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The Effect of DM in Patients on General Anesthesia

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Abstract : The current study was conducted with the aim of knowing the changes in blood sugar in people with diabetes after giving a dose of general anesthesia for the purpose of performing surgical operations to the auditors of Imam Al-Sadiq Hospital (peace be upon him) and Al-Kifl General Hospital in Babel Governorate for the period from 3/1/2022 to 1/3/2022 by 30 samples ranging in age from (25-50) years

2 ml of venous blood was withdrawn and placed in a Gel tube, then placed in a centrifuge to separate the serum for the purpose of conducting a glucose test. The results showed that the diabetes test is 100% positive for diabetic patients. The results also showed a significant increase ($P<0.05$) in the blood sugar level after the operation compared to the blood sugar before the operation.

We conclude from this study that general anesthesia has a moderate effect on diabetic patients after conducting a blood sugar test before and after the operation.

Keywords: Diabetes mellitus, Preoperative management, anesthesia, insulin.

1. Introduction: Diabetics mellitus

During the past 20–30 years, the prevalence of diabetes mellitus (DM) has rapidly increased throughout the world, the prediction being that it will increase by 200% in the next several decades. Inevitably, physicians will be confronted with an increasing population of diabetic patients undergoing anesthesia and surgery who may have serious complications, such as hypertension, ischemic heart disease, nephropathy, and autonomic neuropathy (1). Compared with the standard population, diabetics have as much as a two- to threefold greater frequency of cardiovascular disorders (2), the mortality rate from which is three times higher than in the standard population. Hospital mortality rates among diabetics are also significantly. increased; patients with DM had postoperative strokes more often and spent, on average, more days in hospital (3).

1.1. Prevalence of diabetes mellitus

The drastic increase in the incidence of DM appears to be multifactorial though most heavily impacted by aging of the population and the expanding epidemic of obesity and inactivity. Other factors that impact the development of diabetes appear to be related to chronic inflammatory processes, therapies that result in glucose intolerance, and a genetic tendency to abnormal mitochondrial oxidative phosphorylation (4).

1.2. Glucose control

Recent studies suggest that aggressive glucose control would result in improved survival, decreased incidence of ischemic events, and reduced rate of complications (5). Van Den Berghe et al. (6), using intensive insulin therapy, shed new light on the issue of glucose control in critically ill patients. They reported that tight glucose control could be maintained using insulin infusions, even in patients who received early nutritional support via the enteral or parenteral route, and that improved glucose control resulted in fewer complications and better survival rate. Data from this sentinel network was widely disseminated, generated significant commentary, and stimulated achievement of the common goal of euglycemia in most intensive care units (ICUs). Since then, there have been some published reports proving the efficacy of tight glycemic control during the perioperative period in diabetic patients.

1.3. Anesthetic agents and diabetes mellitus

Anesthetic agents may affect glucose homeostasis perioperatively in diabetic patients either indirectly, by decreasing catabolic hormone secretion, or directly, by altering insulin secretion. The latter mechanism is relevant only in patients with some residual insulin secretion (type 2 diabetes) (7).

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Fragen et al. (8), reported that etomidate inhibits adrenal steroid genesis and may induce a decrease in the glycemic response to surgery. In general, gamma-aminobutyric acid (GABA) agonists reduce the secretion of adrenocorticotrophic hormone and consequently cortisol, and stimulate basal secretion of growth hormone (GH). Several studies have investigated modification of hormonal and metabolic response to surgery by benzodiazepines, such as midazolam.

1.4. Anesthesia

Anesthesia is a state of controlled, temporary loss of sensation or awareness that is induced for medical purposes. It may include some or all of analgesia (relief from or prevention of pain), paralysis (muscle relaxation), amnesia (loss of memory), and unconsciousness. A person under the effects of anesthetic drugs is referred to as being anesthetized. The purpose of anesthesia can be distilled down to three basic goals or endpoints (9):

1. hypnosis
2. analgesia (lack of sensation which also blunts autonomic reflexes)
3. muscle relaxation

1.5. Aim of the study

In this study we focus on the effect of diabetes mellitus on general anesthesia.

