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Nursing Management and Integrative/Integrated Applications in Diabetic Neuropathy

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Abstract
Diabetes is a chronic and systemic disease, characterized by hyperglycemia, with an increasing incidence and prevalence, which seriously affects the lives of individuals with acute and chronic complications. Endothelial damage and microvascular disorders occur as a result of inflammation and oxidative stress, with the increase of protein glycation, non-enzymatic glycation, and consequently the increase of end products in the tissues with hyperglycemia in diabetes. As a result of these events, peripheral and autonomic neuropathy develops in diabetic patients due to demyelination of Schwann cells and decreased neuronal blood flow and nerve ischemia. Neuropathic pain patients due to diabetic peripheral neuropathy are seen in approximately 1/4 of the patients, and it negatively affects their quality of life. In the present study, nursing management and integrative practices in diabetic neuropathy, which is an important complication in diabetes, are discussed.

Keywords: Diabetes, diabetic neuropathy, integrative applications, nursing management

Diyabetik Nöropatide Hemşirelik Yönetimi ve İntegratif/Bütünleştirici Uygulamalar

Özet
Diyabet, hiperglisemiyle karekterize, insidansı ve prevalansı giderek artan, oluşan akut ve kronik komplikasyonlar ile bireylerin yaşamını ciddi şekilde etkileyen, kronik ve sistemik bir hastalıktır. Diyabette oluşan hiperglisemiyle birlikte protein glikasyonunun artması, enzimatik olmayan glikasyon ve buna bağlı olarak dokulardaki son ürünlerin artışıyla inflamasyon ve oksidatif stres sonucu endotel hasarı ve mikrovasküler bozukluklar meydana gelir. Bu olayların sonucunda schwann hücrelerinin demiyelinizasyonu ve azalmış nöronal kan akışı ile sinir iskemisine bağlı olarak diyabetli hastalarda periferik ve otonomik nöropati gelişir. Diyabetik periferik nöropatiye bağlı nöropatik ağrı hastaları ise hastaların yaklaşık 1/4'ünde görülmekte ve yaşam kalitesini olumsuz etkilemektedir. Bu makalede diyabette önemli bir komplikasyon olarak karşımıza çıkan diyabetik nöropatide, hemşirelik yönetimi ve integratif uygulamalar ele alınmıştır.

Anahtar Kelimeler: Diyabet, diyabetik nöropati, hemşirelik yönetimi, integratif uygulamalar

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INTRODUCTION

Diabetes mellitus is a chronic and metabolic disease characterized by hyperglycemia resulting from an absolute or relative decrease in insulin hormone secreted from the pancreas or insulin resistance caused by defects in insulin action (1,2). As a result of not producing the insulin hormone, insufficient or not using the insulin hormone effectively, disorders in carbohydrate, protein, and fat metabolisms occur (3,4). Type 2 diabetes is the most common type of diabetes in adults, characterized by hyperglycemia, varying degrees of insulin deficiency, and insulin resistance (5). In the light of the International Diabetes Federation (IDF) Diabetes Atlas data, it was reported that there were 463 million diabetic patients around the world in 2019. Additionally, those living with diabetes face a severe need for medical care and poor quality of life as a result of the range of serious and life-threatening complications. Diabetes and its complications, if not managed well, can lead to frequent hospitalizations and premature death. However, with early diagnosis and proper care, diabetes can be managed, and its complications can also be prevented (4).

1. Diabetic Neuropathy

Diabetic neuropathy is a neurodegenerative disorder that causes deterioration in sensory axons, autonomic axons, and to a lesser extent, motor axons of the peripheral nervous system (5,6). Endothelial damage and microvascular disorders occur as a result of inflammation and oxidative stress with the increase of protein glycation, non-enzymatic glycation, and consequently the increase of end products in tissues with hyperglycemia in diabetes (7,8). As a result of these events, demyelination of Schwann cells and decreased neuronal blood flow, and nerve ischemia occur in parallel (4,9).

Late findings such as difficulty in detecting peripheral neuropathy reliably and the development of ulcers and infection in Type 2 diabetes are frequently observed. However, the frequent use of simple tests such as monofilament contributes to the identification of high-risk patients. With the weak evidence on the treatment of diabetic neuropathic syndromes, follow-up is becoming increasingly difficult compared to other microvascular complications. Finally, even obtaining point prevalence data for neuropathy is difficult due to methodological variability. In studies using reliable electrophysiology and autonomic function tests on the frequency of adolescent patients with type

1 diabetes, the frequency was reported to be 20-25%. It is observed that the frequency is similar or higher in studies conducted with type 2 diabetic patients (10).

