



TIGHT BLOOD GLUCOSE CONTROLLING IN PATIENTS WITH TYPE 2 DIABETES UNDERGOING CORONARY ARTERY BYPASS SURGERY IN TABRIZ –IRAN.

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ABSTRACT

Background : Diabete mellitus is the most common chronic disease in the worldwide.at least 20% of diabetic patients have experienced one of cardiovascular events strict control of blood glucose, directly and indirectly ,has important role in prevention of cardiovascular disease. This study aimed to evaluated tight blood glucose control in patients with type 2 diabetes undergoing CABG.

Methods : It is a clinical trial study with the control group. Total number of participating samples in this study was 70 .For diabetic and nondiabetic patients whom candidates for CABG, immediately after hospitalization in the surgical ward, blood samples was taken from all .If the blood sugar was high, patient by randomly allocation in either case or control group by using Rand.Lst software version 1.2. New protocol is implemented in three stages, before, during and after surgery. Measuring blood glucose, before surgery is every 6 hours and during surgery in the case of CABG by pump is every one hour and in CABG without pump is every two hours. In intensive care unit if the patient was fast, it was measured every 2 hours. Also After surgery, in surgery ward in the case of oral feeding it was measured every 6 hours.

Results : Average blood glucose during surgery in two case and control group was significant. Also average blood glucose resulted from 19 times measurement in first 24 hour and (19 times measurement) in second 24 hour and four times measurement in third 24 hours in intensive unit generally was decreased and mean difference of glucose in two group in each 3 mentioned times slot statically was significant.

Diccution : tight blood glucose measurement and management in patients with type 2 diabetes CABG had positive results in order to decrease blood glucose after surgery.

Keywords: Tight blood glucose controlling, type 2 diabetes, coronary artery bypass surgery.

Introduction

Diabete mellitus is the most common chronic disease in the worldwide. Type 2 diabete is the most common form of diabetes and 40-45 percent of all cases of diabetes is allocated by type 2 diabetes (1). Serious disabilities such as heart, eye and kidney disease are complications of uncontrolled diabetes (2). According to the studies, at least 20% of diabetic patients have experienced one of cardiovascular events (including myocardial infarction, heart failure or sudden death)(3).In Iran, diabete is the head of non-communicable disease and it is estimated 5/2 % of all Iranians (3/5 million) have diabetes.Risk factors for cardiovascular disease are more common in patients with type 2 diabetes. Therefore, strict control of blood glucose, directly and indirectly, has important role in prevention of cardiovascular disease.Generally, using regular and systematic protocol in tight blood glucose control among type 2 diabetic patients under going coronary artery bypass surgery, decrease the incidence of complications and problems after surgery (4-6). Furnery et al. study, based on type of blood control before surgery, shows decrease in mortality rate from 30% to 5%. .Harold M Lazer et al (7) in the study with tight blood

glucose control by using glucose –insulin –potassium serum and subcutaneous injection of insulin before surgery and 12 hours after surgery proved that consistent control of blood glucose using glucose-insulin –potassium serum in CABG patients improves surgical results, enhance the life span of patients, reduce the incidence of ischemic and infection after surgery.In Zerr KJ,et al study (8) showed consistent control of blood glucose has significant role in improving diabetic patients under CABG.

In a review study by Reddy and et al. (2014) shows creating a secure and functional protocol to control blood sugar level in an appropriate range and prevent its rise (hyperglycemia) can play an important role in preventing mortality after surgery (9).

Furnary and et al, showed that the management and control of blood glucose level in patients with CABG, increase recovery and decrease mortality rate significantly. This study aimed to evaluated tight blood glucose control in patients with type 2 diabetes undergoing CABG (6).

Intense blood glucose control resulted in a reduction in morbidity and mortality in the critically ill patient population,

with a large portion of these patients being cardiovascular surgery patients. Clinical trials evaluating other patient populations have shown a reduction in morbidity with a lesser impact on mortality using tight blood glucose control (10).

Method

It is a clinical trial study with the control group. The study population included diabetic patients admitted for CABG in Shahid Madani hospital in Tabriz university of medical science who were chosen by simple sampling method. Sample size was estimated by a Power & Sample size software 1.2 version.

According to the measurement process of blood glucose level in two stages, and potential loss of samples because of death, lack of cooperation, non-surgical and other cases, finally 70 samples were considered (35 people for both groups).

