Screening Of Acute And Chronic Diabetic Complications Among A Cohort Of Diabetic Patients Admitted To Intensive Care Unit

Fathy Z. El-Sewy[1], Abla A. Abou-Zeid[2], Tamer A. Helmy[3], Amr F. Abou-Alkhair[4] and Soha S. A. El baz[3]

[1]Internal Medicine Dept., [2]Clinical and Chemical Pathology Dept., [3]Critical Care Medicine Dept., [4]Opthalmolgy Dept.
Tamer270103@hotmail.com

Abstract: Background: The present study included two hundreds and fifty patients admitted to intensive care units of the main University Hospital of Alexandria. All patients had diabetes mellitus whether diabetes is the primary or secondary cause for admission. There are 148 females (59.2%) and 102 (40.8%) male patients. The age of these patients varies from 9 to 85 years with a mean 49.55 ± 17.46 years. 80.4% of the patients were type 2 DM and 19.6% were type 1 DM. **Aim of the work**: was to determine the prevalence of acute and chronic diabetic complications among 250 diabetic patients admitted to the Intensive Care units of the Alexandria main University Hospital. **Subjects and methods:** All patients were subjected to thorough clinical examination including: Complete history taking, laying stress on the duration of diabetes, treatment given to control diabetes and the occurrence of the different complications of diabetes. Complete general examination, laying stress on the cardiovascular system, chest examination, abdominal examination, and examination of peripheral nervous system. Laboratory investigation especially: Random blood glucose. Serum creatinine, blood urea nitrogen. Serum cholesterol, serum TG. urinary albumin excretion rate. Electrocardiogram. Fundus examination by direct ophthalmoscope. **Result**: The result of the present study can be summarized as follow: 95.6% of patients are suffering from one or more of the diabetic complications. Either acute in 30.8% or chronic in 81.2% DKA was the most frequent acute complication accounting 23.6% of these complications. It occurred mostly in type 1 diabetes and to lesser extend in type 2 diabetes. Diabetic neuropathy was the most common chronic complications accounting for 56% of complications; somatic peripheral neuropathy is the commonest type of diabetic neuropathy, in our study the incidence of somatic neuropathy was 52.8% and autonomic neuropathy was 10%, most of patients suffering from autonomic neuropathy were having in the same time somatic neuropathy. Followed by diabetic nephropathy (41.2%), cardiovascular complications (34.8%), diabetic retinopathy (32.8%), diabetic foot (25.2%), 59 cases have DKA (23.6%), 37 cases have CVS (14.8%). There was positive correlation between BMI and increase in serum cholesterol and serum TG. DKA was significantly higher in patients with type 1 diabetes than those with type 2 diabetes. Diabetic neuropathy, nephropathy, retinopathy, cardiovascular and diabetic complications were significantly higher in type 2 diabetes than type 1 diabetes. There was negative correlation between DKA and duration of diabetes. But, there was positive correlations between duration of diabetes and retinopathy, neuropathy, foot complications, cardiovascular and cerebrovascular complications. There was significant impact present of some metabolic variants like hyperglycemia, HTN and hyperlipidemia on the development of different complications. Also the effect of the body weight (BMI) and its positive correlation with these variables. There is positive correlations between all diabetic complications and blood pressure, RBG, serum cholesterol, and serum TG.

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1. Introduction

The term diabetes mellitus describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both [(1-4)] .

The classification of DM is based on etiology, not on treatment The terms juvenile-onset, adult-onset, insulin-dependent and non-insulin-dependent are no longer used since they are not helpful for differentiating etiology of the DM. Current classifications based on etiology utilize the terms type 1, type 2 and gestational diabetes to depict the three most common forms[(4,5).]

Patients may be asymptomatic – discovered on routine examination/lab test. Classic symptoms include: Polyuria, polydipsia, Loss of weight, Fatigue, Blurred vision and Recurrent vaginal infections or recurrent UTIs.

Patients with type 1 diabetes usually present with classic symptoms which may culminate in the

development of DKA which considered to be an acute complication.

Patients with type 2 diabetes may be asymptomatic or present with classic symptoms. Sometimes patients present with complications of diabetes: a) Micro vascular complications: neuropathy, retinopathy, nephropathy and b) Macro vascular complications: cardiovascular and, cerebrovascular disease.

Note that up to 20% of newly diagnosed patients with type 2 diabetes may have micro vascular complications at the time of diagnosis.

- Hyperosomolar non ketatic coma (acute).

In people with type 1 diabetes, the cornerstone of treatment remains insulin injections.

In type 2 diabetes, some individuals will initially obtain control of blood sugar with diet modification, weight loss and exercise.

Unfortunately, many people are unable to meet the dietary and exercise recommendations. In addition, the natural history of type 2 diabetes shows that less insulin is made over time. For most patients, medications are generally required early, and often multiple medications with different mechanisms of action are utilized.

But in significant change in the paradigm of treatment of type2 diabetes, early insulin therapy holds place in the management. Recent studies have shown that if insulin therapy is initiated early it prevents further beta cell destruction[(1)] Insulin should be the initial therapy in type2 diabetic particularly in: Lean individual or those with severe weight loss, In individuals with renal or hepatic disease that precludes the use of oral glucose lowering agents, In hospitalized or acutely ill patients, In pregnant patient and Severe hyperglycemia at presentation 250 – 300mg/dl

The aim of this study was to determine the prevalence of acute and chronic diabetic complications among 250 diabetic patients admitted to the Intensive Care units of the Alexandria main University Hospital.