2. Literature review

2.1. Background: Diabetes mellitus

commonly known as diabetes, is a group of metabolic disorders characterized by a high blood sugar level over a prolonged period of time. If left untreated, diabetes can cause many health complications. Serious long-term complications include cardiovascular disease, stroke, chronic kidney disease, foot ulcers, damage to the nerves, damage to the eyes and cognitive impairment (10). Diabetes is due to either the pancreas not producing enough insulin, or the cells of the body not responding properly to the insulin produced (11).

2.2. Signs and Symptoms of diabetic

1. frequent urination (polyuria)
2. increased thirst (polydipsia)
3. increased appetite (polyphagia)
4. weight loss
5. blurred vision
6. headache
7. fatigue
8. slow healing of cuts
9. itchy skin

There are three main types of diabetes mellitus:

1. Type 1 diabetes results from failure of the pancreas to produce enough insulin due to loss of beta cells. "Insulin-dependent diabetes mellitus"
2. Type 2 diabetes begins with insulin resistance, a condition in which cells fail to respond to insulin properly. "non-insulin-dependent diabetes mellitus"
3. Gestational diabetes is the third main form, and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels.

Type 1 diabetes must be managed with insulin injections. Prevention and treatment of **type 2 diabetes involves maintaining a healthy diet, regular physical exercise, a normal body weight, and avoiding use of tobacco**. Type 2 diabetes may be treated with oral antidiabetic medications, with or without insulin. Control of blood pressure and maintaining proper foot and eye care are important for people with the disease. Insulin and some oral medications can cause low blood sugar (hypoglycemia). Weight loss surgery in those with obesity is sometimes an effective measure in those with type 2 diabetes (12). **Gestational diabetes usually resolves after the birth of the baby (13).**

2.3. Complications of diabetes

All forms of diabetes increase the risk of long-term complications. These typically develop after many years (10–20) but may be the first symptom in those who have otherwise not received a diagnosis

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before that time. The major long-term complications relate to damage to blood vessels. Diabetes doubles the risk of cardiovascular disease (14), diabetic retinopathy, diabetic nephropathy and diabetic foot ulcers, muscle atrophy and weakness.

2.4. Causes of diabetics

Type 1 diabetes is characterized by loss of the insulin-producing beta cells of the pancreatic islets, leading to insulin deficiency. This type can be further classified as immune-mediated or idiopathic. The majority of type 1 diabetes is of an immune-mediated nature, in which a T cell-mediated autoimmune attack leads to the loss of beta cells and thus insulin (15).

Type 2 diabetes is characterized by insulin resistance, which may be combined with relatively reduced insulin secretion (16). The defective responsiveness of body tissues to insulin is believed to involve the insulin receptor. However, the specific defects are not known. Diabetes mellitus cases due to a known defect are classified separately. Type 2 diabetes is the most common type of diabetes mellitus.

Gestational diabetes resembles type 2 diabetes in several respects, involving a combination of relatively inadequate insulin secretion and responsiveness. It occurs in about 2–10% of all pregnancies and may improve or disappear after delivery. It is recommended that all pregnant women get tested starting around 24–28 weeks gestation (17).

2.5. Diagnosis of diabetics mellites

1. Fasting plasma glucose level ≥ 7.0 mmol/L (126 mg/dL). For this test, blood is taken after a period of fasting, i.e., in the morning before breakfast, after the patient had sufficient time to fast overnight.
2. Plasma glucose ≥ 11.1 mmol/L (200 mg/dL) two hours after a 75-gram oral glucose load as in a glucose tolerance test (GTT)
3. Symptoms of high blood sugar and plasma glucose ≥ 11.1 mmol/L (200 mg/dL) either while fasting or not fasting
4. Glycated hemoglobin (HbA_{1C}) ≥ 48 mmol/mol (≥ 6.5 DCCT %) (18).

