

PAINFUL DIABETIC PERIPHERAL NEUROPATHY- A CURRENT CONCEPTS REVIEW OF CLINICAL ASSESSMENT SCALES FOR USE IN RESEARCH AND PRACTICE

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Abstract

Diabetes is a global epidemic and one of the most leading complications of diabetes is peripheral neuropathy. Recent research and clinical practice focus is on symptomatic or painful diabetic peripheral neuropathy (PDPN). The objective of this review is to throw light on commonly used and well-established clinical assessment scales in PDPN patients. The various scales reported in the literature are described chronologically in the review. This includes neuropathy disability score, neuropathy symptom profile, diabetic neuropathy symptom score, Michigan neuropathy screening instrument, neuropathic pain scale, neuropathy impairment score, Michigan diabetic neuropathy score, verbal neuropathy screening score, total neuropathy scale, diabetic neuropathy examination score, Leeds assessment of neuropathic symptoms and signs (LANSS) score, diabetic neuropathy symptom score, neuropathy-specific quality of life scale, neuropathic pain questionnaire (NPS),

NPS- short form, brief pain inventory for diabetic peripheral neuropathy, neuropathic pain diagnostic questionnaire, short-LANSS score, and patient interpretation of neuropathy questionnaire. The review would facilitate researchers and clinicians to use these valid and reliable assessment scales in patients with painful diabetic peripheral neuropathy.

Key words

measurement scales, diabetic neuropathy, neuropathic pain, clinical examination.

Introduction

The term diabetes mellitus describes a metabolic disorder of multiple aetiology characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both¹. The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of people with diabetes is projected to rise

from 171 million in 2000 to 366 million in 2030. The prevalence of diabetes is higher in men than women, but there are more women with diabetes than men. The urban population in developing countries is projected to double between 2000 and 2030². The microvascular complications of diabetes are termed collectively as “triopathy” which includes retinopathy, neuropathy and nephropathy and the macrovascular complications include peripheral vascular disease, cerebrovascular disease and cardiovascular disease^{3,4}.

Diabetic peripheral neuropathy (DPN) is a common complication estimated to affect 30% to 50% of individuals with diabetes. Chronic sensorimotor distal symmetric polyneuropathy is the most common form of DPN. The prevalence of neuropathy in type 2 diabetes ranges from 27% to 63% and from 14% to 70% in diabetes mellitus in general.⁴ The higher prevalence of neuropathy in type 2 diabetes patients is related to greater age, male gender, longer diabetes duration, higher levels of glycosylated hemoglobin, lower HDL cholesterol, smoking; peripheral vascular disease and insulin use⁵.

Diabetic neuropathy has been defined as Peripheral somatic or autonomic nerve damage attributable solely to diabetes mellitus. It may be of two types-symmetrical and asymmetrical. The symmetrical type was the commonest and it affects the sensory and autonomic functions of mostly peripheral nerves whereas the asymmetrical type affects the cranial nerves in their sensory and

motor functions.⁶ The first description of “diabetic neuropathy as a presence of pain and paresthesiae in lower limbs” was done by Rollo in 1798.⁷ The consensus of opinion at the San Antonio conference on diabetic neuropathy was that diabetic neuropathy was “a descriptive term meaning a demonstrable disorder, either clinically evident or subclinical that occurs in a setting of diabetes mellitus without other causes of neuropathy. The neuropathic disorder includes manifestations in both somatic and/or autonomic parts of the nervous system.”

Diabetic peripheral neuropathic pain (DPNP) affects approximately 11% of patients with diabetic peripheral neuropathy (DPN). The most common type of neuropathy in DM is DPN, with up to 50% of patients experiencing some degree of painful symptoms and 10% to 20% having symptoms severe enough to warrant treatment. A classic population-based study found some degree of neuropathy in 66% of patients with DM. Among those with type 1 and type 2 DM, 54% and 45%, respectively, had DPN and 15% and 13%, respectively, were symptomatic.⁸

The purpose of this review paper is to describe the clinicians and researchers working on diabetes, diabetic peripheral neuropathy and neuropathic pain, to update on currently available assessment scales used for measurement purposes of screening, diagnosis and prognosis in this patient population. The scales are described chronologically below;

Materials and Methods

Independent search was carried out by testers using a well-defined search strategy as follows; We searched the databases- PubMed, CINAHL, EMBASE, SCOPUS, PROQUEST, OVID and Google scholar were searched using the key terms- neuropath*, scale, tool, questionnaire, inventory, score, instrument profile. A total of 112 studies were potentially identified by the authors. Studies published in English on development of a scale or measure was included and studies on comparison of scales (86 studies) or reliability (28) and validity (16) studies were excluded. Some of the excluded studies were on studying both reliability and validity (22 studies). A total of 19 studies were finally identified published from 1985 to 2006 and then considered for review.

