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***Screening techniques to identify occurrence of peripheral neuropathy  
among diabetic patients***

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**Abstract**

**Background** Neuropathy is the greatest source of morbidity associated with diabetes, affecting up to 50% of those with long-standing disease, and pain as a symptom of neuropathy may be seen in as many as one third of all patients with diabetes.

**Aim:** - The aim of this study was screen the occurrence of peripheral neuropathy among diabetic patients.

**Subjects and methods** The design used for conduction of this study was prospective (cohort) study). Subjects: - A total 300 adults diabetic patients. Tools of data collection:-Tool I Diabetic patient knowledge scaduale, Tool II Diabetic foot examination checklist. It contained two items. General examination Hightet , weight , BMI , heart rate , blood pressure, specific foot examination, diagnosis of diabetic peripheral neuropathy using neuropathy symptoms score (NSS),neuropathy disability score (NDS),Pressure perception using 10gm Semmes Winston monofilament on10 sites in two feet and sensory assessment

**Results:** -. The patients who had  $\geq 3$ in total score of neuropathy symptoms score (NSS) were 23%, (10.3%) had total score  $\geq 6$  in neuropathy disability score. Loss of protective sensation was common in (11.0%) of patients. The total patients diagnosed with neuropathy (Abnormal with one of these three parameters) were 27.3 % of studied sample. Also the study reveals that assessment of foot pressure perception using 10gm monofilament had the best sensitivity. **Conclusion** based on the findings it was concluded that diabetic peripheral neuropathy was diagnosed in one third of studied sample ,10gm monofilament had the best sensitivity **Recommendations** .All patients with diabetes should be screened at least annually for presence of diabetic

peripheral neuropathy. Foot care education must be provided to every diabetic patient with regular confirmation

**Key words** :- Diabetic peripheral neuropathy - Screening techniques

### **Introduction**

Neuropathy is the greatest source of morbidity associated with diabetes, affecting up to 50% of those with long-standing disease, and pain as a symptom of neuropathy may be seen in as many as one third of all patients with diabetes. Neuropathic pain is difficult to manage, and the available treatment options rarely provide total relief. Lack of definitive treatment success is related to the multifocal and poorly understood pathogenesis of painful diabetic neuropathy (PDN). Painful diabetic neuropathy affects all areas of patients' lives including sleep, mood, mobility, ability to work, interpersonal relationships, overall self-worth, and independence. An understanding of PDN assessment and management strategies is therefore essential for diabetes educators. (*Igbinovia ,2009; Bartly , 2007*)

Most screening instruments for diabetic peripheral neuropathy are non-invasive, inexpensive, sensitive, specific and highly predictive of clinical end points to evaluate a patient for neuropathy. Clinicians need to ask patients about signs and symptoms.

Physical exam includes ; vibration perception using 128 HZ tuning fork , Temperature sensation, hot and cold , pain, pinprick using sharp and blunt , light touch by cotton wisp , deep tendon reflexes (Ankle, knee) , pressure perception using 10gm Semmes–Weinstein 10-gram monofilament , test sensory function by two point discrimination, and babinski test, and steriognosis (*Abdul Rehuman et al.,2009-Doworkin et al., 2003-Lavery et al. ,2004; American Diabetes Association 2007* )

### **Aim of the Study**

The aim of this study was screen the occurrence of diabetic peripheral neuropathy among diabetic patients.

### **Subjects and Methods**

The design used for conduction of this study was prospective (cohort) study)

Subjects: - A total 300 adults diabetic patients were recruited from diabetic clinics of six main hospitals and primary health care centers in port said city by stratified random sample, inclusion Criteria were patients diagnosed with diabetes mellitus age 18 years and more from both sex . Patients with any type with diabetes and requiring insulin or hypoglycemic agent to control blood glucose level.

Setting: - Port Said General Hospital, Omer Iben Elkhatab Health care center, Port Foad Thane "Elamal". Health care center, Port Foad General Hospital, Markez ELManakh Health care center ,Elmabara Hospilal

### **Tools of data collection:-**

#### **Tool I Diabetic patient knowledge schedule :**

A structured interview was developed by the researcher to collect the necessary data about subjects .It was divided to three parts: **Part(1)**Socio demographic characteristics It includes personal data as name, age, gender address, telephone number, education, occupation, marital status, work hours and health care providers **Part (2)** past medical history. The second part was developed to collect data related to past medical history , surgeries. **Part (3)** .Present health status, the third part included questions about diabetes duration, type of diabetes, patient's diet, management medication, exercise, self monitoring, smoking and other complications and stressors.

