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Assessment of Podiatric Disorders and Quality of Life in elderly diabetic patients with Diabetic Neuropathy

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Abstract:

Introduction:
Diabetic neuropathy is the most common chronic complication of diabetes. It is a heterogeneous condition including various types of nerve damage. The most prevalent form is symmetrical distal polyneuropathy, which is diagnosed clinically. It involves symmetric and bilateral impairment of nerves, mainly in the distal parts of the lower limbs.
Pain associated with diabetic neuropathy is a major health issue and significantly impacts quality of life. The aim of our study is to examine podiatric disorders and quality of life in elderly diabetic patients with and without neuropathy.

Patients and Methods:
This is a case-control study involving 70 elderly diabetic patients (35 with neuropathy and 35 without), selected through non-probabilistic sampling over a 4-month period. Assessment included the SF-36 quality of life questionnaire, the DN4 score, and a complete clinical podiatric examination in an off-load podiatry assessment. Data entry and statistical analysis were conducted using SPSS version 25.

Results:
Our analysis revealed that elderly diabetic patients with neuropathy had significantly more comorbidities, trophic disorders, and podiatric issues. Comparison of average SF-36 scores and global quality of life scores between cases and controls showed significant differences across all assessed parameters. The overall score indicated a marked deterioration in both physical and mental health among cases compared to controls, with mean scores of 37.09 and 69.82, respectively ($p < 0.001$).

Conclusion:
Preventing diabetic foot complications requires meticulous examination and strict monitoring of patients from the early stages of diabetes to preserve their quality of life.

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Keywords:
Diabetic neuropathy; podiatric disorders; quality of life; SF-36

Introduction:

Diabetes mellitus is defined by a chronic elevation of blood glucose concentration and include several diseases with different pathogeneses, resulting from disturbances in insulin secretion and/or action [1].
The prevalence of diabetes is increasing dramatically. According to the International Diabetes Federation (IDF), approximately 589 million adults (aged 20–79) worldwide currently live with diabetes, a number expected to reach 853 million by 2050 [1].

Chronic hyperglycemia in diabetes can lead to long-term complications affecting both small and large vessels, such as cardiovascular diseases, nephropathy, neuropathy, and diabetic retinopathy. Diabetic neuropathy is the most common chronic complication of diabetes. It is a heterogeneous condition including multiple forms of nerve damage, with symmetrical distal polyneuropathy being the most frequent form, diagnosed primarily through clinical examination [2].

Diabetes is also the leading cause of chronic neuropathic pain, with a prevalence ranging from 10% to 50%. This great variability is explained by the diversity of the tools used to make the diagnosis [3].

The clinical manifestations of neuropathy have both physical and psychological consequences, affecting negatively the quality of life (QoL), which has become an essential aspect of managing these patients.

There are a number of tools available for this purpose. In particular, the “Neuropathic Pain in Four Questions” (DN4) questionnaire is a validated, easy-to-use tool with high sensitivity and specificity for diagnosing neuropathic pain of diabetic origin. [3].

Among the instruments for measuring health-related quality of life (HRQoL), the generic 36-item Short-Form Health Survey (SF-36) is applicable to all patients, whatever their state of health. It is a reference tool for quality-of-life surveys in clinical and public health research, widely used around the world, and validated in Arabic in Tunisia [4,5].

In this context, our research objective is to study podiatric disorders and quality of life in elderly diabetic patients, both with and without neuropathy.

Patients and Methods:

To meet the objective of this study, we conducted a case-control study during a data collection period from January 2024, to April 2024. This study used non-probabilistic sampling, including a total of 70 elderly diabetic individuals: 35 with neuropathy and 35 without.

Clinical and biological data were collected from patient records at the time of diagnosis. Patients were interviewed about their personal and family medical history, such as diabetes, hypertension, cardiovascular incidents, associated comorbidities, duration of diabetes, and current treatment.

Neuropathic pain and quality of life were assessed using the DN4 score and the SF-36 questionnaire.

The specific podiatric examination included tests evaluating foot disorders in diabetic patients with and without neuropathy, aiming to identify sensory disturbances, trophic disorders, deformities, and vascular anomalies.

Data entry and statistical analysis were performed using SPSS version 25.
Qualitative variables were analyzed using the chi-square test. For quantitative variables following a normal distribution, the Student's t-test was used. When variables did not follow a normal distribution, the Mann–Whitney U test was applied. A p-value of <0.05 was considered statistically significant.

