ISSN No:-2456-2165

The Effect of Preoperative Glucose Administration on Blood Glucose Levels and Patient Well-Being in Surgery Under General Anesthesia

Firdaus Sukarno Putra, Achsanuddin Hanafie, Dadik Wahyu Wijaya
Department of Anesthesiology and Intensive Care, Medical Faculty,
North Sumatera University, Haji Adam Malik General Central Hospital,
Medan, Indonesia

Abstract:-

- ***Background:***

Surgical action causes a metabolic stress response that triggers an increase in cortisol levels and causes insulin resistance. The hyperglycemic state has a significant effect on increasing the morbidity and mortality of patients undergoing surgery. The purpose of this study was to determine the effect of preoperative oral glucose administration on blood glucose levels and well-being of patients in surgery under general anesthesia.

- ***Methods:***

Research with randomized control trials and double-blind. 64 laparotomy patients with general anesthesia were randomly selected by simple random sampling. Patients were divided into two groups, namely treatment (n = 32) given 50 g preoperative 2 hour oral glucose and control (n = 32) given preoperative 2 hour mineral water. Blood glucose levels were assessed at 2 preoperative hours (T1), durante (T2) and 1 hour postoperatively (T3). Well-being is measured by VAS (Visual Analogue Scale) 1 hour postoperatively (WB1) and 24 hours postoperatively (WB2). Data were analyzed using SPSS.

- ***Results:***

The results of the Wilcoxon statistical test showed a significant effect of preoperative oral glucose administration on T2 and T3 in the control group (p <0.05) but not significantly in the treatment group (p> 0.05). There were differences in the effect of preoperative oral glucose administration in the treatment and control groups (p <0.05). While the effect of preoperative oral glucose administration on WB1 and WB2 in each group showed significant results (p <0.05). The difference in the effect of preoperative oral glucose administration on WB1 and WB2 was significant in the variables of thirst, hunger and dry mouth (p <0.05).

- ***Conclusion:***

There is an effect of preoperative oral glucose administration on glucose levels and patient well-being in surgery under general anesthesia.

Keywords:- *Preoperative Oral Glucose, Blood Glucose Levels, Well-Being, VAS.*

I. INTRODUCTION

In surgery or trauma, a catabolic phase occurs which causes an increase in insulin resistance and hyperglycemia. This starts with the nervous system that activates stress responses by sending impulses to the hypothala]]mus (Finnerty et al., 2013). Then, the hypothalamus activates the sympathetic nervous system and secretes CRH which stimulates the release of ACTH and cortisol, and triggers the release of vasopressin. Cortisol decomposes fat and protein deposits, increases carbohydrate deposits and increases blood glucose supply (Sherwood, 2015), while on the other hand there is also an increase in the secretion of growth hormone (GH) in response to surgery and trauma. GH will then inhibit glucose use by cells (Desborough, 2000), resulting in an increase in blood sugar levels and even hyperglycemia (Lubis et al., 2016) and risk of postoperative surgical site infection (Ata et al., 2010).

Hyperglycemia that occurs after surgery is a crucial problem to be addressed immediately because it can put patients at high risk for various complications, a longer healing period, increased length of stay, and can cause death (Van Cromphaut, 2009).

Globally, it is estimated that there are 234 million surgical procedures performed annually (Roscio et al., 2014). In Indonesia, the number of surgical procedures in 2012 reached 1.2 million (Sartika, 2013). National Tabulation Data of the Ministry of Health of Indonesia in 2009 outlined that surgery ranked 11th out of 50 disease patterns in Indonesia with a percentage of 12.8% (Zurianti et al., 2014). The rate of surgery at H Adam Malik General Central Hospital Medan in January to November 2018 period reached 5,833 people consisting of 1766 (30.27%) people who underwent emergency surgery and 4067 (69.73%) underwent elective surgery. (SIRS RSUP HAM, 2018).