1.1. Symptoms of the Diabetic Neuropathy

One of the earliest observed symptoms of type 2 diabetes is erectile dysfunction, although it is not a symptom of somatic neuropathy. This is the most important indicator of endothelial dysfunction. Somatic neuropathy has an insidious onset and often presents with unrecognized loss of sensation and progressive paresthesia starting in the fingers and extending into the proximal tissues. Neuropathic symptoms may be observed intermittently for years before the onset of diabetic symptoms. Upper extremities with shorter axons are involved later and with less intensity. If there is neuropathy observed more prominently in the upper extremity, other diagnoses such as muscle wasting should be considered.

Symptomatic neuropathy can sometimes be seen as the initial symptom of type 2 diabetes. It should be remembered that pain and symptoms observed in the feet can be vital if the clinical features are not typical. Although it is considered equivalent to diabetic nephropathy, it should be considered that peripheral neuropathy may have other causes (neurotoxic drugs, alcohol, vitamin B12 deficiency, uremia, vasculitides, chronic inflammatory demyelinating neuropathy, or hereditary neuropathy) in 50% of the patients (11).

2. Diabetic Peripheral Neuropathy

Diabetic Peripheral Neuropathy (DPN) is the most common complication of diabetes mellitus (5,12). The most important risk factors in the development of neuropathy are the duration of diabetes and poor glycemic control. In patients with diabetes, peripheral nerve damage occurs as a result of exposure of peripheral nerves to high doses and long-term glucose levels (13). DPN affects autonomic, motor, and sensory nerve functions, and as a result, it may cause foot ulceration and amputation (12,14).

Peripheral neuropathy is the most common form of diabetic neuropathy, which is seen in approximately half of all diabetes cases. Nerve cells may be affected by thin fibers, thick fibers, or both. While thin fiber neuropathy is associated with decreased heat and pain sensation, the involvement of thick fibers causes sensory loss and numbness (15-17). Inappropriate and weakened pain response, loss of sensation, and presence of peripheral arterial disease associated with peripheral neuropathy with progressive, distal to proximal destruction of nerves increase the risk of injury,

infection, and ulceration as a result of trauma (15,18).

Sensory examination reveals allodynia, hyperalgesia, and increased sensitivity (19,20). In addition, an imbalance occurs between the flexor and extensor muscles of the foot due to developing motor neuropathy, and thus deformations such as hammer toe, Charcot deformity, and flattening of the foot arch occur (21,22). Depending on the autonomic effect, sweating and temperature regulations are disrupted. The risk of injury increases with disruption of temperature regulation. With the deterioration of sweating, the skin dries and cracks, causing an increased risk of infection (14,19).

2.1. Symptoms of the DPN

Localization of the sensory loss in the sock area, starting from the fingertips, moving proximally, and typically being in the shin area of the leg can be counted. Sensory loss is often seen in all sensory compartments, all long and short nerve fibers are affected.

- Light touch
- Pain (with the needle stimulus)
- Temperature
- Vibration
- Proprioception (23,24).

However, in some patients, the short fiber-mediated sensations (pain and temperature) were more prominently affected, while in some patients the long fiber sensations of touch, vibration, and proprioception were primarily affected. In some patients, severe propagation loss leads to a kind of pseudo-tabesis. In these patients, the Romberg sign is positive, and deterioration in standing up and walking especially on uneven surfaces is observed. There is a weakening of the short muscle fibers in the feet, clawing of the fingers, and an increase in the pressure on the soles of the feet. Clawing is probably due to motor neuropathy and weakening of the intrinsic muscles of the foot, and disruption of plantar fascia integrity is also involved (10).

Feet are often warm, pulse is strong. Enlarged veins gradually increase blood flow due to sympathetic denervation. Anhidrosis is observed and there is little or no friction on the back of the hand and the sole of the foot. Thinning of the hair on the dorsum of the feet and on the big toes is considered one of the trophicneuropathic changes, and it is not a reliable finding in the elderly because of the atrophy of the fibro-fatty tissue in the heel supports. A smooth, shiny, featureless skin (similar to skin wrinkles in long soaked fingers and associated with advanced sympathetic denervation) is observed. It should be constantly checked for pain and fungal infections between the fingers. Because these disorders in skin integrity cause

bacteria to enter and cellulite develops (25).

2.2. Measurement of the Loss of Protective Sense

In order to show the loss of protective sensations in the routine clinical examination of the foot, it is recommended to perform one, preferably two of the following tests with the 2006 ADT/AACE statement (Figure 1).