(60%) μ_2 , (75%) μ_1 , (0.3) S_2 , (0.2) S_1 , $\beta=80\%$, $\alpha=95\%$) this amount shows changes rate of blood glucose levels.

$$N = \frac{(Z_{1-\alpha/2} + Z_{1-\beta}) \times S_1^2 \times S_2^2}{(\mu_1 - \mu_2)^2} \quad N=70$$

Total number of participating samples in this study was 70 people which totally 3 people missed (1 person from case group and 2 person from control group).

Inclusion criteria

patients with type 2 diabetes undergoing CABG for the first time (with pump or without it) Diagnosis of type 2 diabetes in hospitalization or hospital admission process, with fasting blood glucose test, blood sugar after meal and glucose tolerance test. Patients who have any other chronic disease except coronary artery disease. Patients who have Creatinine level below 2 during admitted process. Patients who don't have any kidney disease when were admitted to hospital.

Exclusion criteria

The patient leave the study group.

The patient dies during study.

For any reason it will be impossible for study units to continue

Data collecting tools included the following items

The questionnaire included demographic and information related to disease and surgery

Registration form of medical fees, hospitalization period and blood glucose levels

Revised protocols for intravenous infusion of insulin and subcutaneous insulin injection implemented before, during and after CABG. Blood glucose chart record, protocols that used for intravenous infusion of insulin and subcutaneous insulin injection in 3 period before, during and post surgery both case and control group.

This form is designed to register information during one day and it is possible to record blood glucose between 1-2-4-6-12 hours.

Validity of tools

Validity of check lists in this study was determined with

content validity method. Firstly a questionnaire was designed, then reform comments of 10 professor were applied in the research. Total cost of project was paid by Tabriz university of medical science. The patients didn't pay any charge for participating in this research. It should be noted that participating in study was optional for patients and they could leave the study at any time.

Method

For diabetic and nondiabetic patients whom candidates for CABG, immediately after hospitalization in the surgical ward, blood samples were taken from all patients to study fasting blood glucose. Then samples were sent to the laboratory and then 35 gr monosaccharide glucose was given to patients orally and 1 hour and 2 hour later on, blood samples were collected from patients and sent to laboratory in order to examine the level of the glucose. If the blood sugar was high, patient by random allocation in either case or control group by using Rand.Lst software version 1.2.

Diabetes definition according to America diabetes association criteria in 2013, is defined as fasting blood glucose more than 126 mg/dl (7mmol/L) or 2 hours after glucose tolerance test, blood sugar more than 200mg/L (11.1 mmol/L). If the chosen patient is placed in control group, he/she was placed under protocols for intravenous infusion of insulin and subcutaneous insulin injection implemented before during and post-surgery among control group patients. In this way that target blood glucose in this group was considered 80-150 mg/dl before and after surgery and during surgery was considered 80-200 mg/dl.

Measuring blood glucose, before surgery is every 6 hours and during surgery in the case of CABG by pump is every one hour and in CABG without pump is every two hours. In intensive care unit if the patient was fast, it was measured every 2 hours. Also After surgery, in surgery ward in the case of oral feeding it was measured every 6 hours.

Common protocol

New protocol is implemented in three stages, before, during and after surgery.

Before surgery stage:

The night before the surgery from 9 pm liquid diet without calories started and blood glucose of patients until they go into surgery room was measured every 4 hours. Measuring blood glucose was done by using calibrated glucometer from capillaries of fingertips. If blood glucose remain at the expected level for 4 hours, measuring is done every 2 hours and without informing doctors changes was done continuously. Blood glucose level less than 40 mg/dl and more than 500 mg/dl was measured in laboratory. It must be noted that measuring blood glucose in two control and case groups wasn't at the same time.

If the blood glucose in two hours after patients meal was less than 150 mg/dl, by doctor prescription insulin injection stopped and oral pill, Metformin and Glibenclamide medication started.

During surgery

Insulin infusion was as following

For blood glucose 200-250 mg/dl 4 ml in hour

For blood glucose 250-300 mg/dl 6 ml in hour
 For blood glucose 300-350 mg/dl 8 ml in hour
 For blood glucose 350-400 mg/dl 10 ml in hour
 Subcutaneous injection after surgery was as following:

- 150-200 mg/dl 4 IU
- 200-250 mg/dl 5 IU
- 250-300 mg/dl 10 IU
- 300-350 mg/dl 12 IU
- And more than 350 mg/dl 16 IU

Solution for infusion was prepared as following:
 50 IU in 50 cc normal saline serum (1 cc solution equal to 1 unit insulin crystals)

Blood glucose level of patients in control group was recorded in” chart record of glucose levels , in patients in case and control group “.

