Original Article

Microbiological profile and antimicrobial resistance profile of patients admitted to the Burn Unit of Hospital Geral "José Pangella" in Vila Penteado in Vila Penteado, Brazil

Perfil microbiológico e de resistência aos antimicrobianos dos pacientes internados na Unidade de Queimaduras do Hospital Geral "José Pangella" de Vila Penteado

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■ **ABSTRACT**

Introduction: Burns are responsible for about 180,000 deaths per year worldwide and about 1,000,000 accidents, more than 100,000 hospital admissions and 2,500 deaths per year in Brazil. Among the causes of morbidity and mortality of burn patients, infections stand out. Knowledge of the microbiological profile and appropriate treatment of infection cases impact on the decrease in morbidity and mortality rates. The Objetive is to analyze the microbiological profile and antimicrobial resistance profile of patients admitted to the Burn Unit of the General Hospital "José Pangella" of Vila Penteado from 2011 to 2018. **Methods:** This is a retrospective study and surveyed all microbiological examinations of patients hospitalized for burns at the "José Pangella" Burns Unit of Vila Penteado General Hospital, located in the city of São Paulo, from January 2011 until the end of December 2018. **Results:** 495 microorganisms were isolated, being 436 bacteria (88,080%) and 59 fungi (11,919%). Among the samples analyzed, the highest prevalence was *Staphylococcus sp.*, followed by Pseudomonas sp., *Klebsiella sp.*, *Candida sp.* and *Acinetobacter sp.* **Conclusion:** Handling burn patients remains a major challenge for burn treatment centers. Identifying the pathogens responsible for patients infections may result in optimal treatment, with an effective antibiotic choice and reducing the morbidity and mortality of these patients, as well as significantly reducing hospitalization time and costs.

Keywords: Burn units; Burns; Microbial sensitivity tests; Indicators of morbidity and mortality; Bacterial infections and mycoses; Bacterial infections.

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RESUMO

Introdução: As queimaduras são responsáveis por cerca de 180.000 mortes por ano no mundo e cerca de 1.000.000 de acidentes, mais de 100.000 internações hospitalares e 2.500 mortes por ano no Brasil. Dentre as causas de morbidade e mortalidade do paciente queimado, destacam-se as infecções. O conhecimento do perfil microbiológico e o adequado tratamento dos casos de infecção impactam na diminuição nas taxas de morbimortalidade. O objetivo é analisar o perfil microbiológico e de resistência aos antimicrobianos dos pacientes internados na Unidade de Queimaduras do Hospital Geral "José Pangella" de Vila Penteado, durante o período de 2011 a 2018. **Métodos:** O estudo é retrospectivo e levantou todos os exames microbiológicos dos pacientes internados por queimaduras na Unidade de Queimaduras do Hospital Geral "José Pangella" de Vila Penteado, localizado na cidade de São Paulo, durante o período de janeiro de 2011 até o final de dezembro de 2018. **Resultados:** Foram isolados 495 microrganismos, sendo 436 bactérias (88,080%) e 59 fungos (11,919%). Entre as amostras analisadas, a maior prevalência foi do *Staphylococcus sp.*, seguido por Pseudomonas sp. e Klebsiella sp., destacando-se, ainda, Candida sp. e Acinetobacter sp. **Conclusão:** O manuseio dos pacientes vítimas de queimaduras continua sendo um grande desafio para os centros de tratamento de queimaduras. Identificar os patógenos responsáveis pelas infecções dos pacientes pode acarretar em uma otimização do tratamento, com a escolha de um antibiótico eficaz, e, dessa forma, acarretar na redução da morbimortalidade desses pacientes, além de diminuir tempo de internação e custos utilizados de maneira significativa.

Descritores: Unidades de queimados; Queimaduras; Testes de sensibilidade microbiana; Indicadores de morbimortalidade; Infecções bacterianas e Micoses; Infecções bacterianas.

INTRODUCTION

Burns are considered a public health problem due to their high prevalence[1]. They are responsible for around 180,000 deaths per year worldwide[2] and are classified as the fourth most common type of trauma, second only to traffic accidents, falls, and interpersonal violence [3]. They mainly affect low-income and developing countries, where mortality is up to 11 times higher than in developed countries[3]. The United States has the highest burn victim mortality rate among industrialized countries. In Brazil, according to the *Sociedade Brasileira de Queimaduras* (SBQ Brazilian Burns Society), burns are responsible for approximately 1,000,000 accidents, more than 100,000 hospitalizations, and 2,500 deaths per year[4-7].

