Indications and Outcome of Admission of Patients with Diabetes into Benha University Hospitals, Egypt: A Prospective Study

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Received:

Accepted:

Abstract

Background: Patients with diabetes have a 3-fold greater chance of hospitalization compared to those without diabetes. The risk factors for hospitalizations in diabetic patients constitute poor glycemic control, longer diabetes duration, and coexisting morbidity. Other factors include, old age groups, insulin use, hypoglycemia, presence of chronic renal insufficiency and diabetes-related hospitalizations in the preceding year are other important risk factors. **Aim:** Our aim of the study is to report the causes, patient characteristics, and outcome of admissions of diabetic patients to the wards and emergency unit of Benha university hospital **Methods:** The study included 260 patients with known history of type 1 or 2 DM who were admitted from the emergency department, outpatient clinic ,and other departments of the hospital.Demographic data and laboratory investigations were collected. **Results:** The study constituted mainly type 2DM (90.4%). The mean age of the study population was 57± 14 years, most of them were females (55.8%).The median duration of diabetes was 10 years.The most common reason for diabetes related hospitalizations were chronic complications of DM, whereas sepsis is the most common reason of non diabetes related .The mortality rate was 26.9%, of overall deaths, cardiovascular disease was the most frequent(47.7%).**Conclusion:** The most frequent reason for hospitalization in diabetic related admissions was chronic complications of diabetes. Whereas, sepsis is the most common cause in diabetic non related admissions.Cardiovascular disease is still the main cause of death among diabetics.

Key words: Outcome; Diabetes; Hospitalization.

Introduction:

Diabetes is a prevalent metabolic syndrome that affects more than 415 million people globally (1). Diabetes is a costly situation associated with substantial levels of morbidity and mortality (2). Even more, patients with diabetes have a 3-fold greater chance of hospitalization compared to those without diabetes (3). It is estimated that more than 20% of all adults discharged have diabetes, with 30% of them necessitating 2 or more hospitalizations per year (3), and (4).

The care of patients with diabetes carry out a considerable burden on the economy, with a total estimated cost of diagnosed diabetes in the United States in 2012 was $176 billion in medical care. The largest component of this medical expenditure is hospital inpatient care, accounting for 43% of the total medical cost (5). The most frequent diabetes-related hospitalizations were related to renal failure (33.6%), hypertension (12,6%) and cataract (12%), whilst for non-diabetes-related hospitalizations, atherosclerotic heart disease (3.1%), anemia (1.7%), and 'unspecified' illness (1.4%) were most frequently stated (6).

Patients with T2D have a greater risk of vascular complications including cardiovascular (CV) morbidity and mortality (7) and are twice as likely to be hospitalized with a longer hospital stays (8) and (9). The risk factors for hospitalizations in diabetic patients constitute poor glycemic control, longer diabetes duration, and coexisting morbidity (10). In addition, old age groups, insulin use, hypoglycemia, presence of chronic renal insufficiency and diabetes-related hospitalizations in the preceding year are other important risk factors for hospitalization (6). In patients with type 1 DM, hospital admission for DKA and severe hypoglycemia may be influenced by age, sex, diabetes duration, ethnic origin (11) and, insulin treatment regimen (use of insulin pump or multiple daily insulin injections) (12). Patients hospitalized with a diagnosis of diabetes stay in the hospital for longer than those without a diagnosis of diabetes admitted for the same condition (13). A large proportion of hospitalizations for diabetes are avoidable by improvements in the quality of primary care outpatients clinics for diabetes (14).

So, our aim of the study was to investigate the indications and outcome of admissions of diabetic patients to the hospital for proper care of diabetics in hospitals and if these admissions can be prevented or not. Identification of hospitalization of patients with diabetes and who may be managed as

outpatients is important in reducing healthcare costs.

Aim of the work:

The aim of our study is to report the causes of admissions of diabetic patients to medical wards and emergency unit of Benha university hospital, and to determine the demographic characteristics of the patients, different risk factors, outcome, and duration of the hospital stay.

Patient and method:

This is a prospective descriptive hospital based study of patients with diabetes admitted into the medical wards and emergency unit of Benha University Hospital, in Egypt over a six months period from October 2019 to April 2020.

The study included 260 patients with known history of type 1 or 2 DM who were admitted from the emergency department, the medical out-patient department, and the patients transferred into medical wards from the other departments of the hospital.

Patients without a known history of diabetes, and with pregnancy were excluded. Approval for the study was obtained from the Ethics Committee of Benha Univeristy. Relevant data (age, gender, diagnosis, indications of admission, risk factors, treatment, duration of hospital stay and outcome) were extracted from the case files of patients, and from the records department of the hospital in conjunction with ward admissions discharge logs and accident emergency records. Laboratory investigations (CBC, renal function tests, urine analysis, HbA1c, TSH, serum cholesterol, serum Na, serum K, FBG, 2hPPBG, CRP, albumin, 24 h urinary albumin) of the patients were done in the clinical pathology department of Benha university Hospital according to the local routine methods. Good glycemic control was defined as HbA1c $\leq$ 7.5% and bad glycemic control >7.5%. The indications for admitting diabetic patients were broadly classified into non-diabetes-related and diabetes-related. Diabetes-related indications were further classified into acute metabolic emergencies and chronic complications of diabetes mellitus. Acute emergent conditions included diabetic ketoacidosis, hyper osmolar non ketotic states, hypoglycemia, uncontrolled hyperglycemia (in either type of diabetes).

While, severe chronic complications of diabetes that require intensive treatment included microvascular complications (diabetic nephropathy) and macrovascular complications (diabetic foot, MI, stroke related to DM). The outcome of the hospitalization was recruited, including improvement of the condition, the mortality rate of the hospitalized patients and the causes of death.

Statistical analysis:

The statistical analyses were completed using SPSS (Statistical Package for Social Science) version 16. The data were expressed as number percentages, means ±standard deviation (SD), and median and inter-quartile range (IQR). As regards the normally distributed (parametric) quantitative data, the means and standard deviations were used and P values of less than 0.05 ($P < 0.05$) are considered significant. While, the non parametric data were presented as median and inter-quartile range (IQR).

Results

The mean age of the study population was 57± 14 years. Males were 44.2%, while females 55.8% of the study population. The median duration of diabetes was 10 years (IQR; 0.5 to 35 years), most of them were type 2DM (90.4%). In terms of treatment of diabetes, 32.7% received insulin, 34.6% received OAD, while the remaining 32.7% shifted from OAD to insulin. The patients who were admitted to the ICU were 51.9%, while those admitted to the ward were 48.1%.

The medication used during the hospitalization included, basal-bolus insulin regimen 67.3% of patients, insulin infusion 30.8% of patients, and only 1.9% received glucose 25% continuous infusion (table 1). In terms of laboratory findings(table 2); the median WBCs was 4.9×10^9/L (IQR; 2.9-35), and the mean HB value was 10.7 gm/dl (SD; ± 1.7). The median creatinine was 2 mg/dl (IQR; 0.1 to 9).

Abnormal Pus cells in urine were seen in 51.9 % of the admitted patients. The glycemic control parameters were as follows; the mean ± SD of HbA1c, FBG,PPBG were 9.1 ±1.2 %, 265 ±66 mg/dl, 338 ±86 mg/dl respectively.The median CRP was 48mg/L(IQR; 3.2 to 125). In terms of the causes of admission (table 3)(figure 1), all diabetes related admission were 73.9% of the study populations; acute complications of diabetes were 23.1% of the cases with DKA as the most frequent cause of admission (13.5 %), followed by uncontrolled hyperglycemia (7.7 %) then hypoglycemia (1.9 %).

The prevalence of chronic complications of diabetes was 50.8 % of the cases, including diabetic nephropathy (32.7%), diabetic foot (9.6 %), MI (7.7 %), and stroke related to DM (0.8 %). The diabetes non related admissions accounted for 47.3 % of all admissions, including sepsis (28.8 %), non diabetic nephropathy (7.7 %), stroke related to other causes (7.7 %), arrhythmia (6.9 %), emergency HTN (1.9 %), and PE (1.2 %). The outcome of hospitalization was summarized in table (4); most of the study population showed improvement (73.1%)

meanwhile 26.9% died for different reasons including; septic shock (23.1%), cardiogenic shock (20%), uremic complication (18.5%), myocardial infarction (12.3%), DKA (10.8%), PE (7.7%), stroke (4.6%), and rapid AF (3.1%) (table 5). The patients with worse glycemic control were 60.8 %. The median length of stay was 7 days (IQR 1-30 days). Higher percent of patients were discharged on insulin therapy (65.4 %).

Table (1) General characteristic of study population.

General characteristics		
-Age (years)	**Mean ±SD**	57 ±14
-Gender.	**-Males**	115 (44.2)
	-Females	145 (55.8)
Duration of DM (year)	**Median (range)**	10(0.5 - 35)
-Type of diabetes.	**-T1DM**	25 (9.6)
	-T2DM	235 (90.4)
-Treatment.	**-Insulin**	85 (32.7)
	-OAD	90 (34.6)
	-OAD shifted to insulin	85 (32.7)
-Site of admission.	**-ICU**	135 (51.9)
	-Ward	125 (48.1)
-Operation.	**Yes**	70 (26.9)
	-Basal bolus insulin.	175 (67.3)
-Medication for diabetes during hospitalization.	**-Glucose 25% continuous infusion.**	5 (1.9)
	-Insulin infusion	80 (30.8)

Table (2): Laboratory findings of the study population.

Laboratory findings		
HB (gm/dl)	Mean ±SD	10.7 ±1.7
Platelets	Mean ±SD	276 ±131
WBCs (× 10^9/L)	Median (range)	4.9 (2.9 - 35)
Urea (× 10^9/L)	Median (range)	54 (10 - 228)
Creatinine (mg/dl/)	Median (range)	2 (0.1 - 9)
Urine analysis	Free	125 (48.1)
	Pus 20-25	10 (3.8)
	Pus 50	15 (5.8)
	Pus 8-10 cell	10 (3.8)
	Pus over 100	100 (38.5)
HbA1c (%)	Mean ±SD	9.1 ±1.2
TSH (mIU/L)	Mean ±SD	1.76 ±0.93
AST(U/L)	Mean ±SD	19.4 ±6.6
Cholesterol (mg/dl)	Mean ±SD	194 ±41
Na (mEq/L)	Mean ±SD	133 ±4
K (mEq/L)	Mean ±SD	3.6 ±0.4
CRP (mg/L)	Median (range)	48 (3.2 - 125)
Albumin (g/dl)	Mean ±SD	3.4 ±0.5
FBG (mg/dl)	Mean ±SD	265 ±66
PPBG (mg/dl)	Mean ±SD	338 ±86
24 hr urinary albumin(mg)	Median (range)	1.8 (0.227 - 12)

Table (3) Causes of admission of the study group.

Diabetic related- Acute complications	**N**	**%**
Hypoglycemia	**5**	**1.9**
HHS	**0**	**0**
DKAA	**35**	**13.5**
Uncontrolled hyperglycemia	**20**	**7.7**
Diabetes related chronic complications		
Diabetic Nephropathy	**85**	**32.7**
Diabetic foot	**25**	**9.6**
MI	**20**	**7.7**
Stroke related to DM	**2**	**0.8**
Non diabetic related		
Non Diabetic nephropathy	**20**	**7.7**
Emergency HTN	**5**	**1.9**
Sepsis	**75**	**28.8**
Stroke related to other causes	**5**	**7.7**
PE	**3**	**1.2**
Arrhythmia	**18**	**6.9**

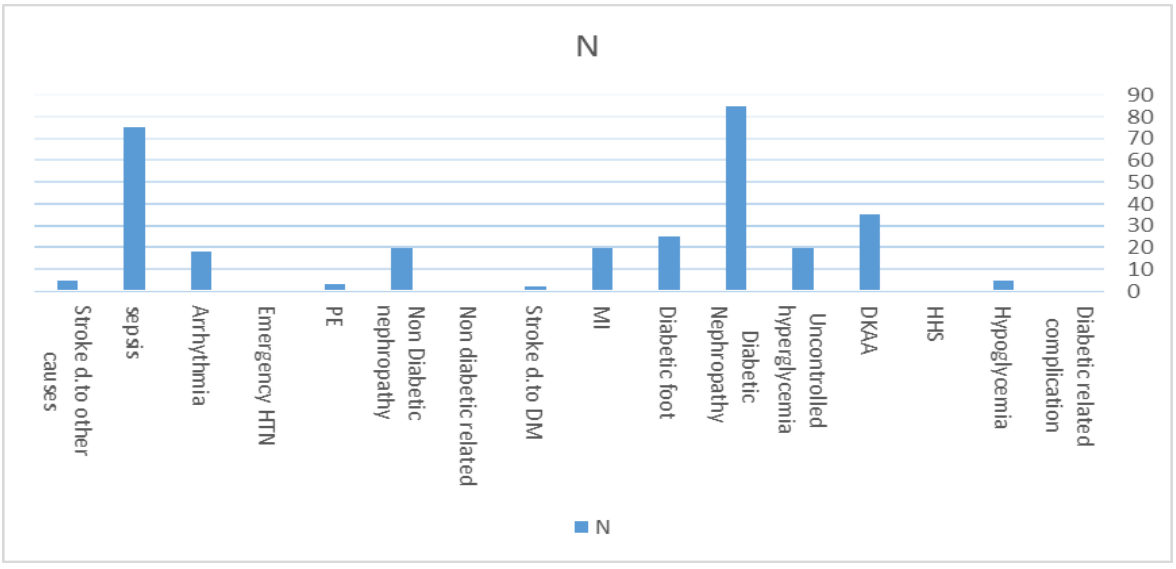

Figure (1): Causes of admission of the study group

Table (4): Outcome of the study group.

Outcome		*N*	*%*
Improvement	**Yes**	**190**	**73.1**
On discharge	**Die**	**70**	**26.9**
Treatment on discharge	**Insulin**	**170**	**65.4**
	OAD	**20**	**7.7**
Refer to other department	**Yes**	**40**	**15.4**
Glycemic control overall	**Good**	**102**	**39.2**
	Poor	**158**	**60.8**
Length of stay (days)	**Median (range)**	**7 (1-30)**	

Table (5) Causes of death among the admitted diabetics.

		N	**%**
Cardiogenic shock	**Yes**	**52**	**20.0**
	No	**208**	**80.0**
Uremic complication	**Yes**	**48**	**18.5**
	No	**212**	**81.5**
PE	**Yes**	**20**	**7.7**
	No	**240**	**92.3**
Myocardial infarction	**Yes**	**32**	**12.3**
	No	**228**	**87.7**
Rapid AF	**Yes**	**8**	**3.1**
	No	**252**	**96.9**
DKA	**Yes**	**28**	**10.8**
	No	**232**	**89.2**
Septic shock	**Yes**	**60**	**23.1**
	No	**200**	**76.9**
Stroke	**Yes**	**12**	**4.60%**
	No	**248**	**95.40%**

Discussion

Several observational and trial data denoted that inpatient hyperglycemia, in patients with or without a prior diagnosis of diabetes, is connected to an increased risk of complications and mortality, a longer hospital stay, a higher admission rate to the intensive care unit (ICU), and a higher need for transitional or nursing home care after hospital discharge(4). The age of the study population ranged between 71 to 43 years with the mean age of 57±14 years. In a similar fashion, one study showed the mean age of patients was 57± 16 years (15). The burden of diabetes is often described in terms of its influence on working-age adults, diabetes in older adults is linked to higher mortality, reduced functional status, and increased risk of hospitalization (16).

Since aging of the overall population is a substantial driver of the diabetes epidemic. In our study, the majority of the patients were females (55.8%). This may be assigned to the fact that women are more obese with lack of physical activity than men (17). In contrast to another study which found that, 55.9% were males (15). In our study, almost 90% of the patients were Type 2DM consistent with Forouhi & Wareham, who stated that type 2 diabetes constituted the majority (>85%) of the overall diabetes prevalence (18). We observed that, of the 260 overall admissions, 135(51.9%) admissions were in the ICU and 125 (48.1%) in the ward. Admission of diabetic patients in intensive care units (ICU) because of acute complications attributable to DM (diabetic ketoacidosis, hyperosmolar coma, and hypoglycemia), or some other underlying pathology and co-morbidity. The concomitant co-morbidities are the decisive factors responsible for such critical admissions and DM is a secondary contributor or sometimes an accidental finding (4) and (19).

In our study, 67.3% of patients received basal bolus. Moreover, 30.8% received an insulin infusion. The use of oral hypoglycemic agents is mostly not recommended in hospitalized patients due to limited data on their safety and efficacy and lack of flexibility in adjusting the dose in a harmony with the clinical status(20). Insulin is the best method to control hyperglycemia during hospitalization, especially in the critically ill patient. Intravenous insulin is the preferred method to achieve the recommended glycemic target (21). However, most of our patients received subcutaneous basal bolus. This explained by, Intravenous insulin may be suitable for people who are critically ill, people who are not eating and in those with hyperglycemia and metabolic decompensation e.g. DKA (22). Furthermore, in insulin-naive patients, there is evidence demonstrating the

superiority of basal-bolus-correction insulin regimens (23). According to the ADA, intravenous insulin infusions should be administered based on validated written or computerized protocols that allow for adjustments in the infusion rate, glycemic fluctuations and insulin dose (24). Our results reported that most of our patients (65.4%) used insulin therapy at discharge indicating worse glycemic control in 60.8% of them. The mean HbA1c was 9.1 (SD; 1.2) and The mean fasting blood glucose and 2 h postprandial were 265 ±66 mg/dl, 338 ±86 mg/dl respectively indicating uncontrolled hyperglycemia and necessitating insulin therapy. It is worth stating at this point that NICE guidelines recommend the use of insulin therapy if HbA1c is 75 mmol/mol (9.0%) or higher (25). All diabetes related admissions were almost 73.8%, including 23.1% of acute complications (DKA is the most frequent of them), and 50.7 % of them related to chronic complications of diabetes. Likewise, Al-adsani et al., reported that the most common reasons for hospitalizations in patients with diabetes was cardiovascular system diseases (53.6%) including acute coronary syndrome, heart failure, and cerebrovascular accident, indicating the chronic complications of diabetes (2). Another study, demonstrated chronic complication as a main reason for hospitalization among elderly diabetics (26). On the other hand, another study in Ethiopia found that diabetic ketoacidosis (DKA) was the commonest reason for hospitalization which attributed for admission of(33.7%) patients followed by infections, (19.1%), and cardiovascular diseases (CVDs), (18.0%)(27). The cause of this discrepancy as 74% of the patients in the Ethiopian study had type 1DM, while in our study more than 90% of the patients had type 2DM. Regarding diabetes non related admission, sepsis was the most common cause (28.8%), followed by stroke not related to diabetes complications (7.7%) (e.g; embolic and hemorrhagic cerebrovascular stroke) as well as non diabetes related nephropathy (7.7%). On the contrary, one study revealed infection as the third most frequent reason for admission, responsible for 15.7 % of diabetes non related hospitalizations (26). Our study found the mortality rate of 26.9% of the patients. Akirovel et al., revealed the hospital mortality risk was greater in patients with DM (aOR = 1.3, 95% CI = 1.1-1.7) (28). Observational and prospective randomized clinical trials, in patients with and without diabetes, as well as in critically ill and non-critically ill patients have shown a strong relationship between hyperglycemia and poor clinical outcomes, such as mortality, infections and hospital complications (29) and (30). Patients with

blood glucose levels >200 mg/dl (>11.1 mmol/l) were shown to have higher mortality compared to those with blood glucose levels <200 mg/dl (<11.1 mmol/) (5.0% vs. 1.8%, p < 0.001) (31). In fact, FBG & PPBG were higher than 200 mg/dl. Our study clarified that cardiovascular causes of death is the main reason for mortality, accounting 47.7% of deaths, and including; cardiogenic shock, pulmonary embolism, MI, stroke, and rapid AF. One must admit that, patients with T2D are at an increased risk of vascular complications including cardiovascular (CV) morbidity and mortality(32). The rational of the injurious effects of hyperglycemia during acute illnesses are not completely understood. Current evidence indicates that severe hyperglycemia results in impaired neutrophil granulocyte function, high circulating free fatty acids, and overproduction of pro-inflammatory cytokines and reactive oxygen species (ROS) that can lead to direct cellular damage, and vascular and immune dysfunction (33). The median length of stay was 7 days (IQR; 1- 30 d). It was suggested that type 2DM are twice as likely to be admitted to hospital with prolonged inpatient stays (32). Additionally, the severity of hyperglycemia correlates with the hospital stay (34). In a previous study, the duration of hospital stay ranged from 1 to 88 days, with a median duration 9 days. Other studies reported a range of 4.9 to 10.7 days (average of 8 days), and it was found the length of stay is higher than non-diabetic patients (35). The difference from one study to another may be related to the patient characteristics, underlying co-morbidities and the prevalent diabetic complication.

Conclusion

This is a prospective descriptive study highlighted some of the characteristics of hospitalized diabetic patients. The most frequent reason for hospitalization in diabetic related admissions was chronic complications of diabetes. Whereas, sepsis is the most common cause in diabetic non related admissions. Cardiovascular disease still the main cause of death among diabetics. Factors that may have contributed to the decline in diabetes-related preventable hospitalizations include annual screening for complications of DM with proper management, using intervention with approved indications during hospitalizations, health education for diabetic patients, and immunizations against the commonest respiratory infections.

Limitations of the study:

Our study has three limitations; Firstly, we did not have a control group for comparison to identify the significant reason of admissions as well as the risk factors for admission in the study group. Secondly, we did not recruit the repeated admissions of

the same patient to identify the indications and outcome. Thirdly, our results should stimulate further research with strong strategies for risk adjustment to clarify the association between diabetes and poor cardiac outcomes. While DM is a known risk factor for cardiovascular disease, with these results, future studies are required to determine whether improved blood glucose control in long and short term reduces the impact of diabetes on hospitalization outcome.

Abbreviations:

DM(diabetes mellitus).
DKA(diabetic ketoacidosis).
FBG(fasting blood glucose).
PPBG(postprandial blood glucose).
ADA(American diabetes association).
OAD(oral antidiabetic drug).
ICU (internal care unit).
PE (pulmonary embolism).
MI(myocardial infarction).
CV(cardiovascular).
CBC(complete blood count).
HbA1c (glycosylated hemoglobin).
TSH(thyroid stimulating hormone).
IQR(inter-quartile range).
SD (standard deviation).
HTN (hypertension).

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To cite this article: Amira M. Elsayed, Ayman M Elbadawy, Walla M. lbrahim, Rasha O. Abd Elmoniem, Marwa S. Mahfoz. Indications and Outcome of Admission of Patients with Diabetes into Benha University Hospitals, Egypt: A Prospective Study. BMFJ XXXX, DOI: 10.21608/bmfj.2021.49219.1341 .