

A 15-year follow-up report of an elderly diabetic foot with multiple recurrences leading to toe amputation and thoughts on the model of care for diabetic foot ulcer

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Abstract: Diabetic foot ulcer (DFU) is one of the most serious complications of diabetes. Elderly diabetic patients are a high prevalence of diabetic foot ulcers, and their high recurrence, disability, and mortality rates impose a heavy economic burden on families and society. This paper reports a case of an elderly patient with a diabetic foot ulcer who was admitted in April 2007 and discharged after recovery from comprehensive diabetic foot treatment. Due to intermittent foot care and lack of home care, the patient's foot ulcers recurred after repeated healing during home rehabilitation, eventually resulting in the amputation of the right bunion. After the patient was discharged from the hospital with an amputated toe, the whole-process seamless management model of "hospital - community - family" was implemented. The hospital provides specialized foot support and guidance, and the community is responsible for daily disease management and referrals. The family is responsible for the implementation of home rehabilitation programs, and family caregivers need to identify and provide feedback on foot abnormalities promptly. As of May 2022, the patient had not experienced ulcer recurrence. This paper reports the whole process of "ulcer development → ulcer healing → ulcer recurrence healing → toe amputation → continuous care management" experienced by the patient in 15 years, aiming to reflect on the significance of the whole-process seamless foot care management model of "hospital-community-family" for diabetic foot ulcer rehabilitation through the case.

Keywords: elderly, diabetic foot ulcer, recurrence, toe amputation, care

Introduction

According to statistics from the International Diabetes Federation (IDF) in 2019 (1,2), there are approximately 135.6 million elderly diabetes patients aged over 65 years worldwide. The prevalence of diabetes is increasing globally due to the aging population. Elderly diabetic patients are particularly vulnerable to diabetic foot (3), as risk factors for diabetic foot, such as peripheral vascular disease, foot deformity, and peripheral arterial disease, increase with age and are highly susceptible to the development of foot ulcers. A study (4) revealed that patients with diabetic foot ulcers have a very high recurrence rate, which can lead to serious consequences, such as amputation (toe) and death.

This paper reports a case of a diabetic foot ulcer patient admitted in April 2007 who experienced the whole process of "ulcer occurrence → ulcer healing → recurrent ulcer occurrence, healing → toe amputation → continued care management" during the past 15 years, as

reported below. Informed consent was obtained from the patient.

Case characteristics

The patient, a 79-year-old female, who can take care of herself and lives with her daughter. She has been diagnosed with type 2 diabetes for 31 years and has a history of hypertension for 30 years. She is currently taking antihypertensive medications, and her blood pressure is controlled within the range of 120–140/70–90 mmHg. Her hypoglycemic regimen includes Youmirin 70/30 38 u–28 u (subcutaneous injection 30 minutes before breakfast), Gewazhi 250 mg (before breakfast), and Genovil 100 mg (before breakfast). The target fasting blood glucose level is 7–9 mmol/L, and blood glucose levels should be maintained at around 15 mmol/L 2 hours after meals.

The patient underwent electromyography which revealed peripheral neuropathy. Additionally, a color

Doppler angiography showed diffuse thickening of the intima arteriae of both lower limbs with multiple sclerotic plaques, indicating peripheral vascular disease. An ophthalmic consultation suggested retinopathy, a common complication of diabetes. Furthermore, the patient's albumin/creatinine ratio was elevated, measuring up to 22.16 mmol/L, suggesting diabetic nephropathy.

Treatment and care

Phase 1

In April 2007, the patient was admitted to the endocrine ward due to severe onychomycosis infection stemming from poor glycemic control and deformed hyperplasia of a right foot toenail, which compressed adjacent tissues and formed toe ulcers. The patient's random blood glucose was measured at 15.8 mmol/L and glycosylated hemoglobin at 7.5%. The patient complained of foot numbness and foot examination revealed that the right bunion was thickened and hypertrophied, the toenail was thickened, and an ulcer was seen at the end of the toe, measuring approximately 4.5 cm × 3.5 cm × 0.5 cm, with a yellowish wound surface and oozing fluid (Figure 1, A).

