EARLY SURGICAL INTERVENTION IN DIABETES RELATED INFECTIONS: THE ANSWER TO EARLY HEALING AND SHORTENED HOSPITAL STAY?

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ABSTRACT

BACKGROUND

Diabetes mellitus is a growing problem with India, fast becoming the diabetic capital. A significant number of diabetics in our country, particularly in rural areas, do not have good glycaemic control, either due to ignorance, poverty or inaccessibility to medical care. Almost 20% - 25% of these patients develop complications in the form of soft tissue infection, which left untreated invades bones causing both acute and chronic osteomyelitis. Most of these occur in the feet (diabetic foot ulcer), but may also occur anywhere in the body. This causes prolonged hospital stay, with loss of income and expensive treatment. Universally accepted principles of treatment in the cases are glycaemic control, antibiotics after culture and sensitivity tests and surgical debridement.

The objective of the study is to determine whether early surgical intervention has any role to play in shortening hospital stay in these patients by comparing results between two groups in a cross-sectional hospital-based study.

MATERIALS AND METHODS

In all 115 patients with infected lesions including 94 DFU from all four surgical wards over a period of three years from February 2013 to February 2016 were taken up for this study. Patients with end-stage renal disease, other gross systemic diseases or gangrene requiring major amputations were not included. 60 patients admitted under surgical unit I and III, surgical intervention was done within 24 hours of admission and were included in 'early intervention group' (Group A). In 55 patients admitted under surgical unit II and IV, surgical intervention was done after 24 hours of admission and were included in late intervention group (Group B). Treatment outcome was compared between the two groups. Detailed history, physical examination, HbA1c levels, BUN levels, Hb% and ESR were recorded on admission. Blood sugar monitoring was done at regular intervals. In all 60 cases of 'early intervention' group, surgical intervention including I/D, debridement and minor amputations were carried out early and by the same group of senior surgeons. Tissues and pus were sent to the laboratory immediately for culture and sensitivity test. Daily dressing and intervention as required was done by the same group of surgeons. Appropriate antibiotics were given for a period not more than 14 days.

RESULTS

Hospital stay was found to be significantly reduced at an average of 13.3 ± 4.6 days, in Group A with patients being discharged once blood sugar level had stabilised and infection controlled. All patients were taught wound care or told to continue dressing at local health centre with emphasis being laid on sterile wound cover. Patients were called for weekly review. Hospital stay on average in Group B was found to be 21.1 ± 7.59 days post first intervention.

CONCLUSION

We have come to a conclusion that early surgical intervention by experienced surgeons along with appropriate antibiotics and blood sugar control can drastically reduce hospital stay and treatment expense in diabetic related infections.

KEY WORDS

Diabetes, Infection, Surgical Intervention.

BACKGROUND

More than 62 million people in India suffer from diabetes mellitus. The incidence has risen steeply from 31.7 million in the year 2000.[1] The incidence of diabetes has been predicted to double globally from 171 million in the year 2000 to 366 million in 2030. The maximum rise of incidence is projected to be in India.[2] About 15% of this enormous number is likely at some point of time to develop foot infection.[3] Besides foot infection, carbuncles, abscess and cellulitis are common elsewhere in the body. 70% of the Indian population lives in rural areas, where the incidence of diabetes and its complications are not yet fully known. Reports from a large scale survey done in 2005 suggest that the urban epidemic of diabetes may soon be hitting rural India.[4] Treatment of diabetes, particularly when complicated with infection, becomes a great burden on the rural poor. The prolonged hospital stay involves loss of working days, not only of the patient but also of the attending family members. Tae Gyun Kim et al reported and average hospital stay of 30.7 days of

patients suffering from diabetic foot.[5] Inadequate surgical procedures and surgery done by inexperienced junior doctors are often the cause of delayed healing. In many instances, the extent of infection is underestimated and the outcome of surgery mainly depends on the skill, care and experience of the surgeon.[6] Aggressive and early surgical procedures when indicated in association with specific systemic antibiotics and proper glycaemic control may reduce the hospital stay and relieve the economic burden of the patients.