2.6. Management of diabetics mellites

1. Lifestyle
2. Medications
   - Glucose control
   - Blood pressure lowering
   - Aspirin
   - Surgery (Weight loss surgery)

Anesthesia is a state of controlled, temporary loss of sensation or awareness that is induced for medical purposes. It may include some or all of analgesia (relief from or prevention of pain), paralysis (muscle relaxation), amnesia (loss of memory), and unconsciousness. A person under the effects of anesthetic drugs is referred to as being anesthetized. And three broad categories of anesthesia exist:

1. **General anesthesia** suppresses central nervous system activity and results in unconsciousness and total lack of sensation, using either injected or inhaled drugs.
2. **Sedation** suppresses the central nervous system to a lesser degree, inhibiting both anxiety and creation of long-term memories without resulting in unconsciousness.
3. **Regional and local anesthesia** which blocks transmission of nerve impulses from a specific part of the body. Depending on the situation (19).

2.7. Medical uses of anesthesia

The purpose of anesthesia can be distilled down to three basic goals or endpoints (9):

1. hypnosis
2. analgesia (lack of sensation which also blunts autonomic reflexes)
3. muscle relaxation

Anesthesia is a combination of the endpoints (discussed above) that are reached by drugs acting on different but overlapping sites in the central nervous system. General anesthesia (as opposed to sedation or regional anesthesia) has three main goals: lack of movement (paralysis), unconsciousness, and blunting of the stress response. In the early days of anesthesia, anesthetics could reliably achieve the first two, allowing surgeons to perform necessary procedures (9).

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The most common approach to reach the endpoints of general anesthesia is through the use of inhaled general anesthetics. Each anesthetic has its own potency which is correlated to its solubility in oil. Inhalational anesthetics are thought to exact their effects on different parts of the central nervous system. For instance, the immobilizing effect of inhaled anesthetics results from an effect on the spinal cord whereas sedation, hypnosis and amnesia involve sites in the brain. The potency of an inhalational anesthetic is quantified by its minimum alveolar concentration or MAC (9).

The ideal anesthetic drug would provide hypnosis, amnesia, analgesia, and muscle relaxation without undesirable changes in blood pressure, pulse or breathing. In the 1930s, physicians started to augment inhaled general anesthetics with intravenous general anesthetics. The drugs used in combination offered a better risk profile to the person under anesthesia and a quicker recovery. A combination of drugs was later shown to result in lower odds of dying in the first 7 days after anesthetic. For instance, propofol (injection) might be used to start the anesthetic, fentanyl (injection) used to blunt the stress response, midazolam (injection) given to ensure amnesia and sevoflurane (inhaled) during the procedure to maintain the effects.

2.8. Anesthetic agents and diabetes mellitus

Anesthetic agents may affect glucose homeostasis perioperatively in diabetic patients either indirectly, by decreasing catabolic hormone secretion, or directly, by altering insulin secretion. The latter mechanism is relevant only in patients with some residual insulin secretion (type 2 diabetes) (7).

Fragen et al. (8), reported that etomidate inhibits adrenal steroid genesis and may induce a decrease in the glycemic response to surgery. In general, gamma-aminobutyric acid (GABA) agonists reduce the secretion of adrenocorticotrophic hormone (ACTH) and consequently cortisol, and stimulate basal secretion of growth hormone (GH). Several studies have investigated modification of hormonal and metabolic response to surgery by benzodiazepines, such as midazolam.

