European Review for Medical and Pharmacological Sciences 2023; 27: 1609-1613

Changes of wound area and inflammatory factors in diabetic foot patients after comprehensive nursing of traditional Chinese medicine

L. CHEN[1], W.-H. ZHONG[2], Y.-D. MA[3], Y.-J. ZHANG[1], G.-C. CAI[1], H.-Q. HUANG[1], F.-F. LU[1], X.-D. SU[4]

[1]Department of Endocrinology, [2]Department of Respiratory and Critical Care Medicine, Third People's Hospital of Haikou, Haikou, Hainan, China
[3]Department of Traditional Chinese Medicine, [4]Department of Clinical Laboratory, Danzhou People's Hospital, Danzhou, Hainan, China

Lan Chen, Wanhong Zhong and Yongduo Ma equally contributed to this work and should be considered as co-first authors

Abstract. – OBJECTIVE: The aim of this study is to analyze the application effect of traditional Chinese medicine (TCM) comprehensive nursing in diabetic foot patients.

PATIENTS AND METHODS: 230 patients with diabetic foot admitted to Third people's Hospital of Haikou from January 2019 to April 2022 were classified as two groups, which consisted of a control group (n = 95) and an experimental group (n = 135). The control group took routine nursing intervention, while the experimental group took TCM comprehensive nursing intervention. The effect of intervention was compared by inflammatory factors (B-FGF, EGF, VEGF, and PDGF), wound area, self-rated anxiety scale (SAS), and self-rated depression scale (SDS).

RESULTS: After nursing, the levels of B-FGF, EGF, VEGF, and PDGF were higher in the experimental group (all $p < 0.05$). The total effective rate of diabetic foot recovery in the experimental group was 94.87% (74/78), higher than 87.67% (64/73) in the control group ($p = 0.026$). After nursing, the scores of SAS and SDS in the experimental group were lower than those in the control group (all $p < 0.05$).

CONCLUSIONS: The application of TCM comprehensive nursing in diabetic foot patients can greatly change the levels of B-FGF, EGF, VEGF, and PDGF in wound tissue, promote the healing of ulcer surface, improve patients' anxiety and depression, and enhance the quality of life of patients.

Key Words:
Comprehensive nursing, Traditional Chinese medicine, Diabetic foot, Wound area, Inflammatory factors.

Introduction

Diabetic foot (DF) refers to lower limb infection, ulceration, and deep tissue injury caused by neuropathy and vascular lesions in diabetic patients. Diabetic foot is one of the common chronic complications of diabetic patients. Some studies[1] estimate that more than 15% of diabetic patients are likely to develop diabetic foot. Amputation is an important consequence for DF patients, and ulcers, infection, and gangrene are important causes of amputation. Research statistics[2] indicate that 40-60% of amputations of lower limbs are associated with diabetes each year. Research[3] shows that about 25% of patients with nontraumatic amputation have diabetes. About 85% or more diabetic amputees have to be amputated because of severe foot infections, osteomyelitis, or gangrene limbs. The DF incidence is 5.3-10.5% reported abroad; and its incidence in China is 8.57%[4]. With the increasing prevalence of diabetes, the DF incidence is also increasing, so DF prevention and treatment are paid increasing attention.

At present, DF nursing is also the focus of clinical attention. Studies[5-10] show that effective nursing measures have a positive effect on promoting ulcer healing, but previous clinical experience has showed[11] that with the conventional nursing the expected effect was difficult to achieve. In recent years, with the wide application of traditional Chinese medicine (TCM) several studies[12,13] have confirmed that nursing in clinical practice

Corresponding Author: Xiandu Su, MD; e-mail: n3e0r9@sina.com

has a good effect on DF patients. However, previous studies[14,15] have a single index, and their effects are mainly analyzed from the perspective of blood glucose control and nursing satisfaction, which has limitations. Therefore, this study integrates TCM nursing for DF patients and investigates endothelial growth factor, ulcer recovery effect results, patients' psychology, and quality of life, aiming to provide a basis for clinical nursing.

