

Individualized procedures for wound bed preparation and dressings for diabetic foot ulcers in elderly patients.

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Abstract

Objective: This study was designed to investigate the main causes of diabetic foot ulcers and evaluate clinical efficacy and safety of different nursing interventions and care schemes for elderly patients.

Methods: Clinical data of 36 Diabetes Mellitus (DM) patients, aged between 75 and 83 years, who developed diabetic foot ulcers were retrospectively analysed. The pathogenesis and risk factors were investigated. Wound evaluation and bed preparation were implemented. Different dressing materials were selected during different stages. Nursing intervention and care delivery were administered for assessment of clinical efficacy and safety.

Results: All patients were followed up from 6 to 15 months with a mean duration of 9 months. Wound healing was achieved in 34 of all 36 cases (94.4%). The remaining 2 patients developed brown scars on wound surface, whereas they were unable to tolerate and undergo the surgery. Eventually, these 2 patients received chemical autolysis debridement combined with minimally invasive debridement to thoroughly eliminate necrotic tissues and scars.

Conclusion: The incidence of diabetic foot ulcers in DM patients is significantly higher compared with that of their counterparts. Individualized therapy is recommended for the elderly patients with diabetic foot ulcers, aiming to prevent the risk and progression of severe diabetic complications.

Keywords: Foot, Pressure ulcer, Elderly, Diabetes mellitus.

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Introduction

The prevalence of Diabetes Mellitus (DM) in response to an oral glucose challenge has been proven to rise along with aging, suggesting that the diagnostic criteria for DM by blood glucose assessment should be higher in the elderly individuals [1]. In spite of constant controversy in the criteria of abnormal carbohydrate tolerance in aged DM patients, the incidence of DM will absolutely increase both the morbidity and mortality. Hence, it is of significance to screen for DM as the primary healthcare for the elderly subjects. Significant advancement has been accomplished in the treatment of DM and the life expectancy of DM patients has been evidently prolonged [2]. Nevertheless, the ever-increasing prevalence of DM coupling with the extended survival has led to an increased risk of DM-related complications, such as peripheral arterial illness and neuropathy, etc. It is estimated that the incidence of lower extremity diseases is approximately triple time higher than their counterparts without DM. Previous studies have

demonstrated that both peripheral arterial illness and neuropathy are associated with the occurrence of diabetic foot ulceration, which affects approximately 15% of the DM population [3]. It has been estimated that approximately 2% to 5% of DM patients are complicated with foot ulcers. An ulcer is induced by the epidermis injury and subsequent loss of beneath tissues. International Consensus on the Diabetic Foot defines foot ulcer as a wound stretching through the full-thickness skin below the ankle. The Wagner wound classification system has been well established and widely utilized for grading diabetic foot ulcers. Diabetic foot ulcers can significantly affect quality of life of patients and approximately 80% of limb-related amputations are complicated with foot ulceration. DM patients suffer from a 10-time higher risk of losing total or part of a lower extremity due to non-traumatic amputation than those without DM and the risk is even alarmingly higher in elderly individuals [4]. In this study, clinical data and nursing interventions of 36 DM patients complicated with diabetic foot ulcers were

retrospectively analysed. The aim of current investigation is to reduce the risk and severity of diabetic foot ulcers in elderly DM individuals.

Materials and Methods

Baseline data

A total of 36 DM patients, aged between 75 to 83 years, 79.8 years on average, admitted to Dongying People's Hospital between December 2013 and March 2016 were retrospectively analysed. There were 23 male and 13 female. All patients were clinically diagnosed with type 2 DM with a medical history of 7 to 20 years. Pressure ulcer site: pressure ulcer was found in the foot heel of 25 cases, foot lateral malleolus in 8 and the first joint of the third toe in 3 patients, as illustrated in Table 1 in details. Meggitt-Wagner classification system [5] comprises 6 different categories: grade 0: intact skin with no ulcer in a high-risk foot; grade 1: superficial ulcer involving the full-thickness skin but not underlying tissues; grade 2: deep ulcer penetrating down to the ligaments and muscle, but no bone involvement or abscess formation; grade 3: deep ulcers with cellulitis or abscess formation, constantly accompanied by osteomyelitis; grade 4: localized gangrene; and grade 5: extensive gangrene or dysvascularity involving the entire foot. Among 9 cases, 4 were classified into grade II and 5 into grade III. All cases received conservative therapy and the wounds were healed within 15 to 180 days. One patient died from respiratory failure induced by severe pulmonary infection.

Inclusion criteria

The National Diabetes Data Group Criteria were used for the diagnosis of diabetes. Those with a random blood glucose exceeding 12.5 mmol/l were considered as DM, and all of these patients had glycosuria together with elevated total glycosylated haemoglobin and fructosamine concentrations. A diagnostic 75 g oral glucose tolerance test was performed on patients with one or more of the following abnormalities: glycosuria, random plasma blood glucose 7.8 mmol/l to 12.5 mmol/l, glycosylated haemoglobin of 8.5% and fructosamine of 2.20 mmol/l.

