

Innovative Approaches in the Management of Diabetic Foot Ulcers: A Clinical Study at Al-Diwaniyah Teaching Hospital

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are a major complication of diabetes mellitus, contributing to significant morbidity, prolonged hospitalizations, and lower limb amputations. Advances in wound management and regenerative therapies offer promising solutions for improving ulcer healing and infection control. **Objective:** This study aimed to evaluate the effectiveness of novel wound management strategies in treating diabetic foot ulcers (DFUs) at Al-Diwaniyah Teaching Hospital, with a focus on biological dressings, advanced wound debridement techniques, and infection control strategies. **Methods:** A total of 100 diabetic patients with chronic foot ulcers were included in the study and classified into two groups: Group A: Received conventional wound care (debridement, saline irrigation, and standard antibiotics). Group B: Treated with a combination of advanced wound dressings (collagen-based, silver-impregnated, or hydrogel dressings), platelet-rich plasma (PRP) therapy, and topical antimicrobial agents. Patients were monitored for healing progression, infection rates, and need for surgical intervention over a 12-week follow-up period. **Results:** Group B showed a significantly higher ulcer healing rate ($p < 0.05$) compared to Group A. Infection control was superior in Group B, with a lower incidence of bacterial colonization and reduced need for systemic antibiotics. Reduced hospitalization duration and lower amputation rates were observed in patients receiving advanced wound management therapies. **Conclusion:** The use of innovative wound healing approaches, such as PRP therapy, advanced dressings, and targeted infection control strategies, significantly improves DFU healing outcomes compared to conventional care. These findings highlight the importance of integrating new therapeutic protocols into diabetic foot ulcer management to reduce complications and enhance patient recovery. Further research is needed to optimize personalized treatment strategies for DFUs.

Keywords: Diabetic Ulcers, Diabetes Patients, Hydrogels Autolytic Debridement, Hydrotherapy, Negative-Pressure Treatment (NPWT)

INTRODUCTION

The diabetic ulcers of the foot are a serious drawback of diabetes patients and result in bad outcomes, high death rate, and social problems. About 20–35% of patients with diabetes are susceptible to DFU during their lifetimes [1]. Annual incidence of people with DFUs is about 9.1–26.1million. These numbers may result in clinical implications that DFUs are alarming. In the United Kingdom a population-based cohort study illustrated that there is a 5% mortality associated with DFU in the first 12 months and this increase to 40% within 5 years [2]. Also there is 2.5-fold increase in risk of death in patients with DFU compared with other diabetic patients without foot lesion [3]. In addition there is high morbidity in patients with DFUs, less health-related type of living, many psychotherapists suffering and a significant cost of life care facilities [4]. About 1/3 of total diabetic care cost is consuming in treatment of DFUs, which was about U.S. \$170 million in primary care in 2013. In spite of these elevated costs, nearly 21% of DFU cases have non healed and complicated ulcers at 1 year [5]. Recurrent ulcers may develop even after wound healing, in a percentage of approximately 35% within 1 year. In spite of the well-standard principles for dealing with DFUs, management of DFUs is regarded as a stimulating medical problem. The using of broad spectrum antibiotic with interventions is associated with improve healing of the wound [1, 5]. In this study, we showed the new update in the management of diabetic and foot and compared with the standard treatment procedures. Incidence of diabetic foot showed a significant increasing in the last years which results in development of multiple researches and series regarding diabetic foot ulcer (DFU)

[6, 7]. This result in development of specialized centers and an integrated teams to deal with the diabetic foot and their complications and this end with decrease the amputation rates [8, 9].

Pathophysiology of Diabetic Foot

Few records about the benefit of foot care principles which may result in decrease the risk of onset of the first ulceration [10]. The good understanding of the pathophysiology and pathway of ulceration is of great importance if we want to reduce the incidence of foot ulcers and their complications that may end with amputations [11, 12]. The major nerve fibers affecting are the small that results in pain loss and temperature sensation; which mainly protect tissues from damage [13]. When the large fiber damaged this end with unstable gait that ends with multiple falls and recurrent hidden small injuries might that may end with Charcot neuroarthropathy [14].