2. Patients and Methods:

Two hundred and fifty diabetic patients who were admitted to the Intensive Care Units of the Alexandria main University Hospital were included in the present study whether diabetes is the primary or secondary cause for admission. All patients, all ages, different types of diabetes, known or newly diagnosed diabetes were included in the study.

Methods:

All patients were subjected to the following:

1. Complete history taking including: Age, sex, smoking. Duration of diabetes in years and type of diabetes. History of current treatment of hypertension, cerebrovascular disease, cardiovascular, renal, thyroid or other endocrinal diseases. Family history of diabetes: father, mother, brother and sisters and history of consanguinity. Present history of acute symptoms of DM. Symptoms of complications: Ophthalmologic: eg. diplopia, visual loss.Neurological: numbness, hypothesia or anesthesia. Renal: edema, dysuria, and pruritis vulvae. Cerebrovascular events: eg. Stroke. Cardiovascular events: angina or MI.Peripheral vascular disease: intermittent claudication, gangrene or amputation. Autonomic: GIT symptoms, postural hypotension and impotence. History of acute complications: DKA hyperosmolar nonketotic coma and hypoglycemia, and frequency of attacks. History of hospitalization for diabetes related complications and for diseases other than diabetes. Current treatment modalities :Oral drugs (total dose/day). Insulin therapy (type, total dose u/day, number of injections/day) Other ant diabetic treatment. History of discontinuing any treatment for adverse effects. Diet compliance: strict, moderate, or weak.Thorough clinical examination including: Pulse, blood pressure. Body Mass Index (BMI) Body mass index is defined as the individual's body weight divided by the square of his or her height. The formulae universally used in medicine produce a unit of measure of kg/m^2. Head and neck , examination of the extremities for colour changes, fungus infection, coldness, ulcers, gangrene, and amputation. Complete physical examination: with especial stress on chest, cardiac, and nervous system.
2. Laboratory work up: Complete blood picture [(6)]. Random blood glucose level[(7)] . Complete urine analysis including detecting of glucose, and ketones. BUN and serum creatinine[(8)]. Liver function(ALT, AST) [(9)]. Lipid profile including: serum cholesterol, TG [(10)]. Urinary albumin excretion rate[(7)]: normoalbuminuria <30 mg/24h. microalbuminuria 30-300 mg/24h and macroalbuminuria>300 mg/24 h.
3. Direct ophthalmoscopy with pupil dilated by pupil mydriasis (tropicamide 0.5 %). The degree of retinopathy for each patient will be determined. A useful clinical classification according to the types of lesions detected on fundoscopy is as follows:

- **Mild non-proliferative diabetic retinopathy:** Micro aneurysms, Dot, blot hemorrhages and Hard (intra-retinal) exudates.

- **Moderate-to-severe non-proliferative diabetic retinopathy** The above lesions, usually with exacerbation, plus: Cotton-wool spots, Venous beading, loops and Intra retinal micro vascular abnormalities (IRMA)
- **Proliferative diabetic retinopathy**: Neovascularization of the retina, optic disc or iris, Fibrous tissue adherent to vitreous face of retina, Retinal detachment, Vitreous hemorrhage and Pre retinal hemorrhage.
- **Maculopathy**:(difficult to be detected with direct ophthalmoscope), Clinically significant macular edema (CSME) and Ischemic Maculopathy.

4. Autonomic nerve functions: ECG changes (resting tachycardia and variations in PR interval) and orthostatic hypotension.
5. 12 lead Electrocardiogram.
6. Plain X ray chest for detection of chest infection.

3. Results:

Table 1 shows the characteristic features of the studied cases: of the 250 diabetic patients admitted to intensive care units of Alex. University hospitals, 102 were males and 148 females. Their ages ranged from 9.0 to 85.0 years with a mean age 49.55±17.46 SD. 80.4% were type 2 diabetes and 19.6% were type 1. Among type 2 diabetics 10% were newly diagnosed. 31.2% of patients were smokers. Out of the total number of patients 34.8% were receiving insulin, either as mono-therapy or combined with oral agents while 55.2% were receiving only oral hypoglycemic agents. Table (1a) also shows that the duration of diabetes ranged from 0 to 45 years with a mean of 9.46 ±7.84 years. The body mass index (BMI) ranged from 19.10 to 40 with a mean of 24.84 ±4.04 kg/m^2.

Table (1a): Demographic data of studied population

	No.	%
Sex		
Male	102	40.8
Female	148	59.2
Age(years)		
<20	15	6.0
20 - <40	45	18.0
40- <60	110	44.0
60+	80	32.0
Range	9.00-85.00	
Mean ± SD	49.55 ± 17.46	
BMI (kg/m^2)		
Range	19.10-40.00	
Mean ± SD	24.84 ± 4.04	
Smoking		
Non smoker	172	68.8
Smokers	78	31.2
Type of diabetes		
Type I	49	19.6
Type II:	201	80.4
Newly diagnosed	25	10.0
Known diabetic	176	70.4
Treatment of diabetes		
Newly diagnosis	25	10.0
Insulin	87	34.8
OHD (oral hypoglycemic drugs)	138	55.2
Duration of diabetes (years)		
Range	0.00-45.00	
Mean ± SD	9.46 ± 7.84	

Table (1b): Distribution of the studied cases according to BMI:

BMI(kg/m^2)	No.	%
< 25	116	46.4
25 – 29	114	45.6
≥ 30	20	8.0

Table (2) shows past history of the studied cases. Past history of HTN was found in 44.8%, CVS in 4.0%, hyperthyroidism in 1.2%, hypothyroidism in 6%, IHD in 20.0%, bronchial asthma in 5.6%, and pituitary disorders in 0.8%.

