IJBPAS, November, 2021, 10(11): 4181-4192

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

A STUDY IN MICROBIOLOGICAL PROFILE OF SURGICAL SITE INFECTION IN POST-SPLIT SKIN GRAFT PATIENTS WITH TYPE II DIABETES MELLITUS

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Received 22nd Feb. 2021; Revised 20th April 2021; Accepted 6th May 2021; Available online 1st Nov. 2021

https://doi.org/10.31032/IJBPAS/2021/10.11.57442

ABSTRACT

Background: Diabetic patients are immunocompromised and are most prone to develop Leg and Foot ulcers, which might grow bigger in size due to poor attendance of the wound / ulcer. These ulcers are then treated and aided in heal by secondary intention. During this process, if the raw area is more than 5x5cm, these raw area are prone for secondary infections, hence Split Skin Grafting is proposed and done. Diabetic patients are immunocompromised, due to which a variety of organisms grow under the Graft, which invades the wound and delays healing and spread to deeper tissues, resulting in Graft loss and reinfection of the healed ulcer. **Materials and Methods:** The key aim of this study is to identify the most common and prevalent organisms occurring in surgical site infection in Post SSG patient with Type II Diabetes Mellitus and to assess the sensitivity pattern of the antibiotics for controlling the infection.In this study, 63 patients presenting with Diabeticfoot / Leg ulcers to the Department of General Surgery, SBMCH were selected, treated and prepared for SSG, following which serial wound swabs were taken from the SSG site and studied. **Results:** Most common organisms were gram negative rods, gram positive cocci. *Klebsiella pneumoniea* and *Klebsiella oxytoca* were the most common gram negative organisms. Escherichia coli was the most common gram negative rod and Methicillin sensitive

staphylococcus aureus was the most common gram positive cocci. Tobramycin, Piperacillin Tazobactam, Meropenem and third generation cephalosporins were the sensitive antibiotics.

Conclusion: It has been concluded that strict glycemic control, appropriate pre-operative antibiotic prophylaxis, strict maintenance of chain of sterility and regular dressings under strict asepsis along with rational use of antibiotics to prevent the development of resistance and proper wound care.

Keywords: Diabetes, immunocompromised, *Klebsiella pneumoniea* and *Klebsiella oxytoca*

INTRODUCTION

Diabetes mellitus is the most common metabolic disease in India and 3rd commonest in the world. India being Diabetic capital of the world, surgical complications related to diabetes is the most common cause of mortality and morbidity. Among all the complications, Diabetic Foot / Leg ulcers is the one of the leading cause for financial and medical burden for the patients accounting more than 20% of the healthcare cost. An uncontrolled Diabetic person has a 25% risk of developing DiabeticFoot / Legulcer; this may be due to peripheral neuropathy, microangiopathy, chronic immunocompromised state, peripheral arterial disease, poor glycemic control and above all irregular follow-up. According to WHO DiabeticFoot/Leg is defined as the Foot / Leg of a Diabetic patient that has risk of pathological consequences, including infection, ulceration or destruction of tissues associated with neurological abnormalities, various degrees of peripheral vascular disease and metabolic complications of diabetes in lower limb **[1-4]**.

On hospitalisation, proper wound care is provided thus promoting healthy granulation tissue in the ulcer bed, initiating secondary wound healing. After all this the granulated raw area is covered with the Autologous Split skin grafting, thus ensuring proper wound healing and coverage of raw area **[5]**.

- During peri-operative period organisms invading the recipient site of split skin graft either interfere with or prolong the wound healing and graft uptake process leading to graft necrosis, spread of the ulcer and tissue destruction.
- This study aims at identifying the organisms occurring in the surgical site of post-split skin grafting Diabetic patient, empirical and sensitive antibiotic therapy and ways to prevent.
- To study the Microbiological profile of surgical site infection in post-

split skin graft patients with Type II Diabetes Mellitus.

- To assess antibiotics sensitivity and their rational usage.
- Methods & Materials:
- Patient selection: Patients presenting with Diabetic Foot / Leg ulcers to the OPD were selected, hospitalisation done, daily dressings and serial wound debridement were done until healthy granulation bed formed, following which Split skin grafting was done. Patients were followed until wound healed; in the meantime serial surgical site swab culture sensitivities were done.
- Sample size: 63 patients
- Study area: Department of General Surgery, SBMCH, Chennai, Tamil Nadu, India.
- Inclusion criteria:
- Age 35 to 85 years
- Duration of Ulcer
- Duration of Diabetes
- Exclusion criteria:
- Ulcers other than Foot / Leg
- Associated with other dermatological conditions
- Patient under Methotrexate
- Patient under systemic steroids
- Vasculitis
- Peripheral Vascular disease

METHODOLOGY

It was a prospective study. 63 patients presenting with DiabeticFoot / Leg ulcers were subjected to following routines:

I. Elaborate history of patient
II. Complete General examination
III. Complete Systemic examination
IV. Complete examination of the affected limb and ulcer
V. Routine investigations and X-ray of the affected limb

Following all this routine hospitalization and case management protocols, daily wound case and serial wound debridement was done. On hospitalization 1st wound swab will be taken before starting empirical antibiotic therapy. On obtaining healthy granulation tissue in the ulcer bed, patient is planned for SSG. 2nd wound swab was taken before the day of surgery and antibiotic therapy was modified based on the sensitivity pattern. 3rd wound swab was taken on the Post-operative day 3 from the margins of the SSG or from the pus points if any.

Wound Swab Collection: Foot / Leg ulcer was thoroughly washed with 500ml of Isotonic Normal saline. 1st and 2nd wound swab was taken from the deep tissues and sent for Microbiological testing. 3rd wound swab was taken from the free margin of SSG or from the pus points if any,

following thorough washing with 100 ml of Isotonic Normal saline. Cultures were available after 48 hours.

Classification of Split Skin Graft: Based on the thickness, split skin graft is classified into 3 types as per **Table 1**.

Table 1 Classification of Split skin graft

Classification of Split skin graft	Size in Millimetre (mm)
Thin Split skin graft	0.15 – 0.3
Intermediate Split skin graft	0.3 – 0.45
Thick Split skin graft	0.45 – 0.6

RESULTS

Males were predominant in this prospective study accounting 78% and the rest 22% were females presenting with Diabetic Foot / Legulcers **[Figure 1]**. Patients presenting were mostly within age group of 55 to 64 years (38%) followed by 45 – 54 years (22%)

[Figure 3]. Duration of Diabetic ulcer and age of the patient played a major role, more the duration worse the ulcer, which in turn takes more time to heal. Most patients developed DiabeticFoot / Leg ulcers with duration of diabetes between 6 to 10 years **[Figure 2]**. In this prospective study most of the organisms occurring following split skin grafting of a previously Diabetic ulcer were gram negative species. Polybacterial growth was 63%, monobacterial growth was 34% and No growth was 3%. *Klebsiella pneumonea* was the predominant species showing 22% growth **[Figure 6]**.

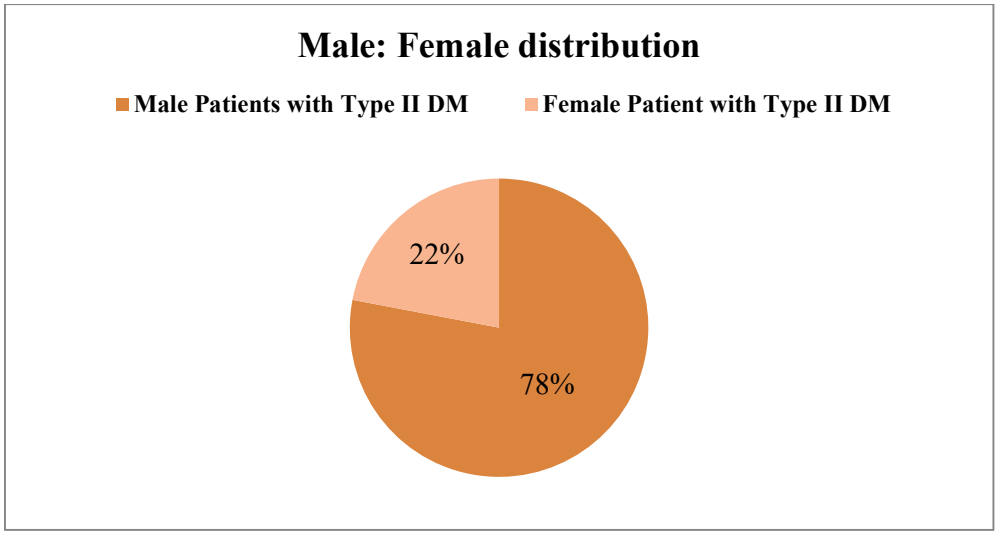


Figure 1: Male: Female distribution

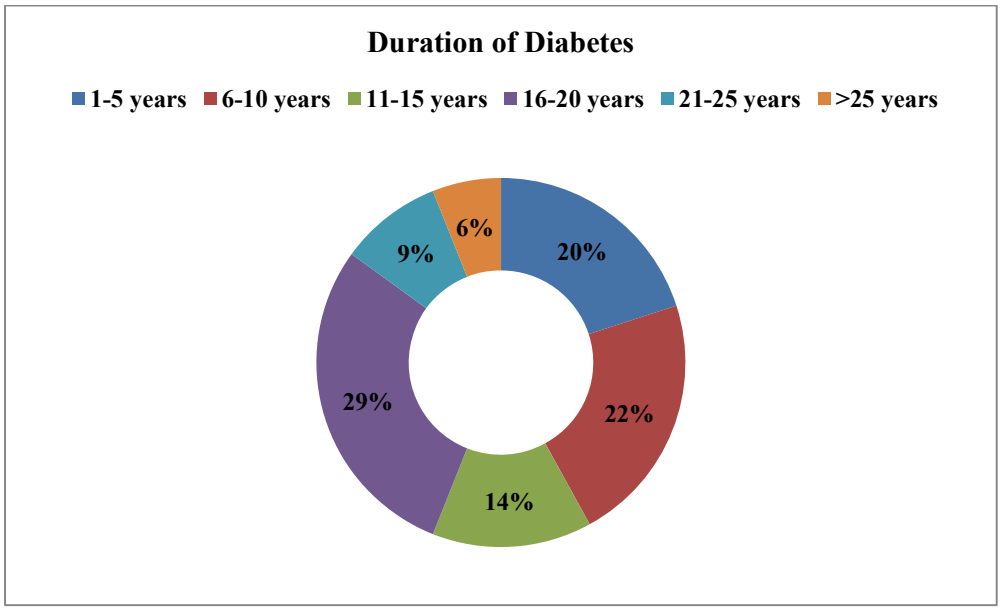
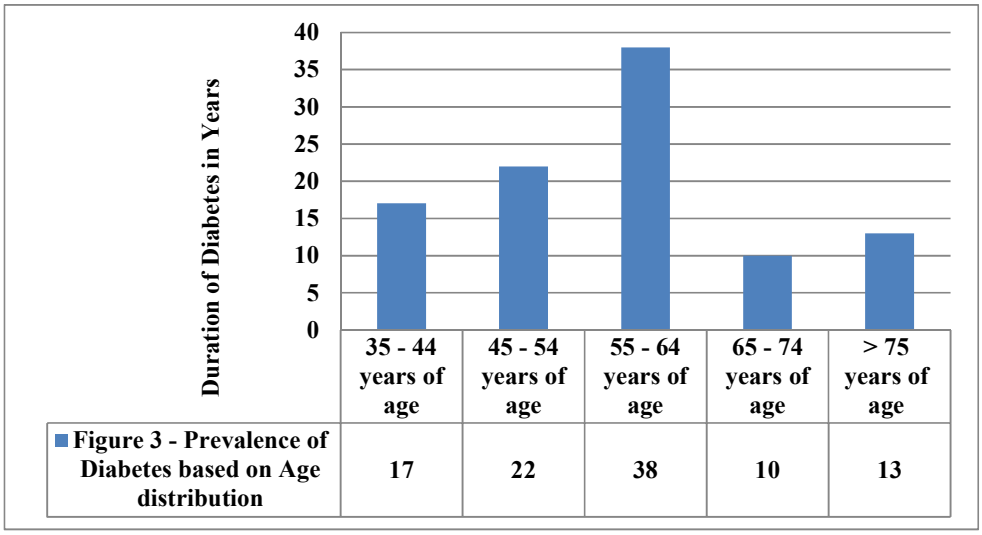


Figure 2: Duration of Diabetes



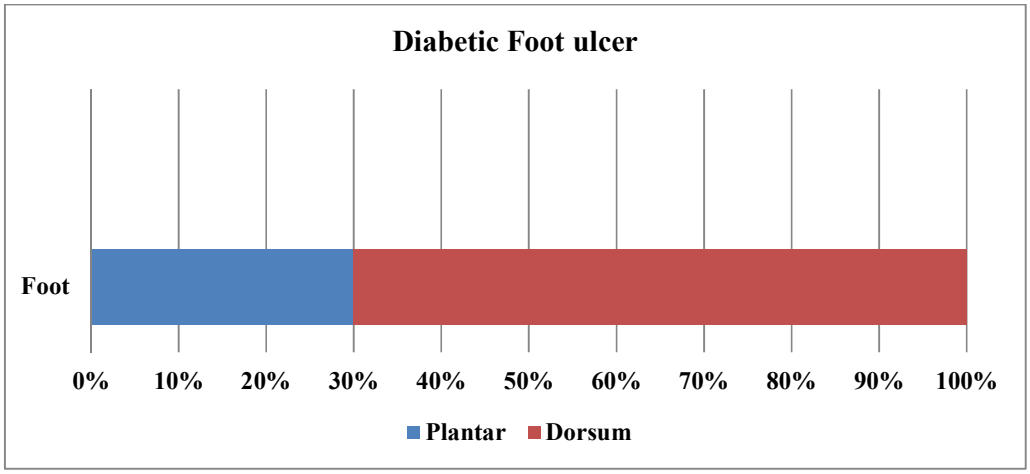


Figure 4: Diabetic Foot ulcer

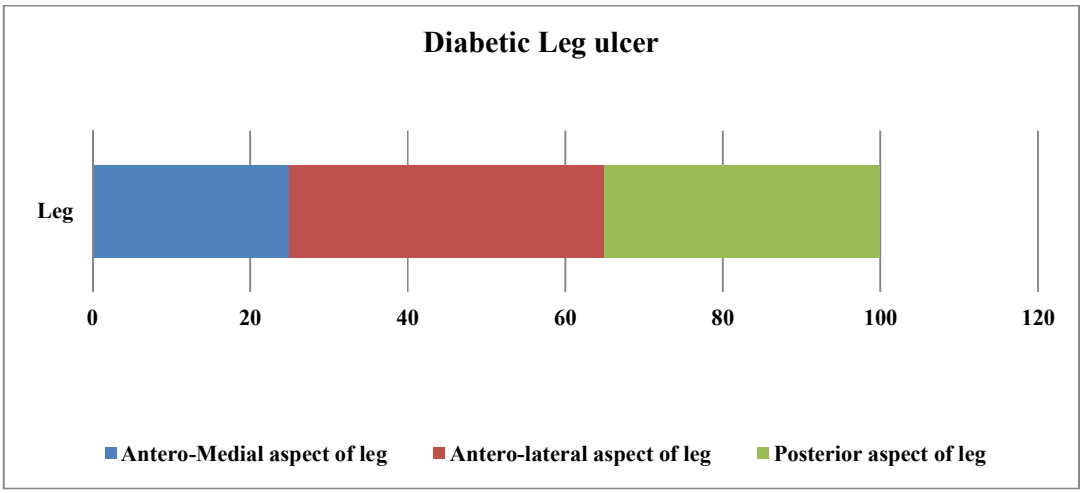


Figure 5: Diabetic Leg ulcer

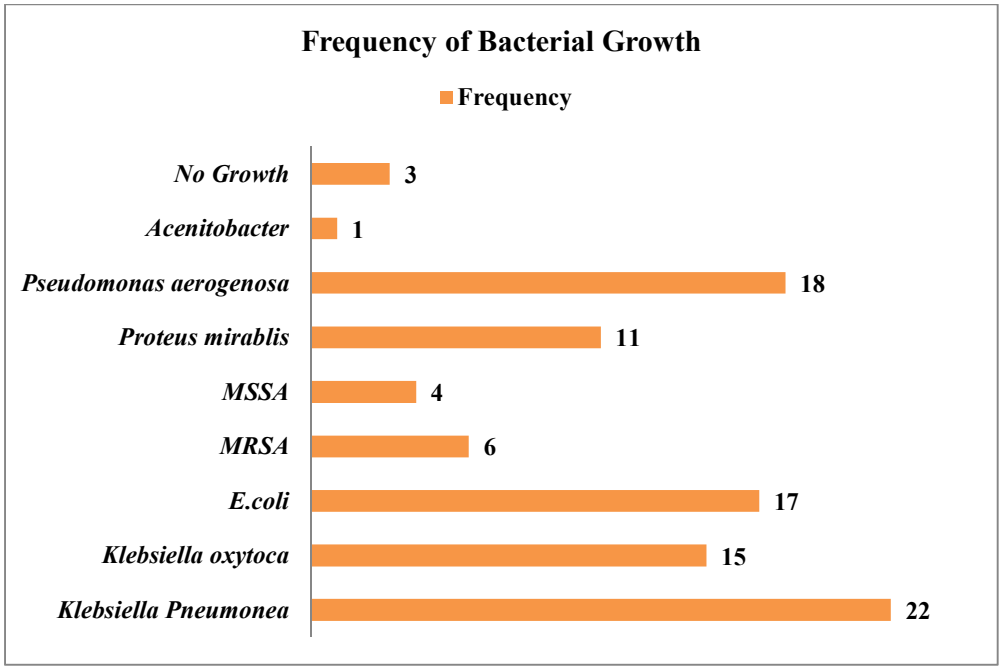


Figure 6: Frequency of Bacterial Growth

Table 2 Microbiological Profile		
Organism	**Frequency**	**Percentage %**
No growth	**3**	**3 %**
Acenitobacter	**1**	**1 %**
Pseudomonas aerogenosa	**18**	**18 %**
Proteus mirablis	**11**	**11 %**
MSSA	**4**	**4 %**
MRSA	**6**	**6 %**
E.coli	**17**	**17 %**
***Klebsiella* oxytoca**	**15**	**15 %**
Klebsiella pneumonea	**22**	**22 %**
Total	**100**	**100 %**

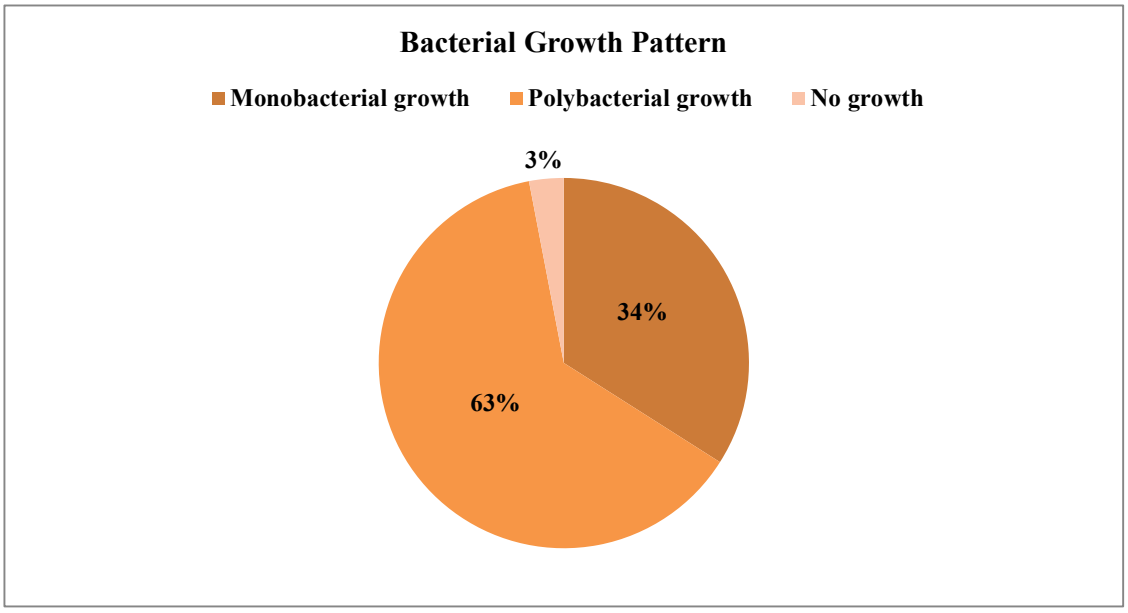


Figure 7: Bacterial Growth Pattern

Various studies have shown that these species are common in the northern part of India. During the course of time, due to irrational usage of antibiotics, it has acquired virulence and exhibited resistance in some cases.

In our study Methicillin sensitive staphylococcus aureus showed 4% of the grown culture. MRSA was on a raising trend accounted for 6% in our study, on view of this raising trend dressings were done under most sterile conditions. In a previous study MRSA accounted for 10.3% of the entire organism.

Other gram negative organism grown during this study in the given sample size like Proteus mirabilis 11%, *Acenitobacter* 1%, *E.coli* 17%, *Klebsiella oxytoca* 15% [**Table 2**]. These were treated meticulously with appropriate antibiotics and proper Post-operative SSG care.

There is no fungal growth in our study.

Antibiotic Sensitivity

In this study *Klebsiella pneumonea* was the most commonly occurring organism in post SSG site. These organisms are mostly sensitive to Aminoglycoside group of antibiotics like Tobramycin and Penicillin group like Piperacillin Tazobactam. *Pseudomonas* was the 2nd most commonly occurring organism in post SSG site. These organisms are mostly sensitive to Penicillin group of antibiotics like PiperacillinTazobactam and carbapenems like meropenem / imepenem. The grown organisms are also moderately sensitive to other aminoglycosides like amikacin, gentamicin and most of the third generation cephalosporins like ceftazidime,

cefuroxime and ceftriaxone. They showed variable sensitivity to Quinolones, tigecycline and colistin. Resistance was noted to Amoxicillin clavulanate.

The best results were seen when the most sensitive Antibiotics were combined with moderately sensitive third generation cephalosporins. Organisms like Proteus mirabilis, Acenitobacter were susceptible to all broad antibiotics and also to quinolones and 3rd generation cephalosporins.

In our study we isolated two species of *Klebsiella* [**Figure 5]**. The two species of *Klebsiella* showed sensitivity to mostly tobramycin, Piperacillin Tazobactam, carbapenems, 3rd generation cephalosporins, cotrimoxazole and quinolones. They were mostly resistant to Ampicillin and Amoxicillin clavulanate; this is because of the irrational usage of the antibiotics at the primary level of treatment. Carbapenems were used for Extended Spectrum Beta Lactamase producing *Klebsiella* and *E.coli.*

Gram positive organisms were uniformly sensitive to amoxicillin clavulanate, quinolones, cotrimoxazole and linezolid. They show variable sensitivity to clindamycin and macrolides. Virulent species have shown high susceptibility to broad spectrum antibiotics.

MRSA (Methicillin Resistant Staphylococcus aureus) is always a pathogen of concern. These are sensitive to vancomycin, linezolid and doxycycline. These have shown resistance to clindamycin, penicillin group of drugs and Macrolides.

According to our study all organisms were mostly sensitive to all the broad spectrum antibiotics. Gram negative organisms showed sensitivity to Tobramycin and Penicillin group like Piperacillin Tazobactam and resistant to amoxicillin and ampicillin drugs. Gram positive organisms showed variable sensitivity to almost all broad spectrum antibiotics.

Out of all broad spectrum antibiotics Piperacillin Tazobactam, meropenem and 3rd generation cephalosporins played a major role in treatment of surgical site infection in Post-Split Skin Graft patients with Type II Diabetes Mellitus. 3rd generation Cephalosporins are active against organisms resistant to other beta lactam antibiotics.

All Antibiotics were given intravenously, after assessing the renal function of the patient. Few combinations of antibiotics such as PiperacillinTazobactam combined with aminoglycosides, Meropenem combined with Metronidazole / quinolones were given for gram positive and gram negative cover for pathogen free ulcer bed, thus facilitating unhindered graft uptake.

DISCUSSION

DiabeticFoot / Leg ulcers are one of the most common complications of Diabetes

mellitus. It plays a key role in medical and socioeconomic problem. Various causes of DiabeticFoot / Leg ulcer include walking in bare Foot mainly due to lack of education / awareness and poverty, poor Foot care accompanied by poor glycemic control.

Initially patient try home remedies and over the counter creams, this in turn causes increase in the ulcer size, thus there is delay in presenting in healthcare facility, thus leading to prolonged hospital stay, expenditure and sometimes might lead to a period of disability and impairment.

Once patient walks to OPD, we advise hospitalisation and wound care. DiabeticFoot / Leg ulcer usually presents with cellulitis, abscess, and gangrene of one or more toes, rarely present with Necrotising fasciitis. Ashwin Alva, *et al*. **[1]** reported that most common presentation of DiabeticFoot / Leg is abscess followed by cellulitis and ulcer.

The virulent infection causing organism produces substances such as haemolysin, proteases, collagenases and short chain fatty acids, which slow down or inhibit the wound healing process and leads to chronic infection and non-healing deep seated ulcer. Resistant organism causes more rapid tissue destruction and sometimes might lead to amputation.

We at SBMCH, after thorough assessment of the patient, advice the proper in-hospital wound care management protocol. 1st wound swab is collected and sent for study; in the meantime empirical antibiotics were started. Based on the wound status once a day or twice a day or thrice a day dressing is advised. During each wound care routine the ulcer is thoroughly washed with 500 ml isotonic saline, under topical analgesia cover (10% Lignocaine spray) sloughed out tissues are removed and the ulcer bed is debrided. This routine is followed until Healthy granulation bed is obtained, which is fit to receive an Autologous Split Skin Graft.

Empirical antibiotics were selected based on clinical features, disease severity and local antimicrobial resistance patterns. Empirical antibiotics are continued or modified based on sensitivity response. Pre operatively 2nd swab was taken. Following SSG, the sterile dressing is left undisturbed for 3 days. On the 3rd day SSG site is inspected for any foul smelling discharge, sloughing out of the graft, purulent discharge or shrivelled out graft. In all these cases a 3rd swab is taken and all the measures to preserve the graft are implemented.

In our study there was 95% graft uptake in 70% of the patients. Once the sterile dressing is opened, the graft site is washed with 100ml isotonic normal saline and all the discharges were gently squeezed out,

shrivelled edges were trimmed out. By following this routine coupled with appropriate antibiotics we were able to reduce the surgical site infection in Post SSG in Type II Diabetic patient by 5%, previously being 19%.

Most of the SSG site infection was Polymicrobial in this study, but because of improper antibiotic exposure without assessing sensitivity few organisms were killed resulting in monomicrobial growth which are resistant to low level narrow spectrum antibiotics used as empirical antibiotics in the past. At present there is a shift in choosing empirical antibiotics from quinolones to 3rd generation cephalosporins.

The most common organism occurred in this study is *Klebsiella Pneumonea* followed by *Pseudomonas aerogenosa* and *E.coli*. Gram negative organisms occurred more frequently than gram positive organisms and are more virulent.

Priyadharshini shanmugam, *et al* **[6]** concluded that gram negative bacilli and gram positive cocci were more prevalent and predominant among monobacterial isolates. *Streptococcus* and *staphylococcus* species were predominant in Polymicrobial growth. Thus selection of appropriate sensitive antibiotics is essential in controlling infection and antibiotic resistance prevention.

Diane M Citron, *et al* **[3]**, concluded that PiperacillinTazobactam can be used as an empirical antibiotic which covers most of the organisms except MRS. A study conducted by **[6]** reported that *Pseudomonas aerogenosa* showed 100% resistance to Amoxicillin and Norfloxacin, which was correlated in our study. The reported that most prevalentorganisms were gram negative aerobes which correlated with our study and most commonly used empirical antibiotics were Cephalosporins and aminoglycosides.

Gadapalli, *et al* **[7]**, described multiple drug resistant organism (MDRO) were extremely common in hospitalized patients with Diabetic ulcer including patient factors like poor Foot control, ulcer size or more than 4cm. sq and Osteomyelitis. In our study most of the patients were MDRO, hence they required multiple wound debridement, prolonged hospital stay and frequent wound dressing.

Akshaya Gunasekar, *et al* **[2]**, described microbiological profile of Diabetic ulcer in the south Indian region, which was correlated with our study by analysing the resistance pattern and starting appropriate antibiotics in empirical therapy

Prevention, proper education and proper management of Diabetic Foot / Leg ulcer is necessary to reduce the burden on Diabetic patient. Proper education of Foot / Leg care

of Diabetic patients is needed to prevent the development of ulcers. Regular self-examination of skin of Leg and feet for cracks, small ulcerations and use of appropriate Foot wear and strict glycemic control should be advised.

Proper identification and treatment of pre ulcerative lesions like removing of callosities, draining blisters, removing ingrown toe nail with proper use of topical and oral antibiotics for initial stages of ulcers is essential in prevention and development of infection and increase in ulcer size.

In addition to all the preventive measures, when a chronic Diabetic ulcer presents, proper in hospital wound care is advised. Chain of sterility is maintained throughout the perioperative period. Preoperative donor site preparations, reusable mesh preparing board, seroma collection below the SSG due to inadequate compressive dressing are the few preventable causes of infection in the SSG site.

When a Diabetic patient develops Foot / Leg ulcer proper education is essential for early health care access with regular debridement, dressing and proper maintenance of perioperative sterility, ensuring good glycemic control. Thus reducing the burden of recurrent infection and good graft uptake and wound healing in Diabetic patients.

CONCLUSION

Through our study we conclude that most of the organism occurring in the surgical site post SSG in Type II Diabetic patient is gram negative aerobes followed by gram positive cocci being the most prevalent. Piperacillin Tazobactam in addition with 3rd generation Cephalosporins were the sensitive antibiotics. Usage of Broad spectrum empirical antibiotics should be rational and appropriate to prevent resistance. Along with all this Strict glycemic control, appropriate perioperative maintenance of sterility, regular dressing of post-operative wound under strict asepsis helps in minimal surgical site infection in post SSG in Type II Diabetic patient and increases the rate of graft acceptance, graft survival and minimises the hospital stay.

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