Effect of Nursing-directed Protocol on the Occurance of Hypoglycemic Episodes among Patients at Medical Intensive Care Unit

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Abstract

Background: Hypoglycemia is a well-recognized complication between type I diabetes patients, and it is the most common diabetes-related emergency. It is an unavoidable diabetic complication as it raises mortality and morbidity rates in those with DM. Thus, better outcomes, shorter hospital stays, and fewer complications are achieved when hypoglycemic patients get coordinated nursing care. **Aim:** Assess the effects of nursing-directed protocol on the occurrence of hypoglycemic episodes among patients at Medical Intensive Care Unit (ICU). **Design:** Quasi- experimental research design. Setting: This study was conducted at the Medical Intensive Care Unit at Tanta Main University Hospital. Subjects: Purposive sampling of 60 adult patients with hypoglycemia who meet all inclusion criteria, were split into 2 equal groups, with 30 individuals in each group. **Tools:** 3 different tools were employed to collect the data. Tool (I): Patients structured assessment tool; socio-demographic data of the patients, patient`s clinical data. Tool (II): Blood glucose measurements flow sheet tool; capillary blood glucose measurements, glycemic penalty index tool. Tool (III): Monitoring hypoglycemic manifestation and its complications among critically ill patients. **Result:** The main results showed that the study group had significantly improved in terms of vital signs, consciousness, and blood glucose readings. Statically significant difference was observed related to hypoglycemic manifestation and complication among the control and study group with $P<0.05$. **Conclusion:** The nursing-directed protocol had positive effect on decreasing hypoglycemic episode by improving blood glucose level, reducing hypoglycemic manifestations and complications. **Recommendation:** Our findings should be repeated with a broader probability sample and in a numerous region to ensure that the findings are generally applicable.

Key words: Critical ill patient, Hypoglycemic episodes, Hypoglycemic complications, Hypoglycemic manifestations, Nursing directed protocol.

Introduction

Hypoglycemia is the most common medical emergency in diabetic patients and perceived as the most important obstacle to tight glucose control using intensive insulin therapy in medical critically ill patients. To avoid harm to the brain and organs, it must be identified and treated quickly [(1)]. Critical illness associated hypoglycemia in non-diabetic patients generally occurs as a result of kidney, liver disorders, insufficient nutritional intake, side effects of some

medications such as antibiotics that is seen frequently in critically ill patients. Hypoglycemia is common in insulin and non-insulin dependent diabetic patients who require an action plan because it is common, clinically significant, measurable, and preventable [1, 2].

When hypoglycemia occurs, it is always an emergency signifying that the brain is not getting enough energy. When hypoglycemia is left untreated It may cause irreversible brain damage or even death. In the context of critical illness that limits endogenous glucose production and increases glucose utilization, inadequate nutrition, or insufficient provision of glucose and intensive insulin therapy is the most frequent cause of hypoglycemia [3].

Numerous factors, including liver diseases, insulin overdoses, and oral hypoglycemic drugs in diabetic patients, may lead to hypoglycemia. Under such circumstances, hyperinsulinemia hypoglycemia is usually observed [4,5]. On the other hand, it is difficult to diagnose hypo insulinemic hypoglycemia, which is sometimes observed in non-diabetic patients [5].

The other contributory factors leading to hypoglycemia may include imbalance between the anti-diabetic regimen, longer time intervals between meals or impaired counter-regulator mechanisms. In addition, the inability to understand warning signs of hypoglycemia, resulting from a diminished autonomic response during sleeping, might further exacerbate the progression of hypoglycemia [6,7].

According to the world health organization, Worldwide, the incidence of severe hypoglycemia event was 4.800 per 100.000 patient per year and moderate events was 13.100 per 100.000 patient per year. There is significant variability in the reported incidence of hypoglycemia across different studies, however in general patients with type I diabetes have an average of two episodes of symptomatic hypoglycemia per week and one episode of severe hypoglycemia once a year [8].

The occurrence of hypoglycemia and sensitization to unpleasant symptoms has been shown to result in fear of future hypoglycemia and avoidance of low blood glucose, particularly among insulin-treated patients. In these patients, mild or moderate and severe hypoglycemia have been reported as the most common adverse effects associated with intensive insulin therapy and have been estimated to occur annually in 5 to 20 % of patients taking oral antihyperglycemic agents. Severe hypoglycemia can result in seizures and coma, which may be complicated by irreversible brain damage [8].

Depending on the length and intensity of hypoglycemia, a person may have a range of symptoms, including autonomic activation, behavioral abnormalities, cognitive impairment, seizures, or coma. Thus, close, and reliable monitoring of the glycemic level is crucial in detecting hypoglycemia [9]. The development of medical intensive care had a huge impact on improving outcomes and reducing mortality in patients with critical medical conditions [9]. The risk for hypoglycemia may be influenced by insulin dose and glucose monitoring guidelines, computerization, attention to modifiable factors extrinsic to insulin algorithms, and response to impending hypoglycemia. Recurring use of intravenous (IV) bolus doses of insulin in insulin-resistant cases may reduce reliance upon higher IV infusion rates [10, 11]. Critical care nurses, on the front lines, that can screen patients for early hypoglycemia identification, recognize and initiate corrective measures for inadequate treatment regimens, help patients set and achieve therapeutic goals, and assess diabetes-related complications as they arise [8].

Moreover, critical care nurses can prevent hypoglycemic episodes by conveying appropriate instructions for meal timing

and medication administration, heightening awareness of medical conditions that influence glucose control, and, if appropriate, encouraging patient self-care [12, 13]. A mean of hypoglycemia reduction is patient self-management whose diabetes is effectively controlled when they are outpatients and they are capable of maintaining their insulin regimen in the hospital, for example if they wear an insulin pump or utilize numerous regular injections of glargine. Capable patients are frequently better than most nurses or doctors in matching their necessary needs in terms of time and amount of carbohydrates [14].

