

Epidemiological Characteristics of Diabetic Foot and Affecting Factors for Amputation in China

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With the increased prevalence of diabetes from 0.67% in 1980 to 11.2% in 2017, the prevalence of diabetic foot has been growing in China in recent years. Diabetic foot ulcer (DFU) was one of the most serious complications of diabetes. Complicated general condition, severe infection and poor outcomes were feature characteristics of Chinese DFU patients. The annual incidence of DFU in China was as high as 8.1% in patients with diabetes, which ranked the first among the causes of chronic wounds in hospitalized patients [1-2]. And the recurrence rate of foot ulcers in healed DFU patients over 50-year-old was as high as 31.6% within one year [1].

Diabetic foot has been recognized as the main reason for the high disability rate and mortality in patients with diabetes. It is estimated that there was an amputation in diabetic patients every 20 seconds in the world. The annual mortality rate for diabetic patients who have an incident diabetic foot ulcer was about 11%; about 22% for those with an incidence of lower extremity amputation [3]. Vadiveloo et al. [4] reported that, in diabetic patients judged to be at high risk of foot ulceration, the risk of death was up to nine times the risk of amputation. Death rates was higher for people with diabetes who had healed ulcers than for those with active ulcers. However, diabetic patients with active ulcers had the highest risk of amputation.

In China, diabetic foot was the leading cause of non-traumatic amputation, which accounting for 39.5% [5], and the annual mortality rate was as high as 14.4% [1]. Chu et al. [6] investigated the reulceration, reamputation and mortality in DFU patients after toe amputation in Tianjin, China, and the result showed that, in the first, third and fifth years after amputation, the cumulative incidence of new foot ulcer was 27.3%, 57.2% and 76.4%, leading to 12.5%, 22.3% and 47.1% reamputation, and the cumulative mortality was 5.8%, 15.1% and 32.7%, respectively.

According to a multi-center clinical investigation in China in 2004, 63.2% ulcers were at Wagner stage 1 or 2, 28.8% DFU patients accompanied with gangrene, and 67.9% patients combined with infection [7]. Through the efforts of several generations of the multidisciplinary collaboration teams in China, the amputation rate in DFU patients has been decreased significantly. Compared with the investigation in 2004, in 2012, DF patients had more complications and comorbidities, severer foot ulcers and infections, higher total amputation rate (17.2% vs 10.2%), but significant lower major amputation rate (2.3% vs 5.9%) and higher ulcer healing rate (52.3% vs 18.2%) [8]. According to the latest screening diabetic foot in China, the overall amputation rate among diabetic foot patients was 19.03%, and the major amputation rate were further reduced to 2.14% [9]. However, it is still far higher than the level of developed countries, such as Europe and the United States.

In addition, regional differences in the prevalence and amputation rate of diabetic foot were startlingly apparent in China. Wang et al. [10] found that, compared with northern patients, diabetic foot patients in south of China existed higher healing rate (19.1% vs 10.3%) and lower amputation rate (2.6% vs 9.7%). Ankle brachial index, white blood cell and platelet count may be associated with this regional differences.

The amputation of diabetic foot was affected by multiple factors. Based on a meta-analysis, Yang et al. [11] indicated that as many as 18 factors, such as age, course of diabetes disease, course of diabetic foot, hypertension, diabetic peripheral neuropathy, peripheral arterial disease (PAD), creatinine, fasting blood glucose, glycosylated hemoglobin A1c, hemoglobin, albumin, white blood cell count, C-reactive protein (CRP), percentage of neutrophils triglyceride, high-density lipoprotein-cholesterol and

Wagner grading, were the important risk factors for lower extremity amputation among patients with diabetic foot. Peled et al. [12] found that patients with acute diabetic foot experiencing hyperglycemia or severe hypoglycemia were more easily to be amputated during hospitalization, and high glycemic variability was associated with major amputations.

A retrospectively study analyzed the risk factors for lower extremity amputation in patients with diabetic foot in China, and the results indicated that Wagner's grade, PAD and CRP were independent risk factors associated with lower extremity amputation in hospitalized patients with diabetic foot [13]. While in elderly patients with diabetic foot, low level of high-density lipoprotein-cholesterol and poor nutritional status were the main risk factors for lower extremity amputation [14].

In addition, a prospective cohort study in China included 245 patients with toe amputation and followed for five years, the results showed that glycosylated hemoglobin A1c > 9% could be identified as an independent predictor of impaired wound healing, reulceration and reamputation [6]. An age of >70 years was identified as an independent predictor of reamputation, mortality and impairment of activities of daily living.

In order to comprehensive and systematic diagnosis and treatment of diabetic foot and decrease the amputation rate of diabetic foot, several guidelines and expert consensus on diabetic foot were issued in China recently [15-18]. It is emphasized the value of active screening and early intervention for patients with high risk of diabetic foot, comprehensive evaluation for diabetic foot patients, hierarchical diagnosis and treatment, and new model for the management of diabetic foot during the pandemic of COVID-19. However, early screening diabetic foot and prevention amputation were presently far from satisfaction in China. In addition, well-designed epidemiological studies on the prevalence of diabetic foot in Chinese diabetes patients, multicenter prospective cohort studies and long-term follow-up were still insufficient. Moreover, with the aim of improving cure rate of DFU and reducing amputation rate, exploring multidisciplinary integrated management model as well as hierarchical diagnosis and treatment should also be urgently needed and promoted in the future.

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