the group subgroup, who received antibiotic treatment between 5 and 10 days, with a percentage of 39% (38 patients), the rest being treated for less than 5 days or more than 14 days. According to the number of days after the infection we have a preponderance with a percentage of 74% (74 patients) from 5 to 10 days, 7 patients with onset below 72 hours, but with recent discharge from other departments and infectious diagnosis, and the remaining 19% of patients with the onset of symptoms from 3 to 5 days of hospitalization. Given the type of pathogen that causes infection we can list 64 patients with an infectious pathogen, and the rest with several pathogens present consecutively. Of the patients with a single pathogen, infection with Acinetobacter baumanni (16 patients), E.coli (14 patients) and Pseudomonas aeruginosa (10 patients) predominate. Of the study group, 14 patients were infected with Klebsiella pneumoniae combined with other bacteria in a percentage of 20%, with Pseudomonas aeruginosa combined with other bacteria in 15% and Acinetobacter baumanni combined with other infections in 15% of patients. From the perspective of bacterial resistance we can emphasize the presence in the study group of 54% of patients without antibiotic-resistant bacteria, 27% with MDR pathogens and 11% BLSE patients. If we are talking about combined bacterial resistors we can mention a total of 12 cases of two combined resistant germs. From the point of view of dispersion on sex and the appearance of infections with resistant pathogens we obtained the following results. From the point of view of infected organs we can emphasize in a percentage of 39% lung, 27% urinary, 28% cutaneous and the rest unspecified, with 10 cases of combined infections. Regarding the financial resources used on these patients we can remember 14 patients with values of over 10000 RON, 17 patients under 10000 RON, with values between 10000-20000 RON 18 patients, 12 cases with costs between 20.000-30.000 RON, and 15 patients in the group with costs between 30.000-40.000 RON. Regarding the status of discharge, 45% of patients had an infectious improved status, and the remaining 55% died. By analyzing the study group we came to statistically significant results on sex dispersion, which influence bacterial resistance of MDR type, which occurs in female patients with a $p = 0.031$, through a confidence interval of 95%, influencing in a percentage of 4.8%. The dispersion by sex analyzed at the discharge status shows significance by p 0.030, with an influence of 3.8%, a 95% confidence interval, confirming the increased mortality of infected men. From an age perspective compared to post-externalization diagnoses and antibiotic therapy, we describe the following statistically significant results. From an age point of view, those with an infectious inpatient diagnosis with $p = 0.041$ have a higher risk, and receive antibiotics on discharge, with $p = 0.037$. From the point of view of the number of days of hospitalization and the appearance of symptoms, we can mention a parallel increase between the day of hospitalization and the appearance of nosocomial infections with $p < 0.001$, OR: 3.467, 95% confidence interval, as well as a parallel increase in the incidence of combined antibiotic therapy relative to the number of hospitalization days with $p = 0.005$, OR: 2.844, at 95% confidence interval. Given the day of the infection associated with healthcare and the organs it affects, we may point out an exponential increase in cases of pulmonary infection that began on day 5-7 of hospitalization, with OR 2,380 and $p = 0.019$, with increased incidence of Acinetobacter baumanni in late hospitalization OR: 2,626, $p = 0.010$, 95% confidence interval. Regarding the number of days of hospitalization, we can show a correlation with the number of days with antibiotic therapy, with

$p < 0.001$, with OR: 3.005, and with the passage of days of hospitalization and the occurrence of infection with Acinetobacter baumanni ($p = 0.011$) and Klebsiella pneumoniae ($p = 0.013$). Analyzing from the perspective of home antibiotic therapy, patients who present with cardiac comorbidities receive antibiotic treatment after discharge with $p = 0.037$, OR: -2.121, 95% confidence interval.

