



Evaluation of Bacterial Species in Patients with Skin Infection and their Antibioqram

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Authors' contributions

This work was carried out in collaboration among all authors. Author IUN designed the study wrote the protocol. Authors IUN and KCE wrote the first draft of the manuscript. Authors CHN and CVO managed the collection of data and analyses of the data used in the study. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The skin is a barrier that limits invasion and growth of pathogenic bacteria. Bacterial species in patients with skin infection and their antibiogram were evaluated for the presence of inhabiting bacteria.

Method: The sample obtained with swab sticks were streaked on their respective culture plates containing nutrient agar, MacConkey agar and blood agar, incubated 37^o for 24h. The recovered bacteria after incubation were characterized and identified according to standard microbiological criteria.

Results: Five bacteria species were isolated which includes *Staphylococcus aureus*; *Escherichia coli*, *Klebsiella specie*, *Proteus sp* and *Pseudomonas aeruginosa*. *Staphylococcus aureus* (33.03%) had the highest percentage occurrence while *Proteus Sp* (9.17%) had the lowest percentage occurrence. The highest number of isolates were recovered from male patients (61.47%). Age wise the least percentage of isolates were gotten from age group 31-40 (1.83%) while the highest was

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obtained from those within the age range of 11-20 (40.37%) followed by 1-10 years of age (25.69%). More isolates were recovered from in-patients (68.81%) than from Out-patients (31.19%). The antibiotic sensitivity test showed that *Klebsiella* sp, *Proteus* spp and *Staphylococcus aureus* were sensitivity to all the antibiotics tested while *pseudomonas aeruginosa* had 30% activity (sensitivity to only 3 drugs) for the antibiotics used in this study.

Conclusion: From this study, it can be said that *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* sp, *Proteus* sp and *Pseudomonas aeruginosa* are implicated in the skin infections in humans and their presence if not treated will lead to long term disease in human affected.

Keywords: Skin infection; bacterial species; antibiogram; patients; wound.

1. INTRODUCTION

The skin represents a distinct ecological habitat, analogue to a cool desert, compared to the warm, moist tropical conditions that exist in other body systems [1]. Large numbers of microorganisms live on and in the various components of the normal skin [2]. The skin is an intricate habitat for many bacteria. The type and density of bacteria are determined by anatomic location, local humidity, the amount of sebum and sweat production, and the host's hormonal status and age [2].

Bacterial skin flora are commensal, symbiotic or parasitic relative to the host; although alterations in host immune status are known to have a significant impact, the type of relationship established is often inherent to the bacteria [3]. Persistent colonization is the result of the ability of bacteria to adhere to skin epithelium, grow in a relatively dry and acidic milieu, and rapidly re-adhere during the normal process of desquamation [3-5].

Healthy skin is the first line of defense and barrier against microbial invasion [6]. When the skin is turned, cut or punctured or where blunt force trauma causes a contusion, an injury (wound) result on the skin [7]. These injury (wound) may be caused as a result of a fall, a surgical procedure, an infectious disease or an underlying pathological conditions. Certain parasites such as Hookworm larvae and bacteria e.g *Treponema pallidum*, can penetrate the intact skin. However, certain primary skin infection like impetigo are caused by *Streptococcus pyogenes* or *Staphylococcus aureus*, both gain access through abrasions as minor trauma of skin is part of our daily life [8].

Patients with diminished immunity are highly susceptible and at high risk of developing a skin infection [9]. There are several factors including age, obesity, malnutrition, endocrine and

metabolic disorders that influences development of wound infectious [9].

Skin infections of bacterial origin are of different forms: infections with a bacterial etiology associated with an inflammatory process limited to the hair follicle are classified as folliculitis, they are characterized clinically by the presence of abscesses and the formation of typical papules or pustules. Impetigo is an infection limited to the epidermis and characterized by a bullous rash that evolves in crusts and pustules. Erysipelas is an acute erythematous infection that spreads rapidly and is usually associated with systemic symptoms. If the lesion is located in the subcutaneous fat and mainly involves the derma, it is called cellulitis. Both infections are associated with an intense inflammatory process. Infections characterized by rapidly progressive cellulitis that causes extensive damage to the tissue below the derma, in particular to the muscular tissue, and impairs the blood flow are known as necrotizing infections, subsequent to which necrotizing fasciitis and gas gangrene (infections not considered of dermatological competence) arise. [8,10-11].

