



## ASSESSMENT OF RATE OF WOUND HEALING IN PATIENTS USING rh-PDGF DRESSING FOR THE MANAGEMENT OF DIABETIC FOOT ULCERS

### General Surgery

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### ABSTRACT

**BACKGROUND:** Diabetic foot ulcers are the most common cause of chronic, non healing ulcers. These foot ulcers are the cause for majority of the amputations. Management of these ulcers require a multidisciplinary approach. The field of wound management has evolved considerably after the understanding of the role of growth factors in wound healing. PDGF is available commercially and has shown to promote wound healing. **METHODS:** This is a descriptive study which was performed prospectively at Sree Balaji medical College and Hospital during the period of June 2018 to December 2018. 100 patients meeting the inclusion criteria were included in the study. The surface area of the ulcers of these patients who were using rh-PDGF dressing were measured at the start of the study, at 1 week and at 2 weeks to assess the rate of wound healing. **RESULTS:** Most patients belonged to 61-70 years of age. In this study the most patients affected were males. The most common site of ulcer was on the plantar aspect. The most common cause was found to be traumatic. The percentage of wound contraction at 1 week found to be 16.42% and at two weeks was found to be 36.77%. **CONCLUSION:** The use of rh-PDGF gel is safe and effective form of dressing and it promotes wound healing.

### KEYWORDS

Diabetic Foot Ulcer, PDGF, Ulcers.

### INTRODUCTION:

Diabetes mellitus directly or indirectly is a cause of lot of morbidity and mortality all around the world. Diabetic patients through various mechanisms are prone to infections which necessitates hospital admission. Foot infections, Ulcerations and gangrene are well documented complications of diabetes mellitus. Diabetic foot ulcers are the most common cause of chronic, non healing wounds which occur in approximately 10% to 15% of the patients. Among them about 12% - 24% individuals undergo amputations<sup>[3]</sup>. These diabetic foot ulcers are resistant to heal due to various factors like presence of infections and microvascular complications<sup>[1,2]</sup>.

Management of such ulcers is challenge and requires multidisciplinary approach and various modalities of treatment. The treatment of such ulcers consist of removal of necrotic tissue, growing infections and to make the conditions inside the wound environment favourable to facilitate healing. This consists of various types of debridement, proper use of antibiotics, creating proper moisture balance, correct use of various types of dressings and topical agents, glycemic control, off loading etc<sup>[3]</sup>.

With advances in materials and tissue science, and improved knowledge in the concepts of wound healing and cell types involved, the field of wound management has evolved considerably. The understanding of the role of various growth factors in wound healing over recent years has brought an interest in their usage in chronic ulcer management<sup>[4]</sup>.

These growth factors are polypeptides similar to hormones and control the growth differentiation and metabolism of cells and regulate the process of wound healing. These growth factors have proven their role in cell proliferation, angiogenesis and wound healing<sup>[5]</sup>. With the advent of recombinant technology it is now possible to generate required quantity of these growth factors for usage in the management of diabetic foot ulcer management<sup>[6]</sup>. They are produced by various cells like platelets, macrophages, fibroblasts etc and they also act as chemo-attractants for neutrophils, macrophages etc. They bind to specific receptors on the cell surface and exert their effects<sup>[5]</sup>.

Platelet derived growth factor (PDGF) is a growth factor protein that is produced by platelets and endothelial cells. Various studies have shown their efficacy in promoting the formation of granulation tissue and reduction in size of the wound<sup>[6]</sup>.

This study was carried out to assess the rate of wound healing in

patients who were using rh-PDGF topical application for the management of diabetic foot ulcer.

### METHODS:

This is descriptive study which was performed prospectively in the Department of General Surgery of Sree Balaji Medical College and Hospital, Chennai during the period of June 2018 to December 2019.

### INCLUSION CRITERIA

- Age between 20 to 80 years
- Ulcers falling under grade 1 and 2 of Wagners classification
- Ulcers with adequate perfusion
- Patients using rh-PDGF dressing for the management of ulcers

### EXCLUSION CRITERIA

- Patients below 20 years and above 80 years of age
- Poor glycaemic control (HbA1c >10%)
- Severe anaemia (Hb <7gm/dl)
- Ulcers falling under grade 3, 4, 5 of Wagners classification
- Ischemic ulcers with doppler proven occlusion of the vessels
- Osteomyelitis of the foot with ulcers
- Malignant ulcers
- Patients using any other modality of dressing or topical agents

100 patients undergoing treatment for the diabetic foot ulcer in the form of rh-PDGF dressing meeting the mentioned criteria were selected for the study after obtaining written and informed consent.

All the patients were advised diabetic diet. Good glycaemic control was achieved either through oral hypoglycaemic agents or insulin. Wound swab was taken at the start of the study and was sent for culture and antibiotics were started according to the sensitivity reports.

The ulcers were cleaned with normal saline first and then a commercially preparation of rh-PDGF topical application gel was applied over it. Moist Gauze piece was placed over the ulcer and covered with pad and roller bandage. Dressings were changed daily.