Among the causes of morbidity and mortality of burned patients, infections stand out (the leading cause of mortality in Brazil and worldwide)[8]. Therefore, 75% of deaths in patients with 40% or more surface area body burns are due to secondary infections[9].

It is inferred, therefore, that knowledge of the microbiological profile responsible for infections in this group of patients and the choice of the most effective antibiotics in their treatment, would result in a decrease in morbidity and mortality rates and a shorter hospital stay and a lower number of interventions, thus resulting in a reduction in public spending.

OBJECTIVE

To analyze the microbiological and antimicrobial resistance profile of patients admitted to the Burns Unit of the General Hospital "*José Pangella*" in *Vila Penteado*, during the period from 2011 to 2018.

METHODS

The study was submitted to the Ethics and Research Committee of the General Hospital of *Grajaú - Associação Congregação de Santa Catarina* (Opinion Number: 3,635,831) and, after its approval (CAAE

23032719.9.0000.5447), we were given access to the clinical records of patients admitted to the Burns Unit.

This one is a retrospective, cross-sectional study, through the analysis of all microbiological exams of patients hospitalized for burns at the Burn Unit of the General Hospital "*José Pangella*" in *Vila Penteado*, located in the city of São Paulo, from January 2011 to the end of December 2018.

All patients were submitted to the Free and Informed Consent Form (FICF) and agreed with it.

Patients of both sexes, aged between 8 and 91 years, were evaluated. The burned body surface varied according to each patient.

The patients were admitted to the burn unit in the period analyzed, according to the following admission criteria: partial-thickness burns> 10% of the burned body surface (BBS); burns in particular regions (face, hands, feet, genitals, perineum, neck, or large joints); partial or full-thickness deep burns at any age; circumferential burns at any age; electrical, chemical burns, suspected of inhalation injury, associated with trauma or concomitant disease; In addition to critically ill patients who needed intensive care[10].

Four hundred twenty-six culture exams of a total of 250 patients admitted to the unit in the specified period were analyzed. Such samples were collected during the entire period of hospitalization of the patient, both at the time of admission and at times with an infectious clinic.

Cultures of blood samples (247 samples), urine (31 samples), tracheal discharge (2 samples), vaginal discharge (1 sample), anal swab (12 samples), axillary swab (2 samples), oral swab (1), nasal swab (2 samples), discharge from the lesion (77 samples) and catheter tip (51 samples) were analyzed. All the samples were collected following the collection rules of the Hospital Infection Control Center (CCIH) of the hospital, so that there was no contamination, and they were sent and processed by the laboratory of the *Associação Fundo de Incentivo à Pesquisa* (AFIP Incentive Association for Research), located in the city of Sao Paulo The collected samples were seeded in specific culture media (blood agar, chocolate agar, and MacConkey agar) and were identified after growth.

In addition to counting the microorganisms present, their sensitivity to the antibiotics currently used in the corresponding groups was also verified, reading their respective antibiograms. These antibiograms, as well as the cultures, were also analyzed and released by the laboratory of the *Associação Fundo de Incentivo à Pesquisa* (AFIP), located in the city of São Paulo.

RESULTS

Four hundred twenty-six microbiological examinations of 250 different patients who were admitted to the Burned Unit of the General Hospital "*José Pangella*" in *Vila Penteado* from January 2011 to the end of December 2018 were evaluated. From these tests, 495 microorganisms were isolated, 436 bacteria (88,080%) and 59 fungi (11,919%) (Table 1).

Of these 426 microbiology exams, they were evaluated 247 blood culture samples (57.891%), 31 urine cultures (7.276%), 51 catheter tip cultures (11.971%), 2 tracheal secretion samples (0.449%), 1 of vaginal secretion (0.234%), 12 samples of anal swab (2.816%), 2 samples of axillary swab (0.469%), 1 oral swab (0.234%), 2 nasal swab (0.469%) and 77 samples of secretion from burned injuries (18.075%).

From these exams, we can highlight blood cultures, catheter tip samples (associated with another positive blood culture) and urine cultures (total of 355 samples or 77.138% of the total) as representative of systemic infection with laboratory microbiological evidence, since they represented circulation of the microorganisms and were collected at moments compatible with the patient's infectious clinical condition. These samples were called, by the author, clinically relevant to the study.

