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FACTORS RELATED TO INFECTION BY *KLEBSIELLA PNEUMONIAE* IN A PRIVATE HOSPITAL

Fatores relacionados a infecçao por klebsiella pneumoniae em um hospital privado

Factores relacionados con la infección por klebsiella pneumoniae en un hospital privado

Rosane da Silva Santana[1]; Naiana Maria Diogo da Silva[2]; Teresa Raquel de Carvalho Castro Sousa[3]; Samya Raquel Soares Dias[4]; Igor Almeida Silva[5]; Aline dos Santos Silva[6]*

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ABSTRACT

Objective: To identify the prevalence of klebsiella pneumoniae and to analyze the factors related to the infection by this bacterium in a private hospital in northeastern Brazil. **Method:** descriptive retrospective documentary study, carried out with patients who developed infection in the year 2017 (n: 64). Sociodemographic and infection information was collected. The data was processed in SPSS 20.0. The project was approved by the ethics committee. **Results:** the most prevalent topographic site was the urinary tract (34; 56.7%). the main risk factor for triggering klebsiella pneumoniae infection was the use of mechanical ventilation, presenting a risk of 43.8% for the appearance of infections by this microorganism. Higher resistance was found for the piperacillin / tazobactam 52 antimicrobial (82.5%). **Conclusion:** because of the high resistance to antibiotics and the great potential of klebsiella contamination, measures should be taken to minimize the high level of contamination and, especially, the negative prognosis for the patient.

Descriptors: Antimicrobials, Bacteria, Hospital, Hospital infection, Klebsiella pneumoniae.

[1] Nurse. PhD in Public Health - Federal University of *Ceará. Teresina-PI*. Brazil.
[2] Nurse (UNINASSAU). Postgraduate student in Urgency and Emergency *(IESM)Teresina-PI*. Brazil.
[3] Nurse (UNINASSAU). Graduate student in Intensive Care *(AMIB)Teresina-PI*. Brazil.
[4] Intensive Care Nurse. Master student in Nursing *(UFPI). Teresina-PI*. Brazil
[5] Intensive Physiotherapist. Postgraduate in High Complexity (*UFPI). Teresina-PI*. Brazil.
[6] Nursing Student *(UNINASSAU). Teresina-PI*-Brasil

RESUMO

Objetivo: Identificar a prevalência de klebsiella pneumoniae e analisar os fatores relacionados à infecção por essa bactéria em hospital privado do nordeste brasileiro. **Método:** estudo descritivo retrospectivo documental, realizado com pacientes que desenvolveram infecção no ano de 2017 (n:64). Coletou-se informações sociodemográficas e referentes a infecção. Os dados foram processados no SPSS 20.0. O projeto foi aprovado pelo comitê de ética. **Resultados:** o sítio topográfico mais prevalente foi o trato urinário (34;56,7%). o principal fator de risco para desencadear infecção por klebsiella pneumoniae foi a utilização de ventilação mecânica, apresentando risco de 43,8% para o aparecimento de infecções por esse microrganismo. Maior resistência foi encontrada para o antimicrobiano piperacilina/tazobactam 52 (82,5%). **Conclusão:** pela alta resistência aos antibióticos e o grande potencial de contaminação da klebsiella, medidas devem ser adotadas para minimizar o alto nível de contaminação e, principalmente do prognóstico negativo para paciente.

Descritores: Antimicrobianos, Bactérias, Hospital, Infecção hospitalar, Klebsiella pneumoniae.

RESUMEN

Objetivo: Identificar la prevalencia de klebsiella pneumoniae y analizar los factores relacionados con la infección por esta bacteria en un hospital privado en el noreste de Brasil. **Método:** estudio descriptivo retrospectivo, realizado con pacientes que desarrollaron infección en el año 2017 (n: 64). Se recogió información sociodemográfica y de infección. Los datos fueron procesados en SPSS 20.0. El proyecto fue aprobado por el comité de ética. **Resultados:** el sitio topográfico más prevalente fue el tracto urinario (34; 56,7%). El principal factor de riesgo para desencadenar la infección por Klebsiella pneumoniae fue el uso de ventilación mecánica, que presenta un riesgo del 43.8% por la aparición de infecciones por este microorganismo. Se encontró una mayor resistencia para el antimicrobiano piperacilina / tazobactam 52 (82.5%). **Conclusión:** debido a la alta resistencia a los antibióticos y al gran potencial de contaminación por klebsiella, se deben tomar medidas para minimizar el alto nivel de contaminación y, especialmente, el pronóstico negativo para el paciente.