The ulcer area was measured by cutting a gauze piece to its size and measuring the surface area using plannimeter. Initial area of the ulcer was measures at the start of the study. Then the area measurement was repeated again at 1 week and 2 weeks.

The reduction in area of the wound over time is the rate of wound healing and it was calculated using the following formula.

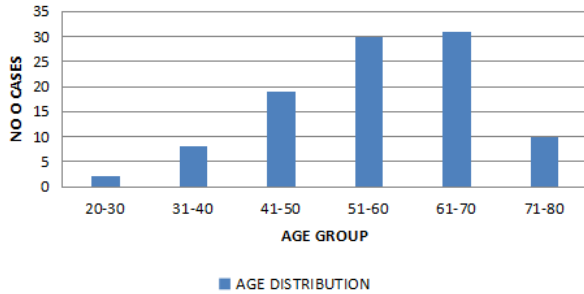
Percentage of area reduction = (initial area - area at 1 and 2 weeks)/initial area x 100

**Statistical Analysis**

The outcome of the study was analyzed statistically to reach a conclusion. Data entry was done using MS excel 2016. Demographics of the study such as Age, Sex, Mode of onset, Site of ulcer and Anti Diabetic agent used were also assessed.

**RESULTS:**

**AGE DISTRIBUTION**



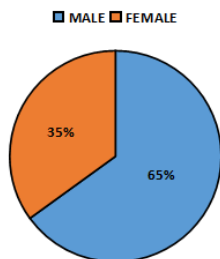
**Chart1 : AGE DISTRIBUTION**

**Table1 : AGE DISTRIBUTION**

AGE GROUP	21-30	31-40	41-50	51-60	61-70	71-80
PERCENTAGE	2%	8%	19%	30%	31%	10%

As shown in Table 1, most of the patients in our study belonged to the age group between 61 to 70 years of age with youngest patient being 26 years and oldest patient being 79 years and an average age of 60.9 years.

**SEX DISTRIBUTION**



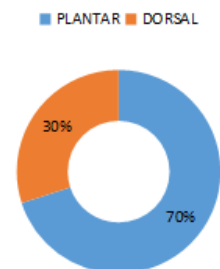
**Chart2 : SEX DISTRIBUTION**

**Table2 : SEX DISTRIBUTION**

SEX	MALE	FEMALE
NO OF CASES	65	35

As shown in chart 2, Diabetic foot ulcers were most commonly seen in males (65%) than in females (35%).

**SITE OF THE ULCER**



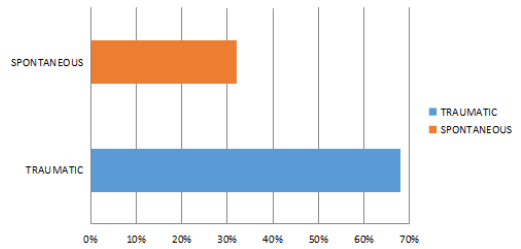
**CHART3 : DISTRIBUTION BASED ON SITE OF THE ULCER**

**Table3 : DISTRIBUTION BASED ON SITE OF THE ULCER**

SITE OF THE ULCER	NO OF CASES
PLANTAR	70
DORSAL	30

As shown in chart 3, the most common site of ulcer in our study was in the plantar aspect of the foot (70%) compared to the dorsal aspect of the foot (30%).

**TYPE OF ONSET**



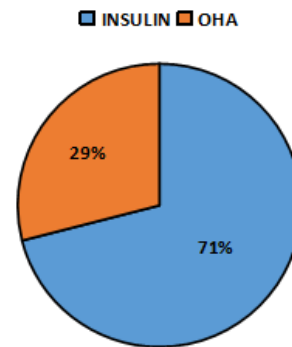
**Chart4 : DISTRIBUTION BASED ON TYPE OF ONSET**

**Table4 : DISTRIBUTION BASED ON TYPE OF ONSET**

TYPE OF ONSET	NO OF CASES
TRAUMATIC	68
SPONTANEOUS	32
TOTAL	100

As shown in chart 4, In our study traumatic type of onset (68%) was more common than spontaneous onset (32%).

**ANTI DIABETIC AGENT USED**



**Chart 5 : DISTRIBUTION BASED ON ANTI DIABETIC AGENT USED**

**Table 5 : DISTRIBUTION BASED ON TYPE OF ANTI DIABETIC AGENT USED**

ANTI DIABETIC AGENT	NO OF CASES
INSULIN	71
ORAL HYPOGLYCAEMIC AGENT	29
TOTAL	100

As shown in chart 5, Most patients in our study used insulin (71%) for glycaemic control as compared to oral hypo glycaemic agents (29%).

**Table6 : MEAN SURFACE AREA OF THE ULCERS**

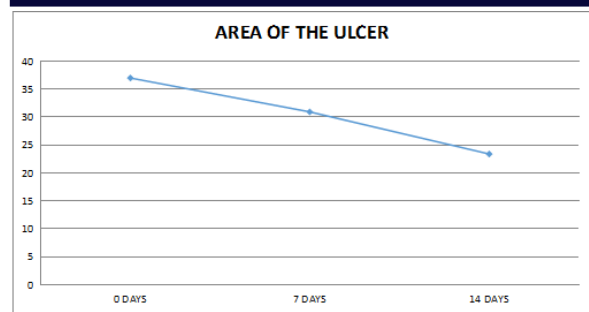
SIZE OF THE ULCER (IN CM2)	MEAN	STANDARD DEVIATION	MEDIAN
	36.96	8.6	35.43

**Table 7 : PERCENTAGE OF AREA REDUCTION OF ULCER AT 1 WEEK**

PERCENTAGE OF AREA REDUCTION OF ULCER	MEAN	STANDARD DEVIATION	MEDIAN
	16.42%	1.8	15.80

**Table 8 : PERCENTAGE OF AREA REDUCTION OF ULCER AT 2 WEEKS**

PERCENTAGE OF AREA REDUCTION OF ULCER	MEAN	STANDARD DEVIATION	MEDIAN
	36.77%	2.51	35.61



**Chart6 : REDUCTION IN THE AREA OF THE ULCER**

As shown in table 6, The mean size of the ulcers in our study was 36.96 cm<sup>2</sup>. There was a 16.42% (30.9 cm<sup>2</sup>) of area reduction in patients using rh-PDGF gel topical application at 1 week and 36.77% (23.37 cm<sup>2</sup>) of area reduction at 2 weeks (Table 7, 8 and Chart 6).

#### DISCUSSION:

Diabetic foot ulcers are chronic wounds that display interruption of epidermal growth, with a prolonged stage of inflammation. Owing to the development of multidrug resistant species and microvascular complications, diabetic foot ulcers are inevitably resistant to healing<sup>[6]</sup>. The present study was carried out at Sree Balaji Medical College and Hospital, Chennai, Tamil Nadu, India, for a period of one and half years from June 2018 to December 2019 to study the effect of use of PDGF in diabetic foot ulcers. In this study it was seen that the incidence of diabetic foot ulcers were more common in males (65%) that in females (35%) which is similar to that of the national data source NHDS and also study conducted by Hardikar et al<sup>[9]</sup>. In this study diabetic foot ulcers were most commonly seen in the 6<sup>th</sup> decade of life (31%) with majority of the cases above 50 years of age (71%). These are similar to the findings of the study conducted by Margolis et al<sup>[7]</sup>.

Most of the patients in our study had ulcers on the plantar aspect of the foot (70%) as compared to the dorsum of the foot (30%). This is findings are consistent with the findings of study conducted by Edmonds et al<sup>[8]</sup>. Most diabetic foot ulcers are often caused by poor foot care and gait abnormalities.

In this study, most of the patients had traumatic type of onset (68%) secondary to the neuropathy caused by diabetes mellitus<sup>[10]</sup>. Some patients developed ulcer spontaneously (32%) due to blister formation or unnoticed trivial trauma. Most patients in our study used insulin (71%) than oral hypoglycaemic agents for the control of diabetes mellitus.

The mean area of the ulcers under study at the start of the study was 39.96cm<sup>2</sup> (SD-8.6). At 1 week the mean percentage of area reduction is 16.42% (SD-1.8). At 2 weeks the mean percentage of area reduction is 36.77% (SD-2.51). These results in our study are similar to the study conducted by Purushothaman R et al<sup>[6]</sup>.

Platelet derived growth factor (PDGF) is a growth factor protein that is produced by platelets and endothelial cells<sup>[11]</sup>. The molecular weight of the PDGF is 24 kDa<sup>[5]</sup>. It is a dimeric molecule that contains two structurally similar polypeptide chains A and B that are bonded as homo-dimers or hetero-dimers by disulfide bond. They bind to and activate two protein kinase receptors. This leads to stimulation of cell growth, changes in cell shape and motility. It also activates actin filament system and stimulates chemotaxis. It is a potent mitogen for fibroblast and smooth muscle cells and it is chemotactic for smooth muscle cells, fibroblasts, macrophages, monocytes<sup>[12]</sup>. Various studies have shown their efficacy in promoting the formation of granulation tissue and reduction in size of the wound<sup>[13,14]</sup>.

Encouraging results have shown, that PDGF is better than good wound care alone. The average time for healing was shorter with greater reduction in ulcer size<sup>[15]</sup>. From our study, we can say that rh-PDGF dressing therapy facilitates wound healing in patients suffering from diabetes mellitus. No complications were noted in this study.

#### CONCLUSION:

The rate of wound healing in diabetic foot ulcer patients using rh-PDGF gel topical application was evaluated in this study. This rh-

PDGF gel topical application is a safe and effective form of dressing which facilitates granulation tissue formation epithelization and wound healing.

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