INTRODUCTION

A diabetic foot is a non healing ulcer due to the presence of diabetes in a patient. A “diabetic foot syndrome” is when several diabetic foot pathologies are present. The organism responsible for a Diabetic foot is clostridium species in the west, hence, we need to know the most common organism involved in DF in our setup. Our research project sheds light on the prevalence of most common organism responsible for diabetic infection and to find out their sensitivity to antimicrobial agents to prevent amputation and sepsis by the administration of empirical treatment. A diabetic foot ulcer (DFU) affects around 15% of all the people suffering from diabetes along the course of their life and is a major factor in predisposing amputations in almost 15% of all cases3,4,5,6.

The most important and serious foot complications in diabetes are:

1. Ulceration (an estimate shows lifetime incidence of foot ulcers among people affected by diabetes is around 15-25%) A Diabetic foot ulcer (DFU) affects around 15% of all the people suffering from diabetes along the course of their life and is a major factor in predisposing amputations in almost 15% of all cases3,4,5,6.
1. Neuropathic osteoarthropathy.

These are the significant risk factors for lower extremity amputation. Administration of antimicrobial agents, to which they are sensitive to, is very important part of the management of these patients. “Of all the methods that are proposed for the prevention of DFU, the only beneficial therapy in RCTs was foot temperature-guided avoidance therapy” a meta-analysis shows.

Treating DFIs with broad spectrum antibiotics is practiced worldwide; however, because of infections with resistant organisms, treating with a narrow spectrum antibiotic may be more appropriate, due to low resistance rates and high bacteriological and clinical cure rates. The fact that antibiotic sensitivity changes with time, therefore knowledge of common bacteria involved and their current sensitivity pattern will help us not only in providing the best initial empirical therapy but also in preventing the emergence of resistance when taken properly and to prevent long term morbidity. Records of 2013 show that around 382 million people worldwide suffer from diabetes. About 90% of these are type 2.

International Diabetes Federation (IDF) in 2014 audited that diabetes resulted in 4.9 million deaths. World Health Organization (WHO) in 2012 estimated that diabetes resulted in 1.5 million deaths, what makes it the 8th leading cause of death. Modeling is used by IDF to estimate the deaths amounting to diabetes. Low and middle income countries amounted for around 80% deaths due to diabetes.

Within this backdrop we propose to study the most common organisms responsible for Diabetic Foot Infection and their sensitivity to antimicrobial agents for the prevention of sepsis/amputation by the administration of empirical treatment. This research work would hopefully give us deeper insights into further understanding, prevention and treatment of this disorder.

**MATERIAL & METHODS**

This study was carried out at the departments of Surgical, Medical and Orthopedic wards of Khyber Teaching Hospital, Peshawar, Pakistan. Convenient sampling technique was used and the sample size was calculated to be 100 using WHO sample size calculator. Patients who were resident of KP and were admitted to Khyber Teaching Hospital for diabetic foot treatment were included in the study and those who refused to participate in the study, patients with documented anatomical abnormalities of lower limbs (based on history and past medical record) and those without a confirm diagnosis of diabetes were excluded from the study.

Diabetes was defined as symptoms of diabetes plus random blood sugar ≥ 11.1 mmol/ L or fasting blood sugar ≥ 7 mmol/L and/or HbA1c ≥ 6.5%. A semi structured questionnaire was used for this purpose having open-ended as well as close-ended questions. In most cases data was collected by person to person interviews with respondents. Study was conducted after approval from ethical & research committee.

**RESULTS**

This section revolves around meaningful facts and figures derived computational statistics of our research work. Our sample size was 100 people belonging to

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<td>36</td>
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<td>6.0</td>
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<td>85.0</td>
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<tr>
<td>Coliform species</td>
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<td>4.0</td>
<td>4.0</td>
<td>89.0</td>
</tr>
<tr>
<td>Proteus vulgaris</td>
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<td>2.0</td>
<td>91.0</td>
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<tr>
<td>MRSA + E.coli</td>
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<td>5.0</td>
<td>96.0</td>
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<tr>
<td>MRSA + pseudomonas</td>
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<td>1.0</td>
<td>1.0</td>
<td>97.0</td>
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<tr>
<td>Staph aureus + coliform species</td>
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<td>3.0</td>
<td>3.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
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</tr>
</tbody>
</table>
Bacterial culture isolates from infected diabetic foot tissue specimens

different walks of life with different occupations 58 were males and 42 were females. Sixty-four were married, 14 were single, 12 were divorced and 10 were widowed. If we talk about their educational background then 37 were uneducated, 26 studied up to primary, 17 were matriculate and 20 had done higher education. Demographically, out of the 100 there were 24 from Peshawar region, 5 from DI Khan, 6 each from Chitral and Charsadda, 7 from Nowshera, 8 from Kohat, 9 from Bannu, 10 each from Sawabi and Sawat, 15 from FATA.