Results:

In our study, we observed a female predominance in the group of patients with diabetic neuropathy: 45.7% were men, and 54.3% were women, with a sex ratio of 0.84. In contrast, in the control group, 57.1% were men and 42.9% were women, with a sex ratio of 1.33. However, this difference was not statistically significant ($p = 0.473$).

Regarding age, the difference between the two groups was statistically significant ($p = 0.01$). The average age in the neuropathy group was 72.66 ± 5.69 years, compared to 69.17 ± 5.29 years in the control group.

Our results also revealed a significant difference in the duration of diabetes between the two groups ($p = 0.001$). Patients in the neuropathy group had an average diabetes duration of 20.69 ± 5.95 years, while those in the control group had an average of 16.23 ± 5.28 years.

In our study, 68.6% of neuropathic patients were on insulin therapy, compared to 51.4% in the control group. This difference was not statistically significant ($p = 0.111$).

In terms of degenerative complications between the groups, the percentage of patients with retinopathy is higher in the case group (62.9%) compared with controls (31.4%), with a p-value = 0.008. Similarly, the prevalence of nephropathy is higher in the diabetic neuropathy group (40%) compared to controls (11.4%), with a p-value = 0.006. However, for arterial hypertension and dyslipidemia, the differences were not statistically significant, with p-values greater than 0.05.

For the assessment of diabetic neuropathy, the results of the DN4 score showed a mean of 6.11 ± 0.99 in the control group ($p<0.001$). Indeed, patients described the pain in the majority of cases as burning in 77.1% or electric shocks in 80.0%.

In addition, the examination revealed hypoesthesia to tact and pricking significantly more frequent in the diabetic neuropathy group than in the control group, with $p<0.001$.

To assess quality of life, a comparison of the mean scores for the various dimensions of the SF-36 and the overall score between cases and controls revealed significant differences in all parameters assessed. The total score shows a marked deterioration in physical and mental health in cases compared to controls, with mean scores of 37.09 and 69.82 respectively ($p<0.001$).

Clinical examination of superficial sensitivity using the 10-gauge Semmes-Weinstein monofilament showed a significant difference between cases and controls ($p < 0.001$). All cases had altered sensitivity, while all controls had normal sensitivity.

Deep sensitivity, assessed with a 128 Hz tuning fork, showed impairment in 91.4% of neuropathic patients versus only 5.7% of controls ($p < 0.001$).

Our study also found a higher prevalence of certain podiatric conditions in the neuropathy group, such as interdigital intertrigo (74.3% vs. 40%, $p = 0.004$) and calluses (82.9% vs. 20%, $p < 0.001$).

Regarding foot deformities, hallux valgus was more common in the control group (74.3%) than in neuropathic patients (51.4%, $p = 0.041$), as well as toe clawing which was more prevalent among neuropathic patients (85.7% vs. 54.3%, $p = 0.004$).

Vascular assessment based on the presence of the posterior tibial and pedal pulses showed significant differences. The posterior tibial pulse was absent in 57.1% of cases but present in all controls ($p < 0.001$). The same trend was found for the pedal pulse ($p < 0.001$).

Lastly, evaluation of deep tendon reflexes showed decreased patellar reflexes in 42.9% of cases versus 17.1% of controls ($p = 0.018$). Achilles reflexes were absent in 65.7% of cases vs. only 8.6% of controls ($p < 0.001$).

Discussion:

Diabetes is the leading cause of neuropathy worldwide. The most common form is symmetrical distal polyneuropathy (SDP), which predominantly affects sensory nerves. It is estimated that approximately 30% of diabetic individuals have SDP at the time of diagnosis, with rates ranging from 8–54% in type 1 diabetes and 13–46% in type 2 diabetes [6].

In our comparative study, epidemiological data revealed a female predominance in the case group (54.3%), with a sex ratio of 0.8. These results are consistent with those of Hamdaoui et al., who reported that 61.1% of SDP cases were female (sex ratio: 0.63), while the ratio among controls was 0.91, also indicating a female predominance [7].

The average age of our neuropathic population was 72.66 ± 5.69 years. This aligns with the findings of Lawler et al., who studied peripheral neuropathy in the elderly and reported a mean age of 75.7 ± 6.2 vs. 73.4 ± 5.6 [8].

Our diabetic patients with neuropathy also had significantly more degenerative complications—retinopathy in 62.9% vs. 31.4% ($p = 0.008$), and nephropathy in 40% vs. 11.4% ($p = 0.006$). These results are in agreement with the 2019 study by H. Aynaou and H. Latrech [6], which found retinopathy in 79% of neuropathic patients and 47% of non-neuropathic ones ($p = 0.001$), and nephropathy in 77% of cases vs. 38% in controls ($p = 0.005$). In fact, the presence of neuropathy appears to correlate strongly with retinopathy and nephropathy [9].