In this study 60 patients of DFU and other diabetes related infections were treated by the same set of senior surgeons from the primary surgery, daily dressing, up to discharge and follow-up to see if early and appropriate surgery when indicated can reduce hospital stay of such patients. The results were compared with 55 patients, where surgical intervention was delayed.

MATERIALS AND METHODS

A prospective observational study was done with 115 cases of diabetes related wound infections who were admitted in all four surgical wards in our hospital located in a rural area from Feb 2013 to January end 2016. Cases with associated atherosclerotic diseases, cardiovascular accident victims or end-stage renal disease were not included.

60 cases, admitted directly under surgical units I and III were included in Group A or early intervention group where the treatment protocol which was strictly followed was-

1. Appropriate surgical intervention (I/D, debridement, amputation) was done within 24 hours of admission. Debridement is defined as a technique aimed at removing non-viable and necrotic tissue, thought to be detrimental to wound healing.
2. Re-look with further debridement was done daily in minor OT subsequently.
3. All procedures were done by senior surgeons with minimum 5 years' experience after post-graduation.
4. Pus, necrotic tissues etc. were sent immediately for culture and sensitivity. Patients were put on broad spectrum antibiotics and later on specific antibiotics as per culture report.
5. Wounds were packed with betadine-soaked gauze, which were later replaced with saline-soaked gauze once infection was controlled.

In 55 patients admitted under surgical units II and IV, surgical intervention was not done within 24 hours of admission. All of them underwent surgery within a varying period of 2 - 4 days after admission to surgical wards. Follow-up dressing and debridement were similar to Group A.

These 55 cases are included in Group B or late intervention group.

In both groups meticulous history was recorded, particularly in regard to duration of diabetes, treatment taken and duration of the infected lesion. Detailed physical examination was done and nutritional status, pallor, oedema and presence or absence of neuropathy were recorded. Foot ulcers were graded according to Wagner's grading system. Blood glucose levels (Fasting and post prandial), HbA1c levels, Hb% and BUN were recorded on admission and repeated at regular intervals. Ulcers were graded according to Wagner's system. Ulcer was taken as healing when it showed- a) Absence of pus or necrotic tissue, b) Absence of foul smell, c) Regression of size, d) Red and healthy granulation tissue in the floor. Healing ulcers were covered with normal saline soaked gauze pieces only and covered with sterile dressing. In both groups patients were discharged as soon as the lesions were labelled as healing and subsequent dressing were advised at the local hospitals with weekly check-up at the OPD at our hospital.

Hospital stay was calculated from the time of first surgical intervention and not from the date of admission to the hospital in both the groups.

Data was entered in excel sheet and analysis was done using MS Excel. Mean and standard deviation was calculated and t-test for difference in sample mean was found out.

Single Digit Amputation

Healing Ulcers

RESULTS

	Group A (n=60)	Group B (n=56)	P value
Age (years)	54.56 ± 14.5	55.23 ± 12.7	P> 0.05
Sex- Male	45 (75%)	42 (75%)	
Female	15 (25%)	14 (25%)	
Ulcer distribution DFU	49	50	
Other sites	11	5	
Duration of disease (years)	4.64 ± 4.4	3.95 ± 3.56	0.17
Haemoglobin %	67.4 ± 6.52	68.12 ± 8.1	0.13
Creatinine (mg%)	1.73 ± 0.49	1.57 ± 0.38	0.03
Glycosylated Hb	9.4 ± 2.17	10.1 ± 1.92	0.33
Duration of ulcer (months)	7.79 ± 2.10	8.29 ± 8.32	P > 0.05
Wagner's grade I	2	2	
II	23	20	
III	21	24	
IV	3	4	
Table I. Distribution of Baseline Information			

In Group A, 41.77% of cases showed predominantly growth of gram positive organism and 49.29% showed gram negative organism. 1, 4% showed growth of candida, while in 7.54% of the cases the culture did not show any growth (sterile).

In Group B gram positive infection accounted for 35.54% of cases, while in 46% of cases the culture yielded predominantly gram-negative organisms. In 18% of cases, the culture did not show any growth (sterile).
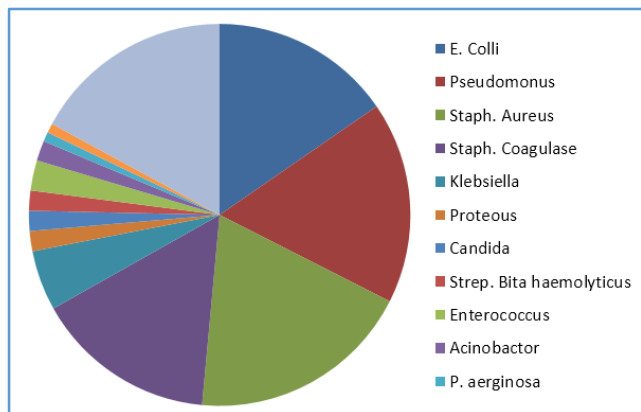

Figure 1. Growth Pattern of Organism in all 115 cases of Diabetic Wounds

Surgical procedures ranged from simple debridement to transmetatarsal amputation. In Group A 19 cases required single digit amputation, 14 cases required more than 1 digit amputation and 2 cases required transmetatarsal amputation. In 25 cases, only debridement was done. In Group B 16 cases required single digit amputation, 17 required more than 1 digit amputation and 6 cases required transmetatarsal amputation. In 16 cases, only debridement was required.

Hospital stay was taken as the period from first surgical intervention upto the time of discharge.

	Group A	Group B	P value
Duration of hospital stay	13.3 ± 4.6	21.1 ± 7.59	P < 0.001
Table II. Showing Distribution of Outcome			

Early surgical intervention group (Group A) showed a gross reduction in the period of hospital stay as compared to Group B with high statistical significance.

DISCUSSION

Diabetes is an increasing problem all over the world. Longstanding diabetics with most often irregular and inadequate treatment suffer from a lot of complications. Peripheral neuropathy leads to loss of sensation and leads to injury. Glucose laden tissues invite infection and peripheral arterial occlusive disease leads to gangrene. Soft tissue infections are therefore common, which can lead to acute and chronic osteomyelitis. About 15% - 25% of diabetic patients will in their lifetime develop diabetic foot ulcers.[7] Besides foot lesions, any skin surface may be affected. Bullosis diabeticorum is a spontaneous, non-inflammatory, blistering condition of the acral skin that typically develops in diabetics. These blisters may get secondarily infected.[8] Small wounds anywhere in the body surface get infected, most commonly by staphylococcus causing cellulitis and lymphangitis. Sepsis may occur, which may be fatal.

In our study, we found a male preponderance in both groups. 75% of both the groups were male. Diabetic foot lesions along with incidence of lower extremity amputation were found to be higher in men (410.3 per 100,000 patient year) than in women (115.2 per 100,000 patient year) in a study by Chen HH et al.[9] A research studying the influence of gender in diabetic foot ulcer found that of 29% of diabetic patients who developed DFU 40% were male, whereas 19% were female.[10] The average age incidence in Group A was 54.56 ± 14.5 and in Group B was 55.23 ± 12.7. The average age incidence was significantly higher (62.9 years) in another study by Limin Jia et al.[11]

A significantly high percentage of cases in our study had HbA1c level higher than 6.5. A research on 183 patients to study HbA1c level as predictor of healing rate found the average HbA1c level to be 8. The study found that of all the other measures assessed, only HbA1c level was found to significantly affect ulcer healing rate.[12] The mean HbA1c level in a study published in 2013 was 10.5. In our study, the level of HbA1c in both groups were comparable.

41.77% of patients in the first group had gram positive infection, whereas in 49.29% of patients the predominant infection was by gram negative organism. In the second group (control) 35.54% of cases showed gram positive infection, whereas 46% showed gram negative infection. In a study by Citron et al,[13] of 427 cases the predominant gram positive organisms were found to be oxacillin-susceptible Staphylococcus aureus (14.3%), oxacillin-resistant Staphylococcus aureus (4.4%), coagulase negative Staphylococcus species (15.3%), Streptococcus (15.5%), Enterococcus (13.5%) and Corynebacterium species (10.1%). Predominant gram-negative isolates were Prevotella species (13.6%), Enterobacteriaceae (12.8%) and Pseudomonas

aeruginosa (3.5%). The study found that Ertapenem and Piperacillin + Tazobactam were active against more than 98% of enteric gram-negative rods, Methicillin sensitive S. aureus and anaerobes. In another study on bacterial aetiology of diabetic foot infection in south India,[14] it was reported that gram negative infection (57.6%) were more common than gram positive infection (42.3%). Ramani A et al[15] in the study of 75 diabetic foot ulcer cases found Staph. aureus to be the commonest isolate recovered in 60% of cases. Most frequent anaerobe isolated was bacteroides fragilis. Metronidazole and Gentamicin were found to be most effective against anaerobic and aerobic organisms respectively. In our study we have found most gram-negative infections to be controlled by Aminoglycosides, Fluoroquinolones or Piperacillin + Tazobactam. Most gram-positive infections were controlled by a combination of Amoxicillin + Clavulanic acid or Cephalosporin or Trimethoprim + Sulfamethoxazole.

In all 60 cases of Group A surgical intervention was done within 24 hours of admission, while in Group B intervention was done after 24 hours. Prompt intervention has been recognised as essential for limb salvage and early healing. It has been established that the outcome of surgery mainly depends on the skill, care and experience of the surgeon. Surgical procedures ranged from simple debridement to digital amputation and transmetatarsal amputation. Ray amputation was carried out in cases requiring amputation of digits. Caputo WJ et al commented that ray amputation is necessary if necrosis has spread through the base of the toe. He suggested that ray amputation should be generally performed for a single outer ray- either first or fifth.[16] Deep abscesses were drained keeping in mind the surgical anatomy of the feet and the pressure bearing regions. Delay in drainage of deep space abscesses were responsible for increase in amputation levels in a study in 106 patients as reported by Faglia et al.[17] Primary surgical procedure was followed by daily dressing and debridement as necessary by the same group of surgeons in our study. Multiple surgical debridement are common in infected diabetic foot and adequate removal of all non-viable tissue is associated with quicker healing time and better outcome.[18] Delay in surgical intervention has been identified as an important cause of delayed healing and prolonged hospital stay in several studies. Lipsky et al commented that despite strong emphasis in recent guidelines and consensus documents on the importance of prompt surgical intervention in many DFI, it is frequently delayed, sometimes leading to amputation.[19]

Average hospital stay in Group A with early intervention was 13.3 ± 4.6 days, while in Group B it was significantly higher at 21.1 ± 7.59 days. Patients were discharged as soon as infection was controlled and wounds show signs of healing along with reasonable glycaemic control. Patients were advised further wound care management either at the local hospital or in the surgical OPD in our hospital. All cases were reviewed on weekly basis by the same group of surgeons. No cases in this series had to be re-admitted for the same lesions, though the period for complete wound healing was variable and occasionally prolonged. Mean hospital stay was recorded as 36.24 ± 12.62 days (18 - 128 days) in a study at Tanzania University Teaching Hospital.[20] In another study by Kim et al, in 79 cases of DFU the average hospital stay was found to be 37.8 days. In this series, the period of follow-up was up to 20 months. In a study of a series of cases of diabetic hand infection, the mean hospital stay was found to be 13.11 days (3 to 25 days).[21] The length of hospital stay is recognised as being directly related to the hospital cost. Wukich et al reported that even a modest 1 day shorter hospital stay can translate into reduction in hospital cost.[22] This reduction can be best achieved by a combined approach by both the physician and surgeon. In this early surgical intervention by experienced surgeons plays a most important role. At the same time, it must be emphasised that without the support of peripheral health centres where follow-up can regularly done, early discharge from hospital can be hazardous and counter-productive. The other disadvantage of early discharge and outpatient follow-up is that a percentage of cases will be lost during the follow-up period.

Further planned study with a good study design will be required for greater clarity on the subject.

CONCLUSION
Early surgical intervention by experienced surgeons along with appropriate antibiotics and blood sugar control can drastically reduce hospital stay and treatment expense in diabetes related infections.

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