Among the samples analyzed, the highest prevalence was *Staphylococcus sp*. (130 cases or 26.262%), followed by *Pseudomonas sp*. (102 cases or 20.606%) and *Klebsiella sp*. (61 cases or 12.323%), with *Candida sp*. (58 cases or 11.717%) and *Acinetobacter sp*. (57 cases or 11.515%) (Figure 1).

There was also an increase in the positivity of the samples in recent years, with *Staphylococcus sp*., *Pseudomonas sp*., *Acinetobacter sp*., and *Klebsiella sp*. (Figure 2).

Table 1. Distribution of microbiological tests.

	2011	2012	2013	2014	2015	2016	2017	2018	Total
Patients	6	30	43	14	17	36	65	39	250
Cultures	7	61	88	17	30	51	105	67	426
Microorganisms	7	67	97	17	30	62	130	85	495
Bacterias	5	58	73	17	28	60	122	73	436
Fungi	2	9	24	0	2	2	8	12	59

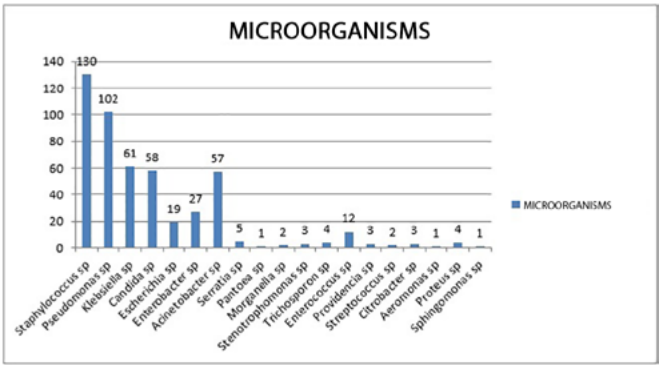

Figure 1. Prevalence of positive samples as a percentage in the period 2011 to 2018.

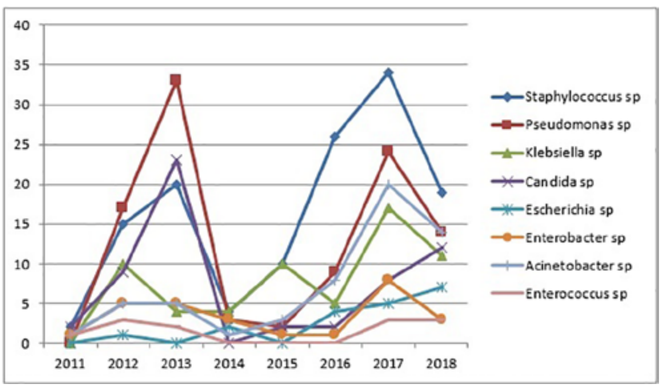

Figure 2. Positive samples of the main microorganisms from 2011 to 2018.

The antibiotic sensitivity profiles of the five most common microorganisms in the study (*Staphylococcus sp.*, *Pseudomonas sp.*, *Klebsiella sp.*, *Acinetobacter sp.* and *Enterobacter sp.*) were also analyzed, disregarding *Candida sp.*, since antifungigram is not routinely performed, as the mutation profile for resistance to yeast antifungals is low (28). The strains of *Staphylococcus sp.* were sensitive to Vancomycin (128 out of 130 microbiological tests or 98.461%), Linezolid (124 out of 130 or 95.384%) and Teicoplanin (120 out of 130 or 92.307%), while being resistant to Penicillin (123 out of 130 or 94.615%), Erythromycin (88 out of 130 or 67.692%) and Clindamycin and Oxacillin (84 out of 130 or 64.615%). *Pseudomonas sp.* was sensitive to Polymyxin B (96 in 102 or 94,117%), Amikacin (40 in 102 or 39,215%) and Imipenem (37 in 102 or 36,274%), while being resistant to Ceftazidime (81 in 102 or 79,411%), Ciprofloxacin (79 in 102 or 77,450%), Meropenem (76 in 102 or 74,509%) and Piperazine-Tazobactam (73 in 102 or 71,568%). *Klebsiella sp.* was sensitive to Amikacin (44 in 61 or 72.131%), Imipenem (30 in 61 or 49.180%), Gentamicin (29 in 61 or 47.540%) and Meropenem (27 in 61 or 44.262%), while being resistant to Ampicillin (57 in 61 or 93.442%), Ciprofloxacin 46 in 61 or 75.409%), Cefepime (45 in 61 or 73.770%) and Ceftriaxone (44 in 61 or 72.131%). *Acinetobacter sp.* was sensitive to Polymyxin B (56 in 57 or 98.245%), Amikacin (43 in 57 or 75.438%) and Gentamicin (42 in 57 or 73.684%), while being resistant to Ceftriaxone (49 in 57 or 85.964%), Ceftazidime (41 out of 57 or 71.929%) and Cefepime, Imipenem and Meropenem (39 out of 57 or 68.421%). Finally, *Enterobacter sp.* was sensitive to Amikacin and Imipenem (25 in 27 or 92.592%), Ertapenem and Meropenem (24 in 27 or 88.888%) and Ciprofloxacin (20 in 27 or 74.074%), while being resistant to Ampicillin (25 in 27 or 92.592%) %), Ceftazidime (24 out of 27 or 88.888%) and Ceftriaxone (23 out of 27 or 85.185%) (Figures 3 and 4).