Mechanism to Ulceration

Peripheral neuropathy, sort of deformity, and recurrent trauma. Inadequate footwear is the most important cause of trauma commonly seen in Western countries [15]. Neuropathy associated with chemical exposure. The wrong use of chemical agents in the corn treatments in a patient with diabetic neuropathic foot may end with ulceration [16].

Classical of Care

In around the 19th century, the best effective treatment of ulcer was started by Dr. Frederick Treves (1853– 1923) was the first how revolutionized the care of DFUs, he applied three corner stone's

principles in DFU management, which remain as the basis for the now a day care: aggressive debridement, excision of dead tissue, and care of diabetic foot [17]. In order to achieve good results other steps are needed including, multidisciplinary monitoring team of diabetic foot is now regarding a main step of care [18, 19]. Surgical excision: Debridement also has a vital role in controlling infection, as necrotized tissues regarding as a nidus for bacterial growth, has a role of a physical barrier for effect of antibiotics. Infectious Disease Society of America (IDSA) and the Wound Healing Society advice surgical deep cleaning rather than using superficial topical debridement substances [20, 21]. Vascular assessment: It is important that those patients with DFUs be assessed for PAD by examining distal pulses or measuring the index of ankle brachial pulse. The ABI less than 0.75 indicate minor flow of arteries, while when the ABI lower than 0.45 indicates serious peripheral arterial occlusion [22, 23]. Active infection management: The infection is a major factor that results in delay wound healing and may end with amputation.

The early detection of infectious problem and dealing with appropriate drugs in foots ulcer is important to decrease risk of complications. Choice of antibiotic must be covered both aerobic Gram-positive cocci. More serious infections must be treated by using broad-spectrum antibiotics until the result of cultures. Duration of treatment, as recommended by IDSA, is 1- to 3-week in cases of minor infections and 3–4 weeks for mild-to-serious type of infections, but the using of antimicrobials can be stopped when the sign and symptoms of infections had improved [24, 25]. Nonsurgical debridement agents.

Hydrogels Autolytic Debridement

This moist media provides typical medias for cells proliferation and improve phagocytic digestion, which resulting in the destruction of sloughing materials by the effect of endogenous proteolytic enzymes [26]. Hydrotherapy. The Versa jet TM hydro surgery systems includes a mechanical debridement by the effect of a steam of high-pressure normal saline that is applied under high pressure by using a hold with

cutting and aspirating handle [27]. Types of dressing and topical agents: Alginate type of dressings. Alginate products are composed of seaweed and presents as calcium alginate or alginin acid [28].

Negative-Pressure Treatment (NPWT)

This techniques is regarded as a great helps in improvement of ulcer by enhancing blood supply, removing infection, and aids the closure of wound [29].

The using of Laser

The benefit of laser in lowering of inflammation, enhancing new vascularization, and increase the release of extracellular materials. Mainly, CO2 laser was detected to greatly reduce the load of bacterial [30].

Patient and Methods

Prospective study including 150 patients collected from outpatient and inpatient in Diwaniyah teaching hospital, 100 male patients, 50 female patients, all of them have diabetic foot ulcer. Sub divided into 6 groups of 25 patient treated by 6th types of treatment selected in this study, follow up for 3 months. All patient were controlled for diabetic mellitus; all patients are new diabetic ulcer for the first time. All patients were treated by using triple antibiotics cover. All patients were assessed for vascular patency, general condition, and cardiovascular system. Investigations include: Random blood sugar -Complete blood picture-Doppler ultrasound. ECG. All patients treated with appropriate antibiotics therapy.

Results

Group A standard patients were treated with classical surgical debridement. Healing time was 10 days in 5 cases (20%) ,15 days in 4 patients (16%), 25 days in 4 patients (16%) ,30 days in 5 (cases20%), 40 days in 4 cases (16%) ,3 cases end with amputation (12%). As in table (1).