2.9. Metabolic effects of surgery

Surgery, especially in the presence of general anesthesia, will produce a diabetogenic response. Hyperglycemia during surgery or postoperatively can occur in nondiabetic patients. The magnitude of the plasma glucose rise is related in part to glucose infusion rates. The hormonal etiology of this form of hyperglycemia is (relative) deficient insulin and Cpeptide secretion, in addition to insulin resistance. The precise cause of this insulin resistance is unclear, but it is thought to be due to elevated counterregulatory hormone levels. Catecholamine increases are the rule during general anesthesia, although this is probably dependent on the anesthetic agent. Epinephrine stimulates muscle glycogenolysis which, besides providing fuel for muscle, provides lactate for hepatic gluconeogenesis. ACTH and cortisol levels are also elevated in the preoperative period, although this is also dependent on the anesthetic agent (20).

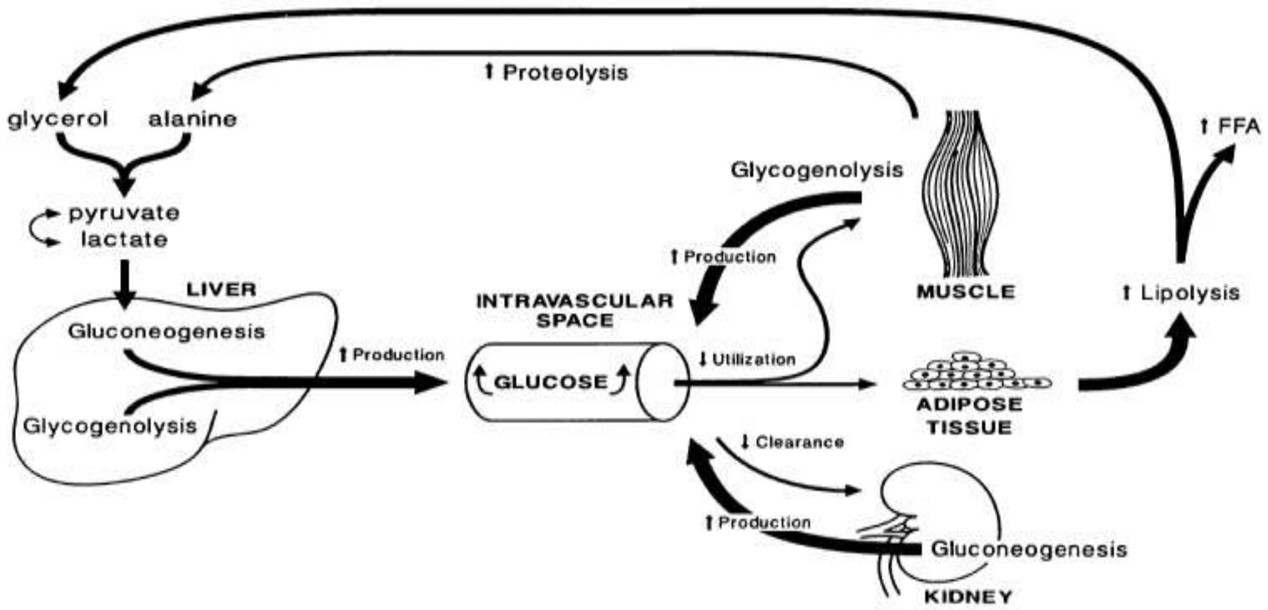

Figure (2-1): Factors resulting in hyperglycemia during surgery. Increased glucose production is due to hepatic and muscle glycogenolysis and hepatic and renal gluconeogenesis. Renal clearance of glucose from circulation may be decreased during volume depletion. Relative insulin deficiency inhibits glucose utilization.

3. Materials and methods

3.1. Ethics

This prospective study was carried out at Al-kifl Hospital and Al-Imam Sadiq hospital, Babil /Iraq from 3 January 2022 to 1 April 2022. Under the supervision of the department of anesthesia technologies at Al-Mustaqbal University College – in Babil.

thirty (30) patients between (25-55) years old were enrolled in this study. The current study was conducted with the aim of knowing the changes in blood sugar in people with diabetes after giving a dose of general anesthesia for the purpose of performing surgical procedures for patients.