Occupationally, out of 100 there were 8 who were students, 8 others were self employed, 10 were unemployed, 38 were employed, 36 were house workers. Out of the 100 patients, 87 presented with Type 2 diabetes and 13 presented with Type 1 diabetes (Figure 1). Thirty-five had no amputation, 35 with amputation below ankle, 16 with below knee amputation and 14 with above knee amputation. The different organisms found are shown in Table 1. The most frequently found Gram positive bacteria are Staph. Aureus (9%), MRSA (6%), the most common Gram negative bacteria are E.coli (19%), Pseudomonas (7%), and Proteus (4%).

Most effective drugs against Gram positive are Cephalosporin’s (Generation II and III (100%)), Vancomycin (100%), Imipenem (100%), Piperacilline/Tazobactam (100%). Most effective drugs against Gram negative are Cefoperazone/Sulbactam (94.4%), Vancomycin (92.3%), Imipenem (89.4%), and Piperacilline/Tazobacteram (89.4%). Most effective drugs against MRSA are Vancomycin (100%), Chloramphenicol (100%), Amikacin (100%), and Minocyclin (100%), Most effective drug against polymicrobial infection is Vancomycin (100%), Chloramphenicol (80%), and amikacin (50%).

DISCUSSION

The global burden of non communicable disease is serious public health issue resulting in increased morbidity & mortality, amongst which diabetes is one big problem rather it’s a global epidemic resulting in 4.9 million deaths each year14. Every year the incidence of diabetes is increasing and it is expected that this ratio will double in the coming years and diabetic foot is one of the most serious complication of diabetes which results in high social and economic costs11. All the patients once diagnosed diabetic are at risk of developing diabetic foot ulcer irrespective of duration of disease, repeated interventions result in progressive disability. A diabetic foot is a non healing ulcer below the ankle due to the presence of diabetes in a patient.

A United States multicenter Clinical Trial was carried out to find out the organism cultured from diabetic foot infections and to compare the effects of Ertapenem and piperacillin-tazobactam for their treatment, especially in cases of moderate to severe diabetic foot infections. A total of 433 patients were brought under observation for this trial. The specimens were mostly collected by biopsy or curettage after the debridement of the wound. The aerobic and anaerobic culture were performed on those samples. After the results were compiled it was evident that almost 84% of the samples were polymicrobial (a huge no, contrary to our study). The predominant organism isolated were oxacillin-susceptible Staphylococcus aureus and Corynebacterium species. The study further sheds light on the antimicrobial therapy. Ertapenem and piperacillin-tazobactam were each active against >98% of the enteric gram-negative rods. Most of the DFIs are polymicrobial and hence need due attention. These antibiotic susceptibility results can help inform therapeutic choices. Initially when a patient presents with DFI, the patient is treated empirically meanwhile a therapy directed at known causative agent is liable to better outcomes, better prognosis and is in better interest of the patient. An interesting fact here is the role of anaerobes which is pretty unclear, because this is believed that in most such studies the specimen collection was not up to the mark. The studies that used appropriate methods are consistent with the findings in favour of a minimal role while others suggest B. Fragilis to be the predominant anaerobe isolated. The bacteriology of DFIs has been the talk of the century and is under taken by different researchers for over three decades now15,16 but it is very interesting to see that the results have varied, misleading and contradictory to the popular belief. We mostly see that a discouraging pattern is observed for commonly used antibiotics on antibiogram in cases of DFIs. Knowing the organism and its sensitivity to the
Bacterial culture isolates from infected diabetic foot tissue specimens..............

microbes is very vital in instituting a treatment plan for
the patient. These ulcers and infections may require
use of combined antimicrobial therapy for initial man-
agement, repeated dressing and wound debridement
may be required

