



**ORIGINAL RESEARCH PAPER**

**General Surgery**

**PRAGMATIC MANAGEMENT OF DIABETIC FOOT INFECTION – AN EXPERIENTIAL PERSPECTIVE**

**KEY WORDS:** Diabetic Foot, Culture, Bacteriological Profile

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**ABSTRACT**

To avoid amputations in patients with diabetic foot we need to manage infection, improve blood flow, off load the foot and local wound care needs to be effective. Along with this a lot of issues which are not addressed in standard surgical reference material are considered. In this narrative article those factors was explored. This is a cross sectional observational study and data was collected from the OP and IP records of patients attending and being referred to our diabetic foot clinic. Off the 114 cases studied 52 of them had some sort of an amputation. We are of the opinion that prevention of diabetic foot ulcers and infections are of paramount rather than treating them, and if we have the inevitability of managing it, a multi disciplinary team and involvement of patient and their attendants in decision making as to the modality of treatment, its duration, probable outcomes and time and money involved also has to be discussed in detail.

**INTRODUCTION**

In order to improve the effectiveness of treatment of diabetic foot infection and avoid amputation as much as possible we wanted to analyze the various parameters involved in patient management.

During this process a lot of issues pertaining to the management of this condition was encountered which is not addressed in standard surgical reference material and most research on the topic is based on knowledge deficit model which is too narrow and restrictive. Hence this narrative was thought of as appropriate to highlight the various problems encountered in management of diabetic foot.

The term diabetic foot comprises of infection, ulceration or destruction of the foot of a diabetic patient[1]. Infection of the diabetic foot follows a break in the cutaneous envelope after which invasion and multiplication of the microbes in the host tissue takes place followed by tissue destruction[2]. The rigid but inter communicating compartments of the foot fosters ischaemic necrosis and proximal spread of infection [3]. Infection increases the morbidity and mortality in diabetic foot ulcer[4]. Deciphering the microbial spectrum and its antibiotic susceptibility is invaluable for effective treatment of infections[5]. The infectious diseases society of America classifies diabetic foot infections into mild, moderate and severe infection[6]. As the diabetic foot flora is usually polymicrobial, the causative organism and the contaminants and their identification becomes difficult as DFI mimics diabetic skin flora [7], and wounds with polymicrobial biofilms overwhelm the capacity to identify the organism by culture methods[8]. Surprisingly increased microbial diversity aids in diabetic foot ulcer healing [9]. Mere presence of an organism or a colony count of  $\geq 10^5$  does not convincingly support the basis of diagnosis of infection [10, 11]. With this background, this study was done to measure the bacteriological profile of the diabetic foot patients.

**MATERIALS AND METHODS**

For the purpose of this cross sectional observational study, data was collected from the OP and IP records of patients attending and being referred to our diabetic foot clinic from January to December 2022. All patients diagnosed as DFU/DFI either at first visit or earlier, underwent clinical assessment by graded according to Wagners classification [12]. Presence or absence of systemic manifestations of infection, HbA1c levels and co-morbid conditions were noted. Patient demographic details were collected and swabs taken using Levines technique[13]. Aspirates / Necrotic tissue

samples and bone biopsy where appropriate and feasible were collected for microbiological study and antibiotic susceptibility testing was done according to Kirby Bauer method[14].

**RESULTS**

In the 12 months of this study there were 114 patients with a diagnosis of Diabetic foot. Of these 102 (89.5%) were males and 12 (10.5%) were females.

The study participants consisted of predominantly 50-65 yr 76 (66.7%), followed by <50 years, 24(21.1%) , and > 65 years 14 (12.3%).

**Table 1: Distribution of study subjects based on Wagners classification**

Wagners Grade	No of Cases	%
Grade 1	5	6.1
Grade 2	9	11.0
Grade 3	29	35.4
Grade 4	28	34.1
Grade 5	11	13.4
Total	82	100

Remaining patients had no record of Wagners grading. The wagners grading did not help in deciding the management strategy except for objective description of ulcer and gangrene alone and not in the overall clinical scenario.