2ml of venous blood was withdrawn and placed in a Gel tube and then placed in a centrifuge to separate the serum for the purpose of performing a glucose test.

The cannula put at site of one of either arm, intravenous ringer lactate infusion as crystalloid solution was given, monitoring of the patients with pulse rate, pulse oximeter, non-invasive blood pressure.

General anesthesia: the patients lie on the couch with left. Lateral till with pillow behind their buttock, the patients received 100% oxygen for 5 min then induction done with 2mg/kg propofol as induction agent, 0.5mg/kg ketamine as analgesic, 0.6mg/kg rocuronium as muscle relaxant. The patients were intubated with proper endotracheal cuffed tube size and ventilated with 100% oxygen and maintained with 0.7% MAC isoflurane. the patients were reversed by given neostigmine 2-5mg with atropine 1mg to reversed the effect of muscle relaxant and then awake extubating done.

We collect an amount of sugar in two-time intervals before and after the surgery, Hb-1C, HR and blood pressure.

Accu-Chek Active test strips are designed for easy handling and allow for dosing outside of the meter.

3.2. Benefits & Features Accu-Chek Active test strips

- Small sample size. Accu-Chek Active test strips only require a very small blood sample to perform a blood glucose test – just 1-2µl of blood.
- Capillary action. Simple capillary action draws blood into the strip for fast, reliable blood glucose testing.
- Out-of-meter dosing. Blood can be applied to the test strip outside of the meter allowing for greater flexibility and is particularly useful for people who have dexterity issues.

3.3. Statistical Analysis

Demographic data, including age, general anesthesia and spinal anesthesia, time of induction to delivery baby, weight of the baby collected information were recorded using a checklist. Data were analyzed using IBM SPSS statistic version 26.0. Results of descriptive statistics were illustrated through frequency distribution tables and charts.

3.4. Results

The data was analyzed using the statistical program IBM SPSS Statistic 26 the results attached below were obtained based on the following hypotheses:

1- The null hypothesis

There is no significant effect of anesthesia on blood sugar level at a significant level of 0.05

2- The alternative hypothesis:

There is significant effect of anesthesia on blood sugar level at a significant level of 0.05.

To verify the above hypotheses, we conducted a Paired Sample Test the results were as follows:

3.5. Test of Normality

According to Kolmogorov-Smirnov test, it was found that the value of the level of significance sig = 0.103 which is greater than 0.05 and this is sufficient evidence that data Measuring sugar level which precedes perform the operation follow a normal distribution.