Descriptores: Antiinfecciosos, Bacterias, Hospital, Hospitalar infection, Klebsiella pneumoniae.

INTRODUCTION

Klebsiella pneumoniae is a Gram-negative bacillus, which does not need oxygen to develop; member of the Enterobacteriaceae family, conducive to survive in inanimate objects or fomites (objects with the ability to absorb, retain and transport contagious or infectious organisms, such as: shoes), colonize the human body and cause severe infections in immunocompromised patients.[1,2] This microorganism is one of the most common hospital pathogens presenting an increasingly restricted vulnerability profile, associated not only with infection, but also with colonization.[3,4]

Infection acquired in the hospital environment is one of the most severe complications for exacerbation of a patient's state of health. The longer the patient is hospitalized, the greater the risk that the patient will be affected by an infection. A daily clinical evaluation of the patient is crucial to verify the need for hospitalization.[5,6]

Klebsiella pneumoniae exhibits an enzyme produced by Gram-negative bacteria called carbapenemase, more exclusively Enterobacteria, restricted to medical care and hospital environment, whose main characteristic is to confer resistance to carbapenemics and inactivation of penicillins, cephalosporins and monobactamics.[7] This enzyme promotes resistance to all beta-lactam agents such as cephalosporins, penincillins, monobactamics and even carbapenemics. This last category of antimicrobials is broad-spectrum, with its use in the treatment of infections caused by multidrug-resistant bacteria. And so, for the treatment of bacteria producing this enzyme, few therapeutic options remain. This characteristic, together with the fact that KPC has high potential for dissemination, has been a cause for concern in hospitals and health institutions.[7]

It is of paramount importance to know and identify resistant KPC strains, in order to apply the correct therapy, reduce their spread and employ preventive techniques, which will contribute to the restriction of morbidity and mortality rates.[8]

Among the prevention and control measures for infections by KPC-producing bacteria, the rapid identification of microorganisms in the hospital environment and protocols to prevent infections stand out. Thus, this study aimed to identify the prevalence of *Klebsiella pneumoniae* and analyze the factors related to infection by this bacterium in a private hospital in northeastern Brazil.

METHODS

This is a descriptive retrospective documentary study based on secondary data. Data collection took place in September and October 2018. The search for the data took place specifically in the Serviço de Arquivos Médicos e Estatísticos (SAME – Medical and Statistical Archives Service).

Initially, we selected all the medical records of patients who developed infection in the period that were hospitalized in 2017. After selection, only those medical records that presented tests with bacterial cultures with positive results for *Klebsiella pneumoniae* were included in the study; and those that did not show microbiological growth for the bacterium, and that expressed inconclusive results or without antibiogram were excluded.

Of all the medical records of patients with infection, only 64 medical records were part of the study. The data were obtained through a script with closed questions created by the authors. The script presents information about the cases of hospital infection by KP in the medical records of the patient who used antibiotics or vasoactive drugs, who underwent complementary tests (uroculture, blood culture, tracheal secretion, wound culture) and invasive procedures. Other information such as positive culture type for *Klebsiella pneumoniae*, antibiotic resistance profile and number of deaths related to infection were also

collected.

For the organization of quantitative data, a database was first created in the Microsoft Excel program, XP version (Microsoft CO, USA). The data collected were double-typed so that later, they were imported into the SPSS Program "*StatisticalPackage for the Social Science*" (version 20.0 for Windows), software that allows to calculate the percentage of the data found and to perform the statistical analysis.