Patients and Methods

Study Subjects

151 patients with diabetic foot admitted to Third people's Hospital of Haikou from January 2019 to April 2022 were classified in two groups, which consisted of a control group (n=73) and experimental group (n=78). DF inpatients in the Third people's Hospital of Haikou from January 1, 2015, to December 31, 2018, were selected as the research subjects. During this time, the subjects were followed-up every three months. Inclusion criteria were as follows:

- Meet the diagnostic criteria of DM issued by the World Health Organization in 1999;
- Conform to the definition standard of DF in the 2019 Guidelines for Prevention and Treatment of Diabetic Foot in China;
- Complete medical records and clinical treatment data of the samples.

Patients with DF combined with malignant tumor or combined with lower extremity varicose ulcers were excluded.

In this study, the control group was given conventional treatment, and the experimental group was given TCM comprehensive nursing, including TCM fumigation, foot bath, dietary nursing and moxibustion.

Comparison of Wound Conditions

The levels of basic fibroblast growth factor (B-FGF), epidermal growth factor (EGF), vascular endothelial growth factor (VEGF), and platelet-derived growth factor (PDGF) were detected by immunohistochemistry using BOND RX automatic immunohistochemistry analyzer of Beijing Hoonos Technology Co., LTD.

Specimens were taken from patients' wound site under aseptic conditions, fixed with 10% formaldehyde, embedded with paraffin, and then sliced continuously, 4 μm thick. After routine dewaxing and hydration, the sections were treated with sheep anti-rabbit B-FGF monoclonal antibody, EGF monoclonal antibody, VEGF monoclonal antibody and PDGF monoclonal antibody as instructed, followed by secondary antibody incubation, routine hematoxylin staining, dehydration, transparency and sealing, and finally observed and photographed under a microscope. Finally, the immunohistochemical staining results were evaluated by two pathologists with more than 10 years of clinical experience. The final result was reached after the two pathologists reached an agreed conclusion through consultation.

Comparison of DF Recovery Effect

Determination criteria: (1) Effective: ulcer area was reduced by 30-60%; wound healing scab with good blood transport; ulcer area decreased by more than 60% and the wound was recovered clearly; (2) Ineffective: ulcer area decreased by <30% with no significant or even serious change.

Comparison of Negative Emotions

The self-rating Anxiety Scale (SAS) and self-rating Depression Scale (SDS) were used for evaluation. SAS included 20 items, and each item was rated from 1 to 4, < 50 was considered as normal, and the higher the score, the more serious the anxiety. SDS consisted of 20 entries, each item was graded from 1 to 4, with < 53 being considered as normal. The higher the score, the more serious the depression.

Every three months, the subjects included in this study went to the follow-up clinic of our hospital for a SAS and SDS questionnaire assessment by the doctor.

Statistical Analysis

SPSS 22.0 statistical software (IBM Corp., Armonk, NY, USA) was applied for data processing. Counting data were expressed as N (%) and counted by χ^2 test. Measurement data were expressed as and counted by *t*-test, respectively. $p<0.05$ was considered statistically significant.

Results

Patients Characteristics

The control group consisted of 38 males and 35 females (age range: 59 to 73 years). The mean fasting blood glucose at admission was (10.36±1.45) mmol/L with average body mass index (BMI) of 25.43±2.56 kg/m^2. A total of 73 diabetic feet were diagnosed. Wagner's classification of diabetic feet was 36 for grade 1 and 37 for grade 2. In the experimental group, there were 43 males and

Table I. Comparison of B-FGF and EGF between two groups before and after nursing.

Group	B-FG		FEGF	
	Before nursing	After nursing	Before nursing	After nursing
Control group	23.65±4.54	28.52±4.77	544.16±64.45	802.44±95.65
Experimental group	23.33±4.14	34.85±4.99	548.16±59.98	935.73±98.68
p	0.746	0.00	0.388	0.00

Table II. Comparison of VEGF and PDGF between two groups before and after nursing.