In all patients in case group that before hospitalization had a positive history of diagnosis of type 2 diabetes or in the admission process ,after hospitalization or before surgery had diagnosis of type 2 diabetes by using fasting blood sugar tests or glucose tolerance test , these patients had 1,2 stage from 8 attachment stages of a4 new protocol.

After assigning a diagnosis of type 2 diabetes among these patients, if the fasting blood glucose was more than 140 mg/dl or less than 180 mg/dl, blood glucose was measured three times: once before meal, sleeping time, at 3 am, also hemoglobin A1c was measured.

If in all three times measurements , the blood glucose was between 140-180 mg/dl for the patient , subcutaneous injection protocol according to b4 attachment of new protocol was preformed, and if the fasting blood glucose was more than 180 Mg/dl , the patient got under continuous insulin infusion protocol according to new protocol and stage related to new protocol preformed.

For patients in control group acceptance protocol was in this way that when the patient was hospitalized, blood glucose was measured. If the patient was diabetic or during hospitalization glucose was more than 140 mg/dl , blood glucose was measured three times, before the meal ,in sleeping time and at 3 am .If before the surgery , blood glucose was more than 140 mg/dl , all anti –diabetic drugs were stopped and basic subcutaneous insulin crystal treatment started.

Pre-surgical protocol was done as following

The night before surgery at 9 pm liquid diet without calories started and level of glucose was measured every 4 hours before going to surgery room.

Insulin infusion was measured 6-8 hours before the surgery. In order to make liquid insulin infusion, used from 250 IU of insulin crystals in 250 cc of normal saline solution .So that 1 cc of this solution contained 1 IU of insulin crystal. Before starting infusion line serum with 30 mm of this solution washed. In order to infuse liquid utilized from infusion pump which had capacity to infuse 0.1 ml/h.

For the treatment of hypoglycemia which means blood glucose less than 90 mg/dl according to presented table insulin infusion decreased and then serum dextrose 5 percent immediately was injected intravenously and 15 minutes later blood glucose level was measured .If the blood glucose hasn’t reached to more than 90 mg/dl this sage was repeated again and blood glucose was controlled every one hour.

Change of insulin treatment from intravenous insulin to subcutaneous injection

In second day after surgery if blood glucose level at least for 4 hours was in the target range , or after beginning of subcutaneous injection treatment for 2 hours still insulin infusion continued and then stopped.

Patients during, before or after surgery, after release from intensive unit and enter to surgery ward were under body temperature monitoring every 12 hours. In intensive unit also body temperature was measured .If the body temperature was above 38.5 centigrade, three times in a row during 24 hours CBC (Complete blood Cell) test was sent immediately. If in two consecutive measurements between 12 hours still CBC was high, the doctor was informed.

Data analysis method

Data was analyzed using descriptive statistics (average , frequency , percentage ...) and chi-square tests and independent t- test and one- way analysis of variance and repeated measure test by SPSS”16 software. In this study P value less than of 0.05 is considered significant.

Results

Table 1-4 characteristics of type 2 diabetic patients under coronary artery bypass in two control group (34 people) and case group (33 people) in in shahid madani hospital of Tabriz in 1392

Variable	variable level	Case Group *N(%)	Control group N (%)	p-value
Age	Average	60.8	59.3	0.76
Gender	Male	15(45.0)	17(51.5)	0.62
	Female	19(55.0)	16(48.5)	
Level of education	Illiterate	16(47.1)	17(51.5)	0.24
	Primary and secondary	13(38.2)	15(45.5)	
	High school and university	5(14.7)	1(3.0)	
Language	Azeri	31(91.2)	32(97.0)	-
	Kurdish	3(8.8)	1(0.3)	
Statement of income	Less income than expenses	8(23.6)	5(14.7)	0/55
	Equal income and expenses	23(67.7)	23(69.7)	
	More income than expenses	3(8.8)	5(15.2)	
Variable	Variable level	Case group *N (%)	Control group N (%)	P-value
Body mass index *(kg/m2)	Normal (18.5-24.9)	13(38.3)	10(30.3)	0/55
	A little fat (25-29.5)	18(52.9)	23(69.7)	
	And fat (30-39.5)			