The data were organized and presented in the form of graphs and tables, in order to facilitate interpretation. The theoretical discussion was based on the treaties, documents and theorists that discuss the resistance profile of *Klebsiella pneumoniae*. The research project was approved and had the authorization of the Comitê de Ética em Pesquisa da Faculdade de Ciências e Tecnologia do Maranhão (FACEMA – Research Ethics Committee of the Faculty of Sciences and Technology of Maranhão) with the opinion No. 2.926.154 approved on September 28, 2018.

RESULTS AND DISCUSSION

The distribution of cases by month of the year showed concentration in April, July and September (**table 01**). It was found that during the year there were fluctuations in prevalence, with the month of March having the lowest index.

Table 1: Absolute values and percentages of infection with Klebsiella pneumoniae in a private hospital in the months of 2017. *Teresina*-PI.

Months	Klebsiella pneumoniae		Agents others		Total	
	n	%	n	%	n	%
January	5	(7,8)	19	(8,1)	24	(8,0)
February	4	(6,3)	15	(6,4)	19	(6,4)
March	1	(1,6)	12	(5,1)	13	(4,3)
April	8	(12,5)	35	(14,9)	43	(14,4)
May	5	(7,8)	29	(12,3)	34	(11,4)
June	7	(10,9)	20	(8,5)	27	(9,0)
July	8	(12,5)	27	(11,5)	35	(11,7)
August	4	(6,3)	28	(11,9)	32	(10,7)
September	8	(12,5)	15	(6,4)	23	(7,7)
October	4	(6,3)	19	(8,1)	23	(7,7)
November	5	(7,8)	10	(4,3)	15	(5,0)
December	5	(7,8)	6	(2,6)	11	(3,7)

Among the positive cultures for *klebsiella*, it is noted that the most prevalent site was the urinary tract, presenting 34 (56.7%) of the number of cases (**table 02**).

Table 02: Absolute and percentage values of Klebsiella pneumoniae distributed by isolation sites in a private hospital in 2017. *Teresina*-PI.

	Klebsiella pneumoniae	
Site	N	%
Abscess	--	--
Blood Flow	5	(8,3)
Operative wound	4	(6,7)
Injury fragment	1	(1,7)
Pressure injury fragment	--	--
Urinary tract infection	34	(56,7)
Bronchial lavage	1	1,7
Peritoneal fluid	1	1,7
Oropharynx	--	--
Catheter tip	2	3,3
Blood	--	--
Purulent secretion	3	5,0
Tracheal secretion	7	11,7
Systemic	2	3,3

It was observed that the main risk factor for triggering *klebsiella* infection was the use of mechanical ventilation. Another risk factor is the use of central catheter, three cases (18.8%).

Table 3: Absolute values and percentages of Klebsiella pneumoniae infection distributed by risk factors in a private hospital in 2017. *Teresina*-PI.

	Klebsiella pneumoniae	
Risk factors	n	%
Cardiac catheter	--	--
Central catheter	3	18,8
Venous catheter	--	--
Bladder catheter	--	--
Colostomy	--	--
Endoscopy	2	12,5
Eschar	1	6,3
Operative wound	--	--
Buttock prosthesis	--	--
Delayed Urinary Catheterization	2	12,5
Tracheostomy	1	6,3
Mechanical ventilation	7	43,8

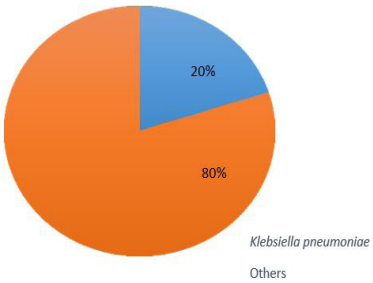
Table 04 shows the distribution of cases of infection with *Klebsiella pneumoniae* and the antimicrobial resistance profile. The most resistant antibiotics were piperacillin / tazobactam and cefixime.