- 10g monofilament test
- Vibration sensory examination (Biothesiometer)
- Diapason (128 Hz)
- Sensory examination with a needle
- Ankle reflexes (26).

2.3. Diabetic Neuropathic Pain

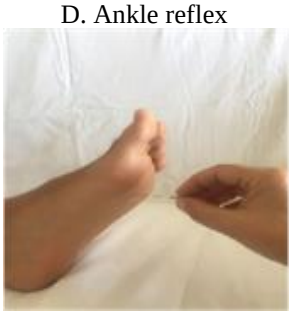
Although the pathophysiology of neuropathic pain is unknown, it is thought that the disorder may be in the spinal cord. There is often poor glycemic control but by no means variable. Pain is partially relieved in some patients, and these chronic symptoms persist for many years in one-third of the patients. Acute pain in the feet and legs (insulin neuritis) is observed shortly after the initiation of insulin therapy. Although it is not common nowadays, this picture is occasionally encountered in patients with high HbA1c levels at the time of diagnosis. This picture resolves spontaneously within a few months. Chronic painful neuropathy is

A.10g monofilament test

B. Vibration test with 128 Hz diapason

C. Neurothesio-meter

D. Ankle reflex



E. Pain test with needle

Figure 1: Tests for Clinical Physical Examination of the Foot

quite common in elderly patients with type 2 diabetes, and it is observed in young female patients with type 1 diabetes,

especially in the presence of eating disorders such as anorexia nervosa (23).

Along with the numbness of the existing polyneuropathy, the quality of life deteriorates considerably with blunt and disturbing pain in the foot with loss of sensation. Diagnosis of polyneuropathy is difficult within the framework of clinical findings. In this context, other painful syndromes in the course of diabetes should be kept in mind. Patients hang their feet out of the bed, avoid contact with the sheets, and resort to other adverse irritants such as cold water or massage (10).

2.3.1. Clinical Features of the Painful Diabetic Neuropathy Include

- It is limited to both legs, and it is asymmetrical.
- It does not get worse with exercise.
- It is worse at night.
- Pain is expressed in dramatic terms such as stabbing, hitting, and burning. There is hypersensitivity by contact.
- Change in sensory perception (allodynia), feeling pain with stimuli that would not normally cause pain, increased awareness of the senses (hyperesthesia).
- Cold feet
- Tightening of the skin (13).

2.3.2. Diabetic Neuropathic Pain Management

With DPN, patients begin to experience neuropathic pain. Neuropathic pain is seen in approximately 1/4 of the patients and negatively affects the quality of life (21). Some drugs and additionally integrative applications are used in the treatment of neuropathic pain (Table 1) (1,4,27-29). In addition, studies on integrative applications in the treatment of neuropathic pain are discussed at the end of the text (Table 2).

Table 1: Treatment of Diabetic Neuropathic Pain and Integrative Applications

Treatment of Diabetic Neuropathic Pain	**Integrative Applications**
Antidepressants Anticonvulsants Opioid Analgesic	Massage Reflexology Aromatherapy Acupuncture Foot bath
Supportive Treatment	
Alphalipolic acid Topical agents (capsaicin, Lidocaine, Botox etc.)	

3. Diabetic Autonomic Neuropathy

Diabetic autonomic neuropathy is a neuropathic complication with systemic and extrasystemic effects, and it can be found together with DPN and other diabetic complications, as well as alone (30). Although all systems in the body are at risk of being affected by diabetic autonomic neuropathy, the most common organ and system involvement areas in the clinic are the cardiovascular, gastrointestinal, and genitourinary systems. Diabetic autonomic neuropathy may also

lead to sudomotor dysfunction, inability to perceive hypoglycemia, and pupillary dysfunction (31-33). The symptoms of autonomic nervous system involvement may be limited to a single target organ or system, as well as the involvement of many systems and organs can be observed. Although diabetic autonomic neuropathy causes an increase in mortality and morbidity, a decrease in quality of life, and an increase in the cost of treatment for diabetic patients, it is the least recognized and understood complication in patients with diabetes (34).

3.1. Cardiovascular Autonomic Neuropathy

Cardiovascular autonomic neuropathy is a common diabetic autonomic neuropathy with an increased risk of cardiovascular mortality due to dysrhythmia, silent myocardial infarction, and sudden death, independent of other cardiovascular risk factors (2,16). Although its prevalence affects approximately 25% of individuals with type 1 diabetes and 33% of individuals with type 2 diabetes, the prevalence increases with age, duration of diabetes, and poor blood sugar control (35,36). In addition, hypertension, smoking, hyperlipidemia, and obesity are important causes of the development of cardiovascular autonomic neuropathy in patients with type 2 diabetes (9,18).