Laboratory findings:

Table (3a) shows the results of some of laboratory finding in studied cases:

1. Serum lipids:

19.2% of all diabetic patients had serum cholesterol level above the cut point of 200 mg/dl, 80.8% had serum cholesterol level < 200mg/dl. 16.4% of studied cases had triglyceride level ≥ 150 mg/dl, 83.6% had TG < 150 mg/dl.

2. Glycaemic levels:

Table (3b), shows that 78.4 % of the diabetic patients had random blood glucose (RBG) ≥ 200 mg/dl which considered as inadequate glycemic control.

Table (2): Distribution of the studied cases according to past history

	No.	%
HTN	112	44.8
CVS	10	4.0
History of hyperthyroidism	3	1.2
History of hypothyroidism	15	6.0
IHD	50	20.0
Bronchial asthma	14	5.6
Pituitary disorders	2	0.8

HTN: hypertension CVS: cerebrovascular stroke IHD: ischemic heart disease

Table (3a): Distribution of the studied cases according to different laboratory findings:

	Range	Mean ± SD
Temp	36.00-40.00	37.34 ± 0.54
Hb (g/dl)	4.00-18.00	11.38 ± 2.39
WBCs ($\times 10^3/\mu l$)	4.20-51.10	12.46 ± 6.24
Normal	124 (49.6%)	
Leucocytosis	126 (50.4%)	
BUN(mg/dl)	5.00-270.00	44.53 ± 42.68
Serum Cr(mg/dl)	0.4-12.00	1.83 ± 1.94
Cholesterol(mg/dl)	90.00-300.00	137.18 ± 61.86
< 200	202 (80.8%)	
≥ 200	48 (19.2%)	
TG(mg/dl)	55.00-398.00	96.40 ± 53.07
< 150	209 (83.6%)	
≥ 150	41 (16.4%)	
ALT(u/l)	10.00-939.00	51.80 ± 93.09
AST(u/l)	8.00-853.00	44.95 ± 87.08

Table (3b): Distribution of the studied cases according to random blood glucose

	Controlled (<200mg/dl)		Uncontrolled (≥ 200mg/dl)	
	No.	%	No.	%
RBG	54	21.6	196	78.4
Range	31.00 – 190.00		200.00 – 1136.00	
Mean ± SD	137.40 ± 43.12		405.76 ± 179.65	

Blood pressure levels:

Table (4) shows that 24.8% of the diabetic patients had systolic hypertension (systolic B.P ≥140 mm Hg) and 27.2% had diastolic hypertension (diastolic B.P ≥90 mm Hg).

Table (4): Distribution of the studied cases according to systolic and diastolic blood pressure:

	No.	%
Systolic BP(mmHg)		
Range	60.00-230.00	
Mean ± SD	127.02 ± 30.72	
Systolic HTN (≥140mmHg)	62	24.8
Diastolic BP(mmHg)		
Range	20.00-140.00	
Mean ± SD	76.73 ± 16.72	
Diastolic HTN (≥90mmHg)	68	27.2

Clinical examination and investigations:

Table (5) shows that 59.2% of patients had normal electrocardiogram (ECG) while the remaining had positive finding either new or old ischemic changes or arrhythmia.

Table (6) shows that 67.2% had normal fundus examination while 20.8% of diabetic patients had non proliferative or background diabetic retinopathy and 12% had proliferative retinopathy.

Table (7) shows the result of neurological examination among studied cases, 52.8% had positive neurological signs ranging from glove and stock parathaesia, loss of ankle reflex and loss of vibration sense, while 47.2% had normal neurological examination.

Urinary albumin excretion:

Table (8a) show that 58.8% of patients had normal level of urinary albumin excretion (<30 mg/24 hour urine), 35.6% had microalbuminuria (30 -300 mg/24 hour urine) and 5.6% had macroalbuminuria (≥ 300 mg/24 hour urine).

Table (8b) shows that 52.4% of patients who had microalbuminuria had end stage renal disease, 38.8% were chronic renal failure with regular renal dialysis and 13.6% were acute renal failure , only 1.9% of them had dialysis .The rest of patients had normal renal function .

Table (9) show that interdigital fungus infection was the most common finding (14.4%). Foot ulcers of different sizes and depths were found in 1.6% and evidences of ischemic changes in 3.2%. Amputations ranging from one toe amputation to complete foot amputation or more extensive limb amputation were found in 6% of cases.

Table (5): Distribution of the studied cases according to ECG finding

	No.	%
Arrhythmia	24	9.6
STEMI	29	11.6
NSTEMI	12	4.8
Old ischemia	39	15.6
Normal ECG	148	59.2

STEMI: ST segment elevation myocardial infraction
NSTEMI: Non ST segment elevation myocardial infraction

Table (6): Distribution of the studied cases according to fundus examination.

	No.	%
Fundus examination		
Normal	168	67.2
Non proliferative	52	20.8
Proliferative	30	12.0

Table (7): Distribution of the studied cases according to examination of peripheral neuropathy

	No.	%
Neurological		
Free	118	47.2
+ve	132	52.8

Table (8a): Distribution of the studied cases according to urinary albumin excretion rate

	NO.	%
Albuminuria (mg/24hour urine)		
Range	6.00-984.00	
Mean ± SD	78.01 ± 120.77	
Normal <30mg/24hour urine	147	58.8
Micro30-300 mg/24hour urine	89	35.6
Macro ≥300mg/24hour urine	14	5.6

Table (8b):Distribution of studied cases with albuminuria (n= 103) according to the presence of renal impairment

	No.	%
With RF	**54**	**52.4**
Acute	**14**	**13.6**

On dialysis	2	1.9
No dialysis	12	11.7
chronic	**40**	**38.8**
On dialysis	40	38.8
No dialysis	0	0.0
Without RF	**49**	**47.6**
Microalbuminuria	47	45.6
Macroalbuminuria	2	1.9

Table (9): Distribution of the studied cases according to foot examination.