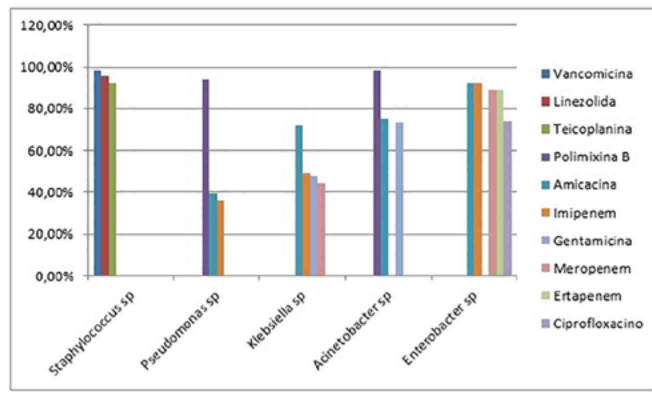

Figure 3. Bacteria sensitive to antibiotics.

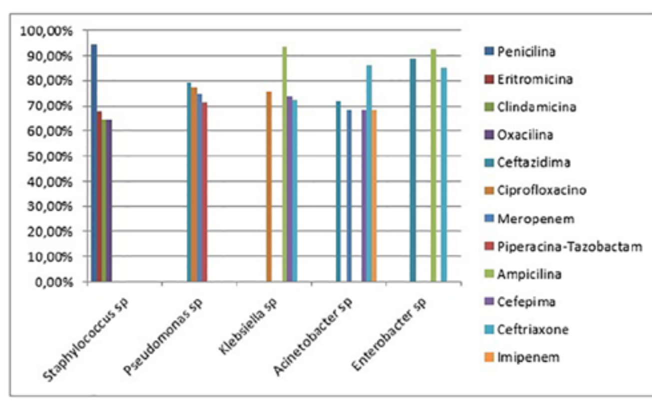

Figure 4. Bacteria resistant to antibiotics.

DISCUSSION

The infection of the burn patient remains a significant cause of morbidity and mortality in this group of patients despite having decreased in incidence in recent years due to improvements in diagnosis and treatment. It mostly affects the male population with 63% of cases[11] and, around 50% of patients with the burned body surface, 20% develop sepsis[12], while 75% of deaths in patients with 40% or more of burned body surface are due to secondary infections[9]. Other literatures point out infections as responsible for about 75% of all deaths in this group[13-15], preferentially affecting the extremes of age groups, such as children (mainly 0-10 years old) and the elderly[13,16,17]. Some studies mention that burns in the child population represent up to 50% of all severe burns, in addition to the population up to 5 years old, representing 50-80% of all childhood burns[1].

According to Coutinho et al., 2015[18], the average body surface burned in 171 patients admitted to the ICU was 28%.

In Brazil, data from the Ministry of Health show that spending on burn victims can reach up to one million reais per month[19], with daily expenses of US $ 1,000 per day[20] for non-fatal cases and more than R $ 1,620.00 for those who die[21,22].

Despite being the fourth most common type of trauma, behind traffic accidents, falls, and interpersonal violence[3], burns have the third place in accidental deaths in the world[21], hence its great importance in public health worldwide. Its leading cause of hospitalization in adults is fire and flammable burns and scalds in pediatric patients[1,10]. According to the National Burn Information Exchange (1996), 60% of accidents happen in the home environment. Luiz Philipe Molina Vana, plastic surgeon and president of SBQ, says that this figure rises to 77%.