The autonomic nervous system regulates the electrical and contractile activity of the myocardium with its role in sympathetic and parasympathetic activity. Myocardial contraction creates cardiovascular neurohumoral stimuli that affect cardiac load by regulating venous capacity and arterial vascular resistance (30). Diabetic autonomic neuropathy primarily occurs in long nerves. Therefore, the vagus nerve, which is the longest autonomic nerve and responsible for 75% of parasympathetic activity, is primarily affected (34,35). With the involvement of the vagus nerve, abnormal predominance of the sympathetic system is observed as a result of parasympathetic dysfunction (32).

The most common symptoms of cardiovascular autonomic neuropathy are exercise intolerance, postural hypotension, and resting tachycardia. Patients also have QT interval prolongation, impaired baroreflex sensitivity, and heart rate variability (18,32). In exercise intolerance, fatigue, shortness of breath, increase in heart rate, cardiac output, and arterial pressure are observed during exercise (9,16). Resting tachycardia is defined as the resting heart rate of 100 beats/min or higher. The observed increase in heart rate reflects a relative increase in sympathetic activity (18). Resting tachycardia may return to normal in the long term, but the necessary responses to changing

physiological changes are usually not provided (32). Orthostatic hypotension, another symptom of cardiovascular autonomic neuropathy, is defined as a decrease of more than 20 mmHg in systolic arterial pressure and a 10 mmHg increase in diastolic pressure, and a 30 mmHg decrease in systolic pressure in hypertensive patients without any change in heart rate (16,35). Orthostatic hypotension can cause fatigue, sweating when standing up, dizziness, nausea, blurred vision, and in more serious cases, syncope (32).

In cardiovascular autonomic neuropathy, the use of free fatty acids instead of glucose in the myocardium increases with the increase in norepinephrine levels as a result of the increase in sympathetic activity and the existing insulin resistance. Since free fatty acids are an inefficient source of energy, they lead to high myocardial oxygen consumption and increased production of reactive oxygen species, leading to cardiac remodeling (9). In the following periods, left ventricular diastolic and systolic dysfunction occur (33).

3.2. Gastrointestinal Autonomic Neuropathy

Gastrointestinal autonomic neuropathy may involve any part of the gastrointestinal tract (29). Depending on the affected area, symptoms such as esophageal dysmotility, gastroparesis, anorexia, nausea, constipation, diarrhea, and fecal incontinence are observed in the patient (32,34). Abnormalities in esophageal function are related to vagal denervation, and the patient may be asymptomatic, or dyspepsia or dysphagia with solid foods may be observed (33). Diabetic autonomic neuropathy affects both gastric acid secretion and motility, causing gastroparesis, which is defined as delayed gastric emptying (32,34). Gastroparesis in the gastrointestinal tract is usually asymptomatic and presents with episodes of unexplained stomach bloating and vomiting with undigested food (35). The presence of undigested food 8-12 hours after feeding in a patient without obstruction is diagnostic for gastroparesis (34). Recurrent episodes of hypo- and hyperglycemia occur, resulting in hypoglycemia due to decreased absorption of glucose with the delay of absorption of food taken due to gastroparesis, and hyperglycemia with reduced absorption of antidiabetic drugs (32,36). For this reason, patients with symptoms of early satiety, quick hunger, feeling of fullness in the stomach, nausea, and vomiting, and especially patients with pronounced glycemic variability should be evaluated in terms of diabetic gastroparesis (15,37). Constipation, seen in 60% of individuals, is the most common gastrointestinal

symptom (34). Diabetic diarrhea occurs at night and after meals, and diarrhea may be accompanied by fecal incontinence (35).

3.3. Genitourinary Autonomic Neuropathy

It can cause genitourinary disorders, including diabetic autonomic neuropathy, sexual dysfunction, and bladder dysfunction (35). In genitourinary autonomic neuropathy, loss of libido, erectile dysfunction, retrograde ejaculation to the bladder, and infertility are seen in men, while it manifests as difficulty in sexual arousal, and decreased vaginal moistness, and painful sexual intercourse in women (5,15). Erectile dysfunction is the most common organic sexual dysfunction in diabetic men (33). In addition to diabetes, vascular risk factors such as hypertension and hyperlipidemia, obesity, endocrine disorders, endothelial dysfunction, smoking, antidiabetic drugs, and psychogenic factors are also effective in the development of erectile dysfunction (32,33). Erectile dysfunction is an early indicator of the development of generalized vascular disease. For this reason, patients with erectile dysfunction should definitely be evaluated in terms of cardiovascular diseases (33).

