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ORIGINAL ARTICLE

Profile of antimicrobial use in burn patients admitted to an intensive care unit

Perfil de utilização de antimicrobianos em pacientes queimados internados em unidade de terapia intensiva

Perfil del uso de antimicrobianos em pacientes quemados ingressados em uma unidad de cuidados intensivos

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ABSTRACT

Background and Objectives: After extensive burns, infections are a major cause of death. This study aimed to identify bacterial infections and antimicrobial consumption in burn patients admitted to an intensive care unit (ICU). **Methods:** A retrospective observational study was conducted at a public trauma referral hospital in 2022. Data were obtained from patient medical records. Antimicrobials were classified following the Anatomical Therapeutic Chemical (ATC) system, and the amount administered was expressed in Defined Daily Dose per thousand patient-days (DDD/1000). **Results:** A total of 64 burn patients were hospitalized during the period, 75% of them were male, aged 18 to 83 years. The main cause of hospitalization were fires (45%), with the mortality outcome observed in 25% of cases. Bacterial infections were present in 73.4% and fungal infections in 4.7% of cases. In total, 263 microorganisms were isolated, including Gram-negative bacteria (n=183), Gram-positive bacteria (n=73), and fungi (n=7). A total of 15 different antimicrobials were used, totaling 13,060 units dispensed. The total antimicrobial consumption during the study period was 1,111.20 DDD/1000, with the most used antimicrobials being meropenem (281.0 DDD/1000), oxacillin (250.5 DDD/1000), polymyxin B (1.8 DDD/1000), and vancomycin (178.0 DDD/1000). **Conclusion:** Bacterial infections show a high incidence among critical burn patients. The use of broad-spectrum antimicrobials, such as meropenem and vancomycin, may be related to the infection profile of these ICU patients.

Keywords: *Burns. Bacterial Infections and Mycoses. Anti-Infective Agents. Burn Units.*

RESUMO

Justificativa e Objetivos: Após queimaduras extensas, as infecções são uma causa de morte importante. O objetivo deste estudo foi identificar as infecções bacterianas e o consumo de antimicrobianos em pacientes queimados internados em uma Unidade de Terapia Intensiva (UTI). **Métodos:** Estudo observacional retrospectivo desenvolvido em um hospital público referência em trauma no ano de 2022. Os dados foram obtidos do prontuário do paciente. Os antimicrobianos foram classificados de acordo com a *Anatomical Therapeutic Chemical* (ATC) e a quantidade utilizada expressa em Dose Diária Definida por mil pacientes-dia (DDD-1000). **Resultados:** Internaram por queimaduras no período, 64 pacientes, 75% do sexo masculino, com idade entre 18 e 83 anos, fogo (45%) foi a principal causa de internação e o desfecho óbito foi observado em 25% dos casos. A incidência de infecções bacterianas foi de 73,4% e de infecções fúngicas de 4,7%. Foram isolados 263 microrganismos, Gram-negativos (n=183), Gram-positivos (n=73) e fungos (n=7). Foram utilizados 15 diferentes antimicrobianos, totalizando 13.060 unidades dispensadas. O consumo total de antimicrobianos no período foi de 1.111,20 DDD-1000, sendo os mais utilizados meropenem (281,0), oxacilina (250,5), polimixina B (1,8) e vancomicina (178,0). **Conclusão:** Infecções bacterianas são de alta incidência em pacientes queimados críticos. A utilização de antimicrobianos de amplo espectro como meropenem e vancomicina podem estar relacionados ao perfil de infecção desses pacientes em UTI.