	No.	%
Foot complication		
Foot infection	36	14.4
Foot amputation	15	6.0
Foot ulcers	4	1.6
Ischemic changes	8	3.2

Complication of DM:

In the present study 4.4% of diabetic patients had no complications and 95.6% had complications, 14.4% had single acute complications, 10.8% had single chronic complications , 54% had multiple chronic complications and 16.4% had combinations of acute and chronic complications (Table 11).

Acute complications:

Diabetic ketoacidosis:

Ketoacidosis ranging from mild short ketonuria to severe ketoacidosis associated with coma was found in 23.6% of patients(Table 10) . 15.2% were type 1 and 8.4% were type 2 DM (Table 16).

Hypoglycemia:

Table (10) shows 3.2% of patients had hypoglycemia. All hypoglycemic patients were type 2 table (16).

Non ketotic hyperosmelar hyperglycemia (NKHH):

Table (10) shows that 4% of studied patients admitted with NKHH , All patients were type 2 diabetes (16).

Chest infection:

Table (10) shows that 5.2% of the patient had chest infection, 4.8% were type2 and 0.4% were type1 DM (Table 16).

Chronic complications:

Macrovascular complications:

Cardiovascular complications:

34.8% of patients had cardiovascular complications in the form of heart failure ,acute coronary syndromes and , or arrhythmia (Table 10) , 33.2% were type 2 DM and 1.6% were type 1 DM (Table 16) .

Cerebrovascular complications:

Table (10) shows that 14.8% of studied cases had one attack of cerebrovascular stroke (CVS) , 13.2% were type 2 DM and 1.6% were type 1 DM (Table 16).

Microvascular complications:

Table 10 shows the distribution of studied cases according to the presence of chronic microvascular complications.

Neuropathy:

56% of patients had neuropathy, 52.8% of them had somatic neuropathy and10% had autonomic neuropathy. 52% of this cases were type 2 DM and 4% were type 1 DM (Table 16).

Nephropathy:

The results revealed that 41.2% of patients had urinary albumin excretion more than 30 mg/24 hour urine table (10) , 35.6% were type 2 DM and 5.6% were type 2 DM (Table 16).

Table (12) ,and fig.(14) show that serum creatinine in patients with normal albumin excretion rate ranged from 0.5- 2.70 mg/dl with a mean of 0.94±0.43 mg/dl, in patients with microalbuminuria 0.4- 9.60 mg/dl with a mean of 2.51±2.05 mg/dl and in patients with macroalbuminuria 0.4- 12.0 mg/dl with a mean of 5.34±3.03 mg/dl. Table (12) also shows that there was significant relation between serum creatinine and urinary albumin excretion rate in detecting renal function integrity.

Retinopathy:

Table (10) shows that 32.8% of cases had diabetic retinopathy, 24.4% were type 2 DM and 8.4% were type 1 DM (Table 16).

Other complications:

Diabetic foot: 25.2% of patients had diabetic foot (Table 10) either fungal infection, ulcers , ischemic

changes and amputations. 22.8% were type 2 DM and 2.4% were type 1 DM (Table 16).

Relation between BMI and different metabolic parameters:

Table (13) and show the relation between the BMI and some risk factors as systolic HTN, diastolic HTN, hyperglycemia, hyperlipidemia. There was positive correlation between BMI and increase in serum cholesterol and TG. But there was no significant correlation between BMI and systolic HTN, diastolic HTN, and hyperglycemia.

Relation between microvascular complications and different metabolic parameters:

Table (14a) show that there is significant association (P≤0.05) between microvascular complications and systolic HTN, diastolic HTN, hyperglycemia, S. cholesterol ≥ 200mg/dl, and S. TG ≥150mg/dl.

Table (14b) shows the correlation between microvascular complications and these metabolic parameters. There is positive correlations between retinopathy and blood pressure (P≤0.05). Also retinopathy is positively correlated with RBG, S. cholesterol, and S.TG.

Diabetic neuropathy is positively correlated with blood pressure, RBG, S. cholesterol, and S.TG.

Diabetic nephropathy is positively correlated with blood pressure, RBG, S. cholesterol, and S. TG.

Table (10): Distribution of the studied cases according to complications

	No.	%
Acute complications	77	30.8
DKA	59	23.6
Hypoglycemia	8	3.2
NKHH	10	4.0
Chronic complications	203	81.2
Microvascular	186	74.4
Retinopathy	82	32.8
Neuropathy	140	56.0
Somatic neuropathy	132	52.8
Autonomic neuropathy	25	10.0
Nephropathy	103	41.2
Macrovascular	139	55.6
Cardiovascular	87	34.8
CVS	37	14.8
Other		
Diabetic foot	63	25.2
Chest infection	13	5.2

Table (11): Distribution of the studied cases according to single and multiple complications

	No.	%
Acute (n=77)		
Single	77	100.0
Chronic (n=203)		
Single	52	25.6
Multi	151	74.4
Complications		
No complications	11	4.4
Single (acute)	36	14.4
Single (chronic)	27	10.8
Multi (chronic)	135	54.0
Multi (acute + chronic)	41	16.4

Relation between macrovascular complications and different metabolic parameters:

Table (15), and show that there is significant association (P≤0.05) between macrovascular complications and systolic HTN, diastolic HTN, hyperglycemia, S. cholesterol ≥200mg/dl, and S. TG ≥150mg/dl.