Significance of the study

Based on clinical observations, patients with liver problems who are admitted to medical ICUs are more susceptible to hypoglycemia due to their critical health condition and impaired cognitive function[15]. The reported prevalence of hypoglycemia in people with liver cirrhosis is 50%. [5].

The inpatient team must be alert to the risk of hypoglycemia and careful in identifying symptoms and signs, avoiding episodes without sacrificing glycemic control for appropriate recovery, and correctly managing hypoglycemia episodes. The goal of this study was to assess how a nursing-directed protocol affected the incidence of hypoglycemia episodes in patients receiving treatment in a medical ICU.

Purpose of the study: to assess how a nursing-directed protocol affected the incidence of hypoglycemia episodes among patients at medical ICU.

Research hypothesis:

Patients who were exposed to nursing-directed protocol on hypoglycemic episodes' occurrence are exhibit early detection of hypoglycemia, decreasing its episodes and complications compared to control group who does not expose.

Subjects and method

Study design: A quasi- experimental research design was used to conduct this study.

Study settings

The research was carried out in the Medical ICU located at Tanta Main University Hospital. They consisted of three rooms, with each room accommodating a total of six beds.

Study subjects

Purposive sampling of 60 patients divided into two groups of 30 in each in the above previously mentioned settings. The Epi-Info 7 Statistical Program was used for calculating sample size and power analysis, using the following parameters: Total patients is 400 per year, there is 99.9% confidence, 50% expected frequency, 5% acceptable mistake, and a 95% confidence rate.

-Inclusion criteria of selection of subjects; Adult patients aged 21 to 60 years, both sex, diabetic patient, and newly admitted patients within 24 hours.

Tools of data collection

Three instruments were utilized to collect patient data.:

Tool (I): Patients Structured Assessment Tool. The researcher prepared this tool following a review of relevant literature [5-10] and consisted of two parts:

Part (1): Socio-demographic data of the patients: It included patient`s age, gender, marital status, level of education, occupation, diagnosis, consciousness level, past medical and surgical history.

Part (2): Patient`s Clinical Data. It included duration of diabetes, risk factors associated with hypoglycemia, previous history of diabetes, prior episodes of severe hypoglycemia, delay in the timing of meals, glaciated hemoglobin A1c, hypoglycemia episodes, vital signs and drug history (beta blocker, pentamidine, aspirine, disopiramid, cotrimoxazol, coticsteroid, metfomin, and glibenclamid).

Tool (II): Blood Glucose Measurements Flow Sheet Tool: It comprised of two parts:

Part (1): Capillary Blood Glucose Measurements: A blood sugar meter or device was used for measuring capillary blood glucose level.

Part (2): Glycemic Penalty Index (GPI) Tool: it was developed by Herpe et al in 2008 (16) and modified by a researcher. It was used to assess and compare different blood glucose control algorithms and assessment of the ICU's (ICU) blood glucose (BG) control.

Scoring system:

Glycemic range (mg/dl)	Clinical description	Penalty
Blood glucose < 40	Severe Hypoglycemia	3
40 ≤ BG < 60	Hypoglycemia	2
60 ≤ BG < 80	Slight hypoglycemia	1
80 ≤ BG ≤ 110	Normoglycemia	0

Tool (III): Monitoring of Hypoglycemic manifestations and their Complications among Critically Ill Patients. It was formulated by the researcher subsequent to an examination of the pertinent literature [17-22]. It was divided into two parts.: -

Part (1): Hypoglycemic Manifestations Assessment. It was used for monitoring signs and symptoms of hypoglycemia such as sweating, facial pallor, shakiness/tremors, increased appetite, nausea, dizziness or light-headedness, sleepiness, weakness, rapid heart rate, headache, tingling around mouth and tongue, difficulty seeing clearly and bizarre behavior or personality changes. Scoring system:

- Present symptom scored (1)
- Not present symptoms scored (0)

Part (2): Hypoglycemic Complications Assessment: It was used to track hypoglycemia-related side effects such seizures, unconsciousness, dizziness, weakness, falls, injuries, an increased risk of dementia in elderly people, and even mortality.

Scoring system:

Each item was scored as present or absent, which present indicated 1 and absent indicated 0.

Method

The following steps were taken to complete the study.

1- Obtaining approval

- Prior to commencing the research, official authorization was sought from the dean of the Faculty of Nursing and the administrators of the Medical ICU at Tanta University Hospital. This authorization was granted to enable the researcher to collect data from the designated location.

2- Ethical and legal considerations

Ethical committee approval was obtained from the Faculty of Nursing Tanta University before conducting the study with code No (19/12/2021).

The core of the research did not induce any discomfort or damage to any of the participants.

Informed consent was taken from each patient if he/she is conscious or from one of the family members if patient is unconscious after explaining the aim of the study to participate in the study and including the right to withdrawal at any time.

Confidentiality of data and privacy of the patients was taken into consideration regarding data collection. A code number used instead of names.

3- Tools development

Three tools were used in this study; Tools I & III were developed by the researcher after reviewing of the relevant literature. Tool II: part 1 and 2 was developed by Herpe et al in 2008 [16] and modified by the researcher.

4- Pilot study

It was carried out on 10% of the patients prior to the real research in order to assess the usefulness, practicality, and clarity of

the various tools' elements. The researcher used the information gathered from the pilot study to make some adjustments and some additional terms were done before the major investigation.
- Data obtained from those patients were excluded and not included in the current study.

5- Content validity of the tools

Seven experts from the University of Tanta's Faculty of Nursing and Faculty of Medicine evaluated the developed tools (I and II) to assure their validity and to check for clarity and application. Modifications were carried out accordingly prior the study was conducted.

6- Reliability of the tools

- The Cronbach's Alpha for tool I was 0.826 for 21 items applied on 6 patients, Cronbach's Alpha for tool II was 0.951 for 2 items applied on 6 patients. Cronbach's Alpha for tool III was 0.802 for 21 items applied on 6 patients. Cronbach's Alpha for the studied sheet in total was 0.881 for 6 patients.