#### **Tool II Diabetic foot examination checklist:**

It contained two items: General examination as hight , weight , BMI , heart rate , blood pressure and the second one was specific foot examination which includes the Diagnosis of diabetic peripheral neuropathy using : Neuropathy symptoms score (NSS) and Neuropathy disability score (NDS) which Pressure perception using 10gm Semmes Winston monofilament on10 sites in two feet.

#### **Sensory assessment**

-Two point discrimination -Babinski reflex- Stereognosis A pilot study was carried out on 10% of the sample (30 diabetic patients' males and females) before implementing the data collection to test the feasibility of study, identify the obstacles. Determine the supplies, equipments needed

### **Procedure**

#### **Phase I**

- Patient was interviewed individually to gain information about age, education, occupation, work hours, address, and telephone number. Past medical history, present health.
- In a private examination area, patient was asked to remove shoes and socket, general examination, specific foot examination were completed using diabetic foot examination sheet (tool II) Patient was asked to stand on scale, weight and height was measured and recorded. Body mass index was calculated by  $\text{weight} / (\text{height}^2)$  to determine the grade of obesity
- After that brachial blood pressure and radial pulse were measured.

## **Phase II**

### **- Diabetic Peripheral neuropathy was diagnosed by**

- Neuropathy symptoms score (NSS)
- Neuropathy disability score (NDS)
- Pressure perception using 10gm Semmes Winston monofilament in 10 sites on two feet.

### **-Assessment of sensory function**

- Two point discrimination by small calipers on face, palms, and tibial region, test the ability to distinguish separation of two simultaneous pinpricks on the skin.
- Babinski reflex using handle end (solid) on feet.
- Stereognosis. Test the patient's ability to recognize objects by feeling their weight and form (*Rathe , 2000* )

Regarding scoring for sensory assessments normal response takes score (0), abnormal takes (1)

## **Results**

**Table (1)** shows that 39.7% of studied patients were of age group 50-61, the mean age of patients was  $(53.86 \pm 9.25)$ . The female patients represented two thirds (65%) , the patients who had higher education were only ( 13%) ,while illiterate , read and write were( 4.75%,) .The majority of studied patients (88.7%) reported that they had active hours less than 8 per day and(99.3%) of studied sample had unsatisfactory

income, while (70.7%) of patient's reported primary health care centers as medical facility available for them.

**Table (2)** shows that (34.3%) of studied patients have diabetes for 6-10 years and (32.7 %) of patients have it for more than 10 years ,out of the total sample,(6.3%) female patients had gestational diabetes .Furthermore, the majority of patients (90.7 %) are non smokers .

**Table (3)** shows that (36%) of studied patients were obese class I .and (23%) of studied sample severally obese class II. Regarding presence of hypertension only (35.7%) of studied patients have hypertension stage I, the rest suffered from it with different stages and degrees. Random blood glucose level was measured and patients who had hyperglycemia were (57.0%).

**Table (4)** shows that (33.75%) of patients reported feeling in their feet as numbness while (23.7% and 23.7%) mentioned tingling or prickling sensation, sharp shooting pain. The patients who had  $\geq 3$  in total score of (NSS) were 23%, (10.3%) had total score  $\geq 6$  in neuropathy disability score. Loss of protective sensation was common in (11.0%) of patients. The total patients diagnosed with neuropathy (Abnormal with one of these three parameters) were 27.3 % of studied sample.

**Table(5)** reveals that assessment of foot pressure perception using 10gm monofilament had the best sensitivity, and negative predicted value (NPV) (36.36, 94.76) respectively and higher accuracy 87.0 Whatever neuropathy disability score (NDS) and neuropathy symptoms score (NSS) both had the higher specificity(94.42,94.37). Positive predictive value (PPV) was the highest with neuropathy symptoms score (40.91 ).

### Discussion

The present study documented the foot examination for 300 diabetic patients. Two thirds of studied sample were females because the diabetic clinic is scheduled in the morning when the majority of male patients are at work. Additionally, the minority of male patients cigarette smoking this was pointed to the patient's negative perception about smoking behavior, awareness regarding a particular health hazard to a patient with diabetes.