Table (15b) shows the correlation between macrovascular complications and these metabolic parameters. There is positive correlations between cardiovascular complications and blood pressure. Also cardiovascular complications are positively correlated with RBG, S. cholesterol, and S.TG.

CVS is positively correlated with blood pressure, RBG, S. cholesterol, and S.TG.

Relation between diabetic foot complications and different metabolic parameters:

Table (15), show that there is significant association between diabetic foot complications and systolic HTN, diastolic HTN, hyperglycemia, S. cholesterol ≥200mg/dl, and S. TG ≥150mg/dl.

Table (15b) shows that there is positive correlations between diabetic foot complications and blood pressure, RBG, S. cholesterol, and S.TG.

Table (12): Relation between serum creatinine and urinary albumin excretion rate

	Normal	Micro	Macro
Serum creatinine Range	0.5-2.70	0.4-9.60	0.4-12.00
Mean ± SD	0.94 ± 0.43	2.51 ± 2.05	5.34 ± 3.03
χ^2 (p)	82.401* (<0.001)		
Z_1 (p)		7.414* (<0.001)	6.301* (<0.001)
Z_2 (p)			4.001* (<0.001)

χ: Chi square for Kruskal Wallis test
Z_1 : Z for Mann Whitney test between normal with micro and macroalbuminuria
Z_2 : Z for Mann Whitney test between micro and macroalbuminuria

- : Statistically significant at $p \leq 0.05$
-

Table (13): Correlation between BMI with systolic HTN, diastolic HTN, hyperglycemia, and hyperlipidemia

	R	P
Systolic HTN	0.007	0.910
Diastolic HTN	0.060	0.345
RBG	-0.027	0.667
Cholesterol	0.380*	<0.001
TG	0.276*	<0.001

r: Pearson coefficient * : Statistically significant at $p \leq 0.05$

Table (14a): Relation between retinopathy, neuropathy, nephropathy with systolic HTN, diastolic HTN, hyperglycemia, hyperlipidemia

	Retinopathy		Neuropathy		Nephropathy	
	No.	%	No.	%	No.	%
Systolic HTN	18	7.2	48	18.0	35	14.0
p	0.001*		0.002*		0.005*	
Diastolic HTN	19	7.6	49	19.6	38	15.2
p	0.002*		0.002*		0.004*	
RBG(>200mg/dl)	25	10.0	99	39.6	90	36.0
p	0.008*		0.001*		0.004*	
Cholesterol (>200mg/dl)	14	5.6	37	14.8	26	10.4
p	0.006*		0.001*		0.042*	
TG(>150mg/dl)	11	4.4	32	12.8	23	9.2
p	0.039*		0.002*		0.034*	

p: p value Chi square test * : Statistically significant at $p \leq 0.05$

Table (14b): Correlation between systolic BP, Diastolic BP, RBG, S. cholesterol and S. TG with retinopathy, neuropathy and nephropathy:

		Retinopathy	Neuropathy	Nephropathy
Systolic BP (mmHg)	**r**	0.289*	0.268*	0.265*
	p	<0.001	<0.001	<0.001
Diastolic BP (mmHg)	**r**	0.295*	0.244*	0.158*
	p	<0.001	<0.001	0.012
RBG (mg/ dl)	**r**	0.242*	0.134*	0.264*
	p	<0.001	0.035	<0.001
S. cholesterol (mg/ dl)	**r**	0.306*	0.203*	0.192*
	p	<0.001	0.001	0.002
S. TG (mg/ dl)	**r**	0.275*	0.226*	0.145*
	p	<0.001	<0.001	0.022

r: Pearson coefficient * : Statistically significant at $p \leq 0.05$

Table (15a): Relation between foot, cardiovascular and CVS with systolic HTN, diastolic HTN, hyperglycemia, hyperlipidemia

	Foot		cardiovascular		CVS	
	No.	%	No.	%	No.	%
Systolic HTN	19	7.6	36	14.4	20	8.0
p	0.255		<0.001*		<0.001*	
Diastolic HTN	21	8.4	35	14.0	17	6.8
p	0.206		0.001*		0.006*	
RBG(>200mg/dl)	54	21.6	62	24.8	24	9.6
p	0.103		0.045*		0.030*	
Cholesterol (>200mg/dl)	18	7.2	27	10.8	12	4.8
p	0.029*		0.001*		0.029*	
TG(>150mg/dl)	15	6.0	24	9.6	11	4.4
p	0.066		<0.001*		0.018*	

p: p value Chi square test * : Statistically significant at $p \leq 0.05$

Table (15b): Correlation between systolic BP, Diastolic BP, RBG, S. cholesterol and S. TG with foot, cardiovascular and CVS

		Foot complications	Cardiovascular complications	CVS
Systolic BP (mmHg)	**r**	0.163*	0.228*	0.169*
	p	0.010	<0.001	0.007
Diastolic BP (mmHg)	**r**	0.213*	0.173*	0.135*
	p	0.001	0.006	0.032
RBG (mg/ dl)	**r**	0.196*	0.136*	0.259*
	p	0.002	0.031	<0.001
S. cholesterol (mg/ dl)	**r**	0.165*	0.323*	0.182*
	p	0.009	<0.001	0.004
S. TG (mg/ dl)	**r**	0.140*	0.304*	0.205*
	p	0.027	<0.001	0.001

r: Pearson coefficient * : Statistically significant at $p \leq 0.05$

Relation between type of diabetes and development of diabetic complications:

DKA was significantly higher in patients with type 1 diabetes than those with type 2 diabetes. Diabetic retinopathy, nephropathy, neuropathy, foot complications, and cardiovascular complications were significantly higher in patients with type 2 diabetes than those with type 1 diabetes. There is no significant difference in hypoglycemia, NKHH, chest infection, and CVS between type 1 and type 2 diabetes (Table 16).