7- Data collection

Data were collected from the beginning of March to the end of September 2022 across a seven-month period. The researcher gave a brief description of the goal and concept of the study after introducing herself to the subject. The researcher began with the control group first then the study group to prevent data contamination. Each patient was individually interviewed in medical ICU to fulfil the sheet questions. Each interview for the patient lasted for about 15-20 minutes. The questionnaire was filled by the researcher according to the answers of diabetic elderly.

8- Phases of the study

1- Assessment phase: -

Assessment of socio-demographic and clinical data was obtained by the researchers through interview using the developed questionnaire. The bio sociodemographic data was collected from patients' files. Patient was assessed by using tool (II and III) pre application and every day until 2 weeks of application of nursing directed protocol for study group and routine ICU care for control group.

2- Planning phase: -

- The development of a nursing-directed protocol for medical ICU patients was informed by the assessment of the study participants and a guideline retrieved from the pertinent literature review [8].
- The nursing-directed protocol for the occurrence of hypoglycaemic episodes among medical ICU patients comprised the subsequent [9, 10, 22]:

Instructing family members and patients on how to identify symptoms of hypoglycaemia and how to prevent and manage it effectively Identification of precipitating or inciting factors or events.

Teaching patients and their families how to recognise symptoms and how to prevent and treat hypoglycaemia appropriately.

3. Implementation phase: -

- Study group: Nursing-directed protocol was implemented by the researcher from the date of admission throughout two weeks during morning and afternoon shifts, while at the night shift was done by the staff nurses after training and under supervision of the researcher.

- Patient`s responses and other complications was monitored using tool II and III.

Blood glucose monitoring

A minimum of four times per day, bedside surveillance of capillary blood glucose was conducted (with four or three consecutive measurements falling within the target range, excluding bedtime and before meals). With each hypoglycaemia episode, blood glucose was measured every 30 minutes.

Blood glucose (BG) was checked at 3:00 a.m. Whereas a low glucose level at that time indicated an early peak in evening insulin or insufficient caloric intake at bedtime.

The glucose levels of patients who are fed continuously through a tube or who are not fed by mouth are monitored at least once each 6 hours.

An unusual bolus tube feeding regimen, in which the timing of the feedings and the bedside glucose tests were precisely matched.

Blood glucose monitoring was performed before the patient leave the unit, and precautions for treating the patient in the event that hypoglycaemia symptoms occur was considered.

Hypoglycemic management algorithm, it included the following:

Preventing hypoglycemic episodes

A low glycemic index was administered which included bran cereals and other grains, 1 to 2 fruits per day, nuts, and green vegetables.

With hypoglycemia episode eat or drink roughly 15 grams of carbohydrates.

Nursing procedures were scheduled in the morning or after a meal to avoid potential hypoglycemia.

Patients were taken off the nursing unit for procedures during scheduled mealtimes.

Nursing measures for hypoglycemia: -

If the patient was unable to eat or swallow safely or unconscious, dextrose 50% was administered by intravenous push as follow; 15 mL (7.5 g) for BG 60-69 mg/dl, 20 mL (10 g) for BG 50-59 mg/dl, 25 mL (12.5 g) for BG 30-49 mg/dl, and 30 mL (15 g) for BG <30 mg/dL.

Unconscious patients were assessed for adequate airway, breathing, and circulation.

Patient was placed in lateral recumbent position to decrease aspiration if possible.

Patient was placed on seizure precautions.

Blood glucose was rechecked every 15 minutes and treatment were repeated until BG was greater than 70 mg/dl.

If the patient was able to eat and swallow safely, patients were given 15 grams of carbohydrate.

Blood glucose was rechecked every 15 minutes and treatment were repeated until BG was greater than 70 mg/dl.

Extra food was administered to patients after blood glucose was greater than 70 mg/dL.

- If hypoglycemia occurred greater than 1 hour from meal or occurred during sleeping hours. Feeding the patient of the following: 8 oz (1 cup) of whole milk, 6 saltine crackers with 2 tablespoons of peanut butter, 6 saltine crackers with 1 oz. cheese.

- **Control group:** were received the routine ICU care such as measuring random blood glucose level and administration of medication.

4- Evaluation phase: -

- Patients of both groups were evaluated in the medical ICU daily using the three mentioned tools expect tool I pre and post application of nursing intervention protocol and every day for two consecutive weeks to evaluate the effect of nursing-directed protocol on hypoglycemic episodes' occurrence among patients in medical ICU

Results

Table (1): Illustrates percentages distribution of the studied patients regarding their sociodemographic characteristics.

This table showed that about two third (60 %) of the control group and near half (46.67%) of the study group had age ranged from (50-60) years old with mean± SD (52.57±7.380) in control group and (48.63±10.447) in the study group. Regarding gender, it was found that about more than half (56.67%) of both control group and study group were males respectively.

Concerning marital status, it was observed that more than two thirds (66.67%) of the control group and (60%) of the patients in the study group were married. Regarding educational level, more than one third (40 %, 36.67 %) of the control and study group were read and write respectively.

Concerning occupation, the result showed that about two thirds (60 %) of the patients in control group and more than two thirds (66.67 %) of the study group were worked respectively. Also, it was found that no statistically significant difference among the control and the study group regarding age, sex, marital status, educational level, and occupation were observed as P value equal (0.354, 0.606, 0.118, 0.953 and 1.00 respectively).

Table (2): Shows percentage distribution of the studied patients regarding their diagnosis and past history. Regarding diagnosis, the result showed that nearly half (43.33%,46.67%) of the control and study group had acute kidney injury (AKI). Also, near half (40%) of both control and study group had hepatic failure respectively. Also, it was found that more than half (53.33%) of both control and study group had renal disease. On the other hand, it was found that (50%) of both control and study group had heart disease. Also, near half (46.67%, 40%) of the control group and study group had hepatic failure.