The majority of studied sample suffered from different degrees of hypertension, which includes pre hypertension – hypertension stage I –hypertension stage II. (*Webier,2009*) demonstrated that diabetes and high blood pressure are closely related diseases, they occur together so frequently that they are officially considered to be “co morbidities” diabetes makes high blood pressure more difficult to treat, and high blood pressure makes diabetes even more dangerous.

Diabetes and high blood pressure tend to occur together because they share certain physiological traits. Diabetes increases the total amount of fluid in the body, which tends to raise blood pressure, increased arterial stiffness, decrease the ability of the blood vessels to stretch, increasing average blood pressure .Impaired insulin handling changes the way the body produces and handles insulin, which can directly cause increases in blood pressure.

Abnormal random blood sugar (RBS)  $\geq 200$ mmHg was recognized in half of the studied sample. (*Ronquillo, 2003* ) clarified that diabetic patients with longer duration, older age have many difficulties to maintain blood glucose level at normal range even with strict dietary regimen. The reasons included coexisting factors as obesity, insulin resistance, depression symptoms, stressors, non-compliance with other elements of disease management

In the current study peripheral neuropathy was diagnosed in (27.3%) of studied sample .The difference in prevalence of neuropathy in the several populations may account for the conflicting results regarding diagnostic performance of screening tests .For example methodological differences of Semmis Wenistien monofilament (SWF )testing regarding the methodology used for conducting the tests, the number and

location of the sites to be tested, the number of applications per site and the criteria for defining an insensate foot. (**Richard , Reilhes et al., 2012**)

Regarding neuropathy symptoms score (NSS) the present study revealed that numbness followed by tingling and sharp shooting pain were the most common symptoms related to peripheral neuropathy ,the same result was found in the study conducted by (**Alston,2008** ) In addition (**Boulton,2012**) agreed that neuropathy cannot be diagnosed without a careful clinical examination; absence of symptoms must never be equated with absence of neuropathy, as asymptomatic neuropathy is common and there are many divisions of the diabetic neuropathies

The present study confirmed that Simmes Weinstein monofilament had the best sensitivity and positive predicted value whatever (NDS) neuropathy disability score had the higher specificity and accuracy .This finding is in agreement with (**Richard ,Reilhes ,et al 2012** ) who confirmed that SWF examination had a better overall diagnostic accuracy than vibratory perception thread (VPT) measurement to predict the incidence of diabetic neuropathy on clinical and electrophysiological criteria

Also, the present study considered 10 gm monofilament as the best predictor to diabetic neuropathy followed by neuropathy disability score (NDS)  $\geq 6$  to define it. This finding is in line with (**Abotte,2002;Edgar et al., 2005** ) who said that Semmis Wenistien monofilament (SWM) has been shown to be an effective screening tool to identify high risk patients .Also (**Peters, Lavery, 2001; Lavery et al., 1998** ) assure that a 128 Hz tuning fork (a strong part in neuropathy disability score ) can be used as an alternative alleging good correlation, based on a single study .

### **Conclusion**

Based on the findings it was concluded that diabetic peripheral neuropathy was diagnosed in one third of studied sample, 10gm monofilament had the best sensitivity.

### **Recommendation**

All patients with diabetes should be screened at least annually for presence of diabetic peripheral neuropathy. Foot care education must be provided to every diabetic patient with regular confirmation

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**Table (1): Distribution of the studied sample according to socio- demographic characteristics.**

	No	%
<b>1- Age(years)</b>		
20- 30	4	1.3
31 – 40	15	5.0
41 – 50	95	31.7
51 – 60	119	39.7
>60	67	22.3
<b>Range</b>	18.0 – 79.0	
<b>Mean ± SD</b>	53.86 ± 9.25	
<b>2- Gender</b>		
male	105	35.0
female	195	65.0
<b>3- Education</b>		
Illiterate	14	4.7
Principal	130	43.3
Secondary	117	29.0
University, Post	39	13.0
<b>4- Occupation</b>		
Skilled worker	65	21.7
Non skilled worker	64	21.3
Housewife	131	43.7
Retired	38	12.7
Others ( Student ,.....)	2	0.7
<b>5- Marital status</b>		
Married	274	91.3
Single	8	2.7
Divorced	4	1.3
Widow	14	4.7
<b>6- Children</b>		
Two	63	21.0
Three	122	40.7
More than three	98	32.7
Without	17	5.7
<b>7- Work hours</b>		
less than 8 hours	266	88.7
8 hours	25	8.3
12 hours	7	2.3
more than 12	2	0.7
<b>8- Income (Satisfactory)</b>		
Yes	2	0.7
No	298	99.3
<b>9- Medical facility</b>		
PHC	212	70.7
Out patients ,inpatient in Hospitals	88	29.3