Group	VEGF		PDGF	
	Before nursing	After nursing	Before nursing	After nursing
Control group	79.15±7.54	97.36±7.83	1.56±0.25	3.94±0.65
Experimental group	80.33±6.24	111.39±7.74	1.66±0.31	6.73±0.98
p	0.746	0.00	0.244	0.00

35 females (age range: 57 to 76). The mean fasting blood glucose at admission was (10.64±1.52) mmol/L with average BMI (25.05±2.48) kg/m^2. A total of 78 diabetic feet were diagnosed. Wagner grade: 35 for grade 1 and 43 for grade 2.

Comparison of Wound Conditions

The levels of B-FGF, EGF, VEGF, and PDGF in the experimental group were higher than that in the control group after nursing care (p<0.05, Table I-II).

Comparison of Diabetic Foot Recovery Effect

The total effective rate of diabetic foot recovery in the experimental group was 94.87% (74/78), higher than 87.67% (64/73) in the control group (p=0.026, Table III).

Comparison of Negative Emotions

Neither SAS nor SDS scores contributed statistical significance to the two groups before nursing (p>0.05); after nursing, they significantly decreased, and the experimental group was significantly lower than the control group (p<0.05, Table IV).

Discussion

DF is a serious complication of DM. With the rapid rise of DM prevalence, the DF incidence is also increasing[10,16]. The pathological process and the development of DF are closely related to the peripheral nerve and the vascular disease of lower limbs, which is difficult to cure[17-19]. It leads to a high amputation rate, poor prognosis, which reduces the quality of life, aggravates the economy

Table III. Comparison of effective rate of diabetic foot recovery between the experimental group and control group.

Group	Number	Effective	Ineffective	*p*
Control group	73	64 (87.67)	9 (12.33)	0.026
Experimental group	78	74 (94.87)	4 (5.13)	

Table IV. Comparison of VEGF and PDGF between two groups before and after nursing.

Group	SAS score		SDS score	
	Before nursing	After nursing	Before nursing	After nursing
Control group	59.32±5.54	49.36±3.83	61.56±4.25	53.94±3.65
Experimental group	60.03±6.04	44.35±3.94	62.66±4.31	47.73±3.98
p	0.746	0.00	0.244	0.00

burden, and has a significant impact on the psychological state of DF patients[20-22].

The formation of sugars in diabetic patients results from foot infections, ulcers, and/or deep tissue destruction due to local nerve abnormalities and peripheral vascular lesions of the distal extremities during the disease. DF is the most serious chronic type of diabetes with the highest treatment cost. Its severe cases can lead to amputation. Diabetic patients are 40 times more likely to develop DF than nondiabetic patients, and about 85% of amputations are caused by the foot.

B-FGF, EGF, VEGF, PDGF, and other growth factors can promote the proliferation of vascular endothelial cells and promote wound healing. The results showed that after nursing, the levels of B-FGF, EGF, VEGF, and PDGF in the experimental group were higher than those in the control group. The effect of DF rehabilitation in the experimental group was better than that in the control group. After nursing, the scores of SAS and SDS in the experimental group were lower than those in the control group, and the scores of the quality of life in the experimental group were higher than those in the control group, indicating that the effect of TCM comprehensive nursing was significant. The reason for analysis is that TCM nursing can help patients to emotionally understand the pathogenic characteristics, recognize the serious impact of negative emotions on the disease, and give patients encouragement and support, in order to let them deal with the disease with a positive attitude. In addition, the diet control of diabetes patients is also essential. Dietary nursing of TCM can regulate blood glucose and prevent diabetes aggravation and significantly improve the disease through syndrome differentiation.

Furthermore, TCM fumigation, foot bath, and moxibustion can improve lower limb blood supply and peripheral nerve function, promoting wound healing, which has been confirmed by the results of the present study.

With the rapid development of high-throughput technologies such as DNA sequencing and mass spectrometry sequencing, the field of life science has entered the era of big data characterized by massive multivariate omics data. Omics big data brings unprecedented opportunities to life science research, which is of great significance in the study of gene function, disease mechanism, precision medicine, and other aspects. Therefore, bioinformatics knowledge should be applied to investigate TCM comprehensive nursing in diabetic foot patients[23-27].

The sample size of this study is small due to limited funds; we will enroll more patients in the future study.