The earliest signs of dysfunction in the neurogenic bladder, which is another genitourinary autonomic neuropathy, are an increased micturition initiation reflex threshold and sensory abnormalities that cause an increase in bladder capacity (34). Intermittent urination, low urine flow, and dripping out of the urethra occur due to damage to the parasympathetic fibers as a result of the autonomic neuropathy in the bladder. Afterward, overflow incontinence is seen due to the denervation of the internal and external sphincter (36,38). Autonomic neuropathy involving the bladder should be considered in unexplained problems associated with bladder emptying (39). In particular, post-void residual volume greater than 150 ml is diagnostic for neurogenic bladder (34). Diabetic patients with recurrent urinary infections, pyelonephritis, incontinence, or a feeling of fullness in the bladder should be evaluated for the presence of autonomic neuropathy (15).

3.4. Autonomic Sudomotor Dysfunction

Autonomic sudomotor dysfunction is a condition associated with the decreased sympathetic activity of sweat glands (39). It manifests as sudomotor dysfunction, anhidrosis, dry skin, and heat intolerance (32). Dryness of the skin and deterioration of the integrity of the skin by cracking create an entry gate for infectious agents (40). Autonomic neuropathy is also associated with thermoregulatory dysfunction and abnormal tissue perfusion (35). With the involvement of autonomic nerves, the control of blood flow in

arterioles and vasodilation are impaired, and the risk of developing ulcers due to ischemia increases (12). In addition, autonomic neuropathy causes arterio-venous shunts in the subcutaneous vascular network (20). The blood perfusion of the deeper skin layers increases, causing the skin to overheat, causing heat intolerance in patients (39). These patients also have postprandial sweating and vasodilatation in the upper part of the chest, neck, and face (35).

3.5. Failure to Diagnose Hypoglycemia

It develops as a result of not being able to feel the symptoms of hypoglycemia due to autonomic neuropathy, decreased autonomic nervous system activity, and non-response of the counter-regulatory hormones. Long-term diabetes, tight glycemic control, heavy alcohol intake, and recurrent nocturnal hypoglycemia may lead to the inability to sense the preliminary signs of hypoglycemia (35,39). Since the sensitivity to hypoglycemia increases in the elderly, it may become more difficult to recognize sympathoadrenergic symptoms such as anxiety, nervousness, sweating, irritability, palpitation, pallor, tremor, nausea, and angina, which develop due to the activation of the autonomic nervous system and adrenal medulla (41,42).

3.6. Pupillary Dysfunction

Since the pupils are innervated by the autonomic nervous system, the size or actions of the pupil reflect the autonomic nervous system function (43). The absence of pupillary dilatation in the dark is a common finding, indicating impaired sympathetic innervation and relatively increased parasympathetic activation (33). Sometimes, while the pupil does not respond to light, the distance response is preserved (7,39).

4. Treatment of the Diabetic Neuropathy

4.1. Pharmacological Treatment

Pharmacological treatment of neuropathy is done in several ways. These are the treatment modalities based on the formation mechanism of neuropathy, such as polyol pathway, protein kinase c mechanism and protein kinase C inhibitors, hexosamine pathway and agents effective in this pathway, advanced glycosylation products pathway and agents effective in this pathway, ROS formation, and ROS inhibitors.

In addition, there are DPP-4 inhibitors, Hsp-90 inhibitors, N-METHYL-D-ASPARTAT (NMDA) receptor antagonists, cannabinoid CB1 receptor antagonists, topical agents (Topical capsaicin, EpiCept NP-1, Clonidine, Topical lidocaine), vasopeptidase inhibition, α4 β2 neuronal nicotinic

acetylcholine receptor agonists, PDE-5 inhibitors, p13/Akt signaling pathway, Galanin receptor-1 treatments.

4.2. Glycemic Control

Tight glycemic control has proven to be effective in the definitive treatment strategy of neuropathy (A1C≤%7, Fbg=80-130 mg/dl). Insulin and oral antihyperglycemic agents have been used to treat neuropathic pain in DPN. Orally administered antidiabetic drugs such as sulfonylureas, α-glucosidase inhibitors, and thiazolidinediones can be used alone or in combination. If glycemic control cannot be achieved with oral antidiabetics, the only effective alternative product is insulin. According to the DCTT (Diabetes Control and Complication Trial), a 1.9% difference in HbA1c values between the groups was recorded in 6.5 years with intensive or conventional treatment with patients with type 1 diabetes mellitus.