The duration of diabetes is a known risk factor for diabetic neuropathy, as supported by our data. Adler et al. similarly reported that the evolution of diabetes over time was statistically significant

between groups ($p < 0.001$), supporting our finding of an average diabetes duration of 20.69 ± 5.95 years in the neuropathy group vs. 16.23 ± 5.28 years in controls [10].

Among associated risk factors, we found a majority of hypertensive patients: 77.1% in the neuropathy group vs. 68.6% in controls. Kammoun et al. reported that 70% of elderly patients with diabetic neuropathy had hypertension [11], likely due to autonomic nerve involvement affecting blood pressure regulation.

For early detection, all diabetic patients should undergo annual screening to assess the presence, extent, and severity of peripheral neuropathy (ADA, 2011). Validated and reliable tools like the DN4 questionnaire are highly recommended [12].

In our study, DN4 scores differed significantly between cases and controls, with averages of 6.11 ± 0.99 vs. 2.03 ± 0.6 ($p < 0.001$). This is comparable to Kammoun et al., who found a mean DN4 score of 6.02 among elderly diabetic neuropathy patients [11].

The most commonly reported symptoms were tingling sensations in 97.1% of cases vs. 68.6% of controls, consistent with Hamdaoui et al., who reported paresthesia in 85.6% of neuropathic patients [7].

Our sensitivity testing confirmed a significant loss of sensation across all modalities in the neuropathy group. This can be explained by the involvement of small fibers: "type A myelin fibers “ responsible for fine touch, vibration, and motor innervation, and C-type fibers responsible for pain and temperature sensations. Damage to these fibers leads to a loss of protective sensation, making feet vulnerable to mechanical and microtraumatic injuries, and ultimately to ulcerations [13].

Podiatric findings in our study showed a significantly higher prevalence of calluses in the neuropathy group (82.9%) compared to controls (20%) ($p < 0.001$), and interdigital intertrigo in 74.3% vs. 40% ($p = 0.004$). A Tunisian study by N. El Fékih et al. also found a significant association between diabetic neuropathy and foot mycoses ($p < 0.049$) [14].

Our deformity analysis showed that hallux valgus was significantly more common in the control group (74.3%) than in the neuropathy group (51.4%) ($p = 0.041$), a result similar to Lázaro-Martínez et al., who reported higher rates of hallux valgus in non-neuropathic diabetics [15]. However, toe clawing was more frequent in neuropathic patients (85.7%) than controls (54.3%) ($p = 0.004$).

Regarding deep tendon reflexes, there was a clear reduction or absence of reflexes in neuropathic patients: Achilles reflexes were absent in 65.7% of cases vs. 8.6% of controls ($p < 0.001$), and patellar reflexes were diminished in 57.1% vs. 8.6% ($p < 0.001$). This is explained by the fact that motor neuropathy results in the abolition of osteotendinous reflexes. Traoré Seydou Sory also concluded that absent reflexes are a sign of motor impairment, found in 85.79% of neuropathic patients [16].

Arterial evaluation also showed significant differences: the posterior tibial pulse was absent in 57.1% of

neuropathy cases and present in all controls ($p < 0.001$). The pedal pulse was similarly absent in 57.1% of cases vs. 0% of controls ($p < 0.001$), increasing podiatric risk, as the combination of obliterative arteriopathy of the lower limbs and neuropathy exposes the patient to a 6-fold increase in podiatric risk [17].

Finally, **quality of life** was significantly reduced in neuropathic patients. SF-36 scores revealed average physical scores of 26.82 ± 11.02 in neuropathy cases vs. 64.75 ± 14.53 in controls ($p < 0.001$), and mental scores of 47.38 ± 13.30 vs. 74.90 ± 17.10, respectively ($p < 0.001$). The total score was significantly lower in cases (37.09 ± 11.56) compared to controls (69.82 ± 14.92) ($p < 0.001$). These findings align with those of Ben Amor et al. [18], who also reported significantly lower quality of life scores in patients with neuropathy ($p = 0.002$).

Conclusion:

Diabetes is a major public health issue due to its growing prevalence and numerous disabling complications. Symmetrical distal polyneuropathy (SDP) is the most common degenerative complication in diabetic patients. Its diagnosis is simple and relies primarily on clinical assessment.

These findings can have a direct impact on our clinical practice. They highlight the importance of early, thorough examination and continuous monitoring—particularly podiatric—starting at the earliest stages of diabetes. This proactive approach is key to preserving patients' quality of life.

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