According to Pogatschnik (2015), preoperative oral carbohydrate administration 2 hours before surgery reduces insulin resistance and reduces catabolic metabolism which has a positive impact on perioperative blood glucose control and prevents muscle glucose breakdown, thus preventing the hyperglycemia. This is in line with the results of a meta-analysis study by Bilku et al. (2014) regarding the comparison of muscle mass in the group given preoperative oral carbohydrates and muscle mass

given placebo, there was a significant difference ($p<0.05$) in the manual muscle test and it was concluded that preoperative oral carbohydrates were able to maintain muscle mass and function.

Based on the above background, and considering the importance for anesthesiologists to understand problems in reducing stress response in patients undergoing surgery, the researchers were interested in knowing the effect of preoperative oral administration of glucose on blood glucose levels and well-being of patients in surgery under general anesthesia.

II. RESEARCH METHODS

A. Research Design

This study used randomized and double-blind, cross-sectional clinical trials as the design. To determine the effect of preoperative oral glucose administration on blood glucose levels and patient well-being in surgery under general anesthesia.

B. Place And Time Of Research

This research was conducted at Haji Adam Malik Hospital, Medan, North Sumatra University Hospital and Dr. Pirngadi Hospital Medan. The study was conducted after ethical clearance was issued and until the number of samples was fulfilled in the period of January - March 2019.

C. Research Population and Samples

The study population was all electively scheduled subjects who underwent surgery under general anesthesia at Haji Adam Malik Hospital Medan, North Sumatra University Hospital and Dr. Pirngadi Hospital Medan.
The study samples were patients who met the inclusion and exclusion criteria. After being calculated statistically, all samples were divided into 2 groups, they are:

- Group A, given 400 ml of mineral water containing 50 grams of glucose (32 samples)
- Group B, given 400 ml of mineral water without glucose (32 samples)

D. Sampling Technique

Subjects who fulfilled the inclusion and exclusion criteria were randomized using simple random sampling with a simple random method. Each sequence number was written on paper and folded, then put in one box. The box containing the paper number is shuffled and taken as the sample.

E. Inclusion and Exclusion Criteria

The inclusion criteria in this study were patients of 19-65 years old, undergoing laparotomy surgery, having ASA 1 and 2, and willing to participate in the study. For patients with type 1 and type 2 diabetes mellitus, gastroesophageal reflux disease (GERD) and in emergency surgery were excluded from this study. **Drop Out Criteria** were if there are life-threatening heart, lung and brain emergencies and the surgery duration of more than 4 hours

F. Informed Consent

After obtaining approval from the ethical committee of the Faculty of Medicine of the North Sumatera University, Haji Adam Malik Hospital, North Sumatra University Hospital, and Dr. Pirngadi Hospital Medan, the patient's family received an explanation of the procedure and stated in writing their willingness on the informed consent sheet.

G. Procedure

- After being approved by the ethical committee of the Faculty of Medicine of the North Sumatera University, Haji Adam Malik Hospital, North Sumatra University Hospital, and Dr. Pirngadi Hospital Medan, and obtained informed consent, all samples were taken ABW (Actual body weight) measurements and then the study subjects were sorted in the inclusion and exclusion criteria.
- The patients were explained during the pre-surgery examination about general anesthesia and research procedures which included examining blood sugar levels before, during, and after surgery using a blood sugar measuring device (GlucoDr) and evaluating the patient's well-being using the Visual Analog Scale (VAS) questionnaire prepared by the researchers. After the patients agreed, the patients were asked to sign an informed consent.
- The patients were randomized into 2 groups, the treatment group, and the control group.
- The treatment and control groups were patients who fasted for 6 hours before surgery.
- The patients were examined for blood glucose levels (T1) 2 hours before induction
- After checking blood sugar, the treatment group was given 400 ml of mineral water containing 50 grams of glucose, while in the control group 400 ml of mineral water without glucose was given. This was done by stakeholders who were not involved in the research to prepare and label drinks in accordance with the randomization code. Researchers and samples did not know about the intervention given (double blind)