Conclusions

The application of TCM comprehensive nursing in diabetic foot patients can greatly change the levels of B-FGF, EGF, VEGF, and PDGF in wound tissue, promote the healing of ulcer surface, improve patients' anxiety and depression, and enhance the quality of life of patients.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

Acknowledgments

We sincerely acknowledge some students from Third People's Hospital of Haikou.

Authors' Contributions

Xiandu Su conceived the study design and the content concept; Lan Chen, Wanhong Zhong, Yajie Zhang, Guicheng Cai performed the data collection, extraction and analyzed the data. Haiqiong Huang, Fangfang Lu interpreted and reviewed the data and drafts. Xiandu Su reviewed the final draft.

Funding

The present study was funded by General Program of Natural Science Foundation of Hainan Province (Project No. 821MS0849).

Ethics Approval

This study was approved by the Medical Ethics Committee of the Third People's Hospital of Haikou (Ethics No. 821MS0849).

Informed Consent

Written informed content was signed and obtained by all participants.

Conflict of Interests

The authors declare that they have no competing interests.

References

1) Boulton AJ. The diabetic foot: a global view. Diabetes Metab Res Rev 2000; 16 Suppl 1: S2-5.
2) Apelqvist J, Larsson J. What is the most effective way to reduce incidence of amputation in the diabetic foot. Diabetes Metab Res Rev 2000; 16 Suppl 1: S75-83.

3) Wang A, Xu Z, Mu Y, Ji L. Clinical characteristics and medical costs in patients with diabetic amputation and nondiabetic patients with nonacute amputation in central urban hospitals in China. Int J Low Extrem Wounds 2014; 13: 17-21.
4) Beckert S, Witte M, Wicke C, K?nigsrainer A, Coerper S. A new wound-based severity score for diabetic foot ulcers: A prospective analysis of 1,000 patients. Diabetes Care 2006; 29: 988-992.
5) Tang Y, Chen Y, Li Y. Effect of Orem's Self-Care Theory Combined with Active Pain Assessment on Pain, Stress and Psychological State of Children with Nephroblastoma Surgery. Front Surg 2022; 9: 904051.
6) Eraydin ?, Av?ar G. The Effect of Foot Exercises on Wound Healing in Type 2 Diabetic Patients With a Foot Ulcer: A Randomized Control Study. J Wound Ostomy Continence Nurs 2018; 45: 123-130.
7) Chen CY, Wu RW, Hsu MC, Hsieh CJ, Chou MC. Adjunctive Hyperbaric Oxygen Therapy for Healing of Chronic Diabetic Foot Ulcers: A Randomized Controlled Trial. J Wound Ostomy Continence Nurs 2017; 44: 536-545.
8) Sharma R, Sharma SK, Mudgal SK, Jelly P, Thakur K. Efficacy of hyperbaric oxygen therapy for diabetic foot ulcer, a systematic review and meta-analysis of controlled clinical trials. Sci Rep 2021; 11: 2189.
9) Suryani M, Samekto W, Heri-Nugroho, Susanto H, Dwiantoro L. Effect of foot-ankle flexibility and resistance exercise in the secondary prevention of plantar foot diabetic ulcer. J Diabetes Complications 2021; 35: 107968.
10) Zhou Y, Chia H, Tang H, Lim S, Toh WY, Lim XL, Cheng LJ, Lau Y. Efficacy of low-level light therapy for improving healing of diabetic foot ulcers: A systematic review and meta-analysis of randomized controlled trials. Wound Repair Regen 2021; 29: 34-44.
11) Chen H, Lv X, Zhang Y. Effect of Nursing Intervention on Promoting Healing of RW in Patients with Diabetic Foot: A Systematic Review and Meta-Analysis. Comput Math Methods Med 2022; 2022: 8284870.
12) Liu FS, Li Y, Guo XS, Liu RC, Zhang HY, Li Z. Advances in traditional Chinese medicine as adjuvant therapy for diabetic foot. World J Diabetes 2022; 13: 851-860.
13) Dai XY, Zi MJ, Liu CX, Wang YM, Gao R. Development of a core outcome set in the clinical trials of traditional Chinese medicine for diabetic foot: A study protocol. Front Med (Lausanne) 2022; 9: 1025833.
14) Rayate AS, Nagoba BS, Mumbre SS, Mavani HB, Gavkare AM, Deshpande AS. Current scenario of traditional medicines in management of diabetic foot ulcers: A review. World J Diabetes 2023; 14: 1-16.
15) Wang Y, Cao HJ, Wang LQ, Lu CL, Yan YQ, Lu H, Zhang K, Zhang HM, Liu JP. The effects of Chinese herbal medicines for treating diabetic foot ulcers: A systematic review of 49 randomized controlled trials. Complement Ther Med 2019; 44: 32-43.
16) Vileikyte L, Crews RT, Reeves ND. Psychological and Biomechanical Aspects of Patient Adaptation to Diabetic Neuropathy and Foot Ulceration. Curr Diab Rep 2017; 17: 109.
17) EL-Mohandes N, Yee G, Bhutta BS, Huecker MR. StatPearls. 2022. Treasure Island (FL).
18) Daneshgari F, Liu G, Hanna-Mitchell AT. Path of translational discovery of urological complications of obesity and diabetes. Am J Physiol Renal Physiol 2017; 312: F887-F896.
19) Papaioannou I, Pantazidou G, Kokkalis Z, Georgopoulos N, Jelastopulu E. Vitamin D Deficiency in Elderly With Diabetes Mellitus Type 2: A Review. Cureus 2021; 13: e12506.
20) Chen X, Wu M, Hu Q, Cheng X. Incidence and risk factors for poor perioperative blood glucose management in patients with diabetic foot: a retrospective study. Ann Palliat Med 2021; 10: 12300-12309.
21) Ricciardiello F, Mazzone S, Viola P, Guggino G, Longo G, Napolitano A, Russo G, Sequino G, Oliva F, Salomone P, Perrella M, Romano GM, Cinaglia P, Abate T, Gargiulo M, Pisani D, Chiarella G. Deep Neck Infections: Decisional Algorithm for Patients with Multiple Spaces Involvement. Rev Recent Clin Trials 2022; 17: 46-52.
22) Fillo J, Breza J, Lev?íkova M, Luha J, Vachulova A, Durdík ?, Laba? P. Occurrence of erectile dysfunction, testosterone deficiency syndrome and metabolic syndrome in patients with abdominal obesity. Where is a sufficient level of testosterone. Int Urol Nephrol 2012; 44: 1113-1120.
23) Qiu Y, Li H, Xie J, Qiao X, Wu J. Identification of ABCC5 Among ATP-Binding Cassette Transporter Family as a New Biomarker for Hepatocellular Carcinoma Based on Bioinformatics Analysis. Int J Gen Med 2021; 14: 7235-7246.
24) Xie J, Li H, Chen L, Cao Y, Hu Y, Zhu Z, Wang M, Shi J. A Novel Pyroptosis-Related lncRNA Signature for Predicting the Prognosis of Skin Cutaneous Melanoma. Int J Gen Med 2021; 14: 6517-6527.
25) Qiu Y, Li H, Zhang Q, Qiao X, Wu J. Ferroptosis-Related Long Noncoding RNAs as Prognostic Marker for Colon Adenocarcinoma. Appl Bionics Biomech 2022; 2022: 5220368.
26) Xie J, Chen L, Sun Q, Li H, Wei W, Wu D, Hu Y, Zhu Z, Shi J, Wang M. An immune subtype-related prognostic signature of hepatocellular carcinoma based on single-cell sequencing analysis. Aging (Albany NY) 2022; 14: 3276-3292.
27) Li C, Qu L, Matz AJ, Murphy PA, Liu Y, Manichaikul AW, Aguiar D, Rich SS, Herrington DM, Vu D, Johnson WC, Rotter JI, Post WS, Vella AT, Rodriguez-Oquendo A, Zhou B. AtheroSpectrum Reveals Novel Macrophage Foam Cell Gene Signatures Associated With Atherosclerotic Cardiovascular Disease Risk. Circulation 2022; 145: 206-218.