The microorganisms most commonly involved in skin infections of a bacterial etiology includes; *S. epidermidis* found in upper trunk produce slime, *S. hominis* found in glabrous skin, *S. haemolyticus*, *S. capitis*, *S. midis*, *S. warneri*, *S. saprophyticus*, *S. cohnii*, *S. xylosus*, *S. simulans*, *S. saccharolyticus* found in forehead/antecubital anaerobic, *Micrococcus*, *M. luteus*, *M. varians*, *M. lylae* found in children/cold temperature, *M. kiistinae*, found in children, *M. nishinomygensis*, *M. roseus* *M. sedentarius* found in petted keratolysis, *M. agieis*, *Corynebacterium*, *C. minutissimum* found in intertriginous lipophilic/porphyrin erythrasma, *C. tenuis* found in intertriginous lipophilic trichomycosis, *C. xerosis* found in conjunctiva lipophilic conjunctivitis, *C. jeikeium* found in intertriginous lipophilic/antibiotic resistant, *Rhodococcus* found

in lipophilic granuloma in HIV, propionibacterium found in acnes sebaceous gland lipophilic/anaerobic acne, *P. granulosum* found in sebaceous gland lipophilic/anaerobic severe acne; *P. avidum* found in axilla lipophilic/anaerobic, Brevibacterium found in toe webs non-lipophilic foot odor, white piedra found in non-lipophilic pitted Keratolysis [10], while Acinetobacter found in dry areas gram-negative burn wounds [12-13].

Following the ubiquitous use of antibiotics which has led to major problems of antibiotic resistance, the knowledge of the bacteriological etiologic agents of skin infections will therefore be helpful for the selection of suitable antibiotic therapy. This study aimed at exploring the bacteria species that causes skin infection as well as determining the antibiotic susceptibility patten for the bacterial isolates.

2. MATERIALS AND METHODS

Study location/population: This study was carried out in Umuahia, Abia State with focal point on different patients-both male and female with degrees of skin infection, attending clinic.

Sample collection: A total of 80 pus samples from skin were collected from patients with skin infections (namely: Cellulitis, Impetigo, Boils and Carbuncles, Folliculitis and Necrotizing fasciitis) using swab stick emulsified with normal saline, the swab stick were used to swab the surfaces of the patient skin which have physical signs of infection. After rubbing the swab stick over the surface of the infection site, the swab sticks were covered, labeled and then taken to microbiology laboratory for analysis [14].

Analysis of samples: The samples swab stick with their respective labeling were streaked on already prepared nutrient agar, MacConkey agar (Hi-media, India) and Blood agar plates and then incubated at 37 °C for 24hours. After incubation, the recovered bacteria from positive cultures

were characterized and identified according to standard microbiological criteria such as colonies morphology (shape, colour, elevation and edge), gram stain and biochemical assays (catalase test, coagulase test, citrate test, indole test, carbohydrate (sugar) utilization test) carried out according to Bergers Manual of determinative Bacteriology [15].

Antibiotic Susceptibility Testing: The antibiotic susceptibility testing of all the isolates was performed by modified Kirby-Bauer's disc diffusion method on Muller Hitton Agar medium (Hi-media, India) [16]; using antibiotics as highlighted in Clinical Laboratory and Standard Institute (CLSI) guidelines.

Statistical Analysis: Analysis of data was carried out using software SPSS version 21.0 (SPSS Inc. Chicago, IL, USA) and Chi-square test was applied, P-value < 0.05 was considered statistically significant.

