主 論 文

Prevalence of peripheral neuropathy and its impact on activities of daily living in people

with type 2 diabetes

(2 型糖尿病患者の末梢神経障害の実態とその障害が ADL へ及ぼす影響)

(○○に関する看護ケアプログラムの開発と評価)

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Introduction

Aligned with increasing trend in the global prevalence of diabetes including developing countries liked Myanmar, major complications of diabetes as diabetic peripheral neuropathy (DPN) and neuropathic pain (DPNP) also affect the quality of life in these patients (Shaw, Sicree, & Zimmet, 2010; WHO, 2011; WHO, 2014). High prevalence rate (30-60%) of DPN was identified in the previous studies with various underlying reason as duration of diabetes, type of diabetes (Jaiswal et al., 2017; Lazo Mde et al., 2014). However, DPN is underdiagnosed because of asymptomatic and unrecognized as serious complication of diabetes (Malik et al., 2017; Pop-Busui et al., 2017; Tanenberg, 2016). The patients with DPN had limitation in the activities of daily living (ADL) because of decreased sensation or weakness and pain especially in the feet and hands.

Prevalence of DPN in Myanmar need to explore the actual situation of DPN and its impact on ADL to provide the appropriate healthcare for these patients to prevent serious complications of DPN and increase ADL. The purpose of this study was to identify the prevalence of DPN and DPNP and their impact on hand and foot function and ADL in patients with type 2 diabetes mellitus (T2DM), and to investigate the background characteristics of those with or without neuropathy and the different levels of pain with increasing severity of DPN in Myanmar.

Methods

This study include the participants (n=975) with T2DM visited to outpatient clinics of four hospitals in Myanmar, with the including criteria of aged over 25 years, T2DM,

receiving anti-glycemic treatment. The patients with neuropathy and neuropathic pain not due to diabetes, severe illness, mental illness, or alcoholism were excluded from this study. The sample size was calculated using the formula described by Kelsey et al. (1996) using the estimated prevalence rate, with α = 0.05, power = 0.8, and adding 20% of the sample to cover the refusal rate. Every 5th patient who came to the clinics was invited to participate and excluded during their follow-up visits, based on the numbers of patients in the previous year.

Data collection was done by interviewing and physical examination after obtaining informed consent. Demographic and health history information were collected at the start of the interview. Interviewing was done to obtain self-reports of the impact of pain on ADL using the Patient Neurotoxicity Questionnaire (PNQ), and a visual analog scale (0-100) in Myanmar languages. After the interview, hand grip (TTM Original Dynamometer 100 kg, Tustsumi Seisakusho, Co. Ltd., Chiba, Japan), pinch strength (B&L Engineering®, Santa Ana, CA, USA), and the Timed Up and Go test (TUG) to predict fall risk were examined as physical functioning. Furthermore, Semmes-Weinstein Monofilament (SWM) test (Touch-Test[TM] Sensory Evaluator 5 Pieces Hand Kit, North Coast Medical Inc., Gilroy, CA, USA) was done at the hands (tips of index and ring fingers) and the feet (plantar surface of the distal hallux, and first, third, and fifth metatarsal heads).

Symptoms were defined as the symptoms of paresthesia (numbness, tingling or both). Sensory loss was defined as one area of decreased sensation below the normal threshold of 4.31 in both feet (Kamei et al., 2005). The presence of pain was determined using a VAS (0-100) score of 5-100 (Hawker, Mian, Kendzerska, & French, 2011). The severity of DPN was defined using the largest known touch sensation filament size in the SWM test. The patients were classified into three groups as: noDPN, people without symptoms and sensory loss; DPN, those with some degree of sensory loss but no pain; and DPNP, those with pain with or without sensory loss.

Data analysis was done using SPSS version 23. A logistic regression model was used to examine the effects of background characteristics. Furthermore, differences in pain intensity among the severities of DPN (DPN 1-5) and the impacts of DPN (patients with noDPN, DPN, and DPNP) on physical functions were compared using the

Kruskal-Wallis *H* test. The Bonferroni correction was applied after analyzing the relationships with difficulties in each component of ADL by Fisher's exact test.

This study was approved by the Nursing Science Ethical Review Committee, Graduate School of Health Sciences, Okayama University, Japan (approval number D16-05), University of Nursing, Yangon, and Department of Medical Research, Myanmar (approval number Ethics/DMR/2017 /049).

Results

This study included 975 participants, 215 male (22.1%) and 760 female (77.9%). the characteristics of the total participant group were: age, 54.90 (±11.24) years; duration of diabetes, 5.42 (±5.87) years; BMI, 25.46 (±5.02) kg/m^2; duration of oral hypoglycemic treatment, 4.99 (±5.53) years; TUG, 7.36 (±3.56) seconds; hand grip, 20 (±7.27) kg, finger pinch force, 10 (±3.86) lbs; and VAS, 14 (±28.76).

In this study, 33.7% (n=329) and 59.5% (n=580) of the participants had DPN and DPNP, respectively, with 93.2% total prevalence rate. The patients in DPNP had the longest duration of diabetes and taking oral hypoglycemic drugs, and half of them are using pain killer (50.3%) and other pain relief techniques (54.1%). Most participants (57.9%), including the vast majority of those with DPNP, had abnormal sensation.

