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Original Research

Role Of Parenteral Amino Acid In Patients Of Diabetic Foot

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Abstract

Objective: To evaluate the efficacy of parenteral amino acid supplementation in the management of diabetic foot ulcers.

Methods: This case-control study was conducted at the Department of Surgery, Muzaffarnagar Medical College and Hospital, between October 2018 and February 2020. A total of 60 adult patients with type 2 diabetes mellitus and foot ulcers were randomized into two groups: Group A (n=30) received standard treatment while maintaining their regular diet, and Group B (n=30) received additional 200ml parenteral amino acids on alternate days for 15 days along with standard treatment. Patients were assessed for serum albumin, lipid profile, hemoglobin, creatinine, and uric acid levels. Wound healing was evaluated using Southampton and Asepsis Wound Scoring Systems on days 0, 5, 10, and 15.

Results: Both groups were comparable in baseline characteristics including age, gender distribution, duration of diabetes, HbA1c levels, and biochemical parameters. Group B showed a significant increase in serum albumin levels (from 3.44g/dl to 4.63g/dl, $p<0.01$) compared to Group A (3.46g/dl to 3.3g/dl). While both groups showed improvement in wound healing, Group B demonstrated significantly better outcomes with 66.67% patients achieving normal healing according to Southampton Scoring System compared to 26.67% in Group A ($p<0.05$). Similarly, satisfactory healing by Asepsis Wound Scoring System was observed in 66.67% of Group B patients versus 23.33% in Group A ($p<0.05$). No severe wound infections were reported in Group B by the end of the study.

Conclusion: Parenteral amino acid supplementation significantly improves serum albumin levels and enhances wound healing in patients with diabetic foot ulcers. This nutritional intervention should be considered as an adjunct to standard care for better management of diabetic foot ulcers.

Keywords: Diabetic foot ulcer, Parenteral amino acids, Wound healing, Serum albumin, Southampton scoring, Asepsis wound scoring

Introduction

Diabetes is a chronic metabolic disease characterized by pancreatic dysfunction, impaired insulin production, and fluctuating blood glucose levels.[1,2] This metabolic imbalance leads to multiple micro and macrovascular complications including blindness, kidney failure, heart disease, venous insufficiency, atherosclerosis, and peripheral neuropathy.[3-7] The combination of peripheral neuropathy and arterial disease with improper footwear often leads to chronically-infected lesions known as diabetic foot ulcers (DFU), which frequently result in limb amputations.[1] DFU is defined as a non-healing or poorly healing partial or full-thickness wound below the ankle in an individual with diabetes.[8]

The wound healing process involves complex interactions between different cell types, cytokine mediators, and the extracellular matrix, requiring adequate blood and nutrient supply to the damaged tissue.[3,4] Nutrition therapy plays a vital role in diabetes management and associated complications.[9] Protein is particularly important for wound healing, as it is essential for fibroblast proliferation, collagen synthesis, angiogenesis, and immune function.[10-13] Amino acids, the building blocks of proteins, can enhance insulin secretion from pancreatic β-cells under appropriate conditions.[14-18] Certain amino acids like leucine, isoleucine, alanine, and arginine are particularly important for stimulating β-cell electrical activity, which is essential for insulin secretion.[19,20]

The European Pressure Ulcer Advisory Panel and Agency for Health Care Policy and Research have recommended increased protein intake for wound healing. While the effect of inadequate protein intake on wound healing has been observed in non-diabetic

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individuals, there is limited data regarding the role of parenteral amino acids in patients with diabetic foot ulcers. Therefore, this study was conducted to analyze the role of amino acid supplementation in type 2 diabetes patients with foot ulcers, evaluating its impact on biochemical parameters and wound healing outcomes.

Methodology

This case-control study was conducted in the Department of Surgery at Muzaffarnagar Medical College and Hospital from October 2018 to February 2020. The study included 60 patients aged 18 years and above with type 2 diabetes mellitus and foot ulcers of any severity. After obtaining written informed consent and approval from the Institutional Ethical Committee, patients were randomly divided into Group A (control group, n=30) and Group B (treatment group, n=30).

Patients in Group A continued with their regular diet while those in Group B received 200ml of parenteral amino acids intravenously on alternate days for 15 days in addition to their regular diet. Baseline data including demographic details, medical history, and physical examination findings were recorded. Laboratory investigations included complete blood count, serum creatinine, total protein, albumin, liver function tests, lipid profile, HbA1c, and random blood sugar.

All patients received standard care including cleaning and dressing of ulcers under aseptic conditions with normal saline and povidone iodine daily. Wound debridement was performed as required, and antibiotics were administered according to culture and sensitivity reports. Patients were assessed on days 0, 5, 10, and 15 based on blood investigations, ulcer size, wound healing, and pain. Wound healing was evaluated using the Southampton Scoring System and Asepsis Wound Scoring System.

Exclusion criteria included children, pregnant women, patients with acute illnesses, type 1 diabetes mellitus, complications like nephropathy or liver diseases, non-diabetic lower extremity wounds, those who received hyperbaric oxygen therapy, and those who had collagen-based topical wound therapy or recent skin grafting.