3. RESULTS

Table 1: shows the percentage occurrence of the recovered bacterial isolates. *Staphylococcus aureus* 36(33.03%) had the highest percentage occurrence followed by *Escherichia coli* 30(27.52%) *Proteus SP* 10(9.17%) and *Pseudomonas aeruginosa is* (13.76%). *Proteus sp* 10(9.17%) and *Pseudomonas aeruginosa* 15 (13.76%) were the least in occurrence.

Table 2 shows the age and sex wise distribution of the bacterial isolates. 67(61.47%) of the isolates were gotten from female patients while 42(38.53%) of the isolates were gotten from the female patients. Age group 11-20 had the highest number of isolates 44 (40.37%). It was followed by those within 1-10 age group; 28(25.69%). The least number of isolates were obtained from 31-40 age group. 2(1.83%) from male and non from female. There was a statistical difference in the rate of isolation based on gender (P-value: 0.023<0.05).

Table 1. Percentage occurrence of bacterial isolates from skin infections

Organism	Number of isolates	Percentage occurrence
<i>Staphylococcus aureus</i>	36	33.03%
<i>Klebsiella sp</i>	18	16.51%
<i>Escherichia coli</i>	30	27.52%
<i>Pseudomonas aeruginosa</i>	15	13.76%
<i>Proteus sp</i>	10	9.17%
Total	109	100%

The percentage isolation of bacterial isolates based on hospital departments is shown in Table 3. As observed from the table, those patients from the out-patient department (OPD) has 34 (31.19%) isolates while those confirmed in the hospital (in patient department (IPD) had 75(68.81%) isolates. The distribution of the isolates in relation to hospital department was not statistically significant (P-value: 0.68>0.05).

Table 4 shows the distribution of the isolates among the hospital departments.

Table 5 shows the antibiotics susceptibility pattern of the bacterial isolates. *Klebsiella sp*, *Proteus sp* and *Staphylococcus aureus* were sensitive to all the antibiotics tested (100% activity). *Pseudomonas aeruginosa* was sensitive to only three out of the 10 antibiotics tested (30% activity), while *Escherichia Coli* had 70% sensitivity and 30% resistance activity against the drugs.

4. DISCUSSION

Skin support the growth of commensal bacteria which protect the host from pathogenic bacteria.

Environmental and local factors, host immunity and organism adherence and virulence are intricately related to contagious infection. This study was carried out in Abia Specialist hospital with an objective to study the bacterial species causing skin infection and their antibiogram.

However, in this study, both gram positive and gram negative aerobic bacteria were isolated from the pus samples obtained from the skin infections. *Staphylococcus aureus* was the predominant cause of skin infection which accounted for 33.03% of all isolates followed by *Escherichia coli* (27.52%). Similar study carried out by Pant et al. [17] and Arjun [18], reported that *S. aureus* (56.8% and 55.7% respectively) was the predominant etiologic agent of skin infection followed by *E. coli* (9.8%). More so, [8] in UK previously stated that *S. aureus* was present in 45% of skin and soft tissue infections and Strange et al. [19] pointed that *S. aureus* is the most common cause of cutaneous and systemic infections. It may transiently colonize the skin of newborn infants, the anterior nares in 20% - 40% of healthy individuals, and the skin of atopic patients.

Table 2. Age and Sex wise distribution of the bacterial isolates

Age	Sex Male N(%)	Female N(%)	Total N(%)
1-10	16(23.88)	12(28.57)	28(25.69)
11-20	27(40.29)	17(40.48)	44(40.37)
21-30	9(13.43)	3(7.14)	12(11.01)
31-40	2(2.98)	-(0)	2(1.83)
41-50	5(7.46)	4(9.52)	9(8.26)
≥ 51	8(11.94)	6(14.28)	14(12.84)
TOTAL	67(61.47)	42(38.53)	109(100%)

P-value = 0.023. P-value < 0.05 is considered statistically significant.

Table 3. Percentage Isolation of the bacterial isolates based on hospital department

Department	Number of isolates	Percentage
OPD	34	31.19%
General wards	54	49.54%
Private wards	21	19.22%
TOTAL	109	100%

P-value = 0.68. P-value < 0.05 is considered statistically significant.