To avoid search bias, the testers performed independent searches and then disagreements were solved by consensus at various stages of the study.

Results and main findings of the review: The 19 studies were on clinical assessment scales which are descriptively reported below;

Neuropathy Disability Score- NDS (1985)⁹:

The total score of 10 based on four tests- vibration perception threshold, temperature perception on dorsum of foot, pin-prick and Achilles reflex. Present/normal finding for first three tests is scored 0 and abnormal is given 1. The fourth test- Achilles reflex in

addition has present with reinforcement scored 1 and abnormal/ absent is given score of 2. a score of greater than 3/10 indicates the presence of neuropathy which would be associated with profound disability.

Neuropathy Symptom Profile- NSP(1986)¹⁰:

NSP is a true-or-false questionnaire with several hundred questions about symptoms encountered in peripheral neuropathy, to be scored by optical reader and computer. Responses were grouped into scales called "Neuropathy," "Weakness," "Sensory," "Autonomic," and subsets of these.

Diabetic Neuropathy Symptom- DNS score (1988)¹¹:

Patients were to be questioned regarding the presence or otherwise of symptoms, either positive or negative suggesting the presence of neuropathy. The questionnaire was the DNS score which was an adapted version of the earlier version- Neuropathy symptom score (NSS). The questions should be answered "yes" (positive- 1 point) if a symptom occurred more times a week during the last 2 weeks or "no" (negative- no point) if did not. The four questions were; Symptoms of unsteadiness in walking; burning/aching pain or tenderness of legs and feet; pricking sensations in legs and feet; and numbness in legs and feet. Score ranged from 0 to 4, where 0 indicated absence of polyneuropathy and 1-4 points indicated presence of polyneuropathy.

Michigan Neuropathy Screening Instrument- MNSI (1994)¹²:

MNSI has two parts- history and physical examination findings. The history part of MNSI questionnaire is self-administered by the patient. Responses are added to obtain the total score. Responses of “yes” to items 1-3, 5-6, 8-9, 11-12, 14-15 are each counted as one point. A “no” response on items 7 and 13 counts as 1 point. Item #4 is a measure of impaired circulation and item #10 is a measure of general asthenia and are not included in scoring. To decrease the potential for bias, all scoring information was eliminated from the patient version. The clinician’s portion based on physical examination consisted of the sum of scores varying from 0 to 1 for each abnormality revealed in foot appearance, Achilles reflexes presence and vibratory threshold (VPT) by tuning fork and monofilament testing.

Neuropathic pain scale- NPS (1997)¹³:

The NPS begins with an introduction that describes how people often experience pain sensations differently, and how pain unpleasantness differs from pain intensity. After the introduction, the NPS asks respondents to rate the severity of each of 10 pain domains by using 0 to 10 numeric rating scales, where 0 _ “no pain” or “not [sensation/item]” and 10 _ “the most [descriptor] pain sensation imaginable.” The NPS items can be scored individually (to help identify a “profile” associated with a specific diagnosis or of

the effects of a treatment on pain qualities) or can be combined into composite scores to determine the effects of treatments on pain quality overall. Because the quality of specific pain sensations can be distinguished from pain location (eg, deep, surface), the 6 NPS pain quality items (sharp, hot, dull, cold, sensitive, itchy) were combined into single composite measure of overall pain quality (NPS6) to help estimate changes after treatment on such a measure. In addition, a total NPS score (NPS10) created by averaging responses to all of the NPS items was computed to help explain the significant interaction and main effects that emerged from the analyses.

Neuropathy Impairment Score (NIS) and NIS (LL)-(1997)¹⁴:

The Neuropathy Impairment Score (NIS) was obtained by evaluating a standard group of muscles for weakness: 1, 25% weak; 2, 50% weak; 3, 75% weak; 3.25, movement against gravity; 3.5, movement with gravity eliminated; 3.75, muscle flicker without movement; and 4, paralyzed. A standard group of muscle stretch reflexes were graded as normal, 0; decreased, 1; or absent, 2. Touch-pressure, vibration, joint position and motion, and pinprick were graded on index finger and great toe as normal, 0; decreased, 1; or absent, 2. For evaluating the NIS for the lower limbs (NIS(LL)), only neurologic abnormalities of the lower limb were to be tallied.