H. Data Analysis

After all the required data had been collected, the completeness of the data was checked again before they were tabulated and processed. The data were coded to facilitate the tabulation. The data were tabulated using SPSS software into the master table. Numerical data was displayed in the mean $\pm$ SD (standard deviation), while categorical data were displayed in numbers (percentages). For the demographic data, the normality tests were analyzed descriptively and displayed in the form of frequency distributions and percentages. The research hypothesis was tested using a t-test. The 95% confidence interval with a value of $p < 0.05$ was considered significant.
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ISSN No:-2456-2165

III. RESEARCH RESULTS

➢ *Demographic Characteristics of Research Respondents*

The data were retrieved during January - March 2019 at the Central Surgical Installation of Haji Adam Malik Hospital, North Sumatra University Hospital and Dr. Pirngadi in Medan. This research was conducted using the Double Blind Randomized Control Trial method. This study had 64 samples divided into two groups, the treatment group (A) and the control group (B). There were 32 research subjects in each group. At the end of the study, no research subjects were excluded from the study so that the total number of research subjects studied was 64 people.

Variable	Group		P
	Treatment	Control	
Age (mean)	44.13 ± 14.30	43.59 ± 12.35	0.874§*
Sex			
Male	8 (61.5%)	5 (38.5%)	0.351¥*
Female	24 (47.1%)	27 (52.9%)	
BW (Kg)(mean)	58.66 ± 9.78	59.25 ± 7,75	0.789§*
Surgery type			
Gynecology	18 (43.9%)	23 (56.1%)	0.193¥*
Digestive surgery	14 (60.9%)	9 (39.1%)	
ASA			
I	13 (48.1%)	14 (51.9%)	0.800¥*
II	19 (51.4%)	18 (48.6%)	
BIS	49.59 ± 4.32	49.09 ± 4.25	0.397£*

Table 1:- Characteristics of Research Descriptive Data
*§ Independent t; ¥ Pearson chi square; £ Shapiro-wilk

Based on Table 1., there were no statistically significant differences in demographic data and type of surgery, nor ASA status and BIS score in both groups. The mean age of the research subjects in the treatment group was 44.1 years old and in the control group was 43.6 years old. From the sex of the respondents, there were 13 male samples of which 8 samples (61.5%) came from the treatment group and 5 samples (38.5%) from the control group. There were 51 female samples, of which 24 samples (47.1%) in the treatment group and 27 samples (52.9%) in the control group.

The mean body weight (Kg) in group A was 58.66 ± 9.78 while in group B it was 59.25 ± 7.75. From the types of surgery, 41 samples underwent surgery in the field of gynecology of which 18 samples (43.9%) in the treatment group and 23 samples (56.1%) in the control group.

Effect of Preoperative Oral Glucose Administration on Blood Glucose Levels in each group

Variable		n	GDS levels	P value
Treatment group	T1	32	110.5 (79 – 218)	0.111
	T2	32	112.5 (72 – 207)	
	T3	32	110 (86 – 213)	
Control group	T1	32	126 (78 – 190)	0.001
	T2	32	172.5 (130 – 240)	
	T3	32	194 (128 – 250)	

Table 2:- Increased Preoperative Oral Glucose Administration on Blood Glucose Levels in Each Group
*Friedman test

Table 2 shows that the mean blood glucose level (mg/dl) in the treatment group experienced a slight increase from observation time T1 to T3, where at T1 (2 hours before induction) it was 110.5, at T2 (1 hour post-induction) it was 112.5, and at T3 (1 hour postoperative) it was 110. Statistically, there was no significant difference in the increase in blood glucose levels in the treatment group with a p value of 0.111. While the mean blood glucose level (mg/dl) in the control group was increased from observation time T1 to T3, where at T1 (2 hours before induction) it was 126, at T2 (1 hour post-induction) it was 172.5 and at T3 (1 hour postoperative) it was 194. Statistically, there was a significant difference in the increase in blood glucose levels in the control group with a p value of 0.001.