Table 1. Illustration of clinical characteristics of diabetic foot ulcers.

Ulcer characteristics	Neuropathic ulcer (n=19)	Ischemic ulcer (n=10)	ulcer	Neuroischemic ulcer (n=7)
Predilection site	Plantar	Plantar and/or dorsal toes and feet	and/or toes and feet	Plantar and/or dorsal toes and feet
Morphology	Surrounding callus	Punched black eschar	out,	Necrosis and callus
Pain	Mild	Severe		Dull pain
Type of pain	Neuropathic; sharp, stabbing or burning	Nociceptive and claudication; dull pain or persistent sharp pain		Both

Callus	+++	–	++ (+)
Bone deformity	+++	–	++ (+)
Pulses	Present	Weak or absent	Weak or absent
Skin temperature	Warm	Cool	Cool
Surrounding skin	Loss of sensation, callus	Pallor, pale	shiny or Both

Nursing care intervention

Comprehensive treatment of diabetic foot ulcers includes pressure relief by resting the foot or wearing special footwear or shoe inserts or both. The removal of dead cellular materials and debridement was administered from the wound surface. Infection control and the use of wound dressings were also prepared. Alternative strategies in the treatment of diabetic foot ulcers included patient education, blood glucose control, arterial insufficiency remedy and surgical interventions, such as debridement, pus drainage, revascularization and even amputation.

Wound bed preparation

Grade II pressure ulcers were characterized with partial superficial skin loss which was merely involved with corium layer and cuticular layer. Superficial ulceration was identified after the formation of blister. The wound surface was fresh and no special preparation was implemented. Grade III pressure ulcers were featured full-thickness skin loss and defects. The ulcer infiltrated into the muscular layer, seen as white and yellow wound surface. The course of grade III foot ulcers endured for at least 2 weeks. Wound surface debridement was primarily implemented for all patients. Surgical option was also considered for DM patients with grade III foot ulcer.

Results

Baseline data

According to the Activity of Daily Living (ADL) scale, the self-care ability of the elderly patients declined along with aging. The ADL score of all patients was lower than 45. One patient rested in bed due to scapular fracture and developed foot pressure ulcer. Another case was clinically diagnosed with Parkinson syndrome and presented with muscle stiffness and foot distortion. The foot toe was found in contraction status, which led to the incidence of pressure ulcer in the first joint of the third toe. The remaining 34 patients were diagnosed with senile dementia of different stages and were unable to attend themselves. Clinical biochemical test revealed that 30 of 36 patients were diagnosed with hypoalbuminemia. The lowest level of total serum protein was quantitatively measured as 23 g/dl. The haemoglobin A1c value was detected as higher than 6.5%. Written informed consents were obtained from all participants or their family members. All study procedures were in accordance with the ethics committee of our hospital.

Blood glucose control

The growth status of the wound was monitored by dynamic observation. The granulation tissues surrounding the wound terminated growth when the blood glucose value was maintained at a high level. Thus, the blood glucose level was strictly controlled to accelerate the growth of granulation tissues.

Dressing preparation and intervention for diabetic foot ulcer

Stage II foot ulcer: For epidermal defects with mild exudate, wound surface was debrided, evenly spray with medicine powder and sealed the wound using hydrogel dressing to create and maintain a moist and airtight environment for the healing of ulcer wound. At approximately 14 d, the hydrogel dressing was separated when the wound surface was healed. Then, pink new epidermis was observed. Transparent adhesive bandage was used to protect the newly-generated epidermis. For the ulcer wound with a depth of >1 mm and serious exudate, wound surface debridement was performed, smeared with 1 mm of tubocapsicumomalum ointment using a sponge dressing. The medicine dressing was changed every 3 to 5 d. When the ulcer lesions became shallow and the quantity of exudate was decreased, the medicine dressing was replaced by hydrogel dressing until the wound healing.

Stage III foot ulcer: Subsequently, the wound bed was prepared. The ulcer depth exceeded 4 mm, accompanied by cave-shaped wounds. During this period, alginate dressing was filled inside the wounds to effectively absorb the wound exudate. The fibrous tissues became thicken and soft, which not only supported the wound, but also caused no pressure or stimulation to the wound tissues. Moreover, the calcium salt released by the dressing contributed to wound haemostasis and accelerate the growth of granulation tissues. The sponge dressing was used to create a moist environment. The interval of dressing change was determined based on the exudate status.