Regarding past surgical history, it was found that about less than one quarter (16.67%) of the control group and more than one third (36.67%) of the study group had appendectomy respectively. Concerning the patient's drug history, the result showed that more than two thirds (63.33%) of the control group and about half (50.00%) of the study group had received glibenclamid drug. Also, one third (30%) of the control group and more than half (56.67%) of the study group had received pentamidine.

Table (3): Shows percentage distribution of the studied patients regarding their clinical data. Regarding duration of diabetes, the results showed that the mean of the control group was 8.80±6.088 year, and the study group was 10.40±5.170 year. It was found that more than three quarters (80.00%) of both control and study groups had past family history of diabetes mellitus. Also, it was found that about more than two thirds (66.67%) of the control group and less than three quarters (70.00%) of the study group respectively had episodes of sever hypoglycemia before.

Concerning the number of hypoglycemia episodes, the results showed that the mean of the control group was 1.43±1.569 episodes, and the study group was 2.13±2.129 episode. Also, Glaciated hemoglobin A1c, the results showed that the mean of the control group was 6.483±0.706 and the study group was 6.163±0.576. Concerning the risk factors associated with hypoglycemia, the result showed that more than two thirds (66.67%,63.33%) of both control and study group had risk factors as delay in the timing of meals. Also, more than half (53.33 ,56.67%) of the control and study group had heavy stress and nearly half (40%, 43.33%) of the control and the study group were heavy exercise.

Table (4): presents percentage distribution of the studied patients regarding level of consciousness throughout periods of study.

This table showed that less than one quarter (20%) of the control group and one third (30%) of the study group were alert on admission. On the other hand, it was found that nearly half (46.67 %) of the control group and (100%) of the study group were alert in the post 2 weeks. Moreover, there was a statistically significant difference between patients in the study group on admission, post a week, post 2 weeks where P- value=0.00.

Table (5): illustrates distribution of the studied patients regarding blood glucose measurements throughout periods of study.

The results showed that less than one quarter (20%) of the control group and nearly half (46.67%) of the study group had normal capillary blood glucose level on admission. On the other hand, it was found that more than two thirds (63.33 %)

of the control group and equal (100%) of the study group were normal capillary blood glucose in the post 2 weeks. Also, it was found that more than three quarters (80%) of the control group compared to (53.33 %) of the study group had hypoglycemia on admission. On the other hand, it was found that more than one third (36.67 %) of the control group had hypoglycemia post 2 weeks while no patient in study group had hypoglycemia post 2 weeks.

Moreover, there was a statistically significant difference between patients in the control and study group on admission, post a week, post 2 weeks where P-value=0.000. Concerning glycemic Penalty Index (GPI), the results showed that less than one quarter (20%) of the control group and nearly half (46.67 %) of the study group were normoglycemia of glycemic penalty index on admission. On the other hand, it was found that about two thirds (63.33 %) of the control group and compared to (100%) of the study group were normoglycemia of glycemic penalty index on post 2 weeks. Also, it was found that one third (33.33%) of the control group and less than one quarter (10.00 %) of the study group had sever hypoglycemia on admission.

On the other hand, it was found that less than one quarter (13.33 %) of the control group had hypoglycemia on post 2 weeks. On the other hand, there was no evidence of hypoglycemia among the study group post 2 weeks. Moreover, there was a statistically significant difference between patients in the control and study group on admission, post a week, and post 2 weeks where P- value=0.000.

Table (6): Represents mean scores of monitoring of hypoglycemic manifestation and complications of the studied patients throughout periods of study.

This table showed that the highest mean score for the hypoglycemic manifestations assessment in the control group was ranged from (0- 6) where the mean ± SD was (2.27±1.48) post 2 weeks respectively. While mean scores for the hypoglycemic manifestation in the study group was ranged from (0-2) where the mean ± SD was (0.57±0.63) of the study group post 2 weeks respectively. Concerning complications assessment, the findings indicate that the control group exhibited the highest mean score for the assessment of hypoglycemic complications, which ranged from 0 to 4. After two weeks, the mean score was 1.57±0.97, representing the standard deviation. The mean scores for assessing hypoglycemic complications in the study group varied between 0 and 1. After two weeks, the mean score was 0.33 with a standard deviation of 0.48.

Also, the study showed that there was a statistically significant difference among patients of the control and study group on admission, post a week, and post 2 weeks at P- value =0.000.

Table (7): Presents Correlation between monitoring of hypoglycemic manifestations and complications of the studied patients among the studied groups.

This table illustrated that there was a high positive correlation was observed among the control group regarding the total monitoring of hypoglycemic manifestations and total monitoring of hypoglycemic complications on admission as R = 0.44 with P value= 0,014 respectively of hypoglycemic manifestations. Also, a high negative correlation was observed among the study group regarding the total monitoring of hypoglycemic manifestations and total monitoring of hypoglycemic complications post 2 weeks as R= -0.077 with P value= 0.688 respectively.

In addition, it was found that there was a significant positive correlation between monitoring of hypoglycemic manifestations and complications score of control group on the admission with p value= .027 and also, there was a significant positive correlation between

monitoring of hypoglycemic manifestations and complications score of control group on the admission as R=0.445 with p value= 0.014

Table (1): Distribution of the studied patients regarding their sociodemographic characteristics.

Characteristics	The studied patients (n=60)				χ^2 P
	Study group (n=30)		Control group (n=30)		
	N	%	N	%	
Age (in years)					
(21-<30)	2	6.67	1	3.33	
(30-<40)	5	16.67	5	16.67	3.253
(40-<50)	9	30.00	6	20.00	0.354
(50-60)	14	46.67	18	60.00	
Range	(21-60)		(35-60)		F=2.837
Mean ± SD	48.63±10.447		52.57±7.380		P=0.097
Gender					
Male	17	56.67	17	56.67	FE
Female	13	43.33	13	43.33	0.606
Marital status					
Single	4	13.33	3	10.00	
Married	18	60.00	20	66.67	5.054
Divorced	1	3.33	5	16.67	0.118
Widow	7	23.33	2	6.67	
Educational level		;			
Illiterate	10	33.33	9	30.00	
Read & write.	11	36.67	12	40.00	0.953
Secondary	6	20.00	5	16.67	0.813
University/Post	3	10.00	4	13.33	
Occupation					
Not worked	10	33.33	12	40.00	FE
Worked	20	66.67	18	60.00	1.00

FE: Fisher' Exact test

Table (2): Distribution of the studied patients regarding their diagnosis and past history.