4.3. Symptomatic Treatment

Symptomatic treatment in DPN is to control the painful symptoms of the disease. Tricyclic and tetracyclic antidepressants, selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, anticonvulsants, and opioids are used by clinicians for symptomatic treatment.

4.4. Natural Products

Metanx, botulinum toxin, antioxidants, growth factors, herbal treatment strategies (such as Oleo Europea L., Mamordica Charantia L., Neuragen PN).

4.5. Other Treatment Strategies

Other treatment strategies used in addition to medication in the treatment of diabetic neuropathy are Iroxanidine, Acetyl L-Carnitine, Olezoxime, Protein associated with islet formation, Gene therapy (44,45).

5. Patient Education

Important points in the education of the patient with neuropathy are:

- First of all, explanatory care should be planned that supports the peripheral vascular evaluation of the patients and the use of orthotic shoes. The shoes should have a full grip on the foot, the width, length, and height should be appropriate, the new shoes should not be worn for more than 2 hours in the first days, the same shoes should not be worn every day, shoes should be changed every 4 hours, high heels and pointed-toe shoes should not be worn.
- The patient should be taught to perform foot self-examination.
- The patients should be evaluated in terms of nail and callus development, the foot should be checked every day by the patient himself or a relative with the help of an eye, hand, and mirror.
- The shoes that the patient wears daily should be checked, and most

importantly, detailed information should be given about daily foot care.

- The importance of blood sugar control should be explained.
- Detailed information about adequate balanced nutrition should be given and daily weight monitoring should be explained.
- The patients should be taught how to control infection (46,47).

6. Nursing Management and Integrative Applications in Diabetic Neuropathy

Many methods and integrating applications are used in terms of nursing in the management of diabetic neuropathy, and nurses undertake important duties in the early diagnosis and care of diabetic neuropathy.

✓ Individuals with type 1 diabetes should be screened for neuropathy within the first 5 years after the onset of diabetes, and individuals with type 2 diabetes should be screened for neuropathy once a year. A detailed history of DPN in diabetic patients is made with physical examination, and simple clinical tests such as 10-gram monofilament and diapason (1,35). In addition, the sensation of pinpricking (pinprick test) and ankle reflexes are evaluated together with the perception of cold and heat (1,48). If there are atypical clinical findings or a non-diabetic neuropathy is suspected, neurology consultation should be performed by performing at least one measurement from each of the electrophysiological tests, quantitative sensory tests, and autonomic function tests (1,13). Since diabetic neuropathy can be seen in the early period, necessary examination and follow-up in prediabetic individuals with symptoms. operations should be done (35,36). In order to prevent the development of neuropathy and delay its progression, training on glycemic control should be provided by nurses (2,39).

✓ Patients should be evaluated by nurses for signs and symptoms of neuropathy, vascular disease, or infection. A detailed foot examination should be performed at least once a year in all diabetic patients, and the frequency of evaluation should be increased in patients with ulcers (17,40). Nurses should definitely consider neuropathy evaluation in diabetic patients within the scope of the examinations of diabetic patients and should provide training on diabetic foot care to patients (1,49).

✓ With the nerve damage seen in diabetic neuropathy, decreased foot sensation and muscle weakness occur, and as a result, gait and balance are affected (8,39). Metabolic imbalances, vision

loss, limitation of movement, and previous amputations increase the susceptibility to trauma. Nurses should use fall risk scales in patients and organize training programs for the prevention of falls (50,51).