	Excessive obesity(40 <)	3(8.8)	2(3.0)	
Diagnosis of diabetes	Already has	28(82.4)	26(78.8)	0/76
	Recently, using GOTT	6(17.6)	7(21.2)	
Duration of type 2 diabetes	0-1 year	7(20.6)	6(18.2)	0.83
	2-5 year	13(38.2)	10(30.3)	
	6-10 year	4(11.8)	4(12.1)	
	<11 year	10(29.4)	13(39.4)	
Diabetic treatment diet	Has	20(58.8)	11(33.3)	0.05
	Doesn't have	14(41.2)	22(66.7)	
Family history of type 2 diabetes	Has	21(61.8)	15(45.5)	0.22
	Doesn't have	13(38.2)	18(54.5)	

*Numbers were reported in frequency form (percentage)

** (BMI body mass index)

W1

Average blood glucose in first 24 hours before the surgery in type 2 diabetes patients with CABG in two case (34 people) and control (33 people)

Average blood glucose in first 24 hours before the surgery blood Glucose Measuring Time	Case Group mean± standard deviation (n=34)	Control Group mean± standard deviation (n=33)	P- value Intergroup
18 o'clock	233.94±71.36 (130-400)	206.33±55.80 (130-470)	0.001
24 o'clock	179.80±47.33 (386-118)	204.83±66.88 (112-410)	0.03
6 o'clock	134.38±19.01 (90-180)	154.58±54.10 (67-306)	0.01
P-value Interaction between time and group	0.001		

Table number 1-4 shows some demographic characteristics of participants in two experimental and control group. According to table number 1-4 results using independent t-test and chi-square test ANOVA indicated that the mean age of patients in case group was 60/8 and in control group was 59.3 years that wasn't significant. Most gender participations was female. Most of patients had already diagnosis of type 2 diabetes more than 11 years that didn't have diabetic treatment diet and also had family history of type 2 diabetes. Chi-square test showed that most of patients had class II heart disease but differences between two group from statistical point of view wasn't significant. Independent t-test and chi-square test showed that ejection fraction was in the range of 40-50. Difference between two group in terms of frequency and mean wasn't statistically significant (P>0.05). Repeated measurement test showed average blood glucose resulted from 3 times measurement decreased. Mean difference of glucose between two studied group and in 3 measured time was significant

(P<0/05). Independent t- test showed average creatinine level in blood before surgery among case group was more than control group and after surgery in case group was more than control group. The mean difference of blood glucose between groups was significant. (p<0/05) but inside groups wasn't significant (P>0/05).

Studied units in two intervention and control group in term of demographic characteristics except two variable "duration of type 2 diabetes " and " diabetic treatment diet" were homogeneous. Average blood glucose during surgery in two case and control group was significant. Also average blood glucose resulted from 19 times measurement in first 24 hour and (19 times measurement) in second 24 hour and four times measurement in third 24 hours in intensive unit generally was decreased and mean difference of glucose in two group in each 3 mentioned times slot statically was significant. Between average duration of hospital stay of patients in control and case group was significantly difference.

Discussion

Considering this fact that participating in this study were chosen simple sampling, basic information between two groups didn't have significant difference. Statistical results showed that between case and control group before intervention was significant difference in blood glucose level. These results with Jiun-Yi Li et al. study in 2006 in China which had checked impact of tight blood glucose management in patients with type 2 diabetes coronary artery bypass surgery is similar(4).

ANOVA test results showed that average blood glucose resulted from 19 times measurement in first 24 hour and 19 times measurement in second 24 hour and 4 times measurement in third 24 hours in intensive unit generally was decreased and mean difference of glucose in two groups in each 3 mentioned times slot statically was significant. These results with results from Lazar et al 2004 that examined impact of sever control of blood glucose in patients with type 2 diabetes CABG in America is similar (7).

Considering this fact that blood glucose in short time and especially in first times after surgery for any verious reasons could show dramatic change(2). Blood glucose measurement in several times and in longer periods could have better results. In this field also studied results of Furnary et al in America which studied 3554 patients with diagnosis of type 2 diabetes who were under open-heart surgery for 14 years (1987-2001). In these patients target blood glucose was, 80-150 mg/dl that showed in the group which their blood glucose managed and controlled, blood glucose level after surgery was significantly decreased in compare with control group. (6). In this regard, results from other studies also showed that control and management of blood glucose level could have better results in decreasing blood glucose level after artery bypass surgery (11-14) according to results of present study and results from similar studies seems tight blood glucose measurement and management in patients with type 2 diabetes CABG had positive results in order to decrease blood glucose after surgery. Therefore placing this intervention in treatment and care program of these kinds of patients is recommended. But along with this recommendation, patients' condition, environmental intervention, cost-effectiveness of this intervention, and other

local and hospital condition before utilizing intervention must be considered and generally in very few studies the influence of tight blood glucose management and control in hospital expenses is considered.

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