Original article

Incidence of Bacterial Skin Infections in Libya: A Retrospective Population-Based Study

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ABSTRACT

Introduction: The global burden of bacterial skin infection is substantial. We aimed to determine the common pathogens causes skin infections and their antimicrobial resistance pattern.

Methods: A retrospective record review of data claimed from the microbiology department at Ber-Ustta Milad skin hospital between Jan 2009 to December 2018 was conducted. The consequence of interest was the antimicrobial sensitivity of bacterial isolates. Chi square was used for statistical analysis.

Results: Out of 1,141 collected samples, a total of 455 isolates of different medically-significant bacteria were analyzed. The most common pathogen was *S. aureus* (97.14%), followed by *E. coli* (93.71%), and the least common was *Shigella* (0.57%). From the various inoculated samples, *S. aureus* and *proteus* were highly resistant to penicillin (34.3%, 75% respectively) and ampicillin (28.6%, 62.5% respectively). *E. coli* was highly resistant to ampicillin (45.12%) and penicillin (35.96%), whereas the lowest resistant was against imipenem (3.05%). While, *Pseudomonas* was highly resistant to ampicillin and augmentin (62.5%), whereas the lowest resistance rate was marked to erythromycin, sulfamethoxazole and imipenem (25%). Ciprofloxacin, gentamicin and nalidixic acid were the only sensitive agents.

Conclusions: There is a high burden of bacterial resistance to common antibiotics in our population samples. Recognition of the potential resistant strains of pathogen causing skin infection can help in guiding proper choice of antibiotic therapy.

1. INTRODUCTION

Skin infections are a worldwide significant clinical concern characterized by microbial attack of the skin layers and underlying soft tissues [1]. The incidence of these infections may differ from one area to another, ranging from mild to life-threatening condition [2]. It has been stated that skin infections (bacterial, viral, fungal) ranged from 42 -65% of the overall skin illness in children in

general practice [3].

Since many incidents of skin infection are not cultured, the most common causes of these infections remain certainly unclear, although *Staphylococcus aureus (S. aureus)* and *beta hemolytic streptococci (BHS)* are stated to be among the most causative agent for skin infection [4,5]. Previously, a report of culture-confirmed skin infection in the United States revealed that the most causative organism is *S. aureus*, although *Enterococcus spp., Pseudomonas aeruginosa, Escherichia coli (E. Coli),* and *BHS* have also been known to cause some types of skin infections [6]. Taken into the consideration, the 2005 WHO report on the epidemiology and management of common children skin illnesses in developing nations, provided that bacteria were the most common cause of skin infection, followed by fungal, parasitic and viral infections [7].

Given the paucity of population-based studies of bacterial skin infection in Libya, with and without cultures, we conducted this study with the aim of determining the common causative bacteria of skin infection and their antibiotic resistance pattern among patients attending specialist skin hospital in Tripoli city of Libya.

2. METHODS

This is a retrospective investigation of bacterial skin infections and antibiotic resistance for samples taken from a total of 1,141 patients confirmed with bacterial skin infection and admitted to *Ber Al-Ustta Milad* hospital in Tripoli city over a period of 10 years from Jan 2009 to December 2018. The criteria for inclusion were adult patients with positive clinical diagnosis and laboratory test of bacterial infection. Patients with skin infections due to a fungal, parasitic or viral cause were excluded.

This is a single-center study which has been approved by the scientific committee of department of Anesthesia and Intensive care, Faculty of Medical Technology, the University of Tripoli, Tripoli, Libya. All patients' data collected in this study were kept secured and confidential.