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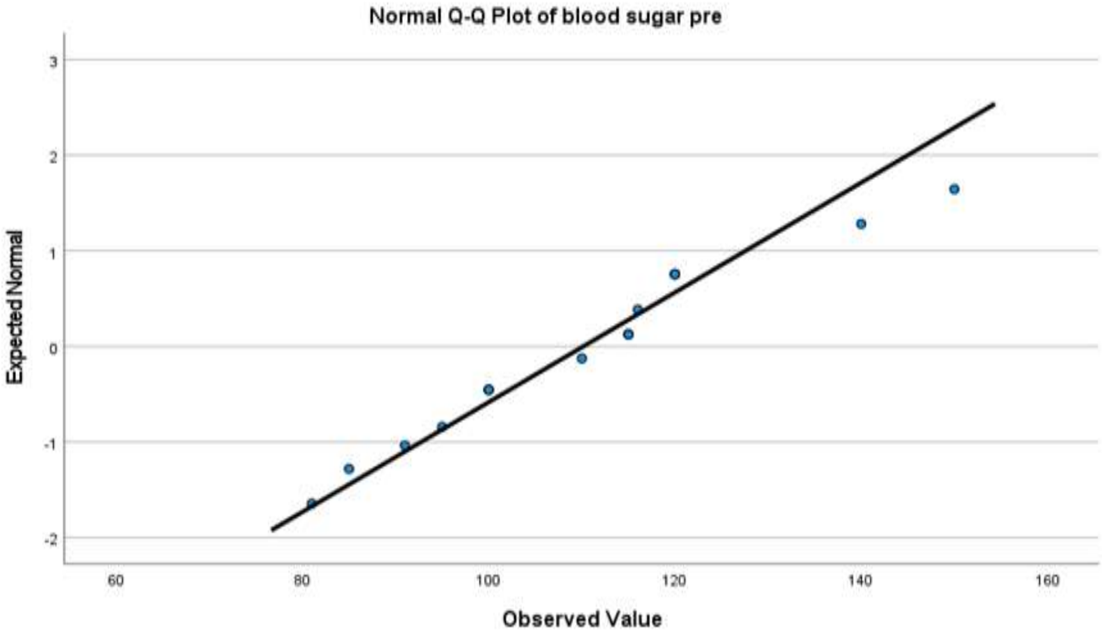
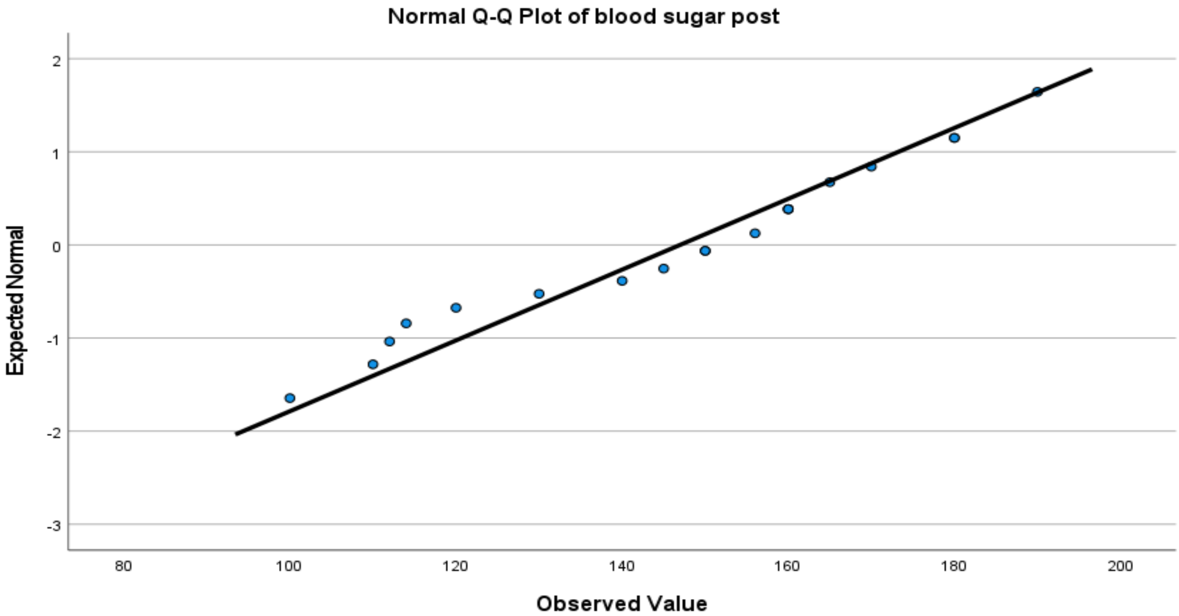


Figure (4-1): represents the data distribution (data Measuring sugar level which precedes perform the operation).

Also, according to Kolmogorov-Smirnov test, it was found that the value of the level of significance sig = 0.2 which is greater than 0.05 and this is sufficient evidence that data



Measuring sugar level which after the operation follow a normal distribution.

Figure (4-2): represents the data distribution (data Measuring sugar level which after the operation).

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Table (4-1): Study sample stats.

