Original Article

The Bacterial Contamination in the Burn Unit of Al- Hussain Teaching Hospital at Al-Samawa City, Iraq

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Abstract

Background: The main causes of a burn patient's mortality are microbial infection which is related to burn unit contamination, which represents a significant health problem in the burn ward. **Objectives:** The aim of this study was to determine the types and microbial contamination degree in eleven different burn wards at AL-Hussain Teaching Hospital in Al-Muthanna Province-Iraq. **Materials and Methods:** This survey study included 770 samples (burn unit swabs) from June 2019 to march 2021 distributed into 70 swabs for each one of the different sources with missing system 3 for each (Floor of the Burn Ward, Locker of the Burn Ward, Bed of the Burn Ward, Floor in Bathroom of the Burn Ward, Chart of the Burn Ward, Door in Bathroom of the Burn Ward, Shower in Bathroom of the Burn Ward, Wall of the Burn Ward, Wall In Bathroom of the Burn Ward, Gauze of the Burn Ward, and Surgical Instruments of the Burn Ward). **Results:** The data of samples cultivation, 284(39%) samples yielded bacterial growth and 453(61%) samples showed no bacterial growth. The highest rate of positive growth was seen in samples of Floor of the Burn Ward 5 (78%) while the lowest incidence of positive growth was 1(1%) in samples of Surgical Instruments of the Burn Ward. Gram-positive bacteria were the predominant 173(61%) as compared with gram negative bacteria 111(39%). **Conclusion:** On the basis of data results we conclude that burn ward especially Floor harbor bacteria. Although some bacteria were normal flora, potentially pathogenic bacterial rates diverse between places.

Keywords: Al-Muthanna, bacterial contamination, burn unit, burn ward, patient

Introduction

Burn infections are considered a significant cause of death among burn patients. As skin represents the first barrier in the forward-facing of foreign pathogens, severe damage of it in severe burns leads to critical cases of necrosis, which introduce an optimum condition for microbial colonization and invasion.[1] Burns are dangerous foci of bacterial reproduction compared to surgical wounds, this is mostly due to the large area of the burns and the length of the patient's hospitalization.[2] It is estimated that around 75% of the mortality related to burns is associated with septicemia, especially in developing countries.[3,4] Overcrowding in hospital burn units is a major source of cross-infection that requires high costs and regular monitoring of hospital bacterial infection and its antibiotic resistance because significant shifts in this resistance may affect drug selection for treatment.[5,6] So, despite intensive treatment with antibiotics, bacterial burn infections may increase morbidity to 50%–60% in the burn unit.[7] Regardless of the procedure used in the surface cleaning and in what way the clinicians wash down their hands, the surfaces and hands may have different microbes. *Pseudomonas aeruginosa*, *Klebsiella* spp., and *Acinetobacter* spp. are three important examples of pathogenic bacteria that are usually associated with medical infections known to lead a septic shock in the burn intensive care patient, especially with their ability for surviving on desiccated

Access this article online

Quick Response Code:

Website: www.medjbabylon.org

DOI: 10.4103/MJBL.MJBL_93_23

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Submission: 29-Jan-2023 **Accepted:** 20-Mar-2023 **Published:** 02-Aug-2023

How to cite this article: Kadhim TA, Al Sa'ady AT, Khayoon HA, Hameed DM, Hussain SS, Kareem AS, *et al.* The bacterial contamination in the burn unit of Al-Hussain Teaching Hospital at Al-Samawa City, Iraq. Med J Babylon 2023;20:357-61.

surfaces for long periods.[8,9] In a review by Williams *et al*.[10] about the causes of death in pediatric burn center for 20 years the period from 1989 to 1999, and 1999 to 2009, bacterial sepsis represented the leading cause of death for 47% of burn patients, especially with multiple antibiotic-resistant bacteria. Patients in the burn intensive care unit (BICU) are at increased risk of infection so this unit should have particular infection control necessities unique to this facility.[11] The development of new agents, the judicious and suitable use of antibiotics, and the improvement of infection control protocols are critical in the current battle against multi-resistant pathogenic bacteria particularly, superbugs.[12] Also, sampling isolates from burn patient's skin demonstrated that the impaired skin contains MRSA bacteria.[13] In this study, we aimed to categorize the types and microbial contamination degrees in eleven different burn wards at AL-Hussain Teaching Hospital in Al-Muthanna Province-Iraq.

Materials and Methods

This survey study was accompanied by institutionally appropriate laboratory protocol for 22 months from June 2019 to march 2021. A total number of 770 samples were taken from the burn unit at AL-Hussain Teaching Hospital in Al-Muthanna Province-Iraq distributed into 70 swabs for each one of the different sources with missing system 3 for each. The total valid number of samples 737 have been distributed as 67 samples for each source (Floor of the Burn Ward, Locker of the Burn Ward, Bed of the Burn Ward, Floor in Bathroom of the Burn Ward, Chart of the Burn Ward, Door in Bathroom of the Burn Ward, Shower in Bathroom of the Burn Ward, Wall of the Burn Ward, Wall In Bathroom of the Burn Ward, Gauze of the Burn Ward, and Surgical Instruments of the Burn Ward). Laboratory diagnosis of bacterial isolates achieved according to the diagnostic characteristics compared with referential references.[14,15]

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients' verbal and analytical approval before the sample was taken. The study protocol and the subject information and the consent form were reviewed and approved by a local ethics committee according to document number 2 (including the number and the date on May 1, 2019) to get this approval.

Results

Table 1 shows numbers and percentages of samples collected from different sources in the burn ward. The total number of samples 770 was distributed into 70 swabs for each one of the different sources with missing system 3 for each. The total valid number of samples 737 has been distributed as 67 samples for each source. Depending on the results of sample cultivation, 284(39%) samples yielded bacterial growth, and 453(61%) samples showed no bacterial growth. The highest rate of positive growth was seen in samples of Floor of the Burn Ward 5 (78%) while The lowest incidence of positive growth was 1(1%) in samples of Surgical Instruments of the Burn Ward.

As detailed in Table 2, there are 284 bacterial isolates isolated in the present study. Gram-positive bacteria were the predominant 173(61%) as compared with gram-negative bacteria 111(39%). The highest isolation rate has been recorded from the floor of the burn ward 52(18%) followed by the locker of the burn ward 34(12%) while the lowest isolation rate has been recorded from the Surgical Instruments of the burn ward 1(0.4%).

Figure 1 emphasizes the prevalence of gram-positive bacteria with the highest percentage of isolation in the chart of the burn ward 28/31(90%) followed by a bed of the burn ward 22/33(67%), locker of the burn ward 22/34(65%) and floor of the burn ward 31/52(60%). On

Table 1: Numbers and percentages of samples collected from different sources of burn ward in the present study

No.	Source of Isolation	Valid Number of samples(no=67)		Missing system	Total number of samples (valid and missing)
		Growth (+)	Growth (-)		
1	Floor of the Burn Ward	52(78%)	15(22%)	3	70
2	Locker of the Burn Ward	34(51%)	33(49%)	3	70
3	Bed of the Burn Ward	33(49%)	34(51%)	3	70
4	Floor in Bathroom of the Burn Ward	33(49%)	34(51%)	3	70
5	Chart of the Burn Ward	31(46%)	36(54%)	3	70
6	Door in Bathroom of the Burn Ward	27(40%)	40(60%)	3	70
7	Shower in Bathroom of the Burn Ward	25(37%)	42(63%)	3	70
8	Wall of the Burn Ward	25(37%)	42(63%)	3	70
9	Wall In Bathroom of the Burn Ward	15(22%)	52(78%)	3	70
10	Gauze of the Burn Ward	8(12%)	59(88%)	3	70
11	Surgical Instruments of the Burn Ward	1(1%)	66(99%)	3	70
Total		284(39%)	453(61%)	33	70
		Total of valid number of samples = 737			

Table 2: Comparison of isolation rate between Gram-negative and Gram-positive bacteria

No.	Source of Isolation	Gram-negative bacteria	Gram-positive bacteria	Total number of bacterial isolates
1	Floor of the burn ward	21	31	52(18%)
2	Locker of the burn ward	12	22	34(12%)
3	Bed of the burn ward	11	22	33(11.6%)
4	Floor in bathroom of the burn ward	24	9	33(11.6%)
5	chart of the burn ward	3	28	31(11%)
6	Door in bathroom of the burn ward	10	17	27(9.5%)
7	Wall of the burn ward	5	20	25(8.8%)
8	Shower in bathroom of the burn ward	19	6	25(8.8%)
9	Wall in bathroom of the burn ward	3	12	15(5.3%)
10	Gauze of the burn ward	3	5	8(3%)
11	Surgical instruments of the burn ward	0	1	1(0.4%)
Total		111(39%)	173(61%)	284

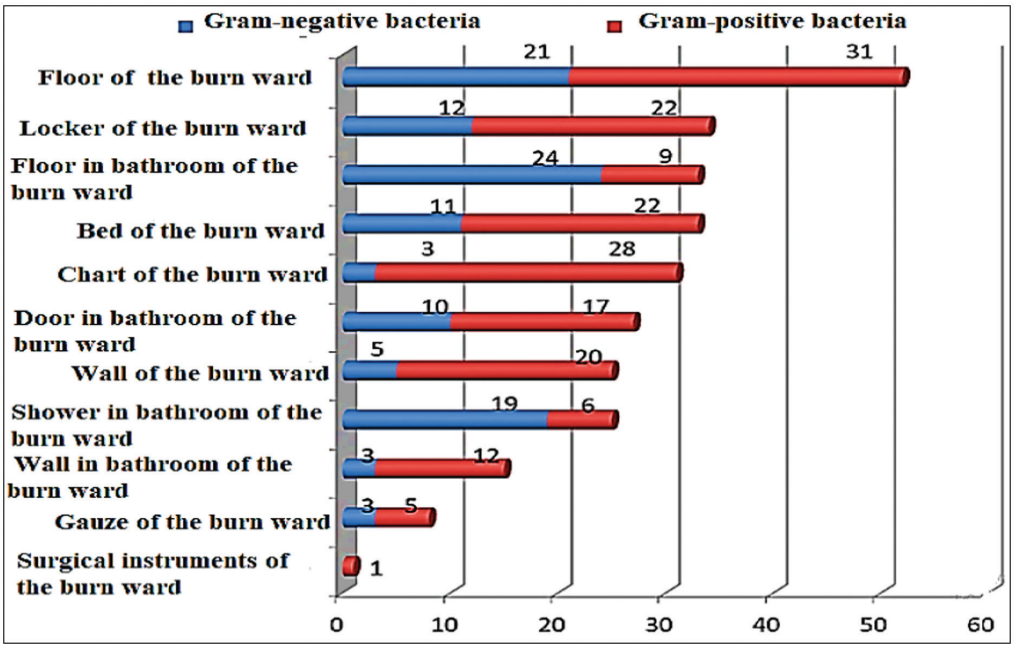

Figure 1: Isolation rate of gram-positive and gram-negative bacteria depending on the source of sample in the present study

Table 3: The isolation rate of bacterial species isolated in the present study

No.	Gram-negative bacteria	Number of isolates(%)	No.	Gram-positive bacteria	Number of isolates(%)
1.	*Pseudomonas aeruginosa*	40(36%)	1.	Bacillus spp.	95(55%)
2.	*Enterobacter* spp.	37(33%)	2.	*Staphylococcus albus*	47(27%)
3.	*Klebsiella spp.*	19(17.1%)	3.	*Staphylococcus aureus*	20(12%)
4.	*Escherichia coli*	14(13%)	4.	CONS	9(5%)
5.	*Citrobacter* spp.	1(0.9%)	5.	*Streptococcus* spp.	1(0.5%)
6.			6.	*Streptococcus thoraltensis*	1(0.5%)
Total of Gram-negative bacteria		111(39%)	Total of Gram-positive bacteria		173(61%)
Total number of bacterial isolates = 284					
CONS: Coagulase Negative Staphylococci					

the other hand, The highest percentage of isolation of gram-negative bacteria was 19/25(76%) from a shower in the bathroom of the burn ward followed by 24/33(73%) from the floor in the bathroom of the burn ward and 21/52(40%) from the floor of the burn ward.

As shown in Table 3, among 173 gram-positive isolates that have been identified in the present study, the highest isolation frequency is for *Bacillus spp*. 95(55%) followed by *Staphylococcus albus* 47(27%) and *Staphylococcus aureus* 20(12%). On the contrary, among 111 gram-negative

isolates that have been identified in the present study, the highest isolation frequency was for *Pseudomonas aeruginosa* 40(36%) followed by *Enterobacter spp*. 37(33%) and *Klebsiella spp*. 19(17.1%).

Discussion

The mortality of burn patients in Iraq has increased alarmingly in recent years. mostly, burn patient has a complex bacterial infection that may develop into septicemia and death. Most of these microbial infections are attributed to multidrug-resistant bacteria making their treatment represents a serious challenge in hospitals. This phenomenon has become an important human aspect that requires more continuous studies to know the possible updates in the patterns of bacteria causing burn infection, such as an increase or decrease in the rate of isolation of a certain bacterial species, or reporting of other bacterial species as contributing etiologies of burn infections.[16]

As shown in Table 1 in the current study, the highest rate of positive growth was seen in samples of the floor of the burn Ward. Other parts of the burn ward also have bacterial growth at different rates and species. The results reported in the current study are lower than the results reported in a study by Alhassi *et al*.[17] who found that positive culture was seen in the burn ward of 143 (73%) samples. In a study by Lyseva *et al*.,[18] the percentages of burn patients with nosocomial infections increased significantly as follows: 34.56% in 2007, 64.24% in 2008, and 75.98% in 2010. These percentages can gradually increase year by year and may even record leaps great in this field. On the contrary, if there is a longer hospital stay, more healthcare procedures, and more antibiotic treatment, there is a higher chance of acquiring antibiotic-resistant bacteria. Efforts and costs spent to prevent nosocomial infections by multidrug-resistant bacteria could save a significant number of lives and keep many healthcare resources.[19,20]

In the current study, gram-positive bacteria were dominant as compared to Gram-negative. The rate of bacterial isolation from the burn ward is a variable with the different sources [Table 2].

As shown in Figure 1, gram-positive bacteria were not isolated at the same rate from all sources of isolation in the current study. It was most common in the chart, bed, and locker in the burn ward. This may be due to more manual handling by healthcare workers and patients.[21]

Taking into consideration that most of the normal human skin flora is Gram-positive bacteria. While Gram-negative bacteria have the most isolation rate from the shower and floor in the bathroom. This may be due to contamination with the urine and stool of the patient, which inevitably contains members of the Enterobacteriaceae family.[22]

The results showed shows that *Bacillus* spp., *Staphylococcus albus,* and *Staphylococcus aureus* are predominant among Gram-positive bacteria[Table 3]. *Bacillus* spp. is linked to airborne transmission because of its ability for spore-forming resulting in its being widely distributed environmentally. it can be considered an uncommon but aggressive and highly virulent pathogen in burn infections associated with a very high mortality rate. there are many Environmental reservoirs for this bacteria in the hospital such as contaminated air filtration systems, linens, towels, linen clothes, gloves, hands of health care workers, bottles' plastic lids, alcohol-based hand wash solutions, and specimen collection tubes.[23,24]

Staphylococcus albus is a member of Coagulase Negative Staphylococci (CoNS), so, this result supports the view that CoNS should not be regarded as a skin contaminant during bacterial culturing but suggests that may result from repeated handling by healthcare workers and family members with poor hygiene.[25]

The high isolation rate of *Staph. aureus* in the current study may be due to the burned skin seeming to have weak resistance to bacterial colonization, particularly by *S. aureus*, so these bacteria easily reach the bed and surrounding environment.[25,26]

Among Gram-negative bacteria, *Pseudomonas aeruginosa* has the most isolation rate [Table 3]. *Pseudomonas aeruginosa* is usually associated with both nosocomial and community-acquired infections. It remained the highest-numbered bacteria present in patients of burn unit and may be described as a problematic, virulent, and ubiquitous pathogen in this unit.[27,28]

Many published evidences emphasized that the hospital environment represents an important reservoir of *P. aeruginosa* because of its ability to adapt to diverse environments and survive with minimal nutritional requirements and toleration of a wide range of extreme physical conditions, furthermore, it can thrive in diluted sterilizers and disinfectants used in hospitals.[29,30]

Enterobacter spp. and *Klebsiella* spp. are members of the Enterobacteriaceae family and coliform bacteria, so their isolation is an indicator of fecal contamination. *Klebsiella* spp. is common commensal in the human gut and may be excreted with feces, vomiting, and respiratory secretions. Outbreaks of *Enterobacter spp*. recorded in previous years varied in their sources from milk powder, thermometers, transducer heads used in the wards, and water which was used to take a shower.[31-33]

Conclusions

In conclusion of this study, gram-positive bacteria were dominant pathogens among burn infections. Bacterial species isolated from the burns unit are different according to the source of samples. Most of the bacterial isolates

have been isolated from the floor of the burn ward, so the floor needs more attention.

Acknowledgments

We are thankful to all staff in the Burn Unit and laboratory at Al-Hussain Teaching Hospital.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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