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Original Article

Effect of Magnesium Supplementation on Wound Healing in Patients with Diabetic Foot Ulcers-A Randomised Control Trial

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ABSTRACT

Hypomagnesemia is associated with neuropathy and abnormal platelet activity, both of which are risk factors for the emergence of DFU. This study was carried out to evaluate the effects of magnesium administration on wound healing in subjects with DFU. This randomized controlled trial was performed among 89 subjects with DFU. Subjects were divided into two groups to receive either oral magnesium oxide supplements for 4 weeks or conventional treatment. Pre- and post- intervention wound depth and appearance were scored in accordance with the SINBAD wound assessment tool. After the 4 week treatment, significant reductions in wound area and random blood sugar level in the group that did not receive Mg supplementation. A significant decrease in the wound area, and random blood sugar level, as well as better neuropathy assessment and SINBAD scores, were reported after 4 weeks in patients who received magnesium supplementation. No significant difference in patient distribution regarding the wound healing characteristics, including discharge, granulation tissue, edge sloping, surrounding normal skin, cellulitis, and exposed bone, was noted between patients receiving and not receiving Mg supplementation.

Key Words: *Magnesium supplementation. Wound healing. Metabolic status. Diabetic foot*

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INTRODUCTION

Up to 25% of diabetic subjects carry a lifetime risk of developing Diabetic Foot Ulcer and poor wound healing is a significant contributor to morbidity and mortality [1]. A lot of these diabetic foot ulcers progress to infection, gangrene, or worst of all the amputation that results in the loss of a limb [2]. According to Rodrguez-Morán et al., there is a strong correlation between foot ulcers and serum magnesium depletion in people with type 2 diabetes [3]. Low Mg levels associated with type 2 diabetes may result from decreased intestinal absorption and increased excretion by glycosuria. It causes decrease in the protective enzymes that fight oxidative stress, increase in vasoconstriction, and induction of pro-inflammatory and profibrogenic responses thus impeding normal cell growth [4]. Magnesium stimulates acetyl-CoA carboxylase enzyme, involved in physiological secretion of insulin and catalyses formation of malonyl-CoA[5]. It also inhibits the voltage dependent calcium channel, involved in insulin secretion[6]. The current study's objectives were to ascertain the magnesium status of patients with diabetic foot ulcers and to assess how magnesium supplementation affected wound healing.

INCLUSION CRITERIA

Adult patients above age 18 who are diagnosed to have chronic non healing diabetic foot ulcers are included in this study.

EXCLUSION CRITERIA

1. People on medication that affect magnesium levels (Aminoglycosides, Amphotericin-b, Digoxin, Loop diuretics) are not included in this study.
2. People with a history of renal failure, acute or chronic diarrhea, malabsorption, malignancies, and sepsis are not included in this study.
3. Pregnant or lactating women taking magnesium, multivitamin-mineral and antioxidant supplements, and anti-inflammatory agents are not included in this study.

MATERIALS AND METHODS

The study comprises of 89 adult patients who are assigned with the help of computer based random number generator assigned to each group. Patients are initially subjected to detailed history taking using a specially designed proforma having general information about the patient, symptoms and wound characterisitics, BMI, random sugar levels, hba1c levels will be filled for each patient during admission. The participants in the control group were treated with necessary conventional therapy and the experimental group received oral magnesium oxide 400mg tablets once daily upto 4 weeks in addition to conventional treatment. They have been followed upto 4 weeks and the wound healing was assessed based on wound characteristics with like size, edge, margin, floor, discharge, surrounding skin and correlated. Each ulcer was classified using the SINBAD score. The contribution made by each of the six elements to outcome (healed vs. non healed) by logistic regression model.