The difference in blood sugar level of the treatment group (A) with the control group (B) at each time

Blood glucose	**Mean Treatment (A)**	**Mean Control (B)**	**p‡**
T1	122.13 ± 37,61	127.31 ± 33.62	0.768
T2	123.50 ± 36,56	180.00 ± 30.43	<0.001*
T3	126.69 ± 38,42	189.19 ± 27,95	<0.001*

Table 3:- Differences in blood glucose based on treatment and control groups
Note : * Significant (p < 0.05); ‡ Mann whitney

Based on table 3., in the assessment of T1 (2 hours before induction) blood glucose levels (mg/dl) in group A and group B did not have a significant difference (P>0.05).

The mean value in group A was 122.13 ± 37.61 and the mean value of group B was 127.31 ± 33.62. Whereas at T2 (1 hour after induction) the mean value of blood glucose in group A was 123.50 ± 36.56 and in group B was 180.00 ± 30.43, this value was statistically significant (P < 0.05). In the T3 assessment (1 hour post-operative) the mean blood sugar value in group A was 126.69 ± 38.42 and in group B, the mean blood sugar value was 189.19 ± 27.95 where it was also statistically significant (P < 0.05).

ISSN No:-2456-2165

Effect of preoperative oral glucose administration on Well Being Score in the treatment group

WB score	Mean ± SD	Median
WB1		
Thirst	3.50 ± 0.84	3 (2 – 5)
Hunger	2.69 ± 0.90	3 (1 – 3)
Anxiety	2.50 ± 0.88	2 (1 – 5)
Dry mouth	2.03 ± 0.82	2 (1 – 4)
Nausea	2.81 ± 0.82	3 (1 – 5)
weakness	2.38 ± 0.75	2 (1 – 4)
Sleep Quality	2.88 ± 0.94	3 (1 – 5)
WB2		
Thirst	1.63 ± 0.55	2 (1 – 3)
Hunger	1.28 ± 0.46	1 (1 – 2)
Anxiety	1.47 ± 0.51	1 (1 – 2)
Dry mouth	1.22 ± 0.42	1 (1 – 2)
Nausea	1.53 ± 0.51	2 (1 – 2)
weakness	1.41 ± 0.50	1 (1 – 2)
Sleep Quality	1.59 ± 0.56	2 (1 – 3)

Table 4:- Well being Mean Score in the Treatment Group (A)

Based on table 4., the well being mean score (WB1) in the treatment group (A) was: Thirst was 3.50 ± 0.84, hunger was 2.69 ± 0.90, anxiety was 2.50 ± 0.88, dry mouth was 2.03 ± 0.82, nausea was 2.81 ± 0.82. weakness was 2.38 ± 0.75 and sleep quality was 2.88 ± 0.94. While the mean score of WB2 in group A was: Thirst was 1.63 ± 0.55, hunger was 1.28 ± 0.46, anxiety was 1.47 ± 0.51, dry mouth was 1.22 ± 0.42. nausea was 1.53 ± 0.51. weakness was 1.41 ± 0.50 and sleep quality was 1.59 ± 0.56.

Effect of preoperative mineral water on Well Being Score in the control group.