Statistical analysis was performed using SPSS 22.00 for Windows. Data were analyzed using one-way ANOVA, Student's t-test, and chi-square test, with a significance level set at $p<0.05$.

Results

Demographic and Baseline Characteristics

Table 1 presents the demographic and baseline characteristics of the study groups. Both groups were comparable with no significant differences in terms of gender distribution, age, location, smoking status, duration of diabetes, HbA1c levels, and random blood sugar. Male predominance was observed in both groups (76.67% in Group A and 70% in Group B). Most patients were in the 51-60 years age range (60% in Group A and 46.67% in Group B). The mean duration of diabetes was 9.40 years in Group A and 9.73 years in Group B, with the majority of patients having diabetes for 6-10 years in both groups.

Laboratory Parameters

Table 2 shows the comparison of key laboratory parameters between the groups over the study period. The most notable finding was a significant increase in serum albumin levels in Group B from baseline (3.44g/dl) to day 15 (4.63g/dl), while levels remained relatively stable in Group A (3.46g/dl to 3.3g/dl). The difference between groups was statistically significant on days 10 and 15 ($p<0.01$).

Group A showed an increase in total cholesterol (from 171.67mg/dl to 183.14mg/dl), while Group B demonstrated a decrease (from 165.20mg/dl to 160.76mg/dl), though these changes were not statistically significant. HDL levels increased slightly in both groups, while LDL levels decreased more in Group B (from 99.82mg/dl to 95.16mg/dl) than in Group A (from 102.40mg/dl to 101.33mg/dl).

Hemoglobin levels showed minimal increase in both groups (from 10.43g/dl to 10.72g/dl in Group A and from 10.29g/dl to 10.48g/dl in Group B). Serum creatinine decreased from 1.46mg/dl to 1.07mg/dl in Group A and from 1.51mg/dl to 1.09mg/dl in Group B. Similarly, uric acid levels decreased in both groups (from 5.58mg/dl to 4.68mg/dl in Group A and from 6.03mg/dl to 4.83mg/dl in Group B).

Wound Healing Assessment

Tables 3 and 4 present the wound healing outcomes using the Southampton and Asepsis Wound Scoring Systems, respectively. By day 15, according to the Southampton Scoring System, normal healing was observed in 66.67% of patients in Group B compared to only 26.67% in Group A. Major hematoma occurred in 10% of Group A patients but none in Group B. The difference in healing outcomes between the groups was statistically significant at all assessment points ($p<0.05$).

Similarly, using the Asepsis Wound Scoring System, satisfactory healing was achieved in 66.67% of Group B patients versus 23.33% in Group A by day 15. Severe wound infection was present in 10% of Group A patients but none in Group B. The differences in healing outcomes between groups were statistically significant throughout the study period ($p<0.05$).

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Table 1: Demographic and Baseline Characteristics

Characteristics	Group A (Control) (n=30)	Group B (With Amino Acids) (n=30)	p-value
Gender			
Male	23 (76.67%)	21 (70%)	0.56
Female	7 (23.33%)	9 (30%)	
Age Group (years)			
31-40	1 (3.33%)	0 (0%)	0.47
41-50	9 (30%)	11 (36.67%)	
51-60	18 (60%)	14 (46.67%)	
>60	2 (6.67%)	5 (16.67%)	
Location			
Rural	15 (50%)	14 (46.67%)	0.79
Urban	15 (50%)	16 (53.33%)	
Smoking			
Present	13 (43.33%)	14 (46.67%)	0.56
Absent	17 (56.67%)	16 (53.33%)	
Duration of DM (years)			
≤5	2 (6.67%)	1 (3.33%)	0.71
6-10	20 (66.67%)	18 (60%)	
>10	8 (26.67%)	11 (36.67%)	
Mean ± SD	9.40 ± 3.40	9.73 ± 3.37	0.70
HbA1c (%)	7.74 ± 0.45	7.92 ± 0.42	0.12
RBS (mg/dl)	178.20 ± 15.04	180.87 ± 15.17	0.50