DISCUSSIONS

Analyzing the studied group, we can highlight multiple relevant aspects. From the point of view of age, we can mention the dominant age group, which is the group 60-80 years, involved in the more frequent occurrence of infections. This is due to multiple triggers, such as decreased body resistance through polyhospitalization, through multiple long-term hospitalizations due to decreased ability to recover organs and their functions early. We can mention a majority of institutionalized patients, which is considered an aggravating factor because the attention of caregivers is divided among all patients present in repressive institutions, we can consider the lack of family aggravating factor, which is considered to be an important psychological factor for the recovery of the countries by increasing the quality of life and the desire to survive. We have noticed 2 categories of extreme ages, such as those over 95 years, which has a clearly negative prognostic factor due to lack of biological resources, and those under 30, who had more enterocolitis infections with C.difficile secondary to antibiotic therapy. As an age/sex ratio, we did not notice major and considerable differences, because the sustainability of the disease is equal, as well as the body, which has approximately the same anatomical constitution. From an age perspective, through regressive analysis we identified a greater predisposition to infectious diagnosis at admission in elderly patients, which is motivated by decreased immunity and increased predisposition to infections, and through prolonged hospitalization due to this fact and the appearance of resistant germs it is necessary to administer antibiotic therapy at home after discharge. After the analysis, we can emphasize a predominance of female receptivity to infections with MDR pathogens through the longer hospitalization period of this sex. In the study group, there are a large number of patients who died of males compared to women, a fact also demonstrated in the literature. Addressing the issue of the number of days of hospitalization, we found a majority of hospitalized patients over 15 days, which produces additional costs related to hospitalization, and resource consumption, which can lead to their exhaustion for serious cases and where intervention with multiple vital resources is required. Regarding the advanced age of inpatients, this is proportional to infections, as demonstrated by multiple studies, due to higher affinity for infections and low resistance, and poor fighting. (8),(9),(10) Through the regressive analysis, we found a parallel increase in the day of infections with a maximum peak of occurrence between days 10-15 of hospitalization, which adheres to the susceptibility to resistant germs, supported by the literature as a decrease in the body's immunity and receptivity, especially in hospitalized patients with pathologies of the lower respiratory tract. We have observed the appearance of Acinetobacter baumanni infection in patients with longer hospitalization, especially due to infectious worsening, with the need for combined, complex antibiotic therapy, because the literature describes a late detection and lack of assumption of these types of infections. Although there is a high cost of healthcare, a large part of the patients: 45% were hospitalized in Medical Clinic I and 55% of them were directly hospitalized or subsequently transferred to the intensive care unit because during the hospitalization they presented even fatal complications related to the underlying disease or in terms of infectious evolution with the need to support vital functions. The appearance of the transfer can generate multiple negative and positive factors by spreading infections to other sections, by creating new contacts, with the possibility of complications and unfavorable evolution. Most patients transferred or hospitalized in the intensive care unit have multiple risk factors for the severity of diseases, such as old age, multiple comorbidities, institutionalization, precarious social environment, polyhospitalization, unindicated home treatment with antibiotics, and delayed presentation in the emergency service. (11),(17) From a cost point of view, we can remember that through this movement the constraints related to the treatment of these pathologies and of this group of patients can be divided. In our study group, a majority of 88% of them have an infectious diagnosis already from hospitalization, with a predominance of 85 patients with respiratory tract infections, which, due to the lack of isolation sites dedicated to them, is a danger through their contagion to other hospitalized patients, with an increased severity factor, because we can object to the fact that they have a greater susceptibility to nosocomial infections due to immune loss and lack of resources to fight the pathogenic multiples present simultaneously. Regarding the day of infection, we can mention a shorter period of occurrence regarding urinary tract infections and an increase in terms of respiratory infection, which occurs within 10-15 days of hospitalization. Of the studied group, a percentage of 40% benefited from antibiotic treatment between 5 and 10 days, and the remaining 39% benefited from between 10-14 days of antibiotic therapy, which shows the severity of the infection, with the decrease in the body's tolerance. As for the onset of symptoms, we can mention 74% of patients with an infection between 5 and 10 days of the day of hospitalization, which is a clear confirmation of nosocomial infections. It is the only factor we can call objective for the emergence of HAI, but also here it can be a delayed testing factor for patients due to a lack of resources within institutions or staff conducting investigations necessary to report infections. In terms of the type of infection, 64 patients have infections with a single pathogen, and the remaining 35 patients have infections with multiple pathogens. In 47% of patients, infection with Acinetobacter baumanni, E.coli, and Pseudomonas aeruginosa is identified, which causes an increased mortality rate due to the severity of the pathogen present by increased microbial resistance. (12),(14) Apart from infection with E. coli, the other pathogens until the twentieth century existed only in institutions, but now there are several patients who present themselves with this infection already from the community environment, which gives a bad prognosis in terms of the evolution of infections and the lack of antibiotic therapy for their cure. In the above-mentioned patients with consecutive infections with several pathogens, we can remember combinations between these above-mentioned agents and their combination with Klebsiella pneumoniae. 14 patients were shown with infections related to Acinetobacter baumanni, combined with Klebsiella pneumoniae and Pseudomonas aeruginosa. The occurrence of Acinetobacter baumanni and Klebsiella pneumoniae infection at more than 15 days of hospitalization suggests a longer incubation period, with lower susceptibility to the body and a need for immunosuppression to contact them, with the presence of exaggerated costs and long-term antibiotic treatment, which can promote C. difficile infection. Regarding the resistance to antibiotic treatment, we can mention a proportion of 22% of inmates with MDR resistance and 11% with BLSE, which indicates a large percentage, with the decrease of the prognosis, which occurs due to the abuse of antibiotics used extra- and intrahospital. What we can emphasize as an even more serious factor is the combination of several resistant antibiotic pathogens, such as BLSE + MDR,