WB score	Mean ± SD	Median
WB1		
Thirst	5.25 ± 0.92	5 (4 – 7)
Hunger	4.53 ± 0.98	4 (3 – 7)
Anxiety	2.78 ± 0.83	3 (1 – 5)
Dry mouth	4.00 ± 1.19	4 (2 – 7)
Nausea	3.06 ± 1.10	3 (1 – 5)
weakness	2.81 ± 0.97	3 (1 – 5)
Sleep Quality	2.84 ± 1.25	3 (1 – 6)
WB2		
Thirst	3.13 ± 0.66	3 (2 – 4)
Hunger	2.50 ± 0.51	2.5 (2 – 3)
Anxiety	1.75 ± 0.67	2 (1 – 3)
Dry mouth	1.69 ± 0.64	2 (1 – 3)
Nausea	1.88 ± 0.75	2 (1 – 3)
weakness	1.66 ± 0.55	2 (1 – 3)
Sleep Quality	1.69 ± 0.78	1.5 (1 – 3)

Table 5:-Well being Mean Score in the Control Group (B)

Based on table 5., the well being mean score (WB1) in the control group (B) was: Thirst was 5.25 ± 0.92, hunger was 4.53 ± 0.98, anxiety was 2.78 ± 0.83, dry mouth was 4.00 ± 1.19, nausea was 3.06 ± 1.10, weakness was 2.81 ± 0.97, and sleep quality was 2.84 ± 1.25. While the mean score of WB2 in group B was: Thirst was 3.13 ± 0.66, hunger was 2.50 ± 0.51, anxiety was 1.75 ± 0.67, dry mouth was 1. 69 ± 0.64, nausea was 1.88 ± 0.75, weakness was 1.66 ± 0.55, and sleep quality was 1.69 ± 0.78.

Well-Being	**WB 1 – WB 2**	
	Glucose	**Water**
Thirst	<0.001†*	<0.001†*
Hunger	<0.001†*	<0.001†*
Anxiety	<0.001†*	<0.001†*
Dry mouth	<0.001†*	<0.001†*
Nausea	<0.001†*	<0.001†*
weakness	<0.001†*	<0.001†*
Sleep Quality	<0.001†*	<0.001†*

Table 6:- Differences in WB1 and WB2 in Each Group
Note : * Significant ($p < 0.05$); † Wilcoxon

Based on Table 6, the difference in WB1 and WB 2 scores in the control group (B) was statistically significant with the P value of each variable < 0.05, this was considered significant.

Differences in Well Being scores in the treatment group (A) with the control group (B).

The differences in Well Being scores in the treatment group (A) with the control group (B) is shown in Table 4.8.

Well-Being	Mean		p‡
	glucose (A)	water (B)	
WB 1			
Thirst	3.50 ± 0.84	5.25 ± 0.92	<0.001*
Hunger	2.69 ± 0.90	4.53 ± 0.98	<0.001*
Anxiety	2.50 ± 0.88	2.78 ± 0.83	0.064
Dry mouth	2.03 ± 0.82	4.00 ± 1.19	<0.001*
Nausea	2.81 ± 0.82	3.06 ± 1.10	0.234
weakness	2.38 ± 0.75	2.81 ± 0.97	0.053
Sleep Quality	2.88 ± 0.94	2.84 ± 1.25	0.883
WB 2			
Thirst	1.63 ± 0.55	3.13 ± 0.66	<0.001*
Hunger	1.28 ± 0.46	2.50 ± 0.51	<0.001*
Anxiety	1.47 ± 0.51	1.75 ± 0.67	0.097
Dry mouth	1.22 ± 0.42	1.69 ± 0.64	0.002*
Nausea	1.53 ± 0.51	1.88 ± 0.75	0.067
weakness	1.41 ± 0.50	1.66 ± 0.55	0.068
Sleep Quality	1.59 ± 0.56	1.69 ± 0.78	0.836

Table 7:- Differences in Well-Being Based on Groups of Glucose (A) and Water (B)

Based on Table 7., at 1 hour postoperative the mean value of well being (WB1) in group A and group B had a significant difference in the following variables: Thirst was 3.50 ± 0.84 in group A and was 5.25 ± 0.92 in group B with a P value < 0.05; The mean of hunger was 2.69 ± 0.90 in group A and was 4.53 ± 0.98 in group B; The mean of dry mouth was 2.03 ± 0.82 in group A and was 4.00 ± 1.19 group B with a P value of < 0.05. While the mean score of WB1 for the variables of anxiety, nausea, weakness and sleep quality in each group A and B did not have a significant difference P > 0.05.