Logistic regression was used to evaluate the background characteristics of DPN after analyzing the significant relationship with the chi-squared test. Among three model of logistic regression, model (3), with χ^2 (24) = 56.731, $P < 0.000$; Nagelkerke R^2 was 14.5%, with classification accuracy of 93.2% for DPN was the most significant model. The longer duration of diabetes (2.8 times in 10-15 years, 3.3 times in over 15 years), smoking (5.5 times in the group of quit), and age (2 times in 40-49 years, 2.5 times in 50-59 and 60-69 years, 3 times in over 70 years) were associated with a higher prevalence of DPN.

There was no significant difference in DPN severity between the DPN and DPNP group according to the Mann-Whitney U test ($U = 98354.5$, $z = 0.84$, $P = 0.401$). In people with DPNP, differences in pain intensity were identified across the severities of DPN (DPN 1-5) using the Kruskal–Wallis *H* test. There was no significant difference in VAS pain scale scores between people with different severities of DPN in the combined groups (DPN and DPNP), (H [4] = 9.13, $P = 0.058$) and the DPNP group, (H [4] = 4.46,

$P = 0.326$). Figure 1 shows the differences in pain intensity across DPN severities in the combined and DPNP group.

TUG duration and hand grip and pinch strengths (dominant hand) were significantly different among the groups ($H(2) = 23.903$, $P = 0.000$), ($H(2) = 34.292$, $P = 0.000$), ($H(2) = 24.576$, $P = 0.000$), respectively. Patients with DPNP had significantly different from those with noDPN and DPN in the pairwise comparison with the longest TUG duration and the weakest strength of both hand grip and pinch. Moreover, those with DPNP had significantly higher in sensory ($H(2) = 205.823$, $P = 0.000$) and motor ($H(2) = 141.287$, $P = 0.000$) difficulties in PNQ in the pairwise comparison of Kruskal-Wallis H test.

Numbers of difficulties in ADL were also significantly different among the groups ($H(2) = 168.860$, $P = 0.00$) with the most difficulties in those with DPNP. The common difficulties in ADL were sleeping (20.6%), climbing stairs (24.5%), walking (21.3%), and work or chores (14.4%). There were also significant differences of difficulties in ADL as putting buttons, using a knife, using a fork, using a spoon, using other eating utensils, opening doors, sleeping, climbing stairs, walking, working or chores among the groups.

Discussion

The majority of the participants were found to have DPN in this study, and higher prevalence (93.2%)than other studies (Gill et al., 2014; Kim et al., 2015; Lazo Mde et al., 2014). This may be due to undiagnosed and uncontrolled diabetes in Myanmar (WHO, 2011). Anti-hyperglycemic treatment also included one of the reasons (Beulens, Hart, Kuijs, Kooijman-Buiting, & Rutten, 2015). The background characteristics of DPN as age, duration of diabetes, and smoking also supported the findings of previous studies (Jaiswal et al., 2017; Jambart et al., 2011; Lazo Mde et al., 2014). The effect of cessation of smoking is not understood because of higher risk of DPN in those who quitted smoking in this study, likewise in the previous study (Clair, Cohen, Eichler, Selby, & Rigotti, 2015). Further studies should be focused on this issue.

Pain intensity was not significantly different across the severity of DPN in this study. Our findings were consistent with the previous study of Abbott, 2011 which stated that severity of neuropathy had no impact on painful symptoms.

The finding of longer TUG duration which means higher risk for falls in DPNP supported the previous study of Timar et al., 2016. The severity of neuropathy also affects functional hand movement in patients with DPN and other types of neuropathy (Adams et al., 2015; Yang et al., 2015). In this study, participants who were suffering DPNP exhibited the greatest functional hand weakness regardless of the severity of DPN. The previous study found that physical strength of the hand affected the independence in ADL (Bae et al., 2015). The weakness in hand and difficulties in doing work or chores in DPNP were relevant finding in this study.

Although most of the difficulties (sleeping, balance and walking, work and chores) in ADL were the same in the previous study, the study identifies other difficulties as putting buttons, using eating utensils and opening doors, and climbing stairs. The qualities of difficulties in ADL and nursing care to improve ADL in these patients need to explore in the further studies.

This study had the limitations to generalize total population of Myanmar. First, the participants did not accurately represent all ethnic groups in Myanmar. The effect of ethnicity on DPN should be identified in future studies because different beliefs, eating habits, and health practices also affect health outcomes. Second, our study involved more female than male participants. Third, only the monofilament test was used to diagnose DPN. Fourth, hemoglobin A1c (HbA$_1$C) levels were not analyzed in this study. Finally, only participants taking anti-hyperglycemic treatment were included in this study to ascertain their glycemic control because of the underdiagnosis and poor control of diabetes in Myanmar (Latt et al., 2016; WHO, 2011).

Conclusion

This study highlighted the prevalence and background characteristics of patients with DPN, the association between the intensity of pain and the severity of DPN, and the difficulties in ADL of patients with T2DM. These findings will be helpful in developing future research and healthcare to prevent further complications and disabilities for patients with DPN.