Table 4: Annual average of Antibiotics used in cases of Klebsiella pneumoniae infection in a private hospital in 2017. *Teresina*-PI

	Susceptible		Resistant	
Antibiotic	**n**	**%**	**n**	**%**
Amicacin	30	(46,2)	35	(53,8)
Gentamicin	35	(54,7)	29	(45,3)
Netilmycin	39	(60,0)	26	(40,0)
Tobramycin	19	(52,8)	17	(47,2)
Streptomycin	22	(36,1)	39	(63,9)
Clarithromycin	7	(22,6)	24	(77,4)
Erythromycin	18	(58,1)	13	(41,9)
Ampicillin	9	(29,0)	22	(71,0)
Carbenicillin	11	(35,5)	20	(64,5)
Oxacillin	42	(64,6)	23	(35,4)
Penicillin	30	(50,0)	30	(50,0)
Clindamycin	12	(36,4)	21	(63,6)
Amoxacillin / Clavuanate	19	(55,9)	15	(44,1)
Ticarcillin / Clavulanate	30	(96,8)	1	(3,2)
Ampicillin / Sulbactam	30	(96,8)	1	(3,2)
Piperacillin / Tazobactam	11	(17,5)	52	(82,5)
Vancomycin	14	(36,8)	24	(63,2)
Linezolide	19	(59,4)	13	(40,6)
Cephalothin	5	(15,2)	28	(84,8)
Cefotaxime	11	(73,3)	4	(26,7)
Cefoxitin	31	(48,4)	33	(51,6)
Ceftriaxone	2	(14,3)	12	(85,7)
Cefixime	19	(30,2)	44	(69,8)
Cefepime	20	(35,7)	36	(64,3)
Meropenem	3	(25,0)	9	(75,0)
Ertapenem	28	(45,2)	34	(54,8)
Co-trimoxazole	3	(60,0)	2	(40,0)
Nalidixic acid	20	(64,5)	11	(35,5)
Pipemidic acid	18	(58,1)	13	(41,9)
Ciprofloxacin	29	(87,9)	4	(12,1)
Levofloxacin	28	(49,1)	29	(50,9)
Moxifloxacin	40	(67,8)	19	(32,2)
Sulfazotrim	18	(54,5)	15	(45,5)
Norfloxacin	21	(52,5)	19	(47,5)
Nitrofurantoin	28	(100,0)	-	-
Rifampicin	1	(100,0)	-	-
Tetracycline	1	(100,0)	-	-
Tigecycline	18	(100,0)	-	-
Colistin	3	(33,3)	6	(66,7)

Among the 64 cases of *klebsiella* infection in the hospital in 2017, 13 (20%) of the patients died.

Figure 1 – Percentage of deaths related to *Klebsiella pneumoniae* in a hospital in 2017. *Teresina*-PI.



Brazil has a frequency of 17.3% of isolates of *Klebsiella pneumoniae* and despite the high incidence and risk to health, there are still few institutions that use techniques to identify KPC in their routine.[9] The topographic distribution in this study showed that the most prevalent site was the urinary tract (56.7%). In Brazil, ITU is responsible for about 35 to 45% of all hospital infections, of which 80% are related to the use of delayed urinary catherization (SVD). It is characterized as the second most frequent infection in the general population and occurs in all ages, but there is a higher frequency in three age groups: children up to 6 years of age, young women with active sex life and elderly adults over 60 years of age.[9,10]

Most infections caused by Enterobacteria that produce the enzyme KPC, occur in patients with impaired immunity, who have comorbidities. These are transplant patients, neutropenic, using invasive ventilatory support, those in ICU, with long periods of hospitalization, who present a high risk of infection or colonization for microorganisms with a broad spectrum of resistance, and also with invasive devices such as: catheter, probe, peripheral venous puncture, LPP, tracheostomy, among others.[7-9]

There was a high use of antibacterial drugs in this study. Bacterial resistance to antibiotics is an important problem associated with public health, considering that the newest therapeutic resources do not accompany the evolution of resistance resources. Similarly, part of the population does not have adequate habits in relation to the use of antimicrobials, which leads to compromising their effectiveness. Bacterial resistance is a method that results from some events, such as: indiscriminate use of antibiotics and change in bacterial genes, which conclude in structural changes in bacterial cells.[4-8]