- ✓ A preventive strategy for cardiovascular autonomic neuropathy should be established by nurses, and an approach should be provided for the control of cardiovascular risk factors such as weight control, physical activity, smoking cessation, healthy dietary changes, glycemic control, dyslipidemia, and stress control (18). Blood pressure should be measured at each routine visit, and if it is high, the measurement should be repeated another day. It should be ensured that individuals' blood pressure targets are systolic<130 mmHg and diastolic<80 mmHg (2,35).
- ✓ In patients with cardiovascular autonomic neuropathy, the cardiac evaluation must be performed before exercise due to reasons such as tachycardia, orthostatic hypotension, and the risk of hypertensive or hypotensive response to exercise. In orthostatic hypotension, adequate fluid and salt intake should be ensured, drugs that increase hypotension should be avoided, and precautions such as compression stockings and bed head elevation should be taken (39). Nurses should definitely evaluate the injury risk of patients (35).
- ✓ In the case of gastroparesis, patients should be fed 4-6 meals a day, meals should consist of low-calorie, low-fat and fibrous foods, and liquid foods should be preferred because they leave the stomach easily (51,52). Some foods, for example, pizza, orange juice, coffee, broccoli, spicy and sauced foods, and acidic drinks should be avoided, smoking and alcohol consumption should be reduced (52). Nurses should educate patients about nutrition. The fluid and electrolyte balance of patients should be monitored, and in case of long-term malnutrition, nutritional support should be provided if necessary (53).
- ✓ Adult men with diabetes should be examined periodically for sexual dysfunction and especially erectile dysfunction (39). In the treatment of diabetic erectile dysfunction, treatment alternatives should be discussed with couples, and their concerns and expectations from treatment should be taken into account. In general, oral agents are used in first-line therapy. Intracavernosal injections and penile prostheses should be used as alternatives to the failure of oral therapy. In the case of diabetic female

sexual dysfunction, reduction of risk factors (weight control, appropriate diet, and regular exercise), psychotherapies, and hormone replacement therapies should be applied in postmenopausal women (54). Nurses should inform and guide patients on these issues.

- ✓ Diabetic neuropathy can cause urinary retention in individuals. As a result, urinary tract infections and renal problems occur. Therefore, individuals should be followed closely in terms of early signs and symptoms, and the nurse should tell the patient to urinate frequently, regardless of the sense of fullness, in order to reduce the risk of infection (33,35).
- ✓ Autonomic failure associated with hypoglycemia is a reversible disease with avoidance of hypoglycemia (20). Nurses should educate patients about measures to prevent the development of hypoglycemia (41,55). In patients who cannot feel the symptoms of hypoglycemia, the problem is greatly improved when glycemic control is relaxed for a few weeks. Tight glycemic control targets should be avoided in cases of advanced autonomic neuropathy (39).

CONCLUSION

Diabetic neuropathy is a condition that occurs in the near or distant time due to the nature of diabetes and affects quality of life. First of all, the goal should be to prevent neuropathy, in patients with type 1 and type 2 diabetes, screening should be done at appropriate times and intervals, and glucose control should be ensured. Diabetic neuropathy symptoms should be carefully observed and necessary follow-up and care should be done by nurses in case of occurrence. However, nurses have important duties in the treatment of neuropathy, there is also limited nursing research on diabetic neuropathy and needs to be expanded. Nursing studies on this subject should be expanded in number and scope.

Tablo 2: Studies on Diabetic Neuropathic Pain

Author (Date)	Title of the Study	Research Design	Sampling	Applications	Method of Application	Results of the Study
Jeong (2006) (56)	Effect of self-foot reflexology on peripheral blood circulation and peripheral neuropathy in patients with diabetes mellitus	Randomized controlled clinical trial	Patients with diabetic neuropathy (n=76)	Patients self-administered foot reflexology massage.	Once a week, 6 weeks	After self-administered foot reflexology, reflexology was found to reduce neuropathic findings and pain.
Dalal et al. (2014) (57)	Determination of efficacy of reflexology in managing patients with diabetic Neuropathy: A randomized controlled clinical trial	Randomized controlled clinical trial	Patients diagnosed with diabetic neuropathy (n=58)	Foot reflexology massage was applied.	1 day per week, 4 weeks, 6 months follow-up	Foot reflexology massage has been found to provide significant improvement in pain reduction, glycemic control, nerve conductivity, and sense of heat and vibration.
Hamidi et al. (2016) (58)	Efficacy of the reflexology and Yumeiho therapy massages on lower limb pain and balance in women with diabetic neuropathy	Quasi-experimental research	Female patients with diabetic neuropathy (n=34)	Foot reflexology massage was applied to one group and Yumeiho massage was applied to the other group.	3 days a week, for a total of 6 weeks	While there was a significant improvement in balance levels in the foot reflexology and Yumeiho massage group compared to the control group, no difference was found between the reflexology and Yumeiho group.
Ibrahim & Rizk (2018) (59)	The Efficacy of Foot Reflexology on the Reduction of Peripheral Diabetic Neuropathic Pain	Quasi-experimental research (two groups: pre-test-post-test design)	Patients diagnosed with diabetic neuropathy (n=100)	Foot reflexology massage was applied.	30 minutes/day foot massage every day for 4 months, 3 months follow-up	A high level of statistically significant difference was found between the pre-test and post-test in terms of the Leeds Assessment of Neuropathic Symptoms Pain Scale (LANSS) between the intervention group and the control group.

