

Management in diabetic neuropathic foot ulcers

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Abstract : Diabetic neuropathic foot ulcer presents tremendous problems to the patient, family, and healthcare team. It's pathogenesis leads to ulcer formation and impairment of both regeneration and repair; resulting in unheal leg ulcer, infection, and amputation. For diabetes, this ulcer has great impact on the quality of life. The key to wound care management are : prevention and control of infection, appropriate wound cleaning and dressing, tigh control blood glucose level, appropriate foot wear, and preserving a good quality of life. Preventive modalities as applied to healthy diabetes through the ones who have foot complication may result in far better control of leg ulcer complications. Rama Nurs J 1998; 4(1):72-9.

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Diabetes mellitus is a chronic disease affects more than 16 million persons¹ of all ages in the United States.^{1,2} Patients with diabetes mellitus are at risk for developing unheal leg ulcer, infection and amputation because of physiological and anatomical changes³ known as diabetic neuropathic foot.² Living with chronically ill diabetes on top of non healing leg ulcer or amputation overwhelms both patient and family, accounts for a significant clinical,

social and health care problems. This article aims to review the research and practice literature on diabetic neuropathic foot ulcer in order to assist nurses to identify and educate the diabetes patients for ulcer prevention, and intervention against complication.

Pathogenesis

Hyperglycemia is a single main cause of all diabetes complications.³ It

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affects eye, heart, renal, vessel, nerve,^{3,4} and immune system.^{3,5} While affect on peripheral vessels and nerves are relevant to the pathogenesis of diabetic foot problems which approximately affect 2 million people.⁶

The development of peripheral arterial disease can be documented in more than 50% of diabetes having disease for 10–15 years.⁶ Atherosclerotic disease manifests at earlier age in diabetes and tends to involve distal and smaller peripheral vessels⁷. Whereas 60–70% of diabetes develop clinical significant of peripheral neuropathy^{1,6} and the incidence is increasing with the duration of disease⁵.

Knowing that diabetes frequently associated with atherosclerosis^{2,6} which develops slowly as plaque forming along the inner lining of blood vessels and causes ischemia, but specific capillary and arteriolar lesions associated with diabetes do not exist. Intimal thickening of the basement membrane is also found as much as in non diabetic atherosclerosis⁶. Recently, advance in molecular genetic and oxidation chemistry studies found that atherosclerosis in diabetes is likely the result of complex interactions between

metabolic derangements such as hyperglycemia, mutation in genes controlling lipid metabolism and anti-oxidation defense mechanism⁷. These interactions produce toxic substance which impair cellular oxygen utilization and impair neural, skeletal and smooth muscle functions^{7,8}. These informations may explain why diabetes are more prone to develop atherosclerotic foot ulcer⁷, and also suggest that control blood glucose level may be important in both the treatment and the healing of foot ulcer⁵.

Peripheral neuropathy frequently is the result of persistent hyperglycemia which slowly destroys the nerve by altering nerve metabolism^{4,7,8}. Peripheral neuropathy clearly predisposes the diabetes to unrecognized injury^{2,6,9} which potentiates the risk of bacterial invasion and infection^{3,4,6}.

Sensory neuropathy contributes to loss of protective sensation^{2,6,9}. The foot with loss of protective sensation is vulnerable to repetition stress while uncovered and while wearing normal footwear.

Motor neuropathy contributes to muscle atrophy and imbalance^{2,6,9}. The imbalance leads to plantar calluses, a new pressure point, which will become

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increasing thick and concentrate the pressure between the callus and the metatarsal bone⁹, lead to haemorrhage and eventual ulcer formation.

Autonomic neuropathy is manifested by decreased sweating. Ulcers may then develop from the faulty healing of dry cracked skin⁹.

Diabetes is prone to develop toe deformities from motor nerve loss to the interosseus muscle and imbalance of the muscle resulting in cocked-up toes, hammer toes or claw-toes^{2,8}. These toes can become ulcerated at the tips or tops or both from increased pressure from the top and/or from inside of the shoe⁹.