Relation between duration of diabetes and development of different complications:

There was negative correlation between DKA and duration of diabetes,. But, there was positive correlations between duration of diabetes and retinopathy,; neuropathy; foot complications,; cardiovascular; and cerebrovascular complications, , (Table 17). There was no significant correlations between duration of DM and nephropathy.

Table (18), show that all studied cases who had diabetes for more than 10 years had complications, and when the duration increased there were increase risk to develop more than one chronic complications as 41.3% of patients who had diabetes for less than 10 years had multiple chronic complications, 15.4% had single chronic complication. And those who had diabetes for more than 20 years no one had single chronic complication, and all patients had multiple complications either multiple chronic 84.2% or multiple acute and chronic 15.8%.

Table (19), show that hyperglycemia was significantly high ($p<0.05$) between patients with single acute, single chronic, multiple acute, and multiple chronic complications and patients with no complications. however hyperglycemia had no significant difference on development single or multiple chronic complications.

Table (16): Relation between type of diabetes and development of diabetic complications :

	Type of diabetes				Test of sig.
	Type I		Type II		
	No.	%	No.	%	
DKA	38	15.2	21	8.4	χ^2= 98.386* p <0.001
Hypoglycemia	0	0.0	8	3.2	FEp= 0.361
NKHHG	1	0.4	9	3.6	FEp= 0.692
Retinopathy	21	8.4	61	24.4	χ^2= 23.340* p <0.001
Neuropathy	10	4.0	130	52.0	χ^2= 31.333* p <0.001
Nephropathy	14	5.6	89	35.6	χ^2= 4.012* p= 0.045
Chest infection	1	0.4	12	4.8	FEp= 0.473
Foot	6	2.4	57	22.8	χ^2= 5.426* p= 0.020
Cardiovascular	4	1.6	83	33.2	FEp <0.001*
CVS	4	1.6	33	13.2	FEp= 0.181

χ^2: Chi square test FEp : p value for Fisher Exact test * : Statistically significant at $p \leq 0.05$

Table (17): Correlation between duration of diabetes with complication

	R	P
DKA	-0.177*	0.005
Hypoglycemia	0.101	0.110
NKHHG	-0.084	0.186
Retinopathy	0.487*	<0.001
Neuropathy	0.512*	<0.001
Nephropathy	0.056	0.376
Chest infection	-0.115	0.069
Foot	0.392*	<0.001
Cardiovascular	0.194*	0.002
CVS	0.178*	0.005

r: Pearson coefficient * : Statistically significant at $p \leq 0.05$

Table (18): Relation between complications with duration and type of diabetes

	Complications									
	No complications		Single (acute)		Single (chronic)		Multi (chronic)		Multi (acute + chronic	
Duration										
<10 (n= 143)	11	7.7	26	18.2	22	15.4	59	41.3	25	17.5
10-20 (n= 88)	0	0.0	10	11.4	5	5.7	60	68.2	13	14.8
>20 (n= 19)	0	0.0	0	0.0	0	0.0	16	84.2	3	15.8
MCp	<0.001*									
Type of diabetes										
Type I (n= 49)	2	4.1	26	53.1	1	2.0	7	14.3	13	26.5
Type II (n=201)	9	4.5	10	5.0	26	12.9	128	63.7	28	13.9
MCp	<0.001*									

MCp: p for Monte Carlo test * : Statistically significant at $p \leq 0.05$

Table (19): Relation between RBG and complications

	No complications	Single (acute)	Single (chronic)	Multi (chronic)	Multi (acute + chronic)
Range(mg/dl	110.00-500.00	58.60-1122.00	110.00-576.00	60.00-594.00	31.00-1136.00
Mean ± SD	253.18 ± 111.85	484.49 ± 222.06	298.41 ± 102.86	298.45 ± 133.08	473.25 ± 283.93
Median	253.00	487.00	274.00	275.00	463.50
χ^2 (p)	38.765* (<0.001)				
Z_1 (p)		3.447* (0.001)	1.288 (0.198)	1.071 (0.284)	2.680* (0.007)
Z_2 (p)			3.957* (<0.001)	4.924* (<0.001)	0.271 (0.786)
Z_3 (p)				0.378 (0.706)	3.010* (0.003)
Z_4 (p)					3.980* (<0.001)

χ: Chi square for Kruskal Wallis test

Z_1 : Z for Mann Whitney test between no complications with single (acute), single (chronic), multi (chronic) and multi (acute + chronic)

Z_2 : Z for Mann Whitney test between single (acute) with single (chronic), multi (chronic) and multi (acute + chronic)

Z_3 : Z for Mann Whitney test between single (chronic) with multi (chronic) and multi (acute + chronic)

Z_4 : Z for Mann Whitney test between multi (chronic) and multi (acute + chronic)

* : Statistically significant at $p \leq 0.05$

4. Discussion:

In the present study,78.4% of patients were uncontrolled and there was positive correlation between RBG and all diabetic complications, and significant association between hyperglycemia and these complications which denotes the great impact of glycemic level and the development and the progress of diabetic complications.

Glycaemic control is fundamental for the management of diabetes, and its improvement is associated with decrease of the rate of several diabetes complications. This was proved by the Diabetes Control and Complication Trial DCCT)[11] and the UK Prospective Diabetes Study (UKPDS)[12] studies.