Past history	The studied patients (n=60)				χ^2 P
	Study group (n=30)		Control group (n=30)		
	N	%	N	%	
Diagnosis					
AKI	14	46.67	13	43.33	
chronic renal disease	2	6.67	3	10.00	26.752
Hepatic encephalopathy	2	6.67	2	6.67	0.031*
Hepatic failure	12	40.00	12	40.00	
Past medical history	6	20.00	3	10.00	
Respiratory diseases	15	50.00	15	50.00	
Heart diseases	16	53.33	16	53.33	
Renal diseases	9	30.00	11	36.67	9.392
Cancer	12	40.00	14	46.67	0.031*
Hepatic failure	5	16.67	3	10.00	
Neurological diseases	0	0.00	0	0.00	
Others					
Past surgical history					
Appendectomy	11	36.67	5	16.67	
Thyroidectomy	8	26.67	4	13.33	
Hemorrhoids/Anal fissure	7	23.33	4	13.33	0.585
Hysterectomy	3	10.00	2	6.67	0.559
Cholecystectomy	1	3.33	2	6.67	
Hernia	2	6.67	2	6.67	
Others	0	0.00	0	0.00	
Drug history					
Beta blocker	10	33.33	8	26.67	
Pentamidine	17	56.67	9	30.00	
Aspirin	13	43.33	14	46.67	
Disopiramid	1	3.33	5	16.67	2.102
Cotrimoxazol	10	33.33	5	16.67	0.153
Corticosteroid	12	40.00	16	53.33	
Metformin	15	50.00	11	36.67	
Glibenclamid	15	50.00	19	63.33	

More than one answer was chosen

Table (3): Distribution of the studied patients regarding their clinical data.

Clinical data	The studied patients (n=60)				χ^2 P
	Study group (n=30)		Control group (n=30)		
	N	%	N	%	
Duration of diabetes					
Range	(1-20)		(0-22)		1.204
Mean ± SD	10.40±5.170		8.80±6.088		0.277
Previous family history of diabetes					
Yes	24	80.00	24	80.00	FE
No	6	20.00	6	20.00	1.00
Episodes of severe hypoglycemia before					
Yes	21	70.00	20	66.67	FE
No	9	30.00	10	33.33	0.601
Number of Hypoglycemia episodes					
Range	(0-7)		(0-5)		2.102
Mean ± SD	2.13±2.129		1.43±1.569		0.153
Glaciated hemoglobin AIc					
Range	(5-7)		(3.5-7.5)		3.695
Mean ± SD	6.163±0.576		6.483±0.706		0.059
# Risk factors associated with hypoglycemia					
Skipping meals	12	40.00	10	33.33	
Drinking alcohol	1	3.33	2	6.67	
Delay in the timing of meals	19	63.33	20	66.67	
Cognitive dysfunction	5	16.67	5	16.67	
Increased age	10	33.33	12	40.00	
Heavy stress	17	56.67	16	53.33	0.361
Erratic eating patterns	2	6.67	3	10.00	0.843
Heavy exercise	13	43.33	12	40.00	
Weight loss	4	13.33	6	20.00	
Taking beta-blockers	3	10.00	3	10.00	
Using the same injection site too frequently	8	26.67	9	30.00	
Antidepressants	3	10.00	3	10.00	
Others	0	0.00	0	0.00	

More than one answer was chosen.

Table (4): Distribution of the studied patients regarding level of consciousness throughout periods of study.

Consciousness AVPU Level	The studied patients (n=60)													
	Study group (n=30)						χ2 P	Control group (n=30)						χ2 P
	On admission		Post a week		Post 2 Weeks			On admission		Post a week		Post 2 weeks		
	N	%	N	%	N	%		N	%	N	%	N	%	
A Alert	9	30.00	29	96.67	30	100.00	55.343 0.000*	6	20.00	20	66.67	14	46.67	11.928 0.064
V Verbal stimulation	6	20.00	1	3.33	0	0.00		6	20.00	2	6.67	6	20.00	
P Pain only	10	33.33	0	0.00	0	0.00		8	26.67	5	16.67	6	20.00	
U Unresponsive	5	16.67	0	0.00	0	0.00		10	33.33	3	10.00	4	13.33	

*Significant at level P<0.0

Table (5): Distribution of the studied patients regarding blood glucose measurements throughout periods of study.

Blood glucose measurements flow	The studied patients (n=60)													
	Study group (n=30)						χ2 P	Control group (n=30)						χ2 P
	On Admission		Post a week		Post 2 Weeks			On admission		Post a week		Post 2 weeks		
	N	%	N	%	N	%		N	%	N	%	N	%	
1. Capilary blood glucose														
Normal	14	46.67	29	96.6	30	100.00	83.182 0.000*	6	20.00	20	66.67	19	63.33	75.38 0.000*
Pre-diabetes	0	0.00	0	0.00	0	0.00		0	0.00	0	0.00	0	0.00	
Diabetes	0	0.00	0	0.00	0	0.00		0	0.00	0	0.00	0	0.00	
Hypoglycemia	16	53.33	1	3.33	0	0.00		24	80.00	10	33.33	11	36.67	
2. Glycemic Penalty Index (GPI)														
-Normoglycemia (80 ≤ BG ≤ 110)	14	46.67	29	96.6	30	100.00	59.777 0.000*	6	20.00	20	66.67	19	63.33	55.03 0.000*
-Slight hypoglycemia (60 ≤ BG < 80)	2	6.67	1	3.33	0	0.00		3	10.00	3	10.00	2	6.67	
-Hypoglycemia (40 ≤ BG < 60)	11	36.67	0	0.00	0	0.00		11	36.67	4	13.33	5	16.67	
-Severe Hypoglycemia (Blood glucose < 40)	3	10.00	0	0.00	0	0.00		10	33.33	3	10.00	4	13.33	

* Significant at level P<0.05

Table (6): Mean scores of monitoring of hypoglycemic manifestations and complications of the studied patients throughout period of study.