**Table( 2): Distribution of the studied sample according to present health status ,life style**

	No	%
<b>31- Diabetes duration (years)</b>		
1-5	99	33.0
6 – 10	103	34.3
>10	98	32.7
Range	0.0 – 40.0	
Mean ± SD	9.89 ± 7.03	
<b>32- Type of diabetes</b>		
Type I	2	0.7
Type II	298	99.3
<b>33- Gestational diabetes</b>		
Yes	12	6.3
No	179	93.7
<b>34- Smoking</b>		
Smoker (male)	28	9.3
Non smoker	272	90.7
<b>35 - If smoking (years)</b>		
Range	4.0 – 40.0	
Mean ± SD	27.36 ± 11.95	
<b>36-How many cigarettes</b>		
Range	3.0 – 100.0	
Mean ± SD	23.0 ± 26.53	
<b>37- If stop smoking how many years?</b>		
Range	5.0 – 40.0	
Mean ± SD	14.68 ± 9.89	
<b>38-Caffeine intake</b>		
Number of cups	5	1.7
1	39	13.0
2	60	20.0
3	155	51.7
4	39	13.0
5	1	0.3
6	1	0.3

**Table (3): Distribution of studied sample according to general physical examination (n = 300)**

<b>General physical examination</b>	<b>No.</b>	<b>%</b>
<b>Weight (Kgm )</b>		
Range	48.0 – 175.0	
Mean ± SD	86.82 ± 14.36	
<b>BMI</b>		
Mild mal nutrition = 17- 18.4	2	0.7
Normal body mass index =18.5- 24.9	7	2.3
Over weight = 25 - 29.9	78	26
Obese class I = 30 - 34.9	108	36.0
Severely Obese class II = 35 - 39.9	69	23.0
Extreme obese class III = > 40	36	12.0
Range	17.20 – 59.30	
Mean ± SD	33.52 ± 6.18	
<b>Heart rate</b>		
Normal	4	1.3
Bradycardia	273	91.0
Tachycardia	23	7.7
<b>Standing blood pressure</b>		
No hypertension	28	9.3
Pre Hypertension 120- 139. 80- 89 mmHg	92	30.7
Hypertension Stage I 140- 159, 90- 99 mmHg	107	35.7
Hypertension Stage II > 160 , > 100mmHg	73	24.3
<b>Supine blood pressure</b>		
No hypertension	29	9.7
Pre Hypertension	92	30.7
Hypertension Stage I	108	36.0
Hypertension Stage II	71	23.7
Total		
No Autonomic neuropathy	278	92.7
Have Autonomic neuropathy (orthostatic blood pressure drop +abnormalities in heart rate )	22	7.3
<b>Random blood glucose</b>		
Normal < 200mm/dl	129	43.0
Abnormal >200mml dl	171	57.0
Range	66.0 –	
Mean ± SD	587.0 237.35 ± 97.36	

**Table (4): Distribution of studied sample according to presence of diabetic peripheral neuropathy using different parameters (peripheral neuropathy score – neuropathy disability score, 10 gm monofilament)**