In the present study, the glycaemic control was assessed from the latest random blood sugar values at the time of admission as in intensive care patients it was difficult to measure fasting and post prandial blood glucose values. It was demonstrated that high number 78.4% of our patients had random blood glucose ≥ 200 mg/dl which considered as inadequate glycaemic control. these findings are consistent with the results of anther study done on the epidemiology of diabetic complications in Egypt, as they found the frequency of patients exceeding the adequate levels were: fasting blood glucose 80.2%, and post prandial glucose 78.6%.[13]

Measuring glycsalated heamoglobin (Hb A1c) level is the perfect way to judge the state of glycaemic control, because it measures the average glycaemic level over a preceding period of 2-3 months and it avoids the misleading impressions from accidental high or low blood glucose values . However, we did not use this parameter because the test is somewhat costly and is not largely requested by the diabetes caring physicians.

Our study revealed that 27.2% of the patients exceeded the diastolic level of 80 mmHg and about 24.8% exceeded the systolic level of 130 mmHg. There are 44.8% of patients had past history of HTN. The great impact of HTN on developing different complications was observed by the significant positive correlation between BP and different complications ($P \leq 0.05$).

The association of hypertension with diabetes is an essential factor known to increase the risk of several complications of diabetes, including specifically cardiovascular complications ,retinopathy, and nephropathy. The recommended target level for adequate blood pressure control among diabetic patients by the ADA (American Diabetic Association) is < 130/80 mm HG [14] ,which was also our cut point for adequate control.

Hypertension is a highly co-morbid condition in diabetic patients. In a study conducted in Punjab, 53.8% of patients with diabetes had hypertension as compared to17.3% in non-diabetic counterparts[15]. Almost the same proportion of hypertension (52%) prevailed in study conducted in Islamabad in which upper limit of blood pressure for diagnosis was taken as 130/80 instead of 140/90 in the former [16] .

Control of body weight is a principal target in diabetes care. Obesity is recognized risk factor, not only for increasing the prevalence of diabetes in the community at large, but also for predisposing diabetic patients to failure of metabolic control and to an increased risk for development of various complications. In this study, more than half of the tested cases (53.6%) were overweight (BMI more than 25), the results of this study also confirm the close relation between obesity and both of hypertension and lack of metabolic control. We found among the very obese group (BMI>30) significantly higher percentages of diabetic patients who exceeded the adequate control cut points (in all

parameters: systolic B.P. 25%, diastolic B.P. 40% ,RBG 65%, total cholesterol 60%, and triglyceride 55%) than among the less obese or normal weight groups. We therefore should consider that in order to improve the overall control and to reduce the risk of complications , we should spare no efforts, through patient education, to keep body weights under closer control.

The present study 239 (95.6%) patients have developed complications either acute or chronic, single or multiple complications , 31.6% from type 1 DM and 65% from type 2 DM . The 2007 report released by the American Association of Clinical Endocrinologists (AACE), showed an estimated three out of five Americans with type 2 diabetes (57.9 percent) have one or more diabetes complications [17] .

In the present study, the most frequent complication is diabetic neuropathy, nephropathy followed by cardiovascular complications. There is an important age effect in the occurrence of diabetic complications. Diabetic ketoacidosis is the most common complication in the early years of life.

Diabetes itself is a risk factor for heart disease and stroke. In this study the incidence of cardiovascular complications was 34.8% and cerebrovascular complications was 14.8%. Also, many people with diabetes have other conditions that increase their chance of developing heart disease and stroke. One risk factor for heart disease and stroke is having abnormal blood fat (cholesterol , triglyceride) levels , having high blood pressure , and smoking.

In our study 44.8% of the patients have history of hypertension,31.2% are smokers. There was positive correlation between cardiovascular, cerebrovascular complications and blood pressure, RBG, serum TG, and serum cholesterol.

The analysis of possible risk factors revealed a significant association between the presence of macrovascular disease and presence of hypertension among the surveyed diabetic population ($p < 0.005$). This is consistent with results from studies in other settings elsewhere. For example, in Spain, a large multicenter, outpatient clinics cross sectional population study, on hypertensive and type 2 DM patients, evaluating the risk of cardiovascular disease and renal damage using ECG-LVH, GFR and/or urinary albumin excretion, was able to establish an increased prevalence of cardiovascular disease in patients with hypertension and type 2 DM [17]

Both in type 1 and type 2 DM it has become increasingly clear that multiple risk factors may be as important as hyperglycemia. A study, comprising two extreme groups, *i.e.* patients with early onset(microangiopathy within 5 years duration) and those with late protection (without microangiopathy even after 14 years) showed that the former group had higher prevalence of associated conditions like hypertension, hyperlipidemia, poor glycemic control, obesity, and smoking indicating their positive correlation with development of micro vascular complications [18] .

In our study the incidence of diabetic neuropathy was 56.0%. In a report on the epidemiology of diabetic neuropathy[19] ,it was noted that the inconsistency in the selection of diagnostic procedures makes it difficult to compare results of different studies. In our study as all our patient were intensive care units patients and their general conditions varies from fully conscious , to comatose patients the results of our neurological examinations may carry false negative results. In fact the precise prevalence of diabetic neuropathy has been always very difficult to determine. A prevalence of as high as 50% was reported from a US population study[20,21] and a prevalence of 30% in European and African populations[22,23].

People with diabetes can develop nerve problems at any time, but risk rises with age and longer duration of diabetes. The highest rates of neuropathy are among people who have had diabetes for at least 25 years. In our study 94.7% of patients who had diabetes for more than 20 years had neuropathy, there is positive correlation between duration of diabetes and development of diabetic neuropathy.