which almost results in the impossibility of treatment for a favorable prognosis. It is necessary to adjust the antibiotic treatment to the pathogen and de-escalation in cases where there is no high resistance because we will soon reach the point where we can no longer treat the acquired intrahospital infections. Adjustment of treatment regimens and treatment guidelines for infections is required. More detailed screening is needed to detect resistant pathogens and avoid the formation of new drug resistance. 39% of the group has lung infections, 27% with urinary tract infections, and 28% with skin infections, of which 50% have a combined lung and skin infection. Most skin infections occur due to the presence of ulcers already before hospitalization, which although there is a rigorous toilet can be superinfected with resistant pathogens due to effective location and incapacity, which can even lead to soft tissue necrosis, with the need for debridement of the wound, where the aggravating factor may be the other infection present, with an unfavorable prognosis. In most cases, these pathogens are of different types, a cause for which they require combined antibiotic therapy, with the production of dysbiosis and the increased risk of developing enterocolitis with C. difficile. Regarding antibiotic therapy at home, we can mention 17 patients for whom there were other factors for which they requested discharge and it is considered important to continue antibiotic therapy at home to avoid superinfection or create microbial resistance. Through the regressive analysis of the group, we noticed the need for antibiotic therapy after discharge in patients with cardiac comorbidities at admission. From a cost perspective, we can appoint 14 patients with costs of over 100.000 LEI, which is a burden for the institution and additional consumption of ancillary resources. Of the study group, 55% of patients died, which is an exaggerated value and shows the severity of infections and the need to develop methods of prevention and treatment more efficiently. (13),(15),(16),(18),(20)

CONCLUSIONS

By analyzing the study group from the point of view of risk factors, as well as their influence on the prognosis we can emphasize the following conclusions: age through immunosuppression is a risk factor for nosocomial infections, the increased risk of women in the development of healthcare-associated infections with increased microbial resistance, increased mortality rate of male patients, an increased hospital stay is a predisposing factor for infections with Acinetobacter Baumanni and Klebsiella Pneumoniae, with the need for combination antibiotic treatment and increased costs, HAI-type lung infections occur later than urinal or skin infections of the same type, patients with cardiac comorbidities need antibiotic therapy at home after discharge.

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