DFIs are a major issue worldwide. The role of
antibiotic in treating such infections is very important
but on the other hand consideration must be given to
the use of selective antibiotics that foster the emergence
of resistance against such drugs and lead to difficult
situations in the clinical setting during treatment of such
patients or in cases of recurrent infections. There are
researchers which advocate the use of only clinically
infected wounds and suggest the use of the narrowest
spectrum treatment options. The organism responsible
for diabetic foot infection in most part of the western
world is clostridium species and other related organ-
isms. The Study took into account samples from 61
patients with DFI. They used the polymerase chain
reaction (PCR) technique for the detection of microbes.
Patients that were PCR positive were randomised into
two groups: Metronidazole and non-Metronidazole.
Antibiotics for the control of infection were given in
both groups according to the need of each patient.
Treatment outcome was assessment of the wound. The
study emphasized the significance of the PCR tech-
nique over culture methods in detection of microbes.
It was found out that among the organisms isolated the
maximum prevalent was Clostridium (75%) followed
by Bacteroides. Clostridium was also found to be the
most prevalent among all Wagner Ulcer Classification
grades. This was found to be significantly associated
with age and the total leukocyte count. There was no
healing difference found between the different groups
undertaken in the study. Metronidazole was found to be
sensitive for a variety of anaerobes and aerobic bacteria.
The study suggests that since there has been a debate
over the use of culture and molecular microbial studies
for organism detection, it is very important to take into
account the role of empiric treatment. The time taken
for cultures to render a specimen negative or positive is
very crucial and plays a vital role in the clinical outcome
of the case. Where cultures might take from 4 days to a
week, a molecular microbial study gives you results in
24 hrs. Hence it is very important in a clinical paradigm
to evaluate, diagnose, treat and reevaluate for better
patient outcomes. The main focus of the physician
should be timely curative intervention and rehabilitation
for the good of his patient.

Our study was aimed to assess the most com-
mon organisms involved in diabetic foot infection and
their sensitivity to antimicrobial agents for prevention
of sepsis/amputation by administering empirical treat-
ment. Bacteriological specimens were obtained and
processed using standard hospital procedure for mi-
crobiological culture and sensitivity testing. This study
was also aimed to improve hospital based framework
for the purpose of diagnosis and treatment of patients
with diabetic foot. Cultures from the ulcers were grown
in aerobic incubation at 37 degree Celsius. The most
common organisms found were aerobic bacteria E.coli
(19%), Staph Aureus (9%), Pseudomonas (7%) and
Proteus (4%) for which the effective treatment was
Cephalosporins 2nd and 3rd generation, Vancomycin,
Imipenem, Piperacillin giving a 100% coverage, these
findings are consistent with the studies carried out
worldwide.

The study result showed that the mostly the pa-
tients were affected by gram positive organisms rather
than gram negative in Khyber Pakhtunkhwa area of
Pakistan. Anaerobes are still the most common cause
for this infection, although the prevalence is less. Our
study helps shed light to choose empirical treatment
for patients with diabetic foot infection and also in the
management of patient who comes with sepsis that
is caused from diabetic foot. Further studies need to
be under taken to have better patient outcomes. Now
that the researchers and physicians are realizing the
diversity they are facing or to face in the near future
in treating infections from new bacterial strains and
diversity observed in bacterial populations, it might be
an important factor in the chronicity of wounds, as is
the case with diabetic ulcers.

CONCLUSION

Staph. Aureus and E.coli are the most common
Gram positive and Gram negative organisms, respec-
tively, in KP. Anaerobes are still the most common
cause for this infection. These ulcers and infections
may require use of combined antimicrobial therapy for
initial management and repeated dressing and wound
debridement.

RECOMMENDATIONS

Diabetic foot infection patients should be educat-
ed to keep their feet clean and healthy. The attendants
of the patients should be advised to take proper care of
their patient. The patient should be compelled to check
their limbs specially lower extremities for any ulcers,
wounds or cuts. Good compliance to therapy will yield
positive results and would eradicate the complications
before it causes further damage to health.

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2. Caroline Ann Abbott PhD, Diabetes Foot Clinic, Disablement Services Centre, Withington Hospital, Manchester M20 8LB, UK. E-mail: ca.abbott@btinternet.com 2002; 5: 377-38.


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AUTHOR’S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

Ayub R: Main Idea
Raza SS: Data collection
Shafiullah: Statistics
Ahsan J: Bibliography
Hussain AK: Data collection
Nadeem MD: Follow-up.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.