Table 2: Comparison of Laboratory Parameters

Parameter	Group	Baseline	Day 5	Day 10	Day 15	p-value
S. Albumin (g/dl)	A	3.46 ± 0.44	3.2 ± 0.49	3.4 ± 0.47	3.3 ± 0.54	0.42
	B	3.44 ± 0.52	3.82 ± 0.57*	4.24 ± 0.48*	4.63 ± 0.56*	0.01*
S. Cholesterol (mg/dl)	A	171.67 ± 36.33	178.33 ± 38.39	183.07 ± 33.41	183.14 ± 32.89	0.10
	B	165.20 ± 34.81	166.27 ± 35.79	162.11 ± 33.08	160.76 ± 37.71	0.27
HDL (mg/dl)	A	35.17 ± 12.99	36.07 ± 8.70	36.32 ± 8.88	36.02 ± 9.09	0.51
	B	35.97 ± 13.08	36.23 ± 9.25	36.53 ± 9.20	36.48 ± 8.91	0.64
LDL (mg/dl)	A	102.40 ± 18.81	104.40 ± 16.53	100.32 ± 16.94	101.33 ± 15.71	0.37
	B	99.82 ± 17.01	96.27 ± 16.13	96.18 ± 18.59	95.16 ± 15.51	0.38
Hemoglobin (g/dl)	A	10.43 ± 1.39	10.52 ± 1.23	10.61 ± 1.52	10.72 ± 1.47	0.18
	B	10.29 ± 1.01	10.34 ± 1.18	10.40 ± 1.34	10.48 ± 1.30	0.31
S. Creatinine (mg/dl)	A	1.46 ± 1.09	1.24 ± 1.24	1.16 ± 1.13	1.07 ± 1.38	0.32
	B	1.51 ± 1.42	1.22 ± 1.33	1.13 ± 1.21	1.09 ± 1.44	0.47
Uric Acid (mg/dl)	A	5.58 ± 2.96	5.27 ± 2.57	4.86 ± 2.90	4.68 ± 3.07	0.26
	B	6.03 ± 2.53	5.50 ± 2.64	5.10 ± 2.84	4.83 ± 2.91	0.34

*Statistically significant ($p<0.05$)

Table 3: Southampton Scoring System for Wound Healing at Day 15

Category	Group A (n=30)	Group B (n=30)	p-value
Normal healing	8 (26.67%)	20 (66.67%)	0.007*
Minor Complication	9 (30%)	7 (23.33%)	
Wound Infection	10 (33.33%)	3 (10%)	
Major Haematoma	3 (10%)	0 (0%)	

*Statistically significant ($p<0.05$)

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Table 4: Asepsis Wound Scoring System for Wound Healing at Day 15

Category	Group A (n=30)	Group B (n=30)	p-value
Satisfactory healing	7 (23.33%)	20 (66.67%)	0.006*
Disturbance of Healing	10 (33.33%)	7 (23.33%)	
Minor Wound Infection	10 (33.33%)	3 (10%)	
Severe Wound Infection	3 (10%)	0 (0%)	

*Statistically significant ($p<0.05$)

Discussion

This study demonstrated that parenteral amino acid supplementation significantly improved wound healing outcomes in patients with diabetic foot ulcers. The most notable finding was the significant increase in serum albumin levels in patients receiving amino acid supplementation, which correlated with better wound healing outcomes. Serum albumin, a key marker of nutritional status, increased from 3.44g/dl to 4.63g/dl in Group B, while it remained relatively unchanged in Group A. This finding is consistent with the established role of protein and amino acids in wound healing processes including fibroblast proliferation, collagen synthesis, and angiogenesis.[12,13]

The significant improvement in wound healing as assessed by both Southampton and Asepsis Wound Scoring Systems underscores the therapeutic benefit of amino acid supplementation. By day 15, 66.67% of patients in Group B achieved normal healing according to the Southampton Scoring System compared to only 26.67% in Group A. Similarly, satisfactory healing by Asepsis Wound Scoring System was observed in 66.67% of Group B patients versus 23.33% in Group A. These findings align with previous studies, including Jones et al.[21] who reported that amino acid supplementation promoted healing of diabetic foot ulcers. Grayet al.[22] also observed that a mixture of amino acids (arginine, glutamine, and β-hydroxy-β-methyl-butyrate) improved wound healing and reduced antibiotic costs. Lee et al.[23] demonstrated that high protein diets improved healing of pressure ulcers in malnourished nursing home residents.

The role of specific amino acids in wound healing has been well-documented. Arginine enhances wound healing through multiple mechanisms including collagen deposition and immune function as reported by Williams et al.[24] Glutamine, another important amino acid, serves as a precursor for proline

synthesis, which is essential for collagen formation as noted by Bellonet al.[25] The combination of arginine, glutamine, and β-hydroxy-β-methylbutyrate has been shown to decrease diabetic wound catabolism and improve wound appearance scores as reported in a retrospective review.

Our findings suggest that amino acid supplementation addresses protein requirements that are essential for optimal wound healing processes. The improvement in serum albumin levels in the treatment group indicates enhanced nutritional status, which is critical for tissue repair and regeneration. Additionally, the reduction in wound infection rates and absence of severe infections in the treatment group by the end of the study period highlight the potential of amino acid supplementation to support immune function and combat infection in diabetic foot ulcers.

The limitation of the present study is its small sample size and short follow-up period. Further studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and establish optimal protocols for amino acid supplementation in diabetic foot ulcer management.

Conclusion

Parenteral amino acid supplementation significantly improves serum albumin levels and enhances wound healing outcomes in patients with diabetic foot ulcers. The notable improvement in wound healing as assessed by standard scoring systems suggests that amino acid supplementation should be considered as an important adjunct to standard care in the management of diabetic foot ulcers. This nutritional intervention addresses the protein requirements that are essential for optimal wound healing processes. Further studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and establish optimal protocols for amino acid supplementation in diabetic foot ulcer management.

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