The risk of the burned patient contracting an infection varies according to the extent and depth of the injury[14,23]. These lesions, to a greater or lesser degree, are responsible for breaking the protective barrier of the skin, which facilitates the entry of microorganisms, in addition to the immunological depression caused in these patients, the formation of necrosis as a favorable environment for bacterial proliferation, of the various invasive procedures, the extended hospital stay of these patients, the gastrointestinal bacterial translocation, among others[13]. There is also vascular obstruction caused by thermal injury, which hinders the arrival of both antimicrobials and components of the immune system to the burned area[15].

Contaminated wounds usually present phlogistic characteristics, such as hyperemia, heat, and discharge of secretion, in addition to, in cases of bacteremia, dysthermias and leukocytosis. Necrosis is a crucial culture medium for the growth of opportunistic microorganisms and needs to be removed as soon as possible. In the first 48 hours, the wounds are already colonized by gram-positive bacteria, which can be reduced with the use of topical antimicrobials. After about 5 to 7 days, however, they are colonized by gram-negative bacteria, of hospital origin or origin of the gastrointestinal or respiratory tracts[24,25], which can have severe consequences for the patient, such as serious infections and increased morbidity and mortality.

According to Nasser et al., 2003[26], in the first week of hospitalization, gram-negative bacteria were predominant (55.7%) against gram-positive bacteria (40.3%), whereas, in the second week, this predominance of gram-negatives becomes even more evident (72.7% x 22.7%). Among bacterial pathogens, we must highlight the microorganisms that potentially cause serious infections, such as the gram-positive *methicillin-resistant Staphylococcus aureus* (MRSA) and the gram-negative *Pseudomonas aeruginosa*, requiring broad-spectrum antibiotic coverage. Its use on a large scale, however, favors the growth of fungal microorganisms, such as *Candida, Aspergillus, and Mucor*[9].

Staphylococcus aureus, the most prevalent pathogen in wounds and blood cultures after the advent of Penicillin, has a mortality rate of up to 30% and can reach 45% when it comes to MRSA. The group A Beta Hemolytic Streptococcus, group A, the primary pathogen present in burn wounds before the development of Penicillin, stands out as a gram-positive[27,28].

Of the gram-negatives, *P. aeruginosa* (most prevalent), *Acinetobacter baumanniie*, and *Enterococcus spp* stand out[9,15,29].

The importance of these pathogens lies, in addition to their higher virulence, in the great capacity to develop resistance to the antibiotic treatments currently used. The use of broad-spectrum drugs should be used carefully to try to avoid the spread of these pathogens, which corroborates the importance of research related to microbiological profiles. Studies show that, of the patients infected with *Acinetobacter baumanniie*, 46% develop bloodstream infection and, of these, 38% end up dying[30], showing the high virulence of the microorganism. Severe patients in the ICU or on mechanical ventilation for more than 24 hours are more likely to develop fungal infections, such as *C. tropicalis, C. parapsilosis, C. krusei*, and *C. glabrata*[31]. Thus, the knowledge of the profile of the most common microorganisms in each Burn Unit is essential to restrict the proliferation of these resistant pathogens.

The present study, as well as in the literature, demonstrates the prevalence of *Staphylococcus sp.* (26.262%), *Pseudomonas sp.* (20.606%) and *Acinetobacter sp.* (11.515%), in addition to highlighting the importance of others, such as *Klebsiella sp.* (12.323%) and *Candida sp.* (11.717%). It also shows a predominance of gram-negative (73.737%) over gram-positive (26.262%)[9].

CONCLUSION

The handling of burn victims remains a significant challenge for burn treatment centers. Identifying the pathogens responsible for infections, as well as the appropriate choice of antibiotic therapy, can lead to an optimization of treatment and, thus, reduce the morbidity and mortality of these patients.

The rationalization of antimicrobial therapy is a mainstay of antibiotic administration programs and is associated with fewer side effects and lesser appearance of resistant microorganisms, in addition to significantly reducing hospital stay and costs.

Besides, it is observed that the number of positive cultures and infections remain high in the population studied, corroborating the importance of studying microbiological profiles.

COLLABORATIONS

AFA Analysis and/or data interpretation, conception and design study, conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, realization of operations and/or trials, resources, writing - original draft preparation, writing - review & editing.

EMT Conception and design study, conceptualization, final manuscript approval, methodology, project administration, supervision, validation, visualization, writing - review & editing.

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