The score of well being 2 (WB2) assessed in the first morning post-operative in groups A and B also had a significant difference in the following variables: The mean of thirst was 1.63 ± 0.55 in group A and was 3.13 ± 0.66 in group B with a P value of < 0.05; The mean of hunger was 1.28 ± 0.46 in group A and was 2.50 ± 0.51 in group B; The mean of dry mouth was 1.22 ± 0.42 in group A and was 1.69 ± 0.64 in group B with a P value of < 0.05. While the mean score of WB2 for the variables of anxiety, nausea, weakness and sleep quality in each group A and B did not have a significant difference P > 0.05.

IV. DISCUSSION

Based on demographic data, the study showed that the samples of the treatment group and the control group were comparable, where it did not show a statistically significant value with a p value of > 0.05.

The increase in blood glucose level 1 hour postinduction (T2) and 1 hour postoperative (T3) shown in table 4.2 in the treatment group did not show statistically significant results with a value (p > 0.05), while in the control group the results were significant with the value (p < 0.05). This is consistent with the research conducted by Perrone, et al. (2011) who concluded that an increase in blood glucose levels was lower in the treatment group who received oral glucose solution at night and morning before surgery compared with the control group. From these results, it indicates that oral glucose administration before surgery has a significant effect in suppressing increased blood glucose levels postoperatively. This is very useful for preventing morbidity caused by hyperglycemia.

From the results of the research shown in table 3. there were differences in the values of T2 and T3 in the treatment and control groups, where the results were significant (p < 0.05), it is in line with the study by Mathur et al. (2010) in New Zealand in patients undergoing elective abdominal surgery. The study compared sample group who received oral glucose before surgery at night and in the morning (2 hours before induction of anesthesia) and the placebo group which resulted in a significant decrease in cortisol levels in the sample group received oral glucose solution compared to the placebo group the first day after surgery. This result is also in accordance with the theoretical concept that the administration of oral glucose solutions before surgery can trigger insulin secretion, thereby changing the patient's metabolic status from fasting to eating. this process is the body's main stress response due to surgical trauma which triggers the release of stress hormones and cytokines that are comparable to the level of trauma. Increased catabolic reactions and loss of anabolic reactions will stimulate insulin resistance. Increased catabolic reactions caused by damage to muscle tissue will increase energy deposit loss which correlates with a reduction in recovery time after injury, because the key to speedy recovery time is to minimize the negative metabolic response causing a catabolic reaction from stress conditions by maintaining protein balance, so that preoperative nutrition has an important role in the recovery period after surgery (Widnyana et al. 2017).

Based on table 6, the effect of preoperative oral glucose administration on well-being 1 hour postoperatively (WB1) and 24 hour postoperative (WB2) was significant (p <0.05) in each treatment and control group. Table 7 shows the difference in the effect of preoperative oral administration on well-being in the treatment and control groups with significant results (p < 0.05) in the variables of thirst, hunger and dry mouth, which is in line with the study by Hausel et al. (2001) which showed that administration of carbohydrate drink (CHO) improved preoperative well-being compared with placebo (water) or fasting, where thirst, hunger, and anxiety before surgery decreased. Measuring methods using VAS proved to be a method with high reproducibility in patients in preoperative situations. Giving CHO two hours before premedication does not increase the volume and acidity of gastric contents, and there are no side effects caused. Giving CHO before surgery can be applied and is very good for most patients who undergo elective surgery.

V. CONCLUSION

There is no effect of preoperative oral glucose administration on Durante and postoperative blood glucose levels in the treatment group, but it affected the well-being in 1 hour postoperative and 24 hours postoperative in the treatment group (p < 0.05 in each variable).

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