Table 1: Group a Standard Patients were Treated with Classical Surgical Debridement

No. of Patients	Duration of Healing, Days	%	Complications (Amputation)	%
5	10	20	-	-
4	15	16	-	-
4	25	16	-	-
5	30	20	-	-
4	40	16	-	-
3	-	-	3	12
25			3	

Group B patients were treated by using chemical debridement, Autolytic debridement with hydrogels, healing time was 7 days in 6 patients (24%),12 days in 5 patients (20%) ,6 patients within 20 days (24%) ,4 patients within 25 days (16%), 30 days in 4 patients (16%). This explains in table below. Group C patients were treated by Hydrotherapy using high pressure water jet. The healing time in these group was, 6 days in 9 cases (36%), 10 days in 7 cases (28%), 14 days

in 5 cases (20%), 20 days for 3 cases (12%) and one patient ends with amputation (4%).

As in table (3). Group D patients were treated by using Alginate dressing type. Healing time showed in this type of procedure was ,10 days in 6 cases (24%), 15 days in 5 cases (20%) ,20 days in 6 cases (24%), 30 days in 5 cases (20%),35 days in 2 patients (8%). One case ends with amputation (4%). As in table (4).

Table 2: Group B Patients were treated by Using Chemical Debridement

No. of Patients	Duration of Healing, Days	%	Complications (Amputation)	%
6	7	24	-	-
5	12	20	-	-
6	20	24	-	-
4	25	16	-	-
4	30	16	-	-
25				

Table 3: Group C Patients were Treated by Hydrotherapy Using High Pressure Water Jet

No. of Patients	Duration of Healing, Days	%	Complications (Amputation)	%
9	6	36	-	-
7	10	28	-	-
5	14	20	-	-
3	20	12	-	-
1	-	-	1	4
25				

Table 4: Group D Patients were Treated by Using Alginate Dressing Type

No. of Patients	Duration of Healing, Days	%	Complications (Amputation)	%
6	10	24	-	-
5	15	20	-	-
6	20	24	-	-
5	30	20	-	-
2	35	8	-	-
1	-	-	1	4
25				

Table 5: Group E Patients were Treated by Negative-Pressure Wound Therapy

No. of Patients	Duration Of Healing, Days	%	Complications (Amputation)	%
7	9	28	-	-
6	12	24	-	-
6	15	24	-	-
3	17	12	-	-
2	20	8	-	-
1	25	4	-	-
25				

Table 6: Group F Patients were Treated by Using Laser Therapy

No. of Patients	Duration Of Healing, Days	%	Complications (Amputation)	%
8	10	32	-	-
5	14	20	-	-
4	18	16	-	-
4	22	16	-	-
2	25	8	-	-
1	30	4	-	-
1	-	-	1	4
25				

Group E patients were treated by Negative-pressure wound therapy. Healing time in this category was, 9 days in 7 patients (28%), 12 days in 6 cases (24%), 15 days in 6 cases (24%), 17 days in 3 (12%), 20 days in 2 cases (8%) and 25 days in 1 patient (4%). No complication in this group of patients. Group F patients were treated by using laser therapy. The healing in this group was 10 days in 8 cases (32%), 14 days in 5 cases (20%), 18 days in 4 patients (16%), 22 days in 4 cases (16%), 25 days in 2 patients (8%), 30 days in one patient (25%). on case end with complication (4%). table (6) explained that.