Discussion

The theory of moist wound healing was proposed in 1962 when George discovered that the progression of epithelisation and wound closure would proceed twice as fast in a moist environment than under a scab [6]. At present, the principle of moist wound healing has been widely accepted in the clinical practice, where multiple categories of products have been developed for the healing of chronic wounds through moist wound therapy. In a moist environment, the necrotic tissues can be hydrated and release the fibrinoclastase and alternative protein enzymes, which are capable of achieving the effect of debridement by inducing the hydrolysis of necrotic tissues [7]. In this study, among 36 patients, 2 cases developed brown scars on the wound surface, whereas they were unable to tolerate and undergo the surgery. Eventually, these 2 patients received chemical autolysis debridement combined with minimally invasive physical debridement to thoroughly eliminate the necrotic tissues and scars. The debridement

procedures were described as below. First, the wound surface was thoroughly debrided using a gauze containing physiological saline, and then fully rinsed using a syringe of physiological saline. Subsequently, incisions were made on the surface of scars and necrotic tissues until mild erythema was documented, and smeared with 3 mm debridement gel in thickness and covered by adhesive bandage to absorb the exudate as possible. The treated wounds were kept in an airtight moist environment. The dressing change was implemented every 3 to 5 d according to the quantity of exudate. At the presence of purulent secretion and unusual smell, silver ion dressing was utilized for topical anti-infection therapy. The entire debridement process endured for 18 to 35 days. Although the debridement time was relatively long, the risk of debridement surgery is reduced and a majority of elderly patients could tolerate the surgery. After thorough and effective debridement, the wound surface scars were eliminated and the yellow wounds became red. Meantime, punctate granulation tissues were observed, which provided favourable basis for subsequent wound healing. Prior to wound management, the wound secretion should be cultured every 1 to 2 weeks based on the status of wound growth. In addition, turning over, topical decompression and friction force reduction could accelerate the healing of diabetic foot ulcers. For instance, the pressure on the right heel exceeded 9.33 kPa when the patient was maintained in a supine position. Therefore, besides the occipital, shoulder and sacrococcygeal pressure ulcers, the foot heel should be closely monitored for the formation of diabetic ulcers [8-10]. To achieve foot heel decompression, soft pillows were placed beneath the calf muscle of lower extremity, and the feet were hanged. In addition, the sponge protective covering was delivered surrounding the lateral malleolus and heel for topical decompression. The purpose of decompression measure was to decrease the topical pressure on the lateral malleolus lower than the capillary pressure. Topical pressure, friction force and shear force on the pressure ulcers should be thoroughly removed to accelerate the ulcer healing [11]. The hyperglycaemia status is likely to induce the generation and proliferation of the bacteria on the surface of wound, aggravate topical microcirculatory disturbance and severely prevent the wound healing [12]. Thus, blood glucose control should be greatly emphasized. Hypoglycaemic medicine should be administered in a timely manner and decrease the blood glucose level below 10 mmol/l and contribute to the growth and proliferation of granulation tissues. The essential elements for wound healing include protein, carbohydrate, lipid, vitamins (vitamin C) and trace elements (zinc) [13-15]. Nutrition supporting therapy is administered to treat the hypoalbuminemia, supply balanced intake of nutrients and accelerate the wound repairing and healing. In this study, 1 patient could receive oral feeding and venous administration of nutrients, and the other cases were subject to nutrition supplement regime. Marco et al. have demonstrated that physicians, care managers, and patients showed unanimous agreement regarding the positive impact on patient health and self-management, and attributed the outcomes to the strong partnership between the care manager and the patient and the

collaboration between the physician and the care manager. Future studies should consider the possibility of incorporating a patient empowerment model which considers the patient as the most important member of the health team and care managers as key health care collaborators able to enhance and support services to patients provided by physicians in the primary health care system [16]. Moreover, Ciccone et al. have evaluated the role of interventional therapy in diabetics with PAD and have made the observation that a rapid diagnosis and early prompt revascularization treatment are essential to improve quality of life and survival [17].

Conclusion

The elderly individuals are at a high risk of pressure ulcer, especially the DM patients who are insensitive to peripheral nervous lesions. The foot heel, lateral malleolus, keratodermal layer are the predilection sites of diabetic ulcers. Due to the elusive onset of diabetic ulcer and lack of healthcare education of the family members, it is highly likely to miss the diagnosis of diabetic foot ulcers, especially in elderly patients. Therefore, family members of the elderly patients should be educated regarding the nursing care, effective prevention and intervention measures against diabetic foot ulcer, aiming to reduce the incidence of pressure ulcer and enhance the quality of life. Individualized therapy and nursing regimes should be implemented to shorten the healing time, promote wound repairing and avert the incidence of lower-extremity amputation. However, several limitations have to be acknowledged in this study. First, the sample size of current investigation is quite small, and subsequent investigations with a larger sample size are urgently required to validate the conclusion. Meantime, clinical data should be statistically analysed by post-hoc analysis method and multivariate regression analysis to validate the role of confounding factors.

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