Key: OPD = out-patient department

Table 4. Distribution of the Isolates among the hospital departments

Department	Isolates					Total
	<i>S. aureus</i>	<i>Klebsiella sp.</i>	<i>E. coli</i>	<i>P. aeruginosa</i>	<i>Proteus sp.</i>	
OPD	10	6	12	3	3	34
General Ward	19	9	13	10	3	54
Private Ward	7	3	5	2	4	21
Total	36	18	30	15	10	109

Table 5. Antibiotics Susceptibility test for the bacteria isolated from Skin infection. Gram negative disc

Isolates	SXT	CPX	AU	CN	PEF	NA	QFX	CEP	PN	S	% activity
<i>E. coli</i> (N=30)	20 (s)	20(s)	19(s)	22(S)	15(R)	15(R)	22(S)	17(S)	15(R)	19(S)	70%
<i>Klebsiella sp</i> (N=18)	16(S)	13(S)	16(S)	13(S)	17(S)	13(S)	16(S)	15(S)	16(S)	12(S)	100%
<i>P. aeruginosa</i> (N=15)	15(R)	10(S)	15(R)	15(R)	15(R)	15(R)	15(S)	15(R)	15(R)	10(S)	30%
<i>Proteus sp</i> (N=10)	7(S)	7(S)	7(S)	7(S)	10(S)	7(S)	8(S)	6(S)	8(S)	6(S)	100%

Gram Positive Disc

	CH	NB	S	AMX	RD	APX	CN	LEV	E	CPX	
<i>Staphylococcus aureus</i> (N=36)	21(S)	17(S)	17(S)	22(S)	20(S)	21(S)	25(S)	20(S)	20(S)	21(S)	100%

Keys: Septrin; CPX=Ciproflox; AU=Augumentin; CN=Gentamycin; PEF=Peflatine; NA=Nalidixic acid; OFX=Tarivid; CEP=Ceproex; PN= Ampicillin; S=Streptomycin, CH=Chlorainphenicol; NB=Norfloxacin; AMX= Amoxil; RD=Rifampicin; APX=Ampiclox RD=Rifampicin; LEV= Levofloxacin; E=Erythromycin; S=Sensitive; R=Resistance

Moreover, the bacteria growth was found to be higher in male patients (67(61.47%), than in female patients (42(38.53%) in accordance with Pant et al. [17] and Yakha [20]. The relative higher percentage of male patients might be due to active involvements of males with knives, sharp instruments, some behavioral works like hunting, tending animals and fighting each other's. Aside from this, patients within the age of 1-20 years were mostly affected (67.06%) followed by those of 51 years and above (12.84%). This could be due to the poor hygienic practices, active playful life and low immunity among these age brackets. Those of > 51 years could be as a result of waned immunity. The least occurrence observed among those of 31-40 years could be attributed to the fact that this age group are hygiene conscious and of cosmetic age.

Furthermore, it was discovered in this study that the rate of skin infection was higher among in-patients (68.81%) than out-patients (31.19%). Similar studies carried out by Pant et al. [17], and Yakha [20] showed that prevalence of skin infection was higher in in-patients (63.1% and 54.9% respectively) than in out-patients (56.2% and 52.63% respectively). The reason behind this could be that those bacterial species were nosocomially acquired.

More so, antibiotic susceptibility testing of all the isolates demonstrated that Tarivid and streptomycin were the most effective anti-bacterial drugs for gram negative bacteria. Whereas, Gentamycin and Amoxil antibiotics were highly effective against the gram positive bacteria.

5. CONCLUSION

Staphylococcus aureus (a gram positive) was found to be more predominant in skin infection compared with gram negative bacteria in Aba Specialist Hospital. In addition, there were more preponderance among in-patients than out-patients. Age group 31-40 had the least percentage occurrence. Proper hygiene should be employed to curb skin infection.

CONSENT AND ETHICAL APPROVAL

The authors declare that all experiments have been examined and approved by the appropriate ethics committee. Informed consents were obtained from all relevant authority.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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