Monitoring of Hypoglycemic manifestation and complications	The studied patients (n=60) Range Mean ± SD							
	Study group			F P	Control group			F P
	On Admission	Post a week	Post 2 weeks		On admission	Post a week	Post 2 weeks	
Hypoglycemic manifestation Assessment	(3-11) 6.40±1.92	(0-2) 0.83±0.75	(0-2) 0.57±0.63	210.13 0.000*	(2-12) 7.77±2.46	(0-6) 2.27±1.39	(0-6) 2.27±1.48	89.18 0.000*
Complications assessment	(0-6) 2.60±1.52	(0-1) 0.10±0.31	(0-1) 0.33±0.48	65.07 0.000*	(0-6) 3.17±1.91	(0-3) 1.17±1.02	(0-4) 1.57±0.97	17.85 0.000*

* Significant at level P<0.05

Table (7): Correlation between monitoring of hypoglycemic manifestations and complications of the studied patients among the studied groups.

Hypoglycemic Complications	The studied patients (n=60) Hypoglycemic manifestation					
	Study group			Control group		
	On Admission	Post a week	Post 2 weeks	On Admission	Post a week	Post 2 weeks
R	0.445	0.076	-0.077	0.404	0.211	0.274
P	0.014*	0.691	0.688	0.027*	0.263	0.142

Discussion

Hypoglycemia is a well-known side effect of diabetes mellitus. Poor hospital outcomes, including longer hospitalizations in intensive care units and greater fatality rates, have been associated with it [(23)]. A nursing-directed protocol for hypoglycemic episodes led to improvements in other glucose parameters and a long-lasting decrease in hypoglycemia [(24)]. Therefore, assessing the impact of a nursing-directed protocol on the incidence of hypoglycemia episodes in patients receiving medical critical care unit treatment was the study's goal. To fulfill this aim one research hypothesis was stated as following: study subjects who exposed to nursing-directed protocol on hypoglycemic episodes occurrence exhibit early detection of hypoglycemia, decreasing its episodes and complications compared to control group who does not expose.

In relation to sociodemographic characteristics of the studied patients, according to the study, the age range of around two thirds of the control group and nearly half of the study groups was between 50 and 60 years old, with mean± SD values of 52.57±7.380 and 48.63±10.447 in the control group and study group, respectively. This study was consistent with that of Horton et al., (2022) [(25)] who found that the mean age of the patients in their age group was 51.17±892 years, indicating that over half of the patients were in the 50–65 age range.

Additionally, Yang et al. (2022) [(26)] provided support for this conclusion by pointing out that the mean age of over one-third of the patients in the study was 59.36±10.74 years. According to the researcher, this may be connected to the fact that individuals with diabetes mellitus who are younger have a higher risk of hypoglycemia.

According to the study, men made up more than half of the study group and the control group. This result was consistent with the findings of Switzer et al (2021) [(27)] who discovered that men made up more than two thirds of the patients under study. Furthermore, this study agreed with Bakar et al (2020) [(28)] who reported that men made up almost two thirds of the patients under study. Men with long-term type 2 diabetes mellitus experience a greater incidence of hypoglycemia than female patients, which may be connected to the previous. Li and associates (2018) [(29)].

The study showed that over two thirds of the study group and the control group were married. According to the researchers, this finding may be connected to hormonal changes and mental discomfort experienced by the partner with type 1 diabetes adults. This outcome was consistent with research by Long and Dungan (2020) that was carried out in the United States of America (USA) [(30)] who stated that most of the patients in the study were married. According to the researcher, the fact that over one-third of the study and control groups could read and write may have something to do with the patients' ability to comprehend how the protocol is applied and take medication on schedule. This study agreed with Shi Min Ko et al (2022) [(31)] who claimed that 25% of the patients in the study could read and write but were not educated.

In terms of sociodemographic data, the study found no statistically significant difference between the control and study groups. From the perspective of the researchers, this finding may be connected to the inclusion criteria that were in place for the current investigation. This indicated homogeneity between the two groups. This finding was like Alghamdi et al (2020) [(32)] who discovered that the features of the control and experimental groups did not differ statistically significantly. Contrariwise, this study was dissimilar to Baretic and Lang (2020) [(33)] who stated that the research group and the control group differed significantly in terms of gender and levels of education.

Concerning diagnosis and history of the studied patients, the study revealed that over half of the control and study groups experienced hepatic failure and acute kidney injury (AKI); according to the researcher, this outcome may be connected to the fact that diabetes mellitus is a risk factor for renal and hepatic diseases [(34)]. Sakane et al. (2022) verified this finding [(35)] who disclosed that renal problems affected 25% of the participants under study. Also, this finding was agreed with Sankar and Jayakrishnan (2023) [(36)] who found

that most of sample of the studied patients had liver diseases.

Concerning past medical history, the study showed that kidney disease affected more than half of the study group and the control group This may be connected to the fact that the occurrence is higher because of reduced gluconeogenesis 40% of which took place in the kidney, reduced degradation of insulin in peripheral tissues, and reduced renal clearance of insulin. However, it was shown that heart disease and liver failure affected half of the study and control groups. This could be related to that hepatic function includes gluconeogenesis, glycogenolysis, and carbohydrate metabolism. An elevated risk of hypoglycemia is ultimately a result of impaired liver function.

The results of this study aligned with the findings of Uemura et al (2022) [37] who reported that Two thirds of research participants had renal problems Also, Samya et al. (2019) provided support for this conclusion [38] who discovered that liver problems affected most of the study participants. Contrariwise, this conclusion disagreed with the findings of Agrawal et al (2022) [39] who reported that cardiovascular problems affected more than one-third of the individuals in the study.

Regarding past surgical history, according to the current research, more than one third of the study group and fewer than 25% of the control group underwent appendectomy. This finding agreed with Tiruneh et al (2019) [40] who mentioned that more than one quarter of the studied patients had past surgeries as appendectomy. Concerning the patient's drug history, according to the present study's findings, glibenclamid was administered to over half of the study group and more than two thirds of the control group. Moreover, pentamidine was administered to almost half of the study group and one-third of the control group. From the perspective of the researcher, this might be connected to that, all study sample had diabetes mellitus so could be some of them treated by glibenclamid that hypoglycemia is typically the result of the interplay of therapeutic insulin excess and compromised physiological and behavioral defenses against falling glucose levels and about less than one quarter of the control group and more than one third of the study group had appendectomy so could be received pentamidine drug as antibiotic post-surgery.

Mahgoub et al. (2023) provided support for this finding [41] who revealed that for the treatment of their diabetic mellitus, almost half of the participants in the study were using glibenclamid. On the other hand, this result disagreed with Yang et al (2022) [26] who found that most of the studied patients didn't take other medications rather than oral hypoglycemic medication.

Regarding duration of diabetes, the results of this study showed that the study group's mean score was 10.40±5.170 years, while the control groups was 8.80±6.088 years this could be related to that for a long period of time, diabetic patients may be exposed to more complications. This result was comparable to that of Olamoyegun et al (2020) [42] who discovered that the bulk of the patients under study had DM for more than 5 years, with a mean duration of 9.57±3.09 years. Contrariwise, this result was dissimilar to Switzer et al (2021) [27] who stated that more over half of the participants in the study had had diabetes for less than 2 years with mean 1.91±0.88.

Concerning previous family history of diabetes, according to the current study, over 75% of the study group and the control group had already experienced DM; this finding may be connected to the fact that diabetes is an inherited condition. This investigation aligned with the findings of AlTowayan et al (2023) [43] who revealed that most of the studied patients had family history for diabetes mellitus. The current investigation discovered that around two thirds of the control group and fewer than three quarters of the study group had experienced severe hypoglycemia episodes in the past. This finding may be connected to the fact that over half of the patients in the study had disease risk factors. This outcome was consistent with the findings of Pratley et al (2020) [44] who reported that more over half of the research participants had episodes of severe hypoglycemia in the previous 12 months. Also, this study was supported by Yun et al (2021) [45] who reported that almost half of the participants in the study had experienced severe

hypoglycemia episodes twice previously. Concerning number of hypoglycemia episodes in ICU, the current study represented that, the range of the control group had episodes of hypoglycemia for 0-5 times, and the study group had episodes of hypoglycemia for 0-7 times, this could be related to that, for a long period of time, diabetic patients may be exposed to more complications and episodes of hypoglycemia. These results agreed with Korea by Yun et al (2019) [46] who discovered that episodes of hypoglycemia occurred in over half of the individuals under study. for ≥ 2 times and less than two thirds of control group had episodes of hypoglycemia for 1-2 times.

Regarding Glaciated hemoglobin A1c, according to the current study, the control group's mean was 6.483±0.706. and the study group was 6.163±0.576, this might be related to that the studied patients had diabetes mellitus. This study was like Popoviciu et al (2019) [47] who found that the mean HA1c 6.75±0.834 was found in more than two thirds of the participants under study. Also, this finding was on the same line with Samya et al (2019) [38] who represented that less than two thirds of the studied patients their HAIc were 6.9, This may have to do with the fact that regular glucose monitoring by blood is helpful in managing diabetes. For a longer length of time, an objective measurement of blood glucose is obtained using a different blood test. The average quantity of glucose that has been in the patient's circulation during the past 3 to 4 months is revealed by the glycated hemoglobin test, also known as glycosylated hemoglobin (HbA1C or A1C). The glucose group A1C typically makes roughly 4% to 6% of hemoglobin. A1C values should be less than 5.4%, with 6.5% being the recommended target level for diabetics [48].

Concerning the risk factors associated with hypoglycemia, the current study found that delayed mealtime was a risk factor for almost two thirds of the study group and the control group. Additionally, nearly half of the control and study groups performed vigorous activity, and more than half of them experienced high levels of stress, this could be related to that, more than two thirds of the studied patients were worker, so they are busy, delay their meals, stress and heavy exercise which leads to hypoglycemia. This result was like Bakar et al (2020) [28] who mentioned that the majority of the studied patients their predisposing factors for hypoglycemia were delay meals after insulin or oral hypoglycemic medication administration and emotional stress. Also, this study was on the same line with Sankar & Jayakrishnan (2023) [36] who stated that after taking insulin or an oral medicine, less than 25% of the participants in the study engaged in intense activity.

In relation to level of consciousness throughout periods of study, less than 25% of the control group and 33% of the study group were alert upon admission, according to the results of the current study. However, it was observed that after two weeks, over half of the research group and the control group were alert. Additionally, a statistically significant difference was seen between the study group's patients upon admission, one week later, and two weeks later. This difference may have resulted from the study group's increased alertness compared to the control group. because of effect of nursing-directed protocol on the occurrence of hypoglycemic episodes among patients.

This result was like Lee et al (2022) [48] who reported that less than one quarter of the studied patients were alert on admission and more than three quarters of them showed the improvement on Glasgow Coma Scale after 2 weeks of treatment. Contrariwise, this study was dissimilar to Saikawa et al (2019) [49] who mentioned that more than half of the studied patients were alert on admission.

Regarding blood glucose measurements throughout periods of study, the present study found that, more than one third of the control group had hypoglycemia post 2 weeks while no patient in study group had hypoglycemia post 2 weeks. From the perspective of the researcher, this might be connected to that, positive effect of implementing current nursing protocol of this study on adjusting blood glucose measurements post 2 weeks.

This result was consistent with Abdalla et al (2019) [50] who found that most of the studied patients had abnormal blood glucose level because of presence of hypoglycemia on admission which improved on treatment post admission within one to two weeks. Also, this result was supported by Shea et al (2019) [51] who reported that the blood glucose level improved significantly both before and after the nursing-driven root was implemented. Concerning glycemic Penalty Index (GPI), In contrast to the entire study group, the results indicated that slightly over two-thirds of the control group experienced normoglycemia as measured by the glycemic penalty index two weeks later. Additionally, after two weeks, it was observed that less than 25% of the control group experienced hypoglycemia. However, after a duration of two weeks, no indications of hypoglycemia were observed in the study group. Furthermore, a statistically significant distinction was observed between patients in the control and study groups at the time of admission, one week later, and two weeks later.

This study was in agreement with Lou et al (2021) [52] who represented that more than three quarters of the studied patients had abnormal HgA1c on admission which was improved post two to three weeks post admission. Also, this finding was agreed with Wu et al (2021) [53] who found that there was highly statistically significant difference between the studied patients' blood glucose level pre and post program. In the researcher point of view this might be related to that, positive effect of implementing current nursing protocol of this study on adjusting blood glucose measurements post 2 weeks.

Moreover, there was a statistically significant difference between monitoring of hypoglycemic manifestations and complications assessment among patients in the control and study group on admission, post a week, and post 2 weeks. This study was on the same line with Santoso and Setyowati (2019) [54] who revealed that there was a statistically significant improvement among the studied patients pre and post educational program implementation. In the researcher point of view; this could be due to the effectiveness of nurse-directed protocol on improving patients' condition. This finding was supported by Veintramuthu et al (2019) [55] who mentioned that there was a statistically significant improvement in glycemic control compliance and life style of the studied patients with hypoglycemia. This result was on the same line with Purwanti et al (2021) [56] who revealed that there was a highly statistically significant difference between pre and post educational program among the studied hypoglycemic patients. Moreover, there were no significant differences of relation between sociodemographic characteristics of the studied patients and hypoglycemic manifestations and complications assessment among the studied groups. This study was in the same line with Almigbal (2021) [57] who revealed that there was no statistically significant relation between the studied patients' demographic characteristics and their clinical manifestation of hypoglycemia with age mean±SD 39.54 ± 15.20 years.

This result was agreed with Samya et al (2019) [38] who mentioned that there was no statistically significant relation between the studied patients' gender and their hypoglycemia level and reported that highest mean scores for the hypoglycemic manifestation among male patients where the mean±SD was 5.84±3.21. This study disagreed with Kahsay et al (2019) [58] who mentioned that there was a statistically significant association between the studied patients' age, gender, and their hypoglycemic events. This finding agreed with AlTowayan et al (2023) [43] who stated that there was no statistically significant difference between the studied patients' marital status and their hypoglycemia. This finding disagreed with Gilmore et al (2022) [59] who reported that there was a statistically significant difference between control group and the studied patients' age and their hypoglycemic prognosis.

This study concurred with the findings of Shea et al. (2019) [51] that no significant correlation existed between the gender of the patients under investigation and their prognosis of hypoglycemia.

This result was corroborated by Hasse et al. (2020) [60], who found no statistically significant

distinction between the marital status of the patients under study and the control group in relation to their hypoglycemic rates and outcomes.

Regarding correlation between monitoring of hypoglycemic manifestations and complications of the studied patients among the studied groups, the findings of the present study indicated a significant positive correlation between the comprehensive surveillance of hypoglycemic manifestations and complications and the control group as a whole. Furthermore, a significant inverse correlation was identified within the study cohort with respect to the overall surveillance of hypoglycemic symptoms and complications after a period of two weeks.

Furthermore, it was discovered that the surveillance of hypoglycemic manifestations and the complications score of the control group upon admission exhibited a significant positive correlation. Also, it was a significant positive correlation between monitoring of hypoglycemic manifestations and complications score of control group on the admission as and also, it was monitoring of hypoglycemic complications on admission, post a week, post 2 weeks. In the researcher point of view; monitoring of hypoglycemic manifestations helping for preventing to hypoglycemic complications; the greater the relationship between monitoring hypoglycemic manifestations, the less hypoglycemic complications will be occurring.

This research was consistent with the findings of Mattathil (2022) [61] who reported a positive correlation between episodes of hypoglycemia and the consequences and outcomes of hypoglycemia in the study group four weeks after bundle implementation. Furthermore, this discovery was corroborated by Gilmore et al. (2021) [59], who documented a positive correlation between the severity of hypoglycemia, complications, and outcomes of the pre-hypoglycemia protocol.

Conclusion:

The results of the research indicate that there were no statistically significant differences in pulse rate and blood pressure between the patients in the control group and those in the study group at the time of admission, one week later, and two weeks later. However, a statistically significant distinction was observed among the patients in the study group with respect to their level of consciousness and blood glucose measurements at the time of admission, one week later, and two weeks later. Furthermore, a significant distinction was observed between patients in the control and study groups with respect to the evaluation of current hypoglycemic symptoms and complications at the time of admission, one week later, and two weeks later. Additionally, complications upon admission were positively correlated with hypoglycemic manifestations. In conclusion, it was determined that the nursing-directed protocol effectively reduced hypoglycemic episodes through the improvement of blood glucose levels, as well as the mitigation of hypoglycemic manifestations and complications.

Recommendation:

Based on the findings of the present study, the following can be recommended:

- Studying hypoglycemic episodes more broadly in the nursing specialty.
- The same study should be repeated with a bigger probability sample and in multiple regions to ensure that the findings are generally applicable.
- To determine if similar factors are equally important for the incidence of hypoglycemia episodes, future research should focus on a variety of groups.

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