Diabetic neuropathies also appear to be more common in people who have problems controlling their blood glucose, as well as those with high levels of blood fat and blood pressure and those who are overweight. In our study we found 39.6% of patients who had neuropathy had uncontrolled hyperglycemia. Also we found positive correlation between neuropathy and RBG, The relation between hyperglycaemia and development of severity of neuropathy has been shown in retrospective and prospective studies, a classic study on 440 diabetic patients who were followed up over 25 years, showed an increase in clinically detectable diabetic neuropathy from 12% at the time of diagnosis of diabetes to about 50% after 25 years and those with poorest diabetic control had the highest prevalence [24]. Also in the present study we found positive correlation between diabetic neuropathy and blood pressure, and significant association between them, Previous observational studies have investigated the link between hypertension and sensorimotor peripheral neuropathy (SMPN) in type 2 diabetes **Valensi *et al*.**[25] showed that the presence SMPN correlated with the presence of retinopathy, hypertension, and macroangiopathy. Logistic regression analysis showed that age, diabetes duration, presence of retinopathy, body mass index, metabolic control, and duration of hypertension were independently associated with SMPN[26] .

Somatic peripheral neuropathy is the commonest type of diabetic neuropathy, in our study

the incidence of somatic neuropathy was 52.8%, and autonomic neuropathy was 10%, most of the patients suffering from autonomic neuropathy were having in the same time somatic neuropathy.

Data from 12 countries in the Asian Pacific region, including Australia and New Zealand, showed an increase in both incidence and prevalence of diabetic nephropathy between1998 and 2000 [27]. The prevalence of diabetic nephropathy as a cause of ESRD in Egypt has previously been examined in 2 small cross-sectional studies with conflicting results[28,29]. Other reports on prevalence of diabetic nephropathy also produced the following widely divergent figures: 8.4% [30], 13.7%[31], 20.1% [32] and 8.9% [33].

In our study the incidence of nephropathy was 41.2%, 35.6% had microalbuminuria , and 5.6% had macroalbuminuria.

Diabetes is the most common cause of kidney failure, accounting for nearly 44 % of new cases [34]. Even when diabetes is controlled, the disease can lead to CKD and kidney failure. Nearly 24 million people in the United States have diabetes,[35] and nearly 180,000 people are living with kidney failure as a result of diabetes [34] .Diabetic kidney disease takes many years to develop. In some people, the filtering function of the kidneys is actually higher than normal in the first few years of their diabetes.

In our study 52.4% of patients who had albuminuria were having renal failure, 13.6% of them had acute renal failure and 38.8% had chronic renal failure.

Overall, kidney damage rarely occurs in the first 10 years of diabetes, and usually 15 to 25 years will pass before kidney failure occurs. For people who live with diabetes for more than 25 years without any signs of kidney failure, the risk of ever developing it decreases. In this study 46.6% of patients had diabetes for 10 to 20 years had diabetic nephropathy, and 52.6% of patients had diabetes for more than 20 years had nephropathy. this clearly proves that the incidence of nephropathy increase with long duration of diabetes. As we found positive correlation between diabetic nephropathy and duration of DM, blood pressure, RBG, and serum lipids.

In our study 35.6% of diabetic nephropathy were type 2 DM, and 5.6% were type 1 DM.

Almost everyone with diabetes develops this complication, but the first to feel its impact are people with type I diabetes, who frequently develop a mild form of this condition within five years of diagnosis of diabetes. In fact, there's a strong correlation between duration of diabetes and the development of retinopathy. the longer the duration of diabetes, the greater the chance of developing retinopathy. This is proved in the present study as we found positive correlation between duration and developing retinopathy and the stage of retinopathy. In our study 32.8% of diabetic patients had retinopathy , 20.8% had non proliferative retinopathy, 12% had proliferative retinopathy.

Hyperglycemia, and hypertension are important risk factors to develop diabetic retinopathy. In our study we found significant association and positive correlations between these risk factors and retinopathy, which confirm that good control to these metabolic variants reduce the development of diabetic retinopathy. Earlier studies have suggested that there is a positive relationship between hypertension and the incidence or progression of diabetic retinopathy [36-38]. Also several studies have shown that normalizing blood glucose over time can significantly reduce one's risk of developing advanced stages of retinopathy [39].

Our study shows that there is positive correlations between serum cholesterol and diabetic retinopathy. The WESDR (Wisconsin Epidemiologic Study of Diabetic Retinopathy) also demonstrated a correlation between serum cholesterol and risk of retinopathy in the diabetic population generally[40].

Better glycaemic control has been established by the DCCT and by UK PDS to reduce the risk of development and progress of diabetic retinopathy[14,32]. Tight blood pressure control has been also shown to reduce effectively the progression of retinopathy.

In a pilot study conducted in Karachi on 3000 diabetic patients, it was shown that 780 (26%) of the patients were affected with retinopathy[41]. Similarly, Ramachandra studied 3010 type 2 diabetic patients noted a prevalence of 23.7% retinopathy, 19.7 % nephropathy, and 27.5% peripheral neuropathy. Duration of diabetes, poor glycemic control and hypertension were shown significantly associated with the complications in his study[42,43]. In contrast our study has demonstrated significantly high frequency of each complication

In the present study the prevalence of diabetic foot is 25.2%. 6% of studied patients had foot amputations,14.4% had foot infection, 1.6% had foot ulcer, and 3.2% had ischemic changes. Compared to a cross-sectional study done in 4 general practitioner practices in the Netherlands showed that the prevalence of an infected foot lesion or ulcer in patients with diabetes was 3% [44]. An other study showed that 5% had an ulcer or had undergone an amputation [45].

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