Michigan Diabetic Neuropathy Score-MDNS,(1998)¹⁵:

MNSI scores together with quantitative neurological examination and electrophysiological evaluation constitute the MDNS score.

Verbal neuropathy screening score (1998)¹⁶:

The University of Texas Subjective Peripheral Neuropathy verbal questionnaire included 4 queries to identify the presence of burning, formication, numbness, and paresthesias: Do your feet ever feel numb? Do your feet ever tingle, as if electricity were traveling into your foot? Do your feet ever feel as if insects were crawling on them? Do your feet ever burn? A positive answer to any 1 of the 4 verbal questions constituted 1 point. A negative answer constituted 0 points.

Total Neuropathy Scale TNS and m-TNSr (1999)¹⁷:

The scale has ten items each of which are scored on a five-point grading scale. The items include sensory symptoms, motor symptoms, autonomic symptoms, pin prick sensibility, vibration sensibility, deep tendon reflexes, muscle strength, vibration sensation with tuning fork % upper limit of normal, sural nerve sensory action potential % lower limit of normal, and common peroneal nerve compound muscle action potential % lower limit of normal. Total score ranges thus from 0 (normal) to 40 (abnormal). A score of ≥ 5 indicated the presence of significant neuropathy. The

scale can also be used to detect changes with interventions as a prognostic measure. *Modified 5-Item Total Neuropathy Scale- reduced* (m-TNSr) version included five items from the original scale- sensory symptoms, pin sensibility, vibration sensibility, deep tendon reflexes and muscle strength scores thus making scores to range from 0 to 20. A higher score indicated severe neuropathy.

Diabetic Neuropathy Examination (DNE) score (2000)¹⁸:

This score was based on a thorough neurological examination, similar to its earlier version- the Neuropathy Disability Score (NDS). The DNE score consisted of eight items , two testing muscle strength, one tendon reflex, and five sensations. The maximum score is 16. A score of > 3 points is considered abnormal.

Muscle strength- quadriceps femoris, tibialis anterior, ankle reflex, pinprick sensitivity, touch sensitivity, vibration perception, and joint position sensation. Only the right leg and foot are tested. The scores for each item include 0- normal and 1- mild/moderate deficit; muscle strength: MRC scale 3-4; reflex: decreased but present; sensation: decreased but present, and 2- severely disturbed/ absent; reflex- absent; sensation- absent. Maximum score was 16 points. A score of > 3 indicated presence of polyneuropathy.

Leeds Assessment of Neuropathic Signs and Symptoms- LANSS (2001)¹⁹:

Leeds Assessment of Neuropathic Symptoms and Signs Scale, which consists of five questions (pins and needles, red skin, sensitive skin, electric shock pain, burning pain,) and two clinical examination tests (allodynia, pin prick threshold) with cut off score of 12 or above out of a total score 24 indicating neuropathic pain with a sensitivity of 79% and specificity of 100% for identifying neuropathic pain.

Diabetic Neuropathy Symptom Score (2002)²⁰:

The DNS score has the following items: (i) unsteadiness in walking, (ii) pain, burning or aching at legs or feet, (iii) prickling sensations in legs or feet, and (iv) numbness in legs or feet. Presence is scored 1, absence 0, maximum score 4 points. 0- absence of polyneuropathy and 1-4 indicated presence of polyneuropathy.

Neuropathy-specific quality of life NeuroQoL (2002)²¹:

The scale is a self-report measure which questions the presence and frequency of symptoms in the past 4 weeks. The first part has seven questions each of which are scored on a 5-point likert scale from "all the time" to "never." Each question is also accompanied with three options for bothersomeness (very much; some bother; none). The second part has on quality of perceived symptoms. The third part is for weakness, unsteadiness

in standing and gait. The fourth part is on influence on work situations and finally on social influence and self-perceived quality of life.

Neuropathic pain questionnaire (2003)²²-

Neuropathic pain questionnaire consists of 32 items, for each of which patients are asked to rate their pain numerically from zero to hundred with anchors at either ends similar to visual analogue scale. The total discriminant function score at or above zero strongly indicates neuropathic pain.

Neuropathic pain questionnaire (short form): (2003)²³-

Neuropathic pain questionnaire (short form) was developed by the same authors with three items which were item subsets of the original neuropathic pain questionnaire which included tingling, numbness and increased pain due to touch, again with total discriminant score at zero or above for neuropathic pain.