Charcot foot, the classic neuropathic diabetic foot deformity, has a clubfoot appearance and rocker bottom configuration because the plantar arch has collapsed². If the patient continues to walk on unprotected foot, a plantar ulceration in the area of the arch develops.

The heel of diabetic neuropathic foot is particularly vulnerable to trauma when the patient is confined to bed. Pressure and friction effects lead to ischemia, pressure necrosis, and skin breakdown. Then gangrene can follow^{2,9}.

The ulcer, despite its outwardly benign appearance, can be much larger in its depth. The tissue loss usually undermines the callous margin and extends to the metatarsal head⁶. If a sinus tract develops, infection may occur and commonly lead to osteomyelitis^{6,8}. Infection in diabetic foot may range from local fungal infection of the nail to severe necrotizing or life-threatening infection^{3,6}.

Impact on quality of life

As the Oxford English Dictionary, "chronic" was defined in terms of time: long lasting, constant; and in terms of quality: bad, incurable¹⁰. For diabetes, leg ulcers occur and recur without any warning. Physiological as well as psychological trauma caused by wound may affect the quality of life. Many studies on, or part of, the quality of life in chronic leg ulcer reveal the similar conclusion that 40–60% of chronic leg ulcer patients troubled by pain, over 40% troubled by discharge and swelling, over 80% felt that their mobility was restricted as a result of leg ulcer. Together with other effects of ulcer such as: sleep disturbance, interfere with work or with doing the housework and social

isolation. (difficulty in getting going, embarrassed to show one's leg, don't feel like going out, ... etc)¹¹⁻¹⁴.

Even the sample of these studies included ulceration of varying etiologies. In diabetic neuropathic foot ulcer, numbness and other painful symptoms may be present as a result of alteration in nerve function (neuropathic pain)¹⁵. As data shown that diabetes results in more than 50% of non traumatic foot amputation¹, the survival rate after amputation are approximated 50% for 3 years and 40% for 5 years⁴. These reveal that, for diabetes, chronic leg ulcer has great impact on quality of life.

Management

Besides wound cleansing and dressing, control of localized infection, provision of a suitable environment for wound healing⁶ and preserving a good quality of life¹⁶ are the key to wound care management.

Wound cleansing with normal saline solution, applying appropriate wound care products to absorb exudate and to keep surface moist. With an ideal of effective treatment of chronic wound

that "to heal the wound with low frequency dressing change"¹⁶. So that, alginate, foam, or damp gauze may be used in high exudate, and film, hydrogel, hydrocolloid, moist gauze may be used in minimal drainage wound.

If the wound is infected, control of localized infection may begin with foot elevation and rest for decreasing local edema⁶. Broad spectrum antibiotic is required because diabetic foot infection are commonly polymicrobial^{2,3,6}. If an accurate diagnosis of microorganism required, the collection of deep tissues specimen for culture is the most appropriated because these wounds may have heavily colonized with resident host flora^{2,6}.

While necrotic tissues present, not dry wound, the meticulous wound debridement of necrotic tissues may required to decrease the bacterial colony count and optimize wound healing^{3,6,17}. Various methods of debridement (sharp, enzymatic, autolytic, mechanical) should be selected appropriately¹⁷.

For the provision of a suitable environment of wound healing, many research studies have been done. Some

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reported that tight control blood glucose level not only can prevent or delay diabetes complications but also help improving the healing of leg ulcer⁸. While growth factors seem useful for healing of chronic leg ulcer^{5,18}, and hyperbaric oxygen therapy is also an effective method in acute and chronic unheal ulcer¹⁹.

Foot support such as formerly L'Nard splint, custom-molded shoe, total-contact cast, when selected appropriately is important for the healing of leg ulcer as it helps release pressure and prevent trauma on ulcer⁶.

In the quality of life, the most important aspect of life which perceived by the patients are free from pain, maintain the independence and ability to continue social contact¹⁶.