Descritores: *Queimaduras. Infecções Bacterianas e Fúngicas. Agentes Antimicrobianos. Unidades de Queimados.*

RESUMEN

Justificación y Objetivos: Después de quemaduras extensas, las infecciones son una causa importante de muerte. El objetivo de este estudio fue identificar las infecciones bacterianas y el consumo de antimicrobianos en pacientes quemados ingresados en una unidad de Cuidados Intensivos (UCI). **Métodos:** Estudio observacional retrospectivo desarrollado en un hospital público de referencia de traumatología en el año 2022. Los datos se obtuvieron de la historia clínica del paciente. Los antimicrobianos se clasificaron según la Química Terapéutica Anatómica (ATC) y la cantidad utilizada expresamente en Dosis Diaria Definida por mil días-paciente (DDD-1000). **Resultados:** 64 pacientes fueron hospitalizados por quemaduras durante el período, 75% del sexo masculino, con edades entre 18 y 83 años, el fuego (45%) fue la principal causa de hospitalización y el desenlace se observó en el 25% de los casos. La infección por infecciones bacterianas fue del 73,4% y por infecciones fúngicas del 4,7%. Se aislaron 263 microorganismos, Gram negativos (n=183), Gram positivos (n=73) y hongos (n=7). Se utilizaron 15 antimicrobianos diferentes, totalizando 13.060 unidades dispensadas. El consumo total de antimicrobianos en el período fue de 1.111,20 DDD-1000, siendo los más utilizados meropenem (281,0), oxacilina (250,5), polimixina B (1,8) y vancomicina (178,0). **Conclusión:** Las infecciones bacterianas tienen una alta incidencia en pacientes críticos quemados. El uso de antimicrobianos de amplio espectro, como meropenem y vancomicina, puede estar relacionado con el perfil de infección de estos pacientes de la UCI.

Palabras Clave: *Quemaduras. Infecciones Bacterianas y Micosis. Antiinfecciosos. Unidades de Quemados.*

INTRODUCTION

Burns are skin injuries resulting from exposure to thermal, chemical, or electrical energy agents, capable of producing excessive heat that damages body tissues and leads to cell death.[1,2,3] Burns are classified into first, second, and third degrees based on the depth of skin damage. The severity of a burn is determined by evaluating its depth, size of the body surface, and region affected. Moreover, the extent of the burn, along with depth, inhalation injury, and other factors, will determine the patient's severity status and therapeutic approaches. Burns also cause significant systemic changes, such as hypermetabolic and inflammatory response, with impact on the patient's general clinical condition.[1,2,3]

Globally, the World Health Organization (WHO) estimates that 11 million burn injuries occur every year, with 180,000 being fatal.[1] The incidence of these events varies across regions,[1] with 90% of mortality occurring in low- and middle-income countries.[4] In the United States, in 2016, approximately 486,000 patients were treated for burns, and approximately 40,000 required hospitalization.[5]

In Brazil, according to the Brazilian Ministry of Health, via the Hospital Information System of the Unified Health System (SIH/SUS), in 2022, 3,836 hospitalizations were recorded due to burns, representing 0.28% of all hospitalizations registered that year.[6]

Infections are the leading cause of death after extensive burns, with burn patients suffering from infections showing double the mortality rate compared to those who are not infected.[5,7] Damage to the integrity of the skin's protective barrier increases the risk of invasion of pathogenic microorganisms that can cause infections.[7] Other factors involved in the infection process in burn patients include inhalation injuries, endotracheal intubation, central venous access, arterial lines, urinary catheters, surgical procedures, and prolonged hospitalization. Moreover, systemic changes in burn patients also impact the immune system, further increasing susceptibility to infections.[1,7,8] The most common infections in burn patients are pneumonia, bloodstream infections, and wound infections.[9]

Prevention and early diagnosis of sepsis are essential in the care of burn patients. Prevention can be achieved via antimicrobial dressings, surgical intervention with early grafting, and nutritional support. However, there is no evidence of effectiveness in administering systemic antimicrobials preventively.[7] Antimicrobial resistance increases morbidity, mortality, and length of hospital stay, while also hindering the prevention of infections in patients undergoing multiple procedures and reducing therapeutic options for treating infections caused by some microorganisms. Furthermore, antimicrobial resistance increases healthcare costs for both public and private/supplementary systems, as well as for society.[10]

In 2021, it is estimated that 4.71 million deaths were associated with bacterial resistance worldwide. Among Gram-negative bacteria, resistance to carbapenems stood out compared to other classes of antimicrobials, with these infections totaling 1.03 million associated deaths.[11]

Given the above, this study aimed to identify bacterial infections and antimicrobial consumption in burn patients admitted to a burn/trauma intensive care unit (ICU).

METHODS

This work followed an observational design with retrospective data collection and was conducted in a reference ICU for the treatment of burn patients, with 10 beds, at a public hospital in the south of Brazil. This unit receives patients from various municipalities statewide and also operates as a backup for other trauma cases. In this study, all patients hospitalized for burns from January to December 2022 were included. Patients hospitalized for other causes were excluded.

The data were obtained via the SIH/SUS, specifically from the Medical Records, Laboratory, and Pharmacy modules, and were compiled into an Excel spreadsheet for analysis. The Medical Records module covers the patient evolution by both the medical and multidisciplinary team perspective, so the information is presented in a complementary way. The Laboratory module provides access to laboratory test results, including cultures and antibiograms. The Pharmacy module provides access to data on medications dispensed by the hospitalization unit. Burn cause was classified at the time of admission following the SIS/SUS categories, including chemical agent, electric current, explosive, fire, or liquids. Data on patient's age, sex, cause of burn, length of stay, burned body surface, outcome, microorganisms identified in culture tests, and the dose and type of antimicrobials used.

The antimicrobials used during the period were grouped following the third level of the Anatomical Therapeutic Chemical (ATC) classification, corresponding to the pharmacological subgroup, then further categorized following the fifth level, corresponding to the specific chemical substance.

The amount of antibacterial used, in grams, was divided by the corresponding Defined Daily Dose (DDD), which represents the assumed average maintenance dose per day for a medication used for its main indication in adults weighing 70 kg, despite not necessarily reflecting the recommended or prescribed daily dose.[12] Then, the number of patient-days was used as the denominator to estimate the density or consumption rate per patient-day. This

consumption density was multiplied by 1,000, transforming into density or consumption rate per thousand patient-days (DDD/1000). The DDD patient-day data is a measure that enables comparisons of medication consumption between studies.[13]

The data were compiled into Excel spreadsheets, analyzed using descriptive statistics, and presented via absolute and relative frequencies.

The research was conducted following the required ethical standards, in accordance with Resolutions 466/2012, 510/2016 and 580/2018, of the Brazilian Ministry of Health. The project was approved by the Research Ethics Committee, CAAE 62935722.1.0000.5338 under opinion 5801905, on December 8, 2022.

RESULTS

During 2022, 197 patients were admitted to the ICU, 64 (34%) due to burns. Most burn patients were male (75%), with a median age of 43 years, ranging from 18 to 83 years. The major cause of burns was fire (45.31%), and death occurred in 25% of cases (Table 1).

Table 1. Characteristics and outcomes of burn patients admitted to a burn/trauma ICU (Porto Alegre, ICU, 2022, n=64).

Parameter	Outcome				
	Discharge on request n (%)	Discharge n (%)	Death n (%)	Transfer n (%)	Total n (%)
Sex					
Female	0	11 (17.2)	3 (4.7)	2 (3.1)	16 (25.0)
Male	2 (3.1)	28 (43.8)	13 (20.3)	5 (7.8)	48 (75.0)
Age group (years)					
15 to 40	2 (3.1)	20 (31.3)	5 (7.8)	4 (6.3)	31 (48.4)
41 to 60	0	15 (23.4)	7 (10.9)	1 (1.6)	23 (35.9)
More than 60	0	4 (6.3)	4 (6.3)	2 (3.1)	10 (15.6)
Cause of burn					
Chemical agent	0	6 (9.4)	3 (4.7)	1 (1.6)	10 (15.6)
Electrical current	0	6 (9.4)	1 (1.6)	0	7 (10.9)
Explosive	1 (1.6)	4 (6.3)	1 (1.6)	1 (1.6)	7 (10.9)
Fire	0	17 (26.6)	10 (15.6)	2 (3.1)	29 (45.3)
Liquids	1 (1.6)	6 (9.4)	1 (1.6)	3 (4.7)	11 (17.2)
Days in ICU					
Up to 10	0	15 (23.4)	8 (12.5)	0	23 (35.9)
11 to 30	2 (3.1)	13 (20.3)	8 (12.5)	3 (4.7)	26 (40.6)
31 to 90	0	9 (14.1)	0	1 (1.6)	10 (15.6)
More than 90	0	2 (3.1)	0	3 (4.7)	5 (7.8)
Body surface area (%)					
Up to 20	2 (3.1)	20 (31.3)	2 (3.1)	2 (3.1)	26 (40.6)
20 to 40	0	15 (23.4)	5 (7.8)	3 (4.7)	23 (35.9)
More than 40	0	4 (6.3)	9 (14.1)	2 (3.1)	15 (23.4)
Not informed	0	1 (1.6)	0	0	1 (1.6)

Total	2 (3.1)	39 (61.0.)	16 (25.0)	7 (10.9)	64 (100.0)

The average length of stay in the ICU was 30.2 days, and total hospitalization was 46.7 days. The incidence rate of bacterial and fungal infections in critically ill burn patients was 73.4% and 4.7%, respectively. Of the 64 patients, 50 (78.1%) received antibiotics and 47 (73.4%) had positive culture results.

In total, 15 different antimicrobials were used, totaling 13,060 units dispensed. The total consumption of antimicrobials during the period was 1,111.60 DDD/1000 patient-days. Meropenem, oxacillin, polymyxin B, and vancomycin were the antimicrobials with the highest DDD/1000 (Table 2).

Table 2. Units consumed and defined daily dose of antimicrobials used in burn patients admitted to a burn/trauma ICU in 2022.

ATC	Antimicrobials	DDD/1000	Consumed units
Other antimicrobials		**361.9**	**3,720**
J01XB02	Polymyxin B 500.000 UI vial	183.9	1,624
J01XA01	Vancomycin 500 mg vial	178.0	2,096
Beta-lactams, penicillins		**346.6**	**3,811**
J01CF04	Oxacillin 500 mg vial	250.5	2,950
J01CR05	Piperacillin 4 g + Tazobactam 500 vial	49.3	508
J01CR02	Amoxicillin 1 g + Clavulanate 200 mg vial	28.5	21
J01CR01	Sulbactam 1 g + Ampicillin 2 g vial	18.8	332
Other beta-lactams		**335.7**	**5,268**
J01DH02	Meropenem 500 mg vial	281.0	4,963
J01DE01	Cefepime 2 g vial	39.9	235
J01DB04	Cefazolin 1 g vial	9.0	8
J01DD02	Ceftazidime 1 g vial	4.8	56
J01DD04	Ceftriaxone 1 g vial	1.0	6
Aminoglycosides		**32.7**	**108**
J01GB03	Gentamicin 80 mg/2 mL ampoule	16.9	15
J01GB06	Amikacin 500 mg/2 mL ampoule	15.8	93
Quinolones		**23.4**	**147**
J01MA12	Levofloxacin 500 mg/100 mL bag	14.6	43
J01MA02	Ciprofloxacin 200 mg/100 mL bag	8.8	104
Macrolides, streptogramins, and lincosamides		**11.3**	**6**
J01FA10	Azithromycin 500 mg vial	6.8	2
J01FF01	Clindamycin 600 mg/4mL ampoule	4.5	4
Total		**1,111.6**	**13,060**

The microorganisms were isolated and identified via cultures of material collected from the respiratory system (tracheal aspirate, sputum, pleural fluid), bloodstream cultures, and urinary system. These tests were requested in order to confirm or reject the diagnosis of an infectious condition associated with devices in ICU patients on mechanical ventilation, with tracheostomy, central and/or peripheral venous line, and indwelling bladder catheters.

A total of 263 microorganisms were isolated, Gram-negative (69.6%), Gram-positive (27.7%), and fungi (2.7%). A single patient could have more than one pathogen identified in more than one collection site. The fungus *Candida* sp. was identified in seven samples, with three from the respiratory system and four from the urinary system (Figure 1).

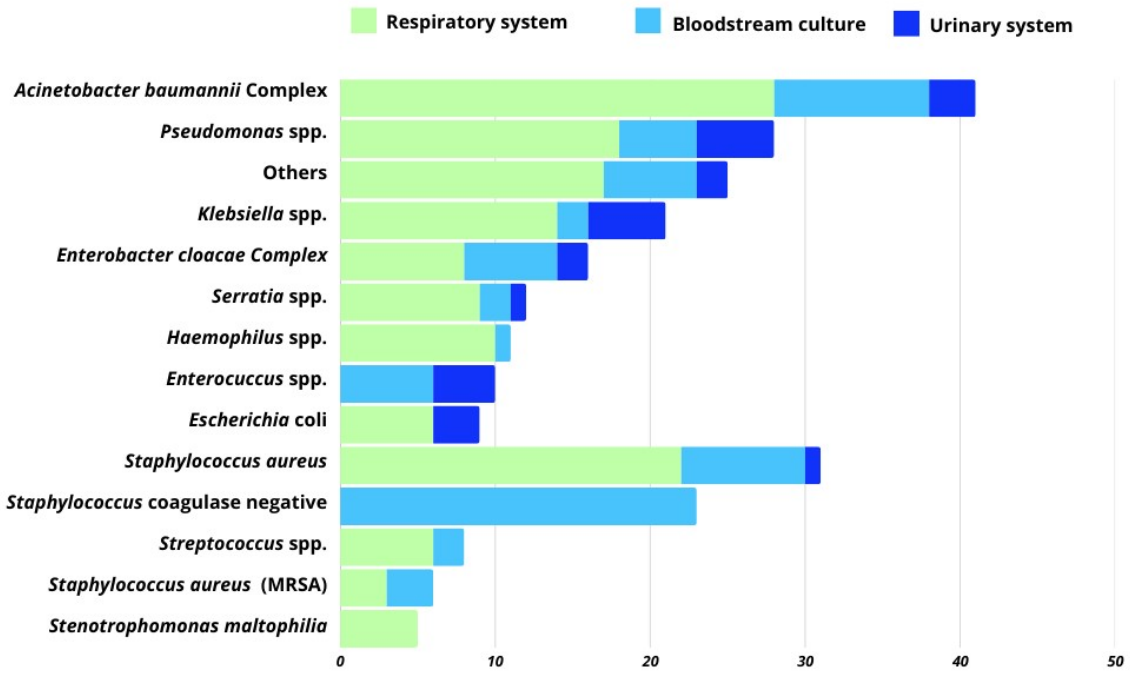

Figure 1. Gram-positive and Gram-negative microorganisms identified by collection site in burn patients admitted to a burn/trauma intensive care unit in 2022.

DISCUSSION

In this study, the incidence rate of bacterial infections in critically ill burn patients was high (almost a third of patients) and resulted in the use of 15 different antimicrobials, with a greater frequency of broad-spectrum antimicrobials such as meropenem and vancomycin. The average age of patients admitted to the ICU was 43 years, mostly males, and a higher prevalence of burns caused by fire, a profile consistent with both international and national studies.[14,15,16]

The average length of ICU stay was 30.2 days, similar to the findings of a study conducted with 711 patients admitted from 2011 to 2020 in Lisbon, Portugal, in which the average was 29 days. The factors that prolonged hospital stay included burn severity, the number of surgeries, the time elapsed until the first surgery, hematological and biochemical laboratory parameters during hospitalization, and the presence and number of documented infections.[17] On the other hand, a study conducted in Goiânia, state of Goiás reported an

average ICU stay of 14.73 days.[14] A review study covering 54,397 burn patients showed a trend towards a positive association between infection and longer hospital stay.[9]

In this context, 62.5% of patients were discharged, whereas 25% had a fatal outcome. Other studies indicated a mortality rate of around 10%.[14,15] A retrospective study conducted at a university hospital in the city of Uberaba, state of Minas Gerais, with 168 burn patients hospitalized from January 2013 to January 2019, found a positive relationship between mortality and incidence of infections, as well as burned body surface, number of accesses used, and hospital expenses. The mortality rate was 7.73%, similar to that found in this study.[18]

We highlight that severe burn injuries are traumatic and physically debilitating, impacting almost all body systems and leading to significant morbidity and mortality.[1] Burn patients are vulnerable to infections, making the rational use of antimicrobials essential in the prevention of the development of bacterial resistance in the hospital setting. Patients with severe burns commonly require prolonged hospitalization, urinary and arterial catheters, central lines, orotracheal intubation, and/or other procedures that also increase the risk of contamination. Moreover, the use of broad-spectrum antimicrobial therapy is an important factor in the development of infections caused by resistant agents.[17]

We found a 73.4% incidence of bacterial infections in critically ill burn patients, with 47.5% in the respiratory system, 28.1% in the bloodstream, and 11.4% in the urinary system. We found no records of skin infections related to burns. A review study found that the main infections in burn patients include pneumonia,[5,8] bloodstream infections, and those in burned areas.[9] The formation of biofilm on catheters plays an important role in infections, as bacteria are in a protected environment, with proximity that enables the exchange of genetic material, thus facilitating the occurrence of phenotypic changes and the production of virulence factors.[19]

Among the 263 microorganisms isolated, 69.6% were Gram-negative and 27.7% were Gram-positive, a result similar to the review study by Braga and collaborators, which evaluated the main pathogens causing infections in burn patients and found a frequency of Gram-positive and Gram-negative bacteria ranging from 21.8% to 24% and from 70.3 to 78%, respectively.[20]

The results regarding Gram-negative bacteria are in line with the findings by Troche-Zaracho and collaborators (2017), who found *Pseudomonas aeruginosa* (37%), *Acinetobacter* spp. (26%), and *Klebsiella* spp. (18%) as the most prevalent strains.[16] A study involving patients in a trauma ICU (without burns), showed a bacteriological profile similar to that found in the burn/trauma ICU in Porto Alegre, state of Rio Grande do Sul, with 75% of the bacteria

isolated being Gram-negative and 25% Gram-positive, in line with our results and with the hospital bacteriological profiles found in the literature.[21]

The risk of infections caused by multidrug-resistant microorganisms increases with the length of hospital stay in burn patients. In the first days of post-burn hospitalization, more susceptible Gram-positive microorganisms predominate, while later more resistant Gram-negative microorganisms are found.[5,8]

A study evaluated 200 burn patients at a hospital in Italy, and the cumulative prevalence of infections was 27% on the 7th day and 43.8% on the 28th day. Skin and soft tissue infections (32%) were the most common. The most prevalent infections included carbapenem-resistant *Acinetobacter baumannii* (28%), *P. aeruginosa* (26%), and *Staphylococcus aureus* (MRSA) (25%). The presence of a central line was associated with a higher infection rate, while surgical treatment acted as a protective factor.[22]

Regarding fungal infections, *Candida* sp. was identified in seven samples, three of which came from the respiratory system and four from the urinary system. *Candida* sp is the main fungus found in burn wounds and represents a significant risk only when it invades certain tissues or the bloodstream, considerably increasing lethality rates. The incidence of this pathogen increases with prolonged hospitalization, especially if it exceeds three weeks, due to the routine antimicrobial use and the presence of extensive lesions not covered by grafts.[19]

It is crucial that antimicrobials are prescribed only when there is a clear clinical indication, administered at the appropriate dose, and for an appropriate period, following the institutional protocols. Moreover, they should be chosen based on the sensitivity of the bacteria causing the infection and monitored for the development of adverse effects.[13]

Regarding the use of antimicrobials, the total consumption during the analyzed period was 1,111.6 DDD/1000, significantly higher than that found in a study conducted at the National Burn Center of Paraguay, which showed an antimicrobial consumption of 78.4 DDD/100 bed-days.[16]

In this study, meropenem, oxacillin, polymyxin B, and vancomycin were the most frequently used antimicrobials. In the study by Troche-Zaracho and collaborattors (2017), ceftazidime was the most used drug, and among the most consumed classes of antimicrobials were “Other antibacterials” (36.19 DDD/100 patient-days), followed by “Beta-lactams and penicillins” (34.66 DDD/100 patient-days),[16] showing a similar profile to that found in our study.

The class of “Other antibacterials,” represented by the drugs vancomycin and polymyxin B, showed the highest consumption (32.5% of the total). Vancomycin is the first

choice for empirical treatment when MRSA infection is suspected, particularly in regions with a high prevalence of methicillin-resistant *S. aureus* isolates and in patients known to be colonized by MRSA.[23] However, the bacterial profile in this study pointed that only 2.3% of the samples were infected with MRSA.

Moreover, vancomycin is generally used as part of combined treatments in cases of infections caused by multidrug-resistant Gram-negative bacteria, including *P. aeruginosa* and *A. baumannii*.[22] The indication of the drug is in line with the bacterial profile identified in this study. However, consumption was found to be disproportional when related to the low prevalence of cultures with MRSA. Some factors such as surgical prophylaxis with vancomycin and a longer time until de-escalation may have contributed to the high rate of use of this medication.

Regarding the "Beta-lactams of the penicillin class," oxacillin was the most used, showing a good safety and efficacy profile considering the assessment of susceptibility to methicillin. Moreover, oxacillin shows good tissue penetration and is one of the drugs of choice in cases of *S. methicillin-sensitive aureus* (MSSA). In a study conducted at a general ICU, which analyzed antimicrobial consumption over five years, there was a large variation in oxacillin consumption over the period. However, a tendency towards an increase in MRSA was found among the isolates of Gram-positive microorganisms, along with an increase in the consumption of vancomycin and a decrease in oxacillin. Overall, the study pointed a decrease in the consumption of medications with a more selective action against Gram-positive microorganisms and an increase in medications with a selective profile for Gram-negative or broad-spectrum microorganisms.[24]

Meropenem is a broad-spectrum antimicrobial and accounted for 38% of the total antimicrobials dispensed. A systematic review and meta-analysis sought to identify potential modifiable risk factors for colonization or infection by multidrug-resistant Gram-negative microorganisms in severely burned patients. Previous exposure to extended-spectrum cephalosporins and carbapenems, as well as the use of urinary and arterial catheters, were found to pose a greater risk of infection or colonization by these microorganisms.[25]

The use of broad-spectrum drugs, such as meropenem and vancomycin, is associated with the infection profile typically found in the ICU setting. The choice of empirical antibiotics in severely burned patients requires a proactive approach by the multidisciplinary infection control team,[5,8] which is in line with the recommendations of the Brazilian National Plan for Antimicrobial Resistance Prevention and Control in Health Services, which considers interaction between prescribers, clinical analysis laboratories, and clinical pharmacy services

to be essential. This interaction enables monitoring of therapy results, as well as directing treatment time and de-escalation of antimicrobials used. Joint actions allow improving patient outcomes and reducing hospital costs.[13]

This study shows limitations, including its retrospective nature, with data collected from medical records, which may be incomplete or inaccurate. For this reason, the data analyzed are associated with information on antimicrobial consumption and test results, which are generally good quality data.

The estimation of DDD/1000 is an antimicrobial consumption data that enables monitoring trends in consumption patterns over time and facilitates comparisons within the same institution and/or other hospitals. However, the tool shows limitations, as it does not analyze the adequacy of antimicrobial indications or treatment time.[12,13,21]

On the other hand, the present study provided a comprehensive overview of the epidemiology and treatment of patients with severe burns in a burn/trauma ICU. The results revealed a significant number of bacterial infections. Understanding the local microbiological profile is important for selecting antimicrobial therapies, thus leading to better patient outcomes.

The results of this study can also encourage the development of a management program for the use of antimicrobials in the institution, that is, a set of actions aimed at controlling the use of antimicrobial medications in the service, including pharmacovigilance.

Further studies can be developed seeking to elucidate the associations between the variables analyzed, in addition to deepening the investigation into the microbiological profile and the prescription of antimicrobials in burn patients. Moreover, economic analyses can be conducted on the use of antimicrobials and other medications used in the care of burn patients.

Understanding microbiological and microbial resistance profiles, along with treatment practices in burn patients, can support the clinical management of the medications used. The rational use of antimicrobials is essential for improving clinical outcomes and addressing the challenges inherent in treating patients with severe burns in hospital settings.

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