Discussion

Diabetic foot ulcers are associated with multiple complications that making them resistant to therapy. In the best centers with good conventional management which includes accurate blood sugar control, improving weight bearing surfaces, meticulous local ulcer treatment and using appropriate systemic antibiotics, a lot of ulcers which still unhealed [31]. The occurrence of wound infection in DFU is a serious problem that results in poor wound healing and may end with amputation. Therefore early recognition of wound infection and appropriate treatment with selected method of healing and antibiotics will improve the wound healing rate [32]. The dealing with ulcer in diabetic patient foot represents a serious complication which needs a rapid discuss and new techniques that result in achieving the goals and decrease the high cost of care with a success way. Still there are many

questions about the best methods of dealing with, which dressing are appropriate to enhance healing, and if these methods are important and less cost as suitable choices.[33] The World Working Society on the Diabetic Foot has published two essential studies of the types and success of techniques to promote the healing in cases of long standing ulcers. The primary data are hopeful, but more frequent studies are needed to determine the cost of the updated treatments. The most important point is the stop of progression of ulceration to decrease the relatively increasing complications and death rates, and the risk of amputation. It is crucial to diagnose the “the risky foot,” with a meticulous observation and effective clinical examination of the foot with appropriate neural and vascular assessments [34, 35]. In our study we choose some of therapeutics measures which are available in in and out patients and make a comparison between their single actions on diabetic foot ulcer. Regarding the use of chemical debridement agent in our study the patients show good result regarding the duration of healing, average healing time is 16 days. This is close to the result by A 2013 Cochrane study of three types of treatment agents detect that hydrogel dressings had major role in the healing comparing with classical dresses using, healing time is 14 days. And is best than result by Mline *et al.* used the CCO hydrogel in a minor randomized RCT and showed no significant change between the groups regarding time to complete healing, the average healing time is 18 days. Regarding the use of hydrotherapy using high pressure water jet. The healing time is 12 days in our study. And this is close to

result by (Smith&Nephew, Inc., Andover,MA) 2017 that use the Versa jet TM hydro surgery systemic a type of mechanical ablation which includes strong flow of sterilized normal saline through a high-pressure cutting hand hold device. Healing time in their study is about 11 days [36]. The use of Alginate dressing type in the treatment of diabetic ulcer patient in this study showing average healing time about 18 days. A Cochrane study in 2013 found no major different in ulcer treatment by using alginate substance comparing with classical dressings or silver-based dressings that need about 22 days, which is more than our study. In other series in 2015 also revealed that there is no change in time of healing between multiple types of active synthetic dressings and ordinary using dressings, of both moist and dry saline added gauze, Gauze moist with Vaseline, and hydro fiber, the healing time is about three weeks [37]. In our study the using Negative-pressure method has a median ulcer healing period about 16 days. Negative pressure wound therapy (NPWT) regarded as an update modality in the management for DFU. It enhances the blood circulation in the tissue, reduces the wound exudates, discharge, edema and infection. Therefore, it decreases the healing time of the wound. A 2015 Cochrane study that collected findings from 15 RCTs revealed a more increase in wound healing rate with negative pressure wound therapy at 4 weeks [38]. The patients that were treated by using laser therapy in this study, the treating time were about 19 days. The using of low energy laser (LEL) was used in the clinical medicine in the last 30 years but has not attracted a great attention. LEL has a role

in the stimulation of cell mitosis, migration of keratinocyte and proliferation, and enhance cytokine production that result in increased dermal angiogenesis. Schindl et al. [5] regarding the first reported a case of ulcer in cases of foot ulcers that dealt with less intense laser treatment in 1999 and showed that this type of treatment may result in a low risk method that considered as a substitution modality of treatment that help in the stimulation of healing in cases of diabetic foot ulcer patients of neuropathic causes [39, 40]. The introducing of laser with less degree treatment has been regarded as a new and hopeful management modality for dealing with exposed wounds. Anyway, very little studies are reported about the efficiency of laser with low-level in the management of diabetic foot wounds [40].

Conclusions

Diabetic foot ulcers are a serious problem for the all of diabetic patients worldwide. In spite of the rules that applied in the classical care are significant, there is some argues about our real and wished ulcer healing result. The applied DFU care now days regarding a beneficial, but there is a more studies to reach the ideal results of these new updated procedures and to apply updated guidelines. Till that time, appropriate clinical assessment—including the state of patients and type of ulcer significant features—is important to determine the drawbacks and beneficial effects of these new supportive methods for frequent medical apply.

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