Neuropathic pain has been treated effectively with antidepressants, lidocaine, mexiletine and capsaicin²⁰. Accupuncture and meditation are also reported having improvement²¹. Other drug/therapy have been reported improving peripheral nerve function which also help increase pain threshold^{21,22}, such as high myo-inositol diet²¹, gamma linolenic acid²¹, tolrestat^{21,22} and glycemic control^{21,22}.

All of these when implemented with psychosocial support strategy may help prevent mobility and emotional adaptation, so that independence and social contact can be maintained.

Prevention

As 90% of diabetes are NIDDM which at least half are underdiagnosed and/or unaware of their disease¹. Treatment in diabetic foot ulcer remains unsatisfactory²¹. Study, research and practice, now, are more directed toward preventive modality.

preventive program, an on going process, not specific only to neuropathic diabetes, needs patient participation, so that patient education, encouragement and support are necessary. The program could be classified as primary (1^o), secondary (2^o) and tertiary (3^o) prevention⁹.

1^o prevention applied for healthy diabetes. The aim is to promote functional health and protect against specific health problems⁹.

Health promotion in 1^o prevention are diet control, exercise, blood glucose and Hb A1c monitoring. These help deter atherosclerosis and maintain a steady state of blood glucose level, lead to prevent

diabetes complications^{9,21} Control of normal blood pressure and quit smoking are also benefit to prevent neuropathies as a prospective research on childhood on set IDDM patients found that hypertension, poor glycemic control and smoking are all independent predictors of the incidence of neuropathies²².

Specific protection in 1^o prevention are skin care, foot care, nail care and comfortable footwear^{2,6,9}.

2^o prevention applied for diabetes who have known neuropathies and ischemia of the lower extremities. The activity involves early diagnosis and treatment of pathologies that affect each area of diabetes person's health⁹.

The assessment for early diagnosis includes physical, functional, family, social and financial aspects such as : lower extremities blood flow measured by Ankle Brachial Index skin sensation, plantar foot pressure, skin breaks and pressure points, blood glucose level, ability to read, speak, activities of daily living, employment, home environment, family and social network.

The treatment to limit disabilities includes 1^o prevention activity; provide appropriate foot wear; preventive operation

for reducing mechanical trauma to foot, wound or plantar surface; reduce the risk of ulceration such as claw toe⁶ and psychosocial support.

3^o prevention applied for diabetes who have foot complications. The aims is to stop the disease process and to return the person to a productive social role. These are accomplished through restorative and rehabilitation treatment⁹. As treats a diabetes ulcer appropriately, then to prevent recurrence of the ulcer. Some patient may need prothesis, job placement or training, and adjustment to the loss⁹.

Conclusion

Patients with diabetic neuropathic foot commonly develop ulcers because of the physiological and anatomical changes. Once the ulcer is developed it is difficult to heal and infection, gangrene and amputation may follow. Living with chronic ulcer as diabetic patients is long lasting peroid, perhap along his/her life. Nurses are in the ideal position to help manage diabetic patients against complication and restore productive life as well as promote and protect diabetes from developing leg ulcer complication.