Group	N	Mean	Std. Error Mean	Std. Deviation	Correlation
blood sugar post	30	146.95	6.033	26.298	0.517
blood sugar pre	30	110.16	3.997	17.42	

From above Table (4-1) and in the special part of the sample data before the operation, we note that the arithmetic mean was 110.16, with a standard error of 3.997, while the Std. Deviation was 17.42.

As for the second part related to the study sample after the operation, we note that the arithmetic mean was 146.95, with a standard error of 6.033, while the Std. Deviation was 26.298.

We also note the correlation value in the above table, which is 0.517, which indicates the presence of a moderately soft correlation between measuring the glucose level before the operation and after the operation.

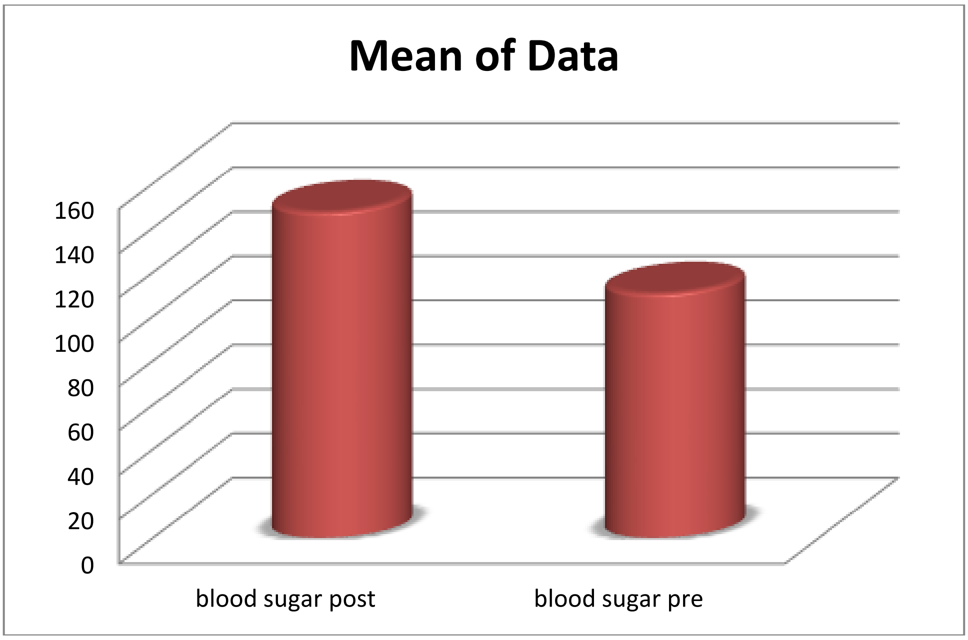

Figure (4-3): represents the average of the data.

Table (4-2): Statistics of the age of the sample under study.

	N	Minimum	Maximum	Mean	Std. Error
age	30	25	54	39.26	2.233

From above Table (4-2) we note the average age of the sample members under study reached 39.26, and the table shows the oldest age, which was 54, as well as the youngest, who reached 25, with a standard error of 2.233.

Table (4-3): Paired Samples Test.

	Paired Samples Test				
Mean	Std. Error Mean	Std. Deviation	t	df	Sig
36.79	5.236	22.826	7.025	29	0.001

From above Table (4-3), which represents the Paired Samples Test, we note the arithmetic mean of 36.79 and with a standard error of 5.236, as well as the Std. Deviation of 22.826, noting the value of the T-test, which is 7.025, with a level of significance of 0.001, We note the value of the level of significance It is less than 0.05, and this explains the existence of a significant difference with a statistical significance in favor of the sample with the largest average

3.6. Discussion

Through the averages shown in Table (4-1), we find that the average of the study sample after the operation is greater, which is 146.95, and this proves that anesthesia has an effect on diabetes and leads to a rise.

From the above results, a decision was made to reject the null hypothesis and accept the alternative hypothesis that proves that there is a significant difference between anesthesia on diