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Clinico-bacteriological profile and antibiotic sensitivity pattern in pyodermas: A Hospital Based study

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Abstract
Introduction: With the emergence of multi drug resistant strains of organisms, it is mandatory to perform a culture and sensitivity testing.

Objectives: To determine the clinico-bacteriological profile and antibiotic susceptibility pattern.

Methods: A prospective cross-sectional study done at the out-patient department (OPD) of the Department of Dermatology, Tribhuvan University Teaching Hospital (TUTH) from June 1st 2008 to May 31st 2009. Ethical approval was taken from Institutional Review Board.

Results: There were 75 patients, [65.3% males and 34.7% females] out of which 21(28%) patients were pediatric and remaining 54(72%) patients were adults patients.

Staphylococcus aureus the organisms isolated included (86.7%) patients, *Enterococcus fecalis* (1.3%) cases, both organisms (5.3%) cases and no growth in 6.7% cases. Out of 75 cases, 60% cases were of primary pyodermas and 40% were secondary pyodermas. Folliculitis (26.7%) was the commonest type of primary pyoderma. Papular urticaria with secondary infection (14.7%) was the commonest among secondary pyodermas.

Out of 69 isolates of *Staphylococcus aureus*, 54(78.26%) were resistant to ampicillin. They were highly sensitive to oxacillin(94.2%), followed by erythromycin(85.5%) and ciprofloxacin(84.05%). Out of 5 isolates of *Enterococcus fecalis*, all were resistant to ampicillin. 100% sensitivity was seen with ciprofloxacin and cotrimoxazole. One isolate each was resistant to oxacillin and erythromycin and 3 isolates (60%) were resistant to cephalexin.

Conclusion: *Streptococcus pyogenes* was a primary pathogen in pyodermas, in patients of TUTH. Although the risk of development of multi-drug resistant strains (MRSA) is increasing, conventional drugs like β- lactam antibiotics (oxacillin /cloxacillin /flucloxacillin), erythromycin and ciprofloxacin can still be considered effective.

Keywords: Antibiotic sensitivity pattern, bacteriological profile, Pyodermas

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Introduction

Pyodermas are purulent skin conditions caused by pyogenic bacterial infections and constitute a large population of skin diseases encountered in dermatological practice.[1]

Primary pyoderma is a pyogenic infection of non diseased skin and its appendages.[2] It includes - impetigo, folliculitis, furunculosis, carbuncle, ecthyma, sycosis while *secondary pyoderma* is pyogenic infection of previously diseased skin. It includes infected scabies, infected eczemas, infected wounds, and infected trophic ulcers.[3] In India different studies have shown a prevalence rate ranging from 9% to 25%.[4,5] In Nepal, prevalence of pyodermas in paediatric age group is 14% to 25%.[6,7] Based on the records of out patient department of Dermatology, TUTH, it is 2.3% to 2.75% in all age groups. It is more common in children but not uncommon in adults *Staphylococcus aureus* and *Streptococcus pyogenes* are the commonest etiological agents implicated in pyodermas.

Though superficial pyodermas may be self limiting, at times they can cause complications like glomerulonephritis and dissemination in the community.[8]

The treatment of pyodermas includes early identification of risk factors for specific pathogens and early initiation of empiric antimicrobial therapy. The problem of emergence of drug resistant strains is increasing, probably due to indiscriminate use of topical and systemic antibiotics.[9] Along with this, the trend of etiological agents in different types of pyodermas is changing.[1] It would therefore be ideal to do the culture and sensitivity tests before prescribing antibiotics. Moreover, studies regarding clinico-bacteriological profile in pyoderma and antibiotic sensitivity patterns in Nepal is limited. Hence, this study was conducted to determine the bacteriological profile and their antibiotic sensitivity patterns in different types of pyodermas and their changing pattern over a period of time.

Methods

This was a hospital based cross-sectional study conducted at the out-patient department, Department of Dermatology and Venereology and the Department of Microbiology, Tribhuvan University Teaching Hospital, Kathmandu. The study was conducted over a period of one year, from 1st June 2008 to 31st May 2009. During the period of one year, information was collected from 75 patients. The patients were selected for the study as per the following criteria:

Inclusion criteria:

Patients belonging to all age groups and either sex presenting with any purulent skin conditions.

Exclusion criteria:

Patient taking or taken antibiotics (local or systemic) during last seven days. mmunocompromised patients or debilitated patients.

Methodology

The patients who reported with purulent skin conditions at the out-patient department of the Department of Dermatology and Venereology were included in the study. The details of these patients were recorded in a proforma . Patients were counseled about the disease and the investigative procedures to be performed. An informed written consent was obtained from every patient enrolled in the study. Ethical approval was taken from the Institutional review board for carrying out the study.

Specimen collection and transportation

For the intact pustular lesions, the area was disinfected with 70% alcohol followed by 10% povidone-iodine solution. Iodine was removed from that area with alcohol prior to pus collection. The intact pustule was ruptured with a sterile needle and the pus was taken with sterile cotton swab stick.

In open wounds, the debris were removed as far as possible and the lesion rinsed thoroughly with sterile saline prior to material collection with sterile cotton swab stick.

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In crusted lesions, the area was cleaned with 70% alcohol, the crust partly lifted using sterile forceps and specimen collected from underneath with the sterile cotton swab stick.

As the sample needed to be inoculated as early as possible, the sample was transported to the Microbiology lab immediately, not later than 30 minutes.

Inoculation, incubation and identification

The swab was inoculated on blood agar and MacConkey's medium and incubated at 37ºC for 24 hours.

After 24 hours, the culture plates were read for any growth. The growth was identified on the basis of culture characteristics, Gram stain and biochemical properties organisms isolated were identified on the basis of the culture characteristics, Gram stain, biochemical properties and other additional tests if needed.

Antimicrobial sensitivity testing

This procedure was carried out with the use of dick diffusion as described by Kirby-Baur. The inoculum of the organism was prepared by suspending the test organism in sterile normal saline and compared with Mc Forlane tube no. 0.5, then swabbed on the surface of a Mueller Hinton agar (MHA) plate. Various antibiotic disks were placed on the surface of the agar plate. Disks containing ampicillin (10mcg), ciprofloxacin(5mcg), cotrimoxazole (trimethoprim /sulphamethoxazole) (1.25/23.75 mcg), cephalexin(30mcg), oxacillin(1mcg) and erythromycin (15mcg) were used. After overnight incubation, the diameter of the zone of inhibition was measured and compared with standard as developed by Kirby-Baur to interpret the result as '*susceptible'*, '*intermediate susceptible* and '*resistant'*.

Statistical analysis

Results were tabulated in terms of age, gender, diagnosis, site and duration of lesion, past and family history of similar lesions, organisms isolated and their sensitivity pattern to antimicrobials. Results were analysed statistically using the windows SPSS 14.0 software programme. Causative organisms and their antimicrobial susceptibility in different types of pyodermas were compared and significance of the difference was tested using the Pearson Chi-Square test.

Results

Demographic characteristics of patients

A total number of 75 patients with pyoderma were studied out of which 34.7% were females and 65.3% were males. Pyodermas was more common in 15-25 years age group with 25(33.3%) patients followed by 26-35 years age group with 17(22.7%) patients

Seasonal variation and associated factors in pyodermas

Pyodermas were more frequent during summer season with 41(54.7%) patients, followed by Autumn with 19(25.3%) patients. Spring and Winter had similar frequencies of 8(10.7%) patients and 7(9.3%) patients respectively. Most of the patients (61 patients i.e. 81.3%) were having the disease for the first time where as past history of similar lesions were given by rest of the 14 patients.

There was no family history of similar lesions in majority of patients i.e. 92% versus 8%, who had positive family history (Figure 4).

Certain triggering factors like insect bites, traumas and other skin lesions were seen in 26 patients (34.7%) and none of these were noted in 49 patients (65.3%)

Clinical profile of patients

On examination, lower limbs were found to be the commonest site to be affected by pyodermas comprising of 22 patients (29.3%) and lesions on multiple site were found in 16 patients (21.3%) (Table 1).

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Table 1: Sites of involvement

Site	No.of patients	Percentage
Face	10	13.3
Scalp	10	13.3
Trunk	1	1.3
Upper limbs	4	5.3
Lower limbs	22	29.3
Hands/palms	6	8.0
Feet/soles	1	1.3
Axilla	1	1.3
Buttock	4	5.3
Multiple sites	16	21.3
Total	**75**	**100.0**

Out of 75 cases, cases of primary and secondary pyodermas are depicted in figure 1.

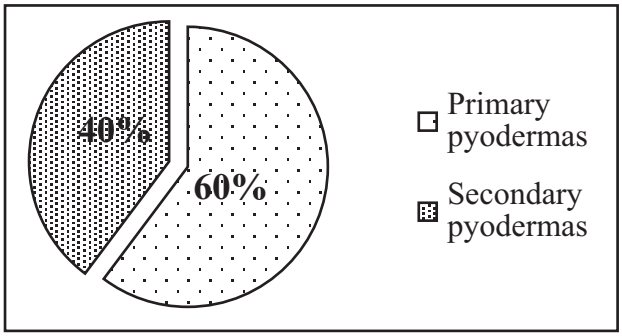

Figure 1: Types of pyodermas

The different clinical patterns of pyodermas have been shown in Table 2.

Table 2: Clinical patterns of pyoderma

	Diagnosis	No. of patients	Percentage
	Primary pyodermas		
1	Impetigo contagiosa	4	5.3
2	Bullous impetigo	1	1.3
3	Folliculitis	20	26.7
4	Furunculosis	17	22.7
5	Ecthyma	3	4.0
	Secondary pyodermas		
1	Infected wounds	7	9.3
2	Infected eczemas	3	4.0
3	Scabies with secondary infection	4	5.3
4	Contact dermatitis with secondary infection	4	5.3
5	Papular urticaria with secondary infection	11	14.7
6	Tinea capitis with secondary infection	1	1.3
	Total	**75**	**100.0**

The duration of the lesions varied from 2 days to 60 days with a mean duration of 12.43 days .

Organisms isolated from the clinical samples of pyodermas

After the culture of the sample, *Staphylococcus aureus* alone was isolated in 65 (86.7%) patients, *Enterococcus fecalis* alone was isolated in 1(1.3%) case, both organisms were isolated in 4(5.3%) cases and no growth was seen in 5(6.7%) cases (Table 3).

Table 3: Organisms isolated in all cases of pyodermas

Organisms	No. of patients	Percentage
Staphylococcus aureus	65	86.7
Enterococcus fecalis	1	1.3
Both	4	5.3
No growth	5	6.7
Total	**75**	**100.0**

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While evaluating the isolates in primary and secondary pyodermas, *Staphylococcus aureus* was the commonest organism isolated in both types of pyodermas.

Among the 45 cases of primary pyodermas, *Staphylococcus aureus* alone was isolated in 40(53.33%) cases, both *Staphylococcus aureus* and *Enterococcus fecalis* were isolated in 2 cases of furunculosis and none of the organisms were grown in 3 cases of folliculitis.

Regarding the secondary pyodermas, both organisms were isolated in 1 case of wound infection and one case of contact dermatitis with secondary infection. *Enterococcus fecalis* alone was isolated in one case of wound infection, no organism was isolated in one case of papular urticaria with secondary infection and one case of contact dermatitis with secondary infection. In the remaining 25(33.33%) cases *Staphylococcus aureus* alone was isolated. There was no statistically significant difference between the number of isolates of *Staphylococcus aureus* and *Enterococcus fecalis* in primary and secondary pyodermas, with a P-value of 0.488 and 0.218 respectively (Table 4 and Table 5).

Table 4: Organisms isolated in primary and secondary pyodermas

Organisms isolated	Primary pyodermas	Secondary pyodermas	Total	P-value
	n(%)	n(%)	n(%)	
Staphylococcus aureus	40(53.3)	25(33.3)	65(86.7)	0.488
Enterococcus fecalis	0(0)	1(1.3)	1(1.3)	0.218
Both	2(2.6)	2(2.6)	4(5.3)	0.675
No growth	3(4)	2(2.6)	5(6.6)	1.000
Total	45(60)	30(40)	75(100)	

Table 5: Organisms isolated in individual types of pyodermas

Diagnosis	Organisms isolated				Total
	Staphylococcus aureus n (%)	*Enterococcus fecalis* n (%)	Both n (%)	No growth n (%)	n (%)
1. Impetigo contagiosa	4(5.3)	0	0	0	4(5.3)
2. Bullous impetigo	1(1.3)	0	0	0	1(1.3)
3. Folliculitis	17(22.6)	0	0	3(4)	20(29.3)
4. Furunculosis	15(20)	0	2	0	17(22.6)
5. Ecthyma	3(4)	0	0	0	3(4)
6. Infected wounds	5(6.6)	1(1.3)	1(1.3)	0	7(9.3)
7. Infected eczemas	3(4)	0	0	0	3(4)
8. Scabies with secondary infection	4(5.3)	0	0	0	4(5.3)
9. Contact dermatitis with secondary infection	2(2.6)	0	1(1.3)	1(1.3)	4(5.3)
10. Papular urticaria with secondary infection	10(13.3)	0	0	1(1.3)	11(14.6)
11. Tinea capitis with secondary infection	1(1.3)	0	0	0	1(1.3)
Total	65(86.7)	1(1.3)	4(5.3)	5(6.6)	**75(100)**

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Antibiotic sensitivity pattern

The organisms isolated were subjected to sensitivity testing for ampicillin (10mcg), ciprofloxacin(5mcg), cotrimoxazole (trimethoprim /sulphamethoxazole)(1.25/23.75 mcg), cephalexin (30mcg), oxacillin (1mcg) and erythromycin (15mcg). Out of 69 isolates of *Staphylococcus aureus*, 54(78.26%) were resistant to ampicillin. They were highly sensitive to oxacillin (94.2%), followed by erythromycin(85.5%) and ciprofloxacin (84.05%). The sensitivity to cotrimoxazole was seen in 76.81% of isolates and 52.17% to cephalexin (Table 6)

Table 6: Anti-microbial sensitivity in *Staphylococcus aureus.* (n=69)

Drugs	Sensitive n(%)	Resistant n(%)
Ampicillin	15(21.7)	54(78.2)
Ciprofloxacin	58(84)	11(15.9)
Cotrimoxazole	53(76.8)	16(23.2)
Cephalexin	36(52.2)	33(47.8)
Oxacillin	65(94.2)	4(5.8)
Erythromycin	59(85.5)	10(14.5)

Out of 5 isolates of *Enterococcus fecalis*, all were resistant to ampicillin. Hundred per cent sensitivity was seen with ciprofloxacin and cotrimoxazole. One isolate each was resistant to oxacillin and erythromycin and 3 isolates (60%) were resistant to cephalexin (Table 7).

Table 7: Anti-microbial sensitivity in *Enterococcus fecalis* (n=5)

Drugs	Sensitive n(%)	Resistant n(%)
Ampicillin	0	5(100)
Ciprofloxacin	5(100)	0
Cotrimoxazole	5(100)	0
Cephalexin	2(40)	3(60)
Oxacillin	4(80)	1(20)
Erythromycin	4(80)	1(20)

Comparison between the sensitivity pattern of isolates of primary and secondary pyodermas

Out of 69 isolates of *Staphylococcus aureus* (42 in primary pyodermas and 27 in secondary pyodermas) ampicillin sensitivity was observed in 16.7% of primary pyodermas and 29.6% of secondary pyodermas, ciprofloxacin in 78.6% of primary and 92.6% of secondary pyodermas, cotrimoxazole in 66.7% of primary and 92.6% of secondary pyodermas, cephalexin in 42.9% of primary pyodermas and 66.7% of secondary pyodermas. Oxacillin was sensitive in 90.5% and erythromycin in 76.2% of primary pyodermas whereas both these drugs were 100% sensitive in secondary pyodermas. Statistically significant difference between the antibiotic sensitivity pattern in primary and secondary pyodermas was seen only with cotrimoxazole and erythromycin with P-values of 0.013 and 0.006 respectively (Table 8).

Table 8: Comparison of antibiotic sensitivity of *Staphylococcus aureus* in primary and secondary pyodermas. (n=69)

Antiboitics	Sensitivity		P-value
	Primary pyoderma	*Secondary pyoderma*	
Ampicillin	16.7%	29.6%	0.203
Ciprofloxacin	78.6%	92.6%	0.120
Cotrimoxazole	66.7%	92.6%	**0.013**
Cephalexin	42.9%	66.7%	0.053
Oxacillin	90.5%	100%	0.098
Erythromycin	76.2%	100%	**0.006**

Out of 5 isolates of *Enterococcus fecalis*, ampicillin resistance was 100% in both primary and secondary pyodermas. 100% sensitivity was seen with ciprofloxacin and cotrimoxazole in both types of pyodermas. With cephalexin, one isolate(50%) in primary and 1 isolate(33.3%) in secondary pyoderma were sensitive. Similar results were seen with oxacillin and erythromycin, with the isolates being 100% sensitive to both drugs in primary pyoderma and only 66.7%

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sensitive in secondary pyoderma. The differences in the sensitivity of pattern in primary and secondary pyoderma were not statistically significant (Table 9).

Table 9: Comparison of antibiotic sensitivity of *Enterococcus fecalis* in primary and secondary pyodermas. (n=5)

Antiboitics	Sensitivity		P-value
	Primary pyoderma	*Secondary pyoderma*	
Ampicillin	0%	0%	
Ciprofloxacin	100%	100%	
Cotrimoxazole	100%	100%	
Cephalexin	50%	33.3%	0.709
Oxacillin	100%	66.7%	0.361
Erythromycin	100%	66.7%	0.361

DISCUSSION

This study included 75 patients with pyoderma among which 65% were males and 35% females. Male preponderance in pyodermas is shown by several studies. [7] Though there are no explainable reasons for male preponderance in our context, increased outdoor activities of males that subjects them to micro-trauma may be a reason for this.

In this study, the number of patients in pediatric age group was only 28% and that in adult age group is 72%. This is similar to the result reported by Ghadage DP et al. [9] But many studies have found pyodermas to be more common in pediatric age group with higher incidence in < 10 years age group, [10,11,12,13,14] and in few studies >40% patients belonged to 1-4 years age group. [2,15] As most of the pediatric patients specifically visit the pediatric and surgical out-patient department for minor skin problems, this may be the reason for a low number of pyodermas in children in this study.

Regarding the seasonal variation, higher occurrence of pyodermas was seen during Summer and Autumn with 54.7% and 25.3% respectively. Kharel C et al reported a maximum occurrence during June and September, which was similar to that reported by Kakar N et al. [7,15] Mathew SM et al also found peak prevalence during Summer.[1] The reasons behind the high prevalence of pyodermas during Summer and rainy seasons could be due to increased chances of minor trauma and insect bites, especially over exposed skin due to loose and short clothing.[1] Very less number(8.7%) of patients gave past history of similar lesions, most of which were cases of folliculitis. Mathew SM et al reported past history of recurrence in 54% of cases of pyodermas whereas Kharel C et al reported it to be 41%. [1,7] This difference may be due to a lower rates of nasal carriers of *Staphylococcus aureus* in our community, however, there are no studies to prove this hypothesis. Similar results were seen with the association of similar lesions in family; only 8% of pyodermas gave a positive history in this study whereas Mathew SM et al reported it in 27%, Nagmoti MJ et al in 21% and Kharel C et al in 22.4% of cases of pyodermas.[1,2,7] This may be due to low virulence of the infecting organisms and less chances of dissemination because of no overcrowding.

None of the triggering factors were noted in primary pyodermas, whereas all secondary pyodermas were precipitated by prior lesions like trauma in wound infections, insect bites in papular urticaria with secondary infection, scabies in scabies with secondary infection. Though primary pyodermas occur in non-diseased skin, it is supposed to be associated with minor traumas and insect bites. An association between impetigo and insect bites was suggested by Elliot J et al. [16] But in our study, no such association was found.

In this study, lower limbs were the commonest site to be affected, accounting for 29.3% cases, followed by multiple sites involvement in 21.3% cases. Other studies have noted face as the commonest site; Kharel C et al reported 67.3% of pyodermas affecting face. [2,7] In many studies, impetigo was found to be the commonest type of pyoderma with face involvement in most cases. [1,7,9,10,11,12,13,15] The reason for this may be the proximity to the common carrier site like nares

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so that the organism easily get disseminated via the fingers.[1] But the higher incidence in lower limbs may be due to the exposure of the parts to the external environment so that they are subjected to more trauma and insect bites.

In this study, 60% of cases were primary pyodermas and 40% were secondary pyodermas. Many other studies have reported a higher rates of primary pyodermas, accounting for more than 60% cases. [5,9,13,15] Few studies have shown almost similar number of primary and secondary pyodermas.[7] The reason behind this may be due to timely management of primary skin disorders and traumas.

Among primary pyodermas, folliculitis was the commonest followed by furunculosis with 26.7% and 22.7% of cases respectively. Folliculitis was noted as the commonest presentation by Parikh DA et al [5] whereas it was the second commonest type in few other studies. [1,9] The average duration of illness was 12.43 days, maximum number of patients(62.7%) presenting within first week of appearance of lesions.

In our study *Staphylococcus aureus* alone was isolated in 86.7% cases, *Enterococcus fecalis* was isolated in a single case(1.3%) and both organisms were isolated in four cases(5.3%) and no organisms were isolated in five cases(6.7%). However, there was no significant difference between the isolation of *Staphylococcus aureus* in primary and secondary pyodermas, the percentage being 53.3% and 33.3% respectively with a P-value of 0.488. In other studies by Baslas RG et al [13], Lee CT et al [17], Kharel C et al[7], Ahmed K et al[14] staphylococcus aureus was isolated in majority of the cases followed by streptococcus. In one study, even in chronic wound infections, *Staphylococcus aureus* was isolated in 70.8% of cases, though more number of Gram -negative bacilli have been isolated from secondary pyodermas and chronic wound infections as compared to primary pyodermas.[18,19] Initially *Streptococcus pyogenes* was supposed to be the most common pathogen causing pyodermas, *Staphylococcus aureus* being a secondary invader. These results showing high isolation rates of *Staphylococcus aureus* as compared to *Streptococcus pyogenes* reflects a changing trend of the etiological agent. Though most studies have shown a significant number of isolates of *Streptococcus pyogenes*, either alone or mixed with *Staphylococcus aureus,* the isolation of *Streptococcus pyogenes* in this study was nil.[1,9,13,14, 15,17] The reason behind this could be due to the change in the etiological agent or due to inhibition of *Streptococcus pyogenes* by secondary invasion of *Staphylococcus aureus* which is supposed to produce bacteriocins, toxic to Streptococci or due to bacterial interference. As *Enterococcus fecalis* is a part of normal fecal flora, the isolation seen in this study may be due to contamination of the lesion or due to opportunistic infection.[20]

The drug sensitivity patterns in this study showed a high resistance of *Staphylococcus aureus* to ampicillin of 78.26%. This probably is due to the â- lactamase producing strains. Similar resistance pattern was shown by Mathew SM et al and Tan HH et al with ampicillin resistance rates of 79.3% and 89.5% respectively.[1,3] First generation cephalosporins like cephalexin and cefadroxil have shown important therapeutic roles in less serious MSSA infections and studies have detected a good response in treatment of pyodermas.[21] One study has reported up to 93% sensitivity of *Staphylococcus aureus* to cephalexin.[3] In this study 47.8% isolates of *Staphylococcus aureus* were resistant to cephalexin. As cephalexin and cefadroxil are commonly used drugs, resistant strains of *Staphylococcus aureus* against these drugs might have emerged . Erythromycin is a drug used as an alternative treatment in patients allergic to penicillin. Few studies have shown rising resistance of *Staphylococcus aureus* to erythromycin, the resistance rates being 10% to 32%.[3] Contrasting results were revealed in some studies with sensitivity being 86% to 97%.[5,7,14] In this study, 14.5% of *Staphylococcus aureus* were resistant to erythromycin.

Kharel C et al reported 86% sensitivity of *Staphylococcus aureus* to ciprofloxacin, Kakar

N et al reported it to be 89% and Ghadage DP et al 61%, whereas in this study it was 84%.[7,9,15] In this study, 76.8% *Staphylococcus aureus* were sensitive to cotrimoxazole, which was similar to that reported by Ghadage DP et al.[9]

Least resistance was seen with oxacillin in this study, 94.2% *Staphylococcus aureus* being sensitive. This result was similar to that shown by other authors.[3,17,7] Fatani et al also reported oxacillin resistance in only 2.1% and thus recommended the use of oxacillin as first line treatment in pyodermas.[22] However, in *Staphylococcus aureus* isolated from chronic wounds, oxacillin resistance was seen in 21.5% cases.[19]

Conclusion

This study gives an indication of the present state of pyodermas, regarding both clinical and bacteriological aspects. Male preponderance was seen in this study and patients in the 15-25 years age group were affected more frequently. Student population was more commonly affected and most pyodermas occurred in Summer. Folliculitis was the most common presentation. Although most of the studies have reported isolation of a significant number of *Streptococcus pyogenes* from pyodermas, in this study, none of the samples had growth of this organism . Instead, *Staphylococcus aureus* was isolated in 92% cases and *Enterococcus fecalis*, which is not regarded as common pathogen causing pyoderma was detected in 6.66%. Multi drug resistance has become a clinical challenge and most strains were found to be resistant to one or more antibiotics. In this study, 78.26% of *Staphylococcus aureus* were resistant to ampicillin and 47.8% were resistant to cephalexin. However, 94.2% sensitivity was seen with oxacillin, 85.5% with erythromycin and 84% with ciprofloxacin. Therefore, conventional drugs like â- lactam antibiotic (oxacillin), erythromycin and ciprofloxacin can still be considered effective based on the results of this study.

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