References

1. Jawa F. Diabetes in the 1990s—An Overview. *Statistic Bulletin* 1997; 1: 2–8.
2. Marvin L. Diabetic foot wounds : pathogenesis and management. *Advance in Wound Care* 1997; 10: 14–37.
3. West NJ. Systemic antimicrobial treatment of foot infections in diabetic patient. *Am J Health Syst Pharm* 1995; 52: 1199–207.
4. Lee BY, Guerra VJ, Civelek B. Compartment Syndrome in the diabetic foot. *Advance in Wound Care* 1995; 8: 36, 38, 41–2, 44–6.
5. Knighton DR, Fiegel VD. Growth factor and Comprehensive surgical care in diabetic wounds. *Current Opinion in General Surgery* 1993:32–9.
6. Bridges JR, Deitch EA. Diabetic foot Infections. *Surgical Clinics of North America*. 1994; 74: 537–55.
7. Semenkovich CF, Heinecks JW. The mystery of DM and atherosclerosis : Time for a new plot. *Diabetes* 1997; 46:327–34.
8. Boel E, et al. Diabetes late complications. *Journal of Diabetes & It Complication*. 1995; 9:104–29.
9. Kaufman MW, Bowsher JE. Preventing diabetic foot ulcers. *Dermatology Nursing* 1994; 6: 313–20.
10. Gillian P. Living under the shadow of illness. *Nursing Times* 1996; 92:46–9.
11. Harmer C, Cullum N, Roe BH. Patient perceptions of chronic leg ulcers. *Journal of Wound Care* 1994; 3:99–101.
12. Hyland ME, Ley A, Thomsar B. Quality of life of leg ulcer patients : Questionnaire and preliminary findings. *Journal of Wound Care*. 1994; 3: 294–8.
13. Phillips T. The quality of life in patients with chronic wounds. Paper presented at the first meeting of the international Committee on Wound management. **Brussels**. 1992.
14. Peter JF, Christine JM. Quality of life and leg ulceration : Use of the Nottingham Health Profile in 758 patients. *Ostomy/Wound Management* 1997; 13:58.
15. Ke Ren. Primary afferents and inflammatory hyperexcitability. *Pain* 1996; 67:1–2.
16. International Committee on Wound Management. Wound management and quality of life in the elderly. *Ostomy/Wound Management* 1994; 40: 96–8, 100, 102, 104.
17. Sieggreen MY. Debridement : Choice and challenges. *Advance in Wound Care* 1997; 10: 32–7.
18. Ricardo Marques da Costa, et al. Double blind Randomized Placebo–controlled Trial of use of Granulocyte–Macrophage Colony–Stimulating Factors on chronic leg ulcers. *American Journal of Surgery* 1997; 173:165–8.
19. Surman MW. An introduction to Hyperbaric Oxygen Therapy for the ET Nurse. *JWOCN* 1996; 23:80–91.
20. Calissi PT, Jaber LA. Peripheral diabetic neuropathy : Current concepts in treatment. *Annals of Pharmacotherapy* 1995; 29:769–77.
21. Pfeifer MA, Schermer MP. Clinical trials of diabetic neuropathy : Past, present and future. *Diabetes* 1995; 44:1355–61.
22. Kimberly YZ, et al. Hypertension as a risk factor for diabetic neuropathy. *Diabetes* 1997; 46: 665–70.

การดูแลแผลที่เท้าของผู้ป่วยเบาหวานที่มีความผิดปกติของประสาท

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บทคัดย่อ แผลที่เท้าของผู้ป่วยเบาหวานที่มีความผิดปกติของประสาทเป็นปัญหาหนักในการดูแลทั้งต่อผู้ป่วย ครอบครัวและเจ้าหน้าที่สุขภาพ พยาธิสภาพที่เท้าก่อให้เกิดแผลและทำให้ประสิทธิภาพของการสร้างเนื้อเยื่อใหม่และการสมานแผลเลวลง เป็นผลให้แผลนั้นเรื้อรังไม่หาย ติดเชื้อ และถูกตัดขา การมีแผลที่เท้าจึงกระทบต่อคุณภาพชีวิตผู้ป่วยเบาหวานเป็นอย่างมาก หลักสำคัญในการดูแลแผลชนิดนี้ประกอบด้วย การควบคุมและป้องกันการติดเชื้อ การใช้อุปกรณ์ และวิธีทำความสะอาดแผลและปิดแผลที่เหมาะสม การควบคุมระดับน้ำตาลในเลือดอย่างเคร่งครัด การเลือกใช้อุปกรณ์รองรับเท้าที่เป็นแผลอย่างเหมาะสม การใช้มาตรการป้องกันในผู้ป่วยเบาหวานที่มีสุขภาพดี รวมถึงผู้ที่มีปัญหาแทรกซ้อนของเท้าแล้ว จะช่วยป้องกันภาวะแทรกซ้อนของแผลได้ดียิ่งขึ้น งามาธิบติพยาบาลสาร 2541 4(1):72-9.

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