Table 2 Continues…

Author (Date)	Title of the Study	Research Design	Sampling	Applications	Method of Application	Results of the Study
Motilal & Maharaj (2013) (60)	Nutmeg extracts for painful diabetic neuropathy: A randomized, double-blind, controlled study	Randomized, double-blind, controlled clinical trial	Diabetic patients who meet the criteria for painful neuropathy (The Brief Pain Inventory for Diabetic Painful Neuropathy was used) (n=74)	Aromatherapy massage group: mace oil (2%), Nutmeg oil (14%), methyl salicylate (6%), menthol (6%), and coconut oil. Placebo group: methyl salicylate (6%), menthol (6%), coconut oil, and alcohol.	Participants received 4 sprays 3 times a day, 4 sprays and light massage for 4 weeks.	There was a significant difference between the neuropathic pain scores and physical activity in the aromatherapy group. In addition to sleep and mood scores, a significant difference was observed in burning, pins pinpricking, and tingling scores. However, there was no statistically significant difference between the two groups after 4 weeks.
Gok Metin et al. (2017) (61)	Aromatherapy massage for neuropathic pain and quality of life in diabetic patients	Randomized controlled clinical trial	Patients with a score of 4 and above from the Douleur Neuropathique questionnaire (DN4) Intervention group (n=21) Control group (n=25)	Aromatherapy Massage (rosemary, geranium, lavender, eucalyptus, and chamomile) were applied.	3 times a week for 4 weeks	It was observed that neuropathic pain scores decreased significantly and quality of life improved in the intervention group.
Rivaz et al. (2021) (62)	The effects of aromatherapy massage with lavender essential oil on neuropathic pain and quality of life in diabetic patients: A randomized clinical trial	Randomized controlled clinical trial (two groups: pre-test-post-test design)	Patients with diabetic neuropathic pain -Aromatherapy group -Placebo group -Control group each group (n=26)	Aromatherapy group (lavender, eucalyptus, rosemary, and geranium), placebo group (sunflower oil) were applied.	10 minutes before going to bed each night for a month.	A statistically significant difference was found between the mean differences of short-term and long-term pain scores in the aromatherapy group and the quality of life scores after four weeks.

Table 2 Continues…

Author (Date)	Title of the Study	Research Design	Sampling	Applications	Method of Application	Results of the Study
Garrow et al. (2014) (63)	Role of acupuncture in the management of diabetic painful neuropathy (DPN): A pilot RCT	Randomized, double-blind, controlled clinical trial	Patients with type 1 or type 2 diabetes and clinical diagnosis of diabetic neuropathy Acupuncture group (n=24) Fake acupuncture group (n=21) Control group (n=20)	Five standard acupuncture points on the lower extremities of both legs were applied. (LR3, KI3, SP6, SP10, and ST36)	It was manipulated with the acupuncture needles and fake needles for 30 minutes. Acupuncture was applied after 15 minutes. (10 sessions)	There were significant differences in the VAS pain score, sleep, self-evaluation, and diastolic blood pressure in the active acupuncture group. In the fake acupuncture group, there was no significant difference in the VAS pain score, systolic blood pressure, and significant difference in the SF-36 somatic pain score.
Jeon et al. (2014) (64)	Effect of acupuncture on diabetic peripheral neuropathy: An uncontrolled preliminary study from Korea	Pilot study (without control groups)	Patients with diabetic neuropathic pain (n=9)	Application points: LR3, GB41, GB39, ST36, GB34, SP6, and SP9.	Needles were held for 25±3 minutes and manipulated after 10 minutes. Traditional acupuncture was applied 3 times a week for 4 weeks. (8 weeks follow up)	There was no significant difference in the Total Symptom Score (TSS) of the patients. A statistically significant difference was found between Michigan Neuropathy Screening Instrument (MNSI) scores.
Vakilinia et al. (2020) (65)	Evaluation of the efficacy of warm salt water foot-bath on patients with painful diabetic peripheral neuropathy: A randomized clinical trial	Randomized controlled clinical trial	Patients diagnosed with diabetic neuropathy (between 30-70 years old) (n=100)	Every night before going to bed for a month	Warm water bath group: A warm foot bath containing 5 liters of water between 40-45 °C was applied for 15 minutes. Salt water bath group: 250 g of salt was added to 5 liters of 40-45 °C warm foot bath water. It was applied for 15 minutes.	It was found that there was a significant decrease in the Douleur Neuropathique Questionnaire (DN4) scores and The McGill Pain Questionnaire scores in the salty warm water group.

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