Neuropathic pain symptom inventory- NPSI (2004)²⁴:

NPSI assessed four distinct dimensions of neuropathic pain as a self administered questionnaire consisting of four distinct dimensions of neuropathic pain: spontaneous ongoing pain (6 items), spontaneous paroxysmal pain (4 items), evoked pain (4 items) and paresthesia/dysesthesia (4 items). Each item was to be scored from zero to ten

numerical scale. Total score thus ranges from 0 to 180.

Brief Pain Inventory for Diabetic Peripheral Neuropathy- BPI-DPN (2005)²⁵:

A version of the BPI modified specifically for use in assessing DPNP (BPI-DPN) was recently validated. Sensitivity using worst pain was 58% and specificity was 79%. The BPI-DPN uses 4 questions to assess pain severity (worst pain, least pain, average pain, and pain now) and 7 items to assess interference with daily life (general activity, mood, walking ability, normal work, relations with others, sleep, and enjoyment of life). Each question uses an 11-point scale (0 indicating no pain or effect to 10 indicating worst pain imaginable or completely interferes) and asks patients specifically about pain related to their diabetes during the past 24 hours. Item scores from 0 to 3 suggest mild pain or interference, whereas scores from 4 to 6 suggest moderate effect and those 7 or higher suggest severe pain or interference.

Neuropathic pain diagnostic questionnaire- DN4 (2005)²⁶:

Neuropathic pain Diagnostic Questionnaire (DN4) consists of two questions (I and II) which were based on the interview of the patient and two questions (III and IV) were based on a standardized clinical examination. Question 1 has five items related to description of pain, question 2 has four items related to paresthesia or

dysesthesia, question 3 has four items related to sensory deficits and; question 4 has four items related to evoked pain.

S- LANSS Score (2005)²⁷:

This scale is a self-report measure which includes an initial numerical pain rating scale for “how bad is your pain” followed by pins and needles (0-5); colour changes (0-5); hypersensitivity to touch (0-3); electrical-shock sensation (0-2); burning sensation (0-1); response to gentle rubbing (0-5); and, response to gentle pressure (0-3). Total score ranges from 0 to 24 where a score ≥ 12 indicated presence of neuropathic pain.

Patient Interpretation of Neuropathy questionnaire- PIN-Q (2006)²⁸:

The PIN questionnaire is a 44- item draft instrument which covered patients' 1) common-sense misperceptions about the nature of foot complications and their efforts to merge these beliefs with the practitioner's diagnosis of DPN (illness identity), 2) levels of understanding of the causal links between DPN and foot ulceration and the self-care- and/or health care provider-related blame for the development of neuropathy/foot ulceration (causes), 3) perceptions of temporal unpredictability of foot ulceration (acute timeline), 4) foot self-care efficacy beliefs and the perceptions that health care providers can prevent foot ulcers (controllability), 5) anticipation of foot ulceration and/or amputation (potential consequences), and 6) worry about these consequences

and anger directed at health care providers stemming from a perceived lack of a clear explanation about neuropathy and perceived lack of compassion (emotions). Responses to each statement were scored on a 5-point Likert scale (1 _ strongly disagree, 2 _ disagree, 3_uncertain, 4_agree, and 5_strongly agree).

Discussion

The review is a clinically and scientifically applicable of its kind for use both by clinicians and researchers involved with patients of painful diabetic peripheral neuropathy. Many of the scales are to be filled by patients^{10-13,16,20-27} of which some of the scales study pain^{13,22,23,26} and its nature^{10-12,16,24,27}, whereas some others study the activity limitations²⁵, and other study the impact on life-issues^{21,28}; while some other scales are filled by clinicians^{9,14,15,17-19}. These scales are simple to understand, cost-effective, easy to administer and less-time consuming. In addition they are accurate and the scores are repeatable between testers and between test repetitions. Thus they form an invaluable part of clinical practice and research. Use of objective outcome measures not only improves documentation which the insurance payers demand but also improves inter-professional communication in a multidisciplinary rehabilitation. Some of the potential limitations of this review were the lack of meta-analysis of the tools and quality scoring of the

diagnostic tools mentioned. Future research could be on developing a comprehensive clinical assessment tool to assess multifaceted impact of painful diabetic peripheral neuropathy on pain, activity limitation, clinical examination findings and psychosocial issues.

We described the available clinical assessment scales for the most common yet most underestimated complication of the global epidemic which is further expected to rise due to our habits and lifestyle. The mentioned scales were previously studied for their diagnostic accuracy and responsiveness to change and hence they can be used by all health professionals involved in the treatment and/or research in patients with painful diabetic peripheral neuropathy.

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Disclosures

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