The patient was initially diagnosed with a diabetic foot ulcer, Wagner grade 2. The foot treatment involved trimming the thickened toenail and ingrown nail, changing the dressings for the ulcer, and administering terbinafine ointment for antifungal infection. The patient was discharged and continued outpatient wound care for 6 weeks, after which the ulcer healed.

Phase 2

In March 2013, the patient was living alone and her daughter was the primary family caregiver and visits her once a week. The patient has impaired vision due to diabetic retinopathy, resulting in insufficient self-care ability. The patient was not receiving good foot care at this stage due to limited self-care and lack of family care.

In September 2013, when the patient's daughter came for a weekend visit, she noticed oozing on the sock of the patient's right foot and immediately examined the foot, which had a recurrence of the foot ulcer. The patient came to the clinic immediately and measured fasting blood glucose of 10 mmol/L, glycated hemoglobin of 7.9%, and the urinary albumin/creatinine ratio of 10.7 mg/mmol. The patient reported experiencing numbness and pain in the affected foot, as well as recurrent edema in the lower extremity. Physical examination revealed thickening and hypertrophy of the right bunion, a 4.6 cm × 3.5 cm × 0.4 cm ulcer with yellowish discharge and odor, and a Wagner Grade 2 ulcer (Figure 1, B). After debridement, local anti-infective treatment, systemic glucose regulation therapy, and administering terbinafine ointment for antifungal infection, the ulcer wound healed within eight weeks. This recurrence was due to the



Figure 1. Multiple recurrent foot ulcers in the patient. First ulcer (A): The patient was initially found to have a fungal infection (red arrow), gray toenail (blue arrow), and exudate from the ulcer (yellow arrow) on the right bunion, diagnosed with Wagner grade 2; Second recurrence (B): yellowish keratinized tissue with fluctuating sensation (blue arrow) was seen in the right bunion. Toe thickening, high skin temperature (red arrow), and loosening of the base of the gray toe metacarpal (yellow arrow), Wagner grade 2; Third recurrence (C): thickened and swollen right bunion with fluctuating sensation and elevated skin temperature (red arrow), fungal infection of the foot with gray toenail (yellow arrow), recurrence of the ulcer in the same location (blue arrow), Wagner grade 2; Toe amputation (D): The patient healed after toe amputation with a clean, dry foot, no fungal infection, and no ulcers (red arrows).

patient's lack of self-care and family care, and the failure to detect the recurrence of the ulcer in time, resulting in a delayed visit to the clinic.

Phase 3

On February 19, 2014, the patient was admitted to our hospital with a fever and a temperature as high as 39.6°C. The patient had self-soaked her right bunion after it had broken due to barefoot walking a week ago and failed to seek medical attention in a timely manner, resulting in a traumatic infection causing bacteremia. Upon admission, the patient's blood routine examination showed elevated levels of white blood cells and neutrophils, as well as a 2-hour postprandial glucose level of 15 mmol/L, glycosylated hemoglobin level of 6.6%, and a urinary albumin/creatinine ratio of 35.41 mg/mmol.

The patient complained of numbness and pain in the affected foot, and upon examination, we observed a thickened and hypertrophied right bunion with an ulcer measuring 3.2 cm × 4.5 cm × 0.4 cm. The wound was exuding pale red exudate and had a Wagner grade 2 classification (Figure 1, C). The patient received anti-infective, nerve nutrition, and glucose-regulating treatment, continued with terbinafine ointment for antifungal infection, and intensive dressing changes for

the foot wound. The ulcer wound healed in 6 weeks.

Phase 4

In April 2014, the patient was alone at home soaking her feet, which caused swelling and breakdown in her right toe. The patient did not recognize the occurrence of the ulcer at the first time and continued to soak her feet, resulting in a severe infection of the ulcer wound complicating osteomyelitis, Wagner grade 3. Due to untimely medication, the patient's fungal infection and gray toenail problems persisted, and the patient continued to soak her feet despite impaired skin integrity this time, aggravating the infection, so the ulcer recurred faster and more severely than the last time. For this recurrence, the orthopedic surgeon recommended toe amputation. In May 2014, the patient underwent a bunion amputation on her right foot, which was successful and the patient made a full recovery after the operation (Figure 1, D).