The most resistant antibiotics were piperacillin/tazobactam 52 (82.5%), cefixime 44 (69.8), streptomycin 39 (63.9), cefepime 36 (64.3), amikacin 35 (53.8) and cefoxitin 33 (51.6). The most susceptible were oxacillin 42 (64.6), moxifloxacin 40 (67.8), netilmycin 39 (60.0), gentamicin 35 (54.7), amikacin 35 (53.8), cefoxitin 31 (48.4) and 30 (46.2) amikacin, penicillin, ticarcillin/clavulanate.

Antibiotic resistance may decrease by rational use, taking into account the pharmacological properties of antimicrobials, such as pharmacokinetics and pharmacodynamics, as well as diagnostic tests and

antimicrobial susceptibility tests. The continuing education of the multidisciplinary team, including doctors, pharmacists, microbiologists, nurses, also has great influence on antimicrobial resistance. Another form of prevention is hand hygiene, which is a measure of great efficiency related to the prevention and control of IRAS and also to reduce the spread of multidrug-resistant bacteria.[11]

The increasing diversity of the mechanisms of resistance and a high percentage of *Klebsiella p*neumoniae resulted in a reliance on the use of carbapenemic antimicrobials, which are considered the last therapeutic option available for the treatment of serious infections, a fact that has contributed to the increase in the prevalence of KPC, and has been associated with an increase in the cost and length of patient stay in the hospital, often leading to a lack of processing, resulting in complication of the clinical picture, and death.[4,12]

This theme has aroused great concern in hospitals and health institutions, as *Klebsiellas pneumoniaes* carbapenemases are increasingly present in hospital infections. In this study, deaths due to KPC infection were recorded. Reports of deaths caused by KPC caused alarm in several regions of Brazil.[13,14]

The high risk of IRAS-related mortality is directly associated with sources such as invasive, diagnostic and therapeutic procedures, the proportion of the underlying disease that affects the patient, the site of infection, the adaptation to therapy and the sensitivity of microorganisms to antimicrobials.[15]

To reduce these high rates and mortality, it is necessary that the hospital adopt preventive measures, such as: establish contact precautions in patients with suspicion, confirmation of infection or colonization by multidrug-resistant microorganisms, make the correct use of PPE and follow the recommendations of the precautions, make *swab* culture in conscious patients and put contact precautions until the result of the examinations, make the use of materials and equipment exclusive (sphygmomanometer, thermometer, stethoscope).[2,4,8-10]

Talk about cleaning care using soap and water and disinfection with alcohol 70% of the surfaces and materials that come into contact with the patient, as recommended by the CCIH. Emphasize the rational use of antimicrobial by physicians. Having, during transport within the hospital environment and between hospital institutions, contact precautions and standard precautions for professionals who establish direct contact with the patient and reinforcing environmental hygiene measures are also important measures to be adopted as reported in the literature.[16-18]

CONCLUSIONS

The study provided the identification of the main antibiotics resistant to treatment for *Klebsiella pneumoniae* infection in hospital, with also the knowledge that the urinary tract was the main site affected by the infection and that mechanical ventilation was the main risk factor for contamination by this bacterium.

Due to the high resistance to antibiotics and the great potential for contamination of *klebsiella*, measures should be adopted to minimize the high level of contamination and, especially, the negative prognosis for the patient. It is necessary that the hospital infection control centers periodically evaluate the mechanisms of resistance and thus be able to implement effective measures of prevention and control of transmission.

It is expected that the study data will be used as parameters for new measures to be adopted to prevent and control the spread of infection, especially with the adoption of precautionary measures and effective treatment.

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***Corresponding Author:**
Rosane Da Silva Santana
Rua Fotografo Costinha, 1880, Block 6, Apto 404
Cristo Rei, Teresina, PI, Brasil
E-mail: rosane_santana5@hotmail.com
Telephone: +55 (86) 9 8846-0957
CEP: 64.015-467

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