Category	Definition	SINBAD score
Site	Forefoot	0
	Midfoot and hindfoot	1
Ischemia	Pedal blood flow intact: at least one pulse palpable	0
	Clinical evidence of reduced pedal blood flow	1
Neuropathy	Protective sensation intact	0
	Protective sensation lost	1
Bacterial infection	None	0
	Present	1
Area	Ulcer $<1cm^2$	0
	Ulcer $\geq 1cm^2$	1
Depth	Ulcer confined to skin and subcutaneous tissue	0
	Ulcer reaching muscle, tendon or deeper	1
Total possible score		6

Figure -1 SINBAD score

RESULTS AND DISCUSSION

The present study assessed wound healing with magnesium supplementation in patients with diabetic foot ulcers. A total of 89 patients with diabetic foot ulcers were included, with a mean age of 57.14 ± 11.08 years, ranging from 30 to 84 years, of which 70 (78.65%) were males and 19 (21.35%) were females. 43 patients in group A received conventional treatment for diabetic foot, and 46 patients received magnesium (Mg) supplementation. Both groups were comparable regarding mean age, BMI, and HbA1c, except for duration of diabetes.

The cornerstones of treatment today are built on these guiding principles: local wound care with surgical debridement, dressings that encourage a moist wound environment, wound off-loading, vascular assessment, treatment of active infection, and glycemic control[7]. A significant factor in reducing the risk of wounds is the nutritional status of diabetic patients[8]. Deficits in micronutrients like vitamin E, vitamin C, and Mg have been linked to a number of diseases brought on by oxidative stress. Mg is the second-most prevalent cation in the human body's intracellular compartments influencing the way that insulin acts and how sensitive the body is to it[9]. It is a necessary element that is important for many biological processes. Insulin resistance, type 2 diabetes, dyslipidaemia, and hypertension are all conditions that frequently result in hypomagnesemia, which is caused by inadequate magnesium intake and increased magnesium loss[10]. Studies in the past have shown that taking extra magnesium has positive effects on fasting glucose and some lipid profiles[11]. According to prior research, timely foot ulcer treatment and effective diabetes management are linked to lower DFU morbidity and mortality rates[12].

Table-1 Wound characteristics and other parameters

	No Mg supplementation	Mean	SD	p value	Mg supplementation	Mean	SD	p value
Wound area	at presentation	12.70	7.508	0.029*	at presentation	12.58	5.80	<0.0001*
	at follow up	11.30	6.489		at follow up	9.40	4.56	
Neuropathy assessment	at presentation	7.10	1.334	0.096	at presentation	7.30	1.09	0.004*
	at follow up	7.49	1.073		at follow up	7.91	1.03	
Peripheral pulses	at presentation	4.20	1.344	0.331	at presentation	4.46	1.29	0.624
	at follow up	4.40	0.810		at follow up	4.35	0.87	
SINBAD score	at presentation	3.82	0.942	0.575	at presentation	3.73	1.04	<0.0001*
	at follow up	4.38	6.568		at follow up	2.84	1.01	
Random blood sugar	at presentation	230.26	80.919	<0.0001*	at presentation	215.71	74.80	0.001*
	at follow up	163.26	49.087		at follow up	167.41	39.28	

Table-2 Comparison of wound healing parameters

		No Mg supplementation	Mg supplementation	P value
Discharge	Pre	22	24	0.8525
	Post	4	5	
Granulation tissue	Pre	5	9	0.8155
	Post	25	39	
Edge sloping	Pre	6	8	0.7779
	Post	26	41	
Surrounding skin normal	Pre	19	21	0.5702
	Post	10	8	
Cellulitis	Pre	16	20	0.1684
	Post	11	6	
Bone exposed	Pre	8	11	0.7070
	Post	8	14	

CONCLUSIONS

There were 77 patients in whom no adverse outcomes were reported. The random blood sugar level, as well as better neuropathy assessment and SINBAD scores, were reported after 4 weeks in patients who received magnesium supplementation. There was no significant difference in patient distribution based on wound healing parameters between patients who received and did not receive magnesium supplementation.

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