**Table 2: Distribution of study subjects based on HbA1c levels**

HbA1c level	No. of patients	%
< 7	4	3.5
7- 8	15	13.2
8 - 9	26	22.8
9 - 10	21	18.4
>10	48	42.1
Total	114	100

Almost all patients had high HbA1c and signify the lack of control of diabetes which is directly responsible for the worsening of the diabetic foot eventually requiring amputation in one form or the other.

Total of 72 samples sent for culture , out of which 65 were swabs, 3 were tissue, 2 were aspirate and 2 were bone.

Bone and Aspirates turned out “No Growth”. It appears that the swab specimen sample is the most preferred culture.

**Table3: Distribution of Organisms grown from the samples**

Sl. No	Organism	Total	%
1	Klebsiella	22	30.6
2	E.coli	8	11.1
3	MRSA	2	2.8
4	Pseudomonas	9	12.5
5	Citrobacter freundii	2	2.8
6	Coagulase negative staphylococcus	1	1.4
7	Staphylococcus aureus	3	4.2
8	Proteus	1	1.4
9	Pseudomonas + Citrobacter	1	1.4
10	Klebsiella + Pseudomonas	2	2.8
11	Klebsiella + Proteus vulgaris	2	2.8
12	Klebsiella + Enterobacteriaceae	1	1.4
13	Klebsiella + Citrobacter	2	2.8
14	Klebsiella + E coli	3	4.2
15	Proteus vulgaris + E coli	1	1.4
16	Enterococcus + E coli	1	1.4
17	No Growth	11	15.3
	Total	72	100.0

Klebsiella and E.coli were most common organisms grown. 70% [15] of Klebsiella were sensitive to Meropenem and 100% E.coli was sensitive to Piperacillin + Tazobactam. Colistin was resistant in 10 culture reports. In one case staphylococcus was sensitive to all antibiotics tested but resistant to Vancomycin. As regards antibiotics Meropenem / Clindamycin was used for badly infected wound and for patients in sepsis on an empirical basis. Patients managed as OP were advised Faropenem as most had already used Cefotaxime, Amoxicillin + clavulanate, ciprofloxacin, ofloxacin and many more combinations on record and many more without record. As the culture reports came in, need for change of antibiotics was based on the clinical deterioration only. If there was clinical improvement and even if the organism showed resistance to Meropenem it was continued. No logical interpretation of antibiotic culture sensitivity is possible to recommend here but culture sensitivity is a most useful tool in management decision.

Most of the patients had wrong perception of managing diabetes or had monetary issues or complained of too many tablets to take. Hence, chose to be irregular on medicines. Many had family members unable to purchase medicines for them. Too many GP's and specialists had seen the patient and multiple antibiotics, dressings were done by doctors, nurses, relatives and self. Most were not sterile as they purchased bandage materials and gauze from over the counter stores. Most had hypertension, liver, lung, renal co morbidities and they were frustrated. Many had big files which showed multiple culture and sensitivity reports with varied organisms grown and variable sensitivity patterns to no growth. Many had spent atleast 3 months shopping and hopping from medical centers to Allopathic doctors to Ayurvedic practitioners to Naturopaths.

Six patients had Necrotizing soft tissue Infection (NSTIs), a term used for necrotizing forms of cellulitis, Faciitis and Mysositis. Soft tissue infection has been classified by Giuliano et al [15] as type 1 ( polymicrobial - aerobic bacteria causing tissue destruction setting the field for anaerobic bacteria to proliferate), and type 2 (Monomicrobial). Most labs do not culture anaerobes routinely or report on fungus unless they see them on smear. In our study amongst the 72 samples cultured 08 polymicrobial growth and 08 mono microbial species were seen. 11 cultures reported no growth. Anaerobes were not cultured at all. Though we say its polymicrobial only 02 organisms were seen in the so called polymicrobial growth.

Off the 52 who underwent some surgical procedures 8 were major amputations( 2 AKA, 5 BKA (1 guillotine at ankle and

converted to BKA), 1 forefoot amputation. 28 were either Ray or Multiple toe amputations, 6 necrotizing fasciitis and 14 minor debridement. 2 of the amputations had prior vascular interventions elsewhere which had failed. 12 patients who underwent one or the other above procedures had long standing trophic ulcers. 4 patients underwent CT angio and one had angioplasty. One had fem - pop bypass followed by 2<sup>nd</sup> toe amputation. Two cases of fulminating necrotizing fasciitis succumbed to their illness. One patient died after below knee amputation.

Another case of diabetic foot with PVD had angioplasty done elsewhere and ended up with gangrene of the foot and amputation was suggested. Patient and his wife attempted suicide and were admitted in our hospital and I also have to tell them the same – Amputation. Yet another case of post vascular bypass comes with gangrene of foot and advised amputation. Patients wife pleads her helplessness regarding money matters and goes on to state that patient was a bad father and an husband and karma has served him right, but still children are willing to help in absentia and wife has to do all the running around and caring. When she speaks the truth in front of her ailing husband, how does the patient feel and what is the level of frustration in his wife. No amount of medical magic will be of any avail in this scenario. In the above cases amputation is just the beginning. What is next, is easy to imagine in terms of post op care and rehabilitation. Assessing the actual expenses incurred in these cases is a good study to be undertaken.

More than half of the cases is from rural areas who had difficulty commuting to our center for dressings. And these were the patients who had financial issues. Many had dressing once in 2 to 3 days from local nurses and in local hospitals where povidone gauze was just changed and no real wound care ( no debridement or cleaning of surrounding areas). Many had not washed the foot as they thought contact with water causes infection and wound will not heal). There was one case of maggots seen in our series and there was utter disgust amongst the family members. The same karma conversation came up in this too.

**Materials for wound care**

Sl No	Materials used for dressing	Number of cases
1	Povidone solution	All had Povidone at one time or the other.
2	Debriding ointments	2
3	VAC	6
4	Woxheal®	10
5	Microdacyn®	6
6	Saline	All had this at one time or the other.
7	Nano Silver dressings	5

There were overlapping of dressings in most cases. Beginning with Povidone and then moving on to Woxheal or Microdacyn and saline till good granulation was seen and ready for split skin graft or till closure. Most were decided on the basis of affordability and access to POC. In one patient with an ulcer cavity and no systemic symptoms with copious pus discharge for almost a month with heavy growth of klebsiella being grown, all antibiotics were resistant except for Colistin. The patient and attendants was counseled and they refused colistin for its cost and patient was not willing for VAC either. She was managed with jugad romovac drain suction dressing and daily wash with betadine. And after 2 weeks the wound closed. Thanks only for the culture positivity without invasive infection or inflammatory response.

**DISCUSSION**

The population of people with Diabetic mellitus is increasing and supposed to hit 80 million by 2030 [16]. About 28% of

diabetics have a life time risk of amputation of some sort [17]. Infection and gangrene as a result of diabetic foot ulcers are the leading causes of amputation [18].

No amount of research data or evidence will help in managing a diabetic foot in a given set up for a given patient, except for the clinician and patient to sit and discuss the options of management based on his own experience and available resources and socio economic background. All the findings from a study done in Malaysia, china, UK, USA , Europe cannot apply in our society except for institutions and patient in metropolitan and cosmopolitan cities because of social stigma associated with disease and disability. Financial issues and family issues are the dominating factors in treating patients and decision making process that is involved. The diverse challenges involved in caring for patients with foot ulcerations and amputations including the need for frequent doctors visits and hospital admissions are brought out in their paper by Ratliff et al [19]. A study by RM Crocker et al showed that the patients with foot ulcers, the emotional distress progressed with patients feeling sadness, fear, frustration, powerlessness and embarrassment, loss of independence, social isolation and body image disturbances[20].

Rosca et al have enumerated the emotional impact, negative affects like anxiety, anger, hostility and their struggle with depression, guilt, social withdrawal, family ties, phantom limb sensation, and later emotional balancing with determination and hope. They also suggest multidisciplinary approach, by surgeons, neurologists, psychologists, physiotherapists and orthotists [21]. All this will add on to the costs and most expertise is not available for patients in rural areas.

In the West where insurance, NHS or the State takes up the expenses it's easy to apply evidence based medicine. Even here we have government institutions where free or subsidized treatment and Ayushman Bharat schemes / SAST and insurance and for referral to specialist centers are there. But the process involved to reach and have treatment in specialized center has its own difficulties involved. As of now patients have to bear full cost of treatment, co-pay or have insurance cover. We also have bare foot walking, neglect of self and from family, Nth hour presentation to hospital to either disown patient or to relegate to destiny or for public display of care by family towards the ailing patient. This coupled with expectation that the doctor can save a patient with gangrenous limb with sepsis, lack of good control of diabetes, cost of medicines, cost of investigations and long term wound care along with a erroneous impression in patients and attendants that the medications available at Jan Aushad stores are substandard. A few of the patients and attendants who were asked to procure medicines from Jan Aushad refused to do so. Rampant antibiotic use, abuse, irregular usage and illogical dosage (a few patients popped a few antibiotic pills purchased from over the counter as and when they thought that they had infection).

Culture sensitivity reports from different centers had different format. No colony count in some to heavy growth to grams smear shows gram –ve bacilli and gram positive cocci but no growth. What is the rationale behind using antibiotic discs used in AST is it based on CLSI guidelines or based on local surveillance, and how does it help clinician when antibiotics like aztreonam, novobiocin, netilmycin, tetracycline is used in sensitivity testing. As to how the specimen for culture is collected, transported, stored also becomes questionable. Solving the dilemma of clinical infection and no organism grown and no clinical infection but heavy growth also needs to be decided on experience rather than on evidence. Regarding Wagners grading – a trophic ulcer causing extensive necrotizing fasciitis does not fit wagner system and similarly if one asks for evidence for performing a BKA in a fore foot gangrene (Wagner 4) where fore foot amputation could suffice, should also consider the presence of peripheral

vascular disease which is out of the purview of Wagners grading system. Atleast 3 patients had been on dressings only, for more than 6 months in our study and progressed from minor debridement to ray amputation to fore foot amputation to BKA. Its hard to get evidence for this type of management strategy in a patient who is disappointed and disapproves for the right treatment at the right time. One female patient with Charcot foot discontinued treatment with us and went elsewhere and got orthodesis of foot bones with K wires and then got infected and went into sepsis and came back to us for BKA when this could have been done much earlier saving a lot of time, money and suffering. This dilemma can only be solved by a compassionate clinician in close consultation with patient and his attendants who must also be equally compassionate and willing to spend time and money.

## CONCLUSION

This study does not follow the classic IMRaD ( Introduction, Methods, Results and Discussion) structure essential for a scientific study. Emotionless sterile information helps understanding the subject but does not help clinician to process information based only on scientific evidence but by a lot of other factors. We cannot be a hypocrite giving excellent ethics speech and evidence based medicine without being compassionate and understanding the socio-economic scenario. Our preliminary data collection sheet could not be exhaustive as each and every patient had a different story and we had to add on notes on the basic information collected on the data sheet. Further studies needs to be done to focus on the individual parameters discussed – the role of microbes, whether anaerobic cultures need to be done routinely, use and abuse of antibiotics, family dynamics, societal role, economics involved, the procedural hiccups involved, the political and administrative lies, corruption etc. I understand certain parameters and observations alluded to will not be accepted at face value in good spirit. But in the best interest of the patient and the limb and life involved we had to be as critical and rhetorical exposing ourselves to the risk of being rubbished. Diabetic foot management is not just an infection or ulcer which needs medicines or surgery. One of the most valuable strategies for managing the diabetic foot is to prevent the development of foot complications[22]. At present in our settings we feel preventive management is more appropriate than curative. For curative management a pragmatic approach is needed than evidence based approach.

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