	No.	%	
<b>Neuropathy symptoms score</b>			
1- Muscular cramps	64	21.3	
2- Numbness	71	33.7	
3- Abnormal hot or cold sensation	41	13.7	
4- Tingling or prickling sensation	71	23.7	
5- Sharp shooting pain	71	23.7	
6- Irritation caused by bed clothes	15	5.0	
7- Burning sensation	49	16.3	
<b>Abnormal total neuropathy symptoms score (NSS)</b>			
No	231	77.0	
Yes	69	23.0	
<b>Neuropathy Disability Score(NDS)</b>	<b>Abnormal</b>	<b>Normal</b>	
Vibratory perception using 128 tuning fork	17	5.7	283 94.3
Temperature	19	6.3	281 93.7
Pinprick	22	7.3	278 92.7
Light touch	19	6.3	281 93.7
Achilles reflex	186	62.0	114 38.0
<b>Total neuropathy disability score (NDS)</b>			
Normal	269	89.7	
Abnormal	31	10.3	
<b>Monofilament test</b>			
<b>Right foot</b>			
Normal	267	89.0	
Abnormal	33	11.0	
<b>Left foot</b>			
Normal	267	89.0	
Abnormal	33	11.0	
<b>Total neuropathic patients</b>			
No	218	72.7	
Yes	82	27.3	
<b>Sensory function</b>			
<b>Two point discrimination</b>			
Normal	276	92.0	
Abnormal	24	8.0	
<b>Babinski reflex</b>			
Normal	249	83.0	
Abnormal	51	17.0	
<b>Stereognosis (patient identify familiar object with eyes closed )</b>			
Normal	291	97.0	
Abnormal	9	3.0	

**Table (5) :- (Sensitivity, specificity and accuracy) of different parameters (peripheral neuropathy score – neuropathy disability score and 10 gm monofilament**

		Not foot ulceration	Foot ulceration	Sensitivity	Specificity	PPV	NPV	Accuracy
<b>Neuropathy symptoms score NSS</b>	<b>No</b>	218	60	13.04	94.37	40.91	78.42	75.67
	<b>Yes</b>	13	9					
<b>Neuropathy disability score (NDS)</b>	<b>No</b>	254	24	22.58	94.42	31.82	91.37	87.0
	<b>Yes</b>	15	7					
<b>Foot perception using monofilament Right</b>	<b>Normal</b>	253	14	36.36	91.01	24.24	94.76	87.0
	<b>Abnormal</b>	25	8					
<b>Left</b>	<b>Normal</b>	253	14	36.36	91.01	24.24	94.76	87.0
	<b>Abnormal</b>	25	8					

## طرق الكشف للتعرف على حدوث اعتلال الاعصاب الطرفية بين مرضى السكر

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### الخلاصة

يعتبر اعتلال الاعصاب الطرفية واحد من اهم المضاعفات المرتبطة بمرض السكرى ويصيب  
اكثر من 50% من المرضى و الالام الملازمة لمرض اعتلال الاعصاب توجد فى ثلث  
المرضى المصابين بمرض السكرى .

تهدف هذه الدراسة الى طرق الكشف عن حدوث اعتلال الاعصاب الطرفية بين مرضى السكر .  
دراسة استكشافية فى مدينة بورسعيد تضمنت 300 مريضا بالسكرى. الادوات التى استخدمت  
فى جمع البيانات الاتى:- استمارة معلومات مريض السكر - استمارة فحص القدمين وهى  
تحتوى على جزئين - الفحص العام ويشتمل على الطول - الوزن - معدل كثافة الجسم -  
النبض- ضغط الدم - والجزء الثانى يحتوى على مقاييس مختلفة لتشخيص اعتلال الاعصاب  
باستخدام (NSS) - (NDS)- خيط تالمونوفيلمنت .

وقد اسفرت نتائج البحث عن الاتى:- المرضى الذين حصلوا على  $\geq 3$  فى مقياس (NSS)  
كانوا (23%) ، (10.3%) فى مقياس (NDS) اما فقد الاحساس فقد مثل 10% من العينة  
الدراسة وجدت ان (27,3%) من المرضى فى العينة كانوا مصابين باعتلال الاعصاب الناتج  
عن مرض السكرى ( اذا كان نتيجة فحص واحد من المقاييس الثلاثة يعطى نتيجة غير طبيعية )  
ايضا اظهرت الدراسة ان خيط المونوفيلمنت كان الاكثر دقة حساسية بين امقاييس الثلاثة  
التوصيات :- - يجب أن يجرى فحص القدمين سنويا ويشتمل على تقييم كلا من الإحساس في  
القدمين والدورة الدموية وان برامج تعليم كيفية العناية بالقدمين يجب ان تطبق باستمرار ويتم  
مراجعتها دوريا على مرضى السكر .

**الكلمات الدالة :-** اعتلال الاعصاب الطرفية - طرق الكشف