Phase 5

During the period from the patient's discharge from the hospital with an amputated toe in May 2014 and rehabilitation at home in May 2022, we implemented a continuous "hospital-community-family" linkage management, prompt identification and prevention of foot risk factors, and enhanced blood glucose management, which effectively prevented the recurrence of diabetic foot ulcers. In this model, the hospital provides professional foot support and guidance, the community is responsible for daily disease management and referrals, and the family is responsible for implementing a home rehabilitation program. Family caregivers are required to identify and provide feedback on foot abnormalities promptly. Community nurses regularly educate patients and their caregivers on diabetic foot care, including self-examination after diabetic foot amputation, regular application of the antifungal ointment, and tips on proper toenail trimming to improve patients' self-management skills. When patients have deformed toenails or a recurrence of ulcers, the community hospital assists them in making online appointments at the diabetic foot clinic of a tertiary hospital for further specialized treatment.

The last follow-up visit was on May 20, 2022, when the patient came to the hospital for a review, which showed clean and dry feet, no fungal infections, neatly trimmed toenails, good blood flow to the feet, and no recurrence of ulcers. As a result of eight years of the whole-process seamless management of "hospital - community - family", the patient's foot is now in good condition.

Discussion

The high recurrence rate of diabetic foot in the elderly and the urgency of improving self-care skills

Elderly diabetic patients with progressive disease and aging may experience peripheral circulation disorders, resulting in lower extremity sensory abnormalities, making them a high-risk population for diabetic foot ulcers (3). Unfortunately, due to the lack of knowledge related to foot ulcer care, many of these patients fail to discover and seek medical treatment in a timely manner, leading to high rates of amputation and mortality (5), as well as increased risk of recurrence (4).

When the patient first presented with a foot ulcer in 2007, she underwent good home care, adhering to the use of terbinafine ointment for antifungal infection and standardized toenail trimming, and was able to have regular rechecks, and the ulcer eventually healed. During 2013-2014, the patient lacked family care support and had insufficient self-care skills when living alone. Due to a lack of attention and knowledge of diabetic foot ulcer care, the patient soaked her own feet after walking barefoot, which led to skin breakdown, however, the patient did not first notice the ulcer occurring and continued to soak her feet, which eventually led to severe osteomyelitis infection and had to be treated by toe amputation. Therefore, it is urgent to improve the self-care ability of elderly patients with diabetic foot ulcers.

It is very crucial to establish a seamless continuous nursing model for senile diabetic high-risk feet

Continuing care is the process of extending care beyond hospitalization to ensure patients receive ongoing and individualized healthcare services across different healthcare settings. This approach emphasizes continuity of care over time and is an effective extension of routine care. Although patients often receive comprehensive medical services during hospitalization, lack of knowledge about diabetic foot ulcer care, poor self-management abilities after discharge, and insufficient supervision and management by medical and nursing staff can seriously impact healing.

For instance, patients may not seek medical attention at a time when ulcers recur due to repeated foot infections during home rehabilitation, which can lead to delayed disease progression, ulcer deterioration, and ultimately, toe amputation. To address this issue, we implemented an eight-year "hospital-community-home" linkage extended management model after the patient's discharge to establish a seamless connection between in-hospital care and out-of-hospital care. This approach has effectively prevented discontinuity of care and ensured the best possible continuity of care.

Since the patient's toe amputation, the ulcers have not recurred and we continue to monitor the patient's progress. This continuous model of care allows us to identify and prevent foot risk factors promptly, enhance blood glucose management, effectively prevent the recurrence of diabetic foot ulcers and reduce the incidence of toe amputation in our patients.

Conclusion

Continuity of care plays a crucial role in reducing the recurrence rate and amputation rate among patients with diabetic foot ulcers, while also improving their quality of life (6). The progress of wound healing in patients with diabetic foot ulcers is directly linked to their self-management and medical expertise, as well as the continuity of care provided. To ensure optimal continuity of care, the "hospital-community-family" model is recommended. This model enhances patient education and guidance, supports family caregivers, and improves patients' self-management ability. By implementing this model, healthcare professionals can achieve "whole-course management and seamless link" for patients with diabetic foot ulcers.

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