The collected specimen was inoculated under a septic technique on petri plates enclosing Blood agar, MacConkey agar and Chocolate agar media, and was incubated at 37°C for 24 h. All bacteria were isolated and identified using morphological, microscopy and biochemical tests. Only positive culture sensitivity reports were further analyzed. Antibiotic sensitivity test was performed by Kirby-Bauer disc diffusion method as previously described [8]. Paper disks were infused with antibiotics including penicillin (10 μg), cefoxitin (30 μg), trimethoprim/sulfamethoxazole (25/23.75 μg), ceftriaxone

(30 μg), clindamycin (2 μg), erythromycin (15 μg), gentamycin (10 μg), ciprofloxacin (5 μg), tobramycin (10 μg), vancomycin (10 μg), tetracycline (30 μg), amoxicillin (10 μg), amoxicillin/clavulanate (20/10 μg), and amikacin (30 μg). The disks were then incubated at 37°C for 24 hours. The width of inhibition zones was measured, and analysis of result was based on *Clinical and Laboratory Standards Guideline*. The collected information was evaluated and analyzed, using SPSS version 22. Chi-square test was used to compare the collected data. *P*-value less than 0.05 was considered statistically significant.

3. RESULTS

After assessing the data collected from the hospital and the tests done in the laboratory, a scenario of antibiotic resistance pattern of bacteria was evaluated. Out of the 1,141 clinical samples studied, 39.87% (n=455) of the samples examined were positive for infectious bacteria (30.9% male and 69.1% female).

From the various inoculated samples, 39.87% (n = 455) of the samples examined were positive for infectious bacteria. The dominated species of pathogenic bacteria were identified as gram-positive bacteria *Staphylococcus Aureus* (n=272, 97.14%) and *Proteus* (n=8, 2.85%). Meanwhile, gram-negative bacteria were *E. Coli* (n=164, 93.71%), *Pseudomonas* (n=8, 4.57%), *Klebsiella* (n=2, 1.14%), and *Shigella* (n=1, 0.57%) (Table 1).

Table 1. Distribution of bacterial infections according to gender in patients referred to the microbiological Laboratory of Ber-Ustta-Milad Hospital		
Type of infection	**Gender**	
	Male	**Female**
Gram positive (n=280)		
S. aureus (n=272, 97.2%)	103 (37.9%)	169 (62.1%)
Proteus (n=8, 2.8%)	4 (50%)	4 (50%)
Gram negative (n=175)		
E. coli (n=164, 93.7%)	28 (17.1%)	136 (82.9%)
Pseudomonas (n=8, 4.6%)	2 (25%)	6 (75%)
Klebsiella (n=2, 1.1%)	2 (100%)	-
Shigella (n=1, 0.6%)	-	1 (100%)

Kirby- Bauer disc diffusion method was used to test the susceptibility of isolated pathogenic bacteria against different antibiotics such as ciprofloxacin, erythromycin, penicillin, ampicillin etc., ranging from (05 – 30 μg), and principles for suggesting whether the isolate is susceptible or resistant toward specific antibiotic was presented in Table 2.

It was observed in gram positive bacteria that the *staphylococcus aureus* and *proteus* were highly resistant to

Antibiotics	Table 2. Resistance pattern of the isolated bacteria to tested antibiotics					
	Gram positive (n=280)			Gram negative (n=175)		
	S. aureus (n=272)	*Proteus* (n=8)	*E. coli* (n=164)	*Pseudomonas* (n=8)	*Klebsiella* (n=2)	*Shigella* (n=1)
Ciprofloxacin	9 (3.31%)	0	18 (10.98%)	0	0	0
Penicillin	95 (34.93%)	6 (75%)	59 (35.96%)	3 (37.5%)	1 (50%)	1 (100%)
Ampicillin	78 (28.67%)	5 (62.5%)	74 (45.12%)	5 (62.5%)	2 (100%)	1 (100%)
Erythromycin	49 (18.02%)	3 (37.5%)	41 (25%)	2 (25%)	0	0
Amoxicilin/Clavulanate	20 (7.35%)	3 (37.5%)	35 (21.34%)	5 (62.5%)	1 (50%)	1 (100%)
Imipenem	20 (7.35%)	4 (50%)	5 (3.05%)	2 (25%)	0	0
Tetracycline	35 (12.87%)	4 (50%)	29 (17.68%)	3 (37.5%)	0	1 (100%)
Gentamicin	8 (2.94%)	2 (25%)	9 (5.49%)	0	0	0
Cefoxitin	37 (13.6%)	4 (50%)	37 (22.56%)	4 (50%)	0	0
Chloramphenicol	30 (11.03%)	3 (37.5%)	21 (12.8%)	2 (25%)	0	0
Nalidixic Acid	11 (4.04%)	1 (12.5%)	9 (5.49%)	0	0	0

penicillin (34.3%, 75% respectively) and ampicillin (28.6%, 62.5% respectively). While the resistance rate of *staphylococcus* to gentamicin (2.94 %) and ciprofloxacin (3.31 %) were the lowest. Moreover, *proteus* had lower resistance rate to sulfamethoxazole and nalidixic acid (12.5%) (Table 2).

Concerning gram negative bacteria, *E. coli* was highly resistant to ampicillin (45.12%) and penicillin (35.96%), whereas the lowest resistant was against imipenem (3.05%). *Pseudomonas* was highly resistant to ampicillin and amoxicillin/clavulanate (62.5%), whereas the lowest resistance rate was marked to erythromycin, sulfamethoxazole and imipenem (25%, for each). Ciprofloxacin, gentamicin and nalidixic acid were the only sensitive agents. Only two samples contain of *Klebsiella* and both of them resistant to ampicillin (100%) and only one sample contain of *shigella* that were resistant to penicillin, ampicillin, sulfamethoxazole, amoxicillin/clavulanate and tetracycline (Table 2).

4. DISCUSSION

Skin bacterial infections are common all over the world. They are an important health problem affecting people in both developing and developed countries [2]. Several epidemiological studies have been undertaken across the world and came with conclusion that the prevalence and pattern of this type of infection is vary depending on the regional and ethnic variation as well as the patients' clinical environment.

In our study, a total of 455 (39.87%) of the skin samples were positive for infectious bacteria. The results of this study are in accordance with some previous studies from UK and in sub-Saharan Africa [9, 10], but differ from other studies [11, 12]. The difference in the occurrence of certain skin diseases among studies may depend on the method of classification or may be due to differences between populations regarding genetic, socioeconomic, or environmental factors. The high incidence of infection can be attributed to poor hygienic and sanitary environments, absence of awareness and deprived health services.

Earlier studies have shown that *S. aureus* is the leading cause of cultured skin infection [13, 14]. A recent study in 2019 conducted among patients with skin infection in Saudi Arabia revealed that S. aureus were the most frequently isolated organisms. In the same study, several well-known species, including *K. pneumoniae*, *A. baumannii*, *P. aeruginosa*, and *Enterobacter spp.*, were also observed [15]. Another study examining the causative agent for skin infection during a 7-year period in Europe, Latin America, and North America reported *E. coli* to be the most important agent causing skin infection, followed merely by *S. aureus* and *Pseudomonas aeruginosa* [6].

The resistance of pathogens to antimicrobial agents is a worldwide health care concerns and a focus of extensive exploration. Numerous studies have exhibited a significantly increased virulence among *E. coli* isolates that are resistant to certain antibiotics, such as ampicillin- and trimethoprim-resistant isolates [16]. In our study, the most prevalent resistances of our identified pathogens were to penicillin, ampicillin, amoxicillin/clavulanate, and tetracycline. These antimicrobials were, or still are, of high clinical worth, and accordingly higher resistance incidence

are not surprising. However, the results of our analysis are in agreement with previous reported studies.

5. CONCLUSIONS

The burden of skin infections in Libya is considerable with *S. aureus* and *E. coli* remain the common causative agents for such infections. The present work confirms that the strains identified in our samples confirmed resistance to broad range of standard antimicrobial agents including; penicillin, ampicillin, amoxicillin/clavulanate, and tetracycline. Such data would support antibiotic stewardship efforts to deliver effective empiric antimicrobial treatment to patients with skin infection while also subsiding irrationally broad-spectrum therapy. Multipronged strategies should be implemented to avert this issue.

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7. DECLARATION OF CONFLICTING INTERESTS

There are no competing financial interests.

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