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RESEARCH ARTICLE

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NURSING ASSISTANCE IN ANTIBIOTIC THERAPY IN FRONT OF BURNED PEDIATRIC PATIENT IN INTENSIVE CARE UNIT

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ABSTRACT

Burned pediatric patients often enter the hospital environment, antibiotic prophylaxis is one of the main approaches to these clinical conditions, which requires adequate skills, techniques and knowledge on the part of nurses to provide assistance to this public. The objective was to analyze the scientific productions on nursing care in antibiotic therapy for pediatric patients burned in the intensive care unit (ICU). The methodological approach constitutes an exploratory, bibliographic study with integrative, qualitative and quantitative analysis of the literature available in virtual libraries such as the PubMed, Google Scholar and Scopus databases in which the free full text, the period of time, was included as inclusion criteria. established between 2014 to 2019, as well as the thematic focus. As a result, it was observed the pharmacokinetics of the main antibiotics used in the pediatric public burned in the ICU environment, biotechnology of antimicrobial drugs, care related to dressings and xenografts, main resistant multidrug bacterial species found in the pediatric ICU environment, in addition to the main nursing actions against burns. It is concluded that the scientific literature on this subject is still limited, in addition, unanimously, studies show that hand washing is the best action against the spread of pathogens.

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INTRODUCTION

The World Health Organization (WHO) considers antimicrobial resistance as one of the most urgent global issues that represents a fundamental threat to human health, development and security [1]. Antimicrobial resistance is a serious worldwide public health problem that can cause an estimated 10 million deaths per year by 2050 [2]. Among the various microorganisms involved in the different infections associated with health care that affect humans, bacteria and fungi account for about 80% to 87% of these causes [3]. In this context, burn patients are within the risk group for the development of infections, especially the pediatric public. At the end of the initial 72 hours after a burn injury, infections are the most common cause of death, with pneumonia associated with ventilation being the most common infectious process in this population. In addition, as the hospital stay is prolonged, the chance of colonization of the patient by microorganisms, especially bacteria, increases [4]. During the first days of hospitalization, the burn victim is more likely to be colonized by Gram-positive organisms, and as the stay in the hospital is

extended it is common to colonization and / or infection by Gram-negative organisms [5]. In this sense, responsible management of available antimicrobials is vital, in order to avoid the indiscriminate and irrational use of antibiotics that lead to a massive development of resistance to human and animal infections [6]. From this research, it is expected to contribute with information on the application of antibiotic therapy, as well as the main nursing care for burned pediatric patients, collaborating for future investigations regarding the optimization of the use of antimicrobial drugs, and thus collaborating in the fight different types of infections and pathologies. Additionally, this proposal will be strategic to guide the use of antimicrobials in the treatment of burns in pediatrics. It should be emphasized that the present study will also allow the encouragement and guidance for the production and diffusion of scientific knowledge, related to the subject studied, from the production of scientific articles in the study area.

Literature Survey: Antibiotics have been widely used to treat and prevent bacterial diseases. However, the indiscriminate

use of antibiotics has led to the emergence of microorganisms resistant to these drugs [7]. Thus, antibiotic resistance has become a global health problem that is closely linked to the misuse of antibiotics, both in humans and in animals [8]. In this perspective, bacterial infections are a frequent cause of hospitalization, and nosocomial infections are an increasingly common condition, especially in the context of acute and critical care. Infection control practices and innovations in antimicrobial development have mainly focused on attacking gram-positive bacteria; however, in recent years, the incidence of infections caused by gram-negative bacteria has increased considerably in intensive care units [9]. Infections caused by multi-resistant Gram-negative organisms are associated with high morbidity and mortality, with significant direct and indirect costs, resulting from prolonged hospitalizations due to failures in treatment with antibiotics. In addition, the increasing prevalence of antimicrobial resistance to β -lactam antibiotics, including carbapenems, aimed at combating microorganisms such as *Pseudomonas aeruginosa* and *Acinetobacter baumannii*, has excessively limited the treatment options for these infections. [9]. In this sense, bacterial infections can have a major impact on the health of patients with burn injuries, especially pediatric patients who sometimes need the specialized assistance found in intensive care units. The burn causes an increase in vascular permeability resulting in loss of water, proteins and electrolytes; which can trigger hypovolemic shock, so the delay in the treatment of burns can be fatal. In the past, hypovolemia was one of the most common causes of mortality in burn patients, however, currently, sepsis remains the main cause of mortality in burn patients, given that the importance of adequate applicability of effective and sensible antibiotics is visible [10].

In Brazil, according to data from the Ministry of Health (MS), burns, in their various forms, are a major cause of hospitalization in children. They are in second place among childhood accidents and occupying the 5th and 6th places in cases of mortality in children from 0 to 4 years old and from 5 to 9 years old, respectively [11]. The average age for susceptibility to triggering burns in children is around the age of 34 months, that is, children between 9 months and 8 years old, with boys as the predominant victims. The main causes of burns are hot oil, flame and hot water, among these types there is a tendency for delayed healing in burns by hot oil when compared to the others. Antibiotics are indicated only for the treatment of confirmed infections, it is believed that antibiotic prophylaxis in burn wounds results in unnecessary costs and a greater risk of inducing antibiotic resistance. *Staphylococcus aureus*, *Pseudomonas* spp., *Escherichia coli*, *Klebsiella* spp. and enterobacteria are the predominant bacteria in burn wounds [12]. So, in order to carry out this research, we started with the following problem: Is antibiotic therapy against pediatric patients burned in the intensive care unit carried out indiscriminately? This research is justified because the context of burns in children is a serious public health problem both in Brazil and in the world, as well as the use of antibiotics has a profound impact on the victims' health prognosis and nursing care has a significant performance, if not to say crucial to alleviate the emotional, physiological and physical integrity needs of the burn victim. In this perspective, the study aimed to carry out a bibliographic survey related to nursing care in antibiotic therapy against pediatric burned patients in the intensive care unit.

METHODS

The present study is a review of the literature, which according to Marconi and Lakatos (2017) the bibliographic research comprises the entire literary production related to the topic of study, which allows the contact of the researcher with all or even much of the content already produced about a certain theme [13]. To survey the articles, an online search was performed in the PubMed, Google Scholar and Scopus databases using the following health descriptors (Decs): Care. Child. Burns. Antibacterial. Inclusion criteria were the full free text, the time period established between 2014 to 2019, as well as the thematic focus.

RESULTS/DISCUSSION

With the aforementioned descriptors, a total of 173 articles were found in the PubMed database, of which only 25 articles had full free text, of these only 6 articles were within the thematic focus and the established publication period. In the Google Scholar database, only 3 articles met the inclusion criteria. In the Scopus database, only 2 articles met the inclusion criteria. Therefore, for this research, 11 articles were used as described in the table below: Analytical reading of the selected articles was carried out, which made it possible to organize the subjects in order of importance and to synthesize them, which aimed at fixing the essential ideas for solving the research problem. To make the research operational, the findings were discussed in categories (Table 1). Of the 11 articles analyzed, three emphasized the pharmacokinetics of the main antibiotics used in the pediatric public burned in an ICU environment such as amikacin, vancomycin, imipenem-cilastatin, piperacillin-tazobactam and daptomycin [14, 15, 16]. In addition, three more publications reported the execution and care of dressings and xenografts in the case of a burnt pediatric patient, development of antibiotic-based dressings, highlighting mupirocin, as well as the development of drugs guided by bacterial genetic material. Another three publications emphasized the general care performed by the nursing team for the burned pediatric patient, as well as the assessment of the professionals' conduct [17,18, 19]. Finally, two publications reported that the presence of *Acinetobacter* sp. and *Stenotrophomonas maltophilia* are the most resistant multidrug bacterial species found in the pediatric ICU environment. They are resistant to antibiotic classes such as aminoglycosides, extended-spectrum cephalosporins, quinolones, carbapenems and penicillins [20, 21]. It is evident that the scientific literature regarding nursing care in antibiotic therapy for pediatric patients burned in an intensive care unit is still limited, since most scientific productions within the theme of antimicrobials emphasize the adult public. In addition, it is important to note that the present study demystified the gloomy prognosis of vancomycin's inherent nephrotoxicity, revealing that some antibacterial combinations can be as or more toxic than this drug alone [22, 23, 24]. In addition, it is also crucial to highlight that in view of the articles used in the research, it can be understood that the septic stage that plagues the pediatric public burned in the ICU environment, is a great predictor for the establishment of antimicrobial doses higher than those Conventional drugs administered routinely, since most pediatric septic burn patients had a high clearance rate of antimicrobials, making conventional doses often subtherapeutic.

Table 1: Characteristics and main results of the studies examined. Teresina-PI, 2019.

Author (Year)	Title	Main results	Conclusion
Ali et al., 2017	Outbreak Of Extensively Drug Resistant <i>Stenotrophomonas Maltophilia</i> In Burn Unit.	<i>Stenotrophomonas maltophilia</i> is an emerging cause of nosocomial infections. The authors reported an outbreak of XDR- <i>Stenotrophomonas maltophilia</i> infection in the burn unit of a tertiary hospital in July 2016. The isolated strain was resistant to all tested antimicrobials except colistin. Patients were treated appropriately by Colistin.	<i>Stenotrophomonas maltophilia</i> it is a potential threat to burn treated patients in a hospital setting. It is recommended that the burn unit equipment be properly sterilized. Water sources should be properly verified as a source that spreads <i>Stenotrophomonas maltophilia</i> in hospital settings.
Antachopoulos et al., 2018	Pharmacokinetics of Daptomycin in Critically Ill Pediatric Patients.	The pharmacokinetics of daptomycin (10 mg / kg once daily) have been studied in 4 severely ill pediatric patients, aged 8 to 14 years. The area under the concentration-time curve of the plasma concentration time on day 1 varied between 123.8 to 663.9 $\mu\text{g} \cdot \text{h} / \text{mL}$, with lower values observed in septic and burn patients; clearance ranged from 15.1 to 80.7 ml / h / kg. Higher than recommended doses of daptomycin in septic children to ensure optimal exposure to the drug.	It demonstrated significantly less drug exposure in pediatric septic patients treated with daptomycin compared to healthy volunteers or patients with mild infections. This suboptimal exposure appears to be associated with increased clearance of daptomycin and was more pronounced in the burned patient. Therefore, higher than recommended doses of daptomycin may be necessary for children with sepsis in order to ensure appropriate exposure.
Cortês et al., 2015	The nursing team's knowledge about care for burn victims	It was observed that nurses, professionals who work between 10.1 to 15 years and professionals with ages between 20 and 29 years had a higher number of correct answers, but without statistical significance.	Incorrect conduct, disrespecting aseptic techniques, can cause serious and irreversible damage to the burned pediatric patient. Therefore, continuing education improves the level of knowledge of the nursing team on the subject and decreases iatrogenies.
Cunha et al., 2017	Care provided by the nursing team to patients who suffered burns	<u>General care front</u> 1) Water balance; 2) Central access in patients with major burns and / or upper limbs; 3) Reverse insulation; 4) Use of personal protective equipment; 5) use of sterile sheets; 6) Change of fixations, 7) Change of position. <u>Facing humanization:</u> 1) Perform analgesia and / or sedation during bathing and dressing; 2) Daily psychological monitoring; 3) presence of a companion. <u>Facing nursing knowledge during the bath:</u> 1) sterile technique; 2) presence of the doctor and the nursing team; 3) duration of the bath; 4) drying the patient with a sterile sheet. <u>In view of nursing knowledge during curative:</u> 1) performing the curative done by the doctor and the nurse; 2) sterile technique; 3) action of nursing technicians during the curative; 4) Papain is used in tissues with slough and / or necrosis; 5) Silver sulfadiazine is used in granulation fabrics; 6) Essential fatty acids are used on the skin whole; 7) Use of Fibers and AGE on the face; 8) occlusive curative	The study enabled knowledge about the assistance to burned patients and at the same time demonstrated the importance of nurses to update themselves and increase their scientific knowledge, in order to provide more adequate assistance to patients. In addition to the care offered by nursing to the patient who suffered a burn, the role of the multidisciplinary team is of paramount importance to ensure comprehensive care, as observed in the study. The need to elaborate and disseminate new studies that involve the studied theme as a way of improvement for the nursing teams that work with burn patients is emphasized.
Elmasry et al., 2016	Treatment of Children With Scalds by Xenografts: Report From a Swedish Burn Centre.	67 children were studied, of which 43 were boys, with a median age of 1 year and about twenty children (30%) required xenograft operation at the scalp level due to burns. Twelve children developed wound infection, 29 had other infections and 26 were infection-free. Despite a high rate of prescribing systemic antibiotics, most were for reasons other than wound infection. Revealing that the systemic administration of antibiotics proved to be unnecessary.	The first-line antibiotic treatment of the burn center is usually a cephalosporin, followed by penicillin. Thus, there was an increase in the number of opportunistic bacteria with more complicated resistance patterns. Thus, as a result of the study, penicillin was started as the first line antibiotic for children with scalp burns. The use of prophylactic systemic antibiotics in burn patients is still debatable. Topical antibiotics in dressings are still recommended and decrease the chances of bacterial resistance.
Hundeshagen et al., 2017	Co-administration of vancomycin and piperacillin-tazobactam is associated with increased renal dysfunction in adult and pediatric burn patients	The aim of the study was to assess the short-term impact of vancomycin, imipenem / cilastatin and piperacillin-tazobactam in renal dysfunction. Of the 718 patients examined, 246 were adults and 472 were children. Administration of vancomycin combined with piperacillin-tazobactam revealed a lower rate of creatinine clearance compared to patients who received Vancomycin alone or a combination of vancomycin and imipenem + cilastatin in adults and children after suffering a burn. Thus demonstrating that vancomycin associated with piperacillin-tazobactam is an independent predictor of renal dysfunction.	Concomitant administration of vancomycin and piperacillin-tazobactam is associated with increased renal dysfunction in pediatric and adult burn patients when compared to vancomycin alone or vancomycin associated with imipenem-cilastatin. The mechanism of this increased nephrotoxicity remains elusive and deserves further scientific evaluation.

Li et al., 2018	Electrospun PCL/mupirocin and chitosan/lidocaine hydrochloride multifunctional double layer nanofibrous scaffolds for wound dressing applications.	Development of double layer curative from mupirocin, lidocaine hydrochloride and chitosan.	The antibiotic dressing showed excellent hydrophilicity, cytocompatibility, sustained drug release and antibacterial activity, highly effective against <i>Staphylococcus aureus</i> , <i>Escherichia coli</i> and <i>Pseudomonas aeruginosa</i> and were non-toxic to fibroblasts.
Melo et al., 2015	Popular knowledge and health production: rethinking practices in maternal and child care	Qualitative, exploratory and descriptive study with 12 pregnant women, between 17 and 40 years old, from the Community Health Agents Program Unit (PACS), in the urban area of Petrolina-PE, chosen due to the cultural insertion and the socioeconomic situation of the neighborhood, the which favors the introduction of popular practices. The pregnant women reported the main popular beliefs for the care with maternal and child health, often taught by older family members, close to burns. In many situations, without having immediate access to health institutions, women opt for popular care.	Popular care should not be the only source of information, but it must be coupled with scientific knowledge, offered by health professionals, not allowing the community to expose itself to unnecessary risks and being able to take care of the health of the binomial in a safer way.
Shaykh Baygloo et al., 2015	Identification of Genomic Species of <i>Acinetobacter</i> Isolated from Burns of ICU Patients.	<i>Acinetobacter</i> spp. 10 of the 80 (12.5%) burned patients investigated were isolated. All 10 isolates of <i>Acinetobacter</i> were identified as <i>Acinetobacter baumannii</i> resistant to multiple drugs, through antibiotic susceptibility tests such as the disk diffusion method according to (CLSI). e Different categories of antimicrobial antibiotics were tested such as amikacin (30 µg) (aminoglycosides), cefotaxime (30 µg) (extended spectrum cephalosporins), ceftriaxone (30 µg) (extended spectrum cephalosporins), ciprofloxacin (5µg), quinone (5µg), quinone Imipenem (10µg) (carbapenemic), piperacillin (100µg) (penicillin)	Of the members of the <i>Acinetobacter baumannii</i> complex, only the species <i>A. baumannii</i> was identified among the isolates obtained from patients with infected burns in a hospital in Isfahan for a period of 9 months. The bacteria that infect ICU patients, including burn patients, can originate from the patient himself, the contaminated hospital, equipment, environment, staff and other patients. In addition, resistance can be achieved during long periods of treatment.
Sherwin et al., 2014	Amikacin population pharmacokinetics among paediatric burn patients	The pharmacokinetics of amikacin in children with severe burns were evaluated. weight, age, sex, height, serum creatinine, C-reactive protein, platelet count, extent and type of burn and concomitant administration of vancomycin were not influenced by the pharmacokinetics of amikacin. Children with burn had a high amikacin clearance when compared to healthy adult volunteers. However, maximum concentrations of amikacin are comparable to those obtained in other critically ill children, suggesting that high amikacin clearance may not result in sub-therapeutic antibacterial effects.	Amikacin exhibits pharmacokinetics in two compartments, with weight having a strong effect on amikacin clearance. Additional pharmacodynamic studies are needed to establish the ideal dosage regimen for amikacin in pediatric burn patients.
Tong et al., 2018	Synthesis of DNA-guided silver nanoparticles on a graphene oxide surface: enhancing the antibacterial effect and the wound healing activity	Development of a compound with silver nanoparticles guided by single-stranded DNA in graphene oxide that exhibits synergistic antibacterial activity against <i>Escherichia coli</i> , <i>Pseudomonas aeruginosa</i> , <i>Staphylococcus aureus</i> and <i>Bacillus subtilis</i> with low minimal inhibitory concentrations. In addition to the healing capacity of wounds infected with <i>Staphylococcus aureus</i> .	In conclusion, the properties of nanoparticles with antibacterial capacity and improved wound healing will offer wide applications in the future, for different injuries, whether due to burns and other causes.

Font: Own authorship

Conclusion

In view of the theme discussed in this study, about nursing care in antibiotic therapy for pediatric patients burned in the intensive care unit, it can be concluded that the main bacterial agents that plague pediatric patients burned in ICU environments are *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Acinetobacter* sp. and *Stenotrophomonas* sp. multidrug resistant. In addition, the articles unanimously report the power of hand washing against the spread of these pathogens. The prophylaxis and antibiotic treatment of burned children admitted to the ICU, according to the study's target literature, mostly include vancomycin, amikacin, piperacillin-tazobactam, imipenem-cilastatin and daptomycin. The most common adverse effects of these antibiotics, observed in the studies, are the high clearance rate of these substances in patients, especially in septic, which may turn a conventional dose into subtherapeutics, in addition to the nephrotoxicity resulting from some of these drugs and or the combination of themselves. Additionally, it was observed

that the nursing professionals with the greatest success in terms of their behavior towards the burned pediatric patient are those professionals aged between 20 and 29 years old and with experience time between 10.1 and 15 years of employment. In this way, it is noticed that the young audience is more open to information and requests for learning, disentangling itself from traditionalisms, conservatisms and certain resistance found in older professionals.

Future scope

In view of the theme worked in the present study, it is intended to articulate a field research, involving the respective theme of this study, in an intensive care unit environment, in order to list and discuss the experience of the clinical practice of antibiotic therapy and main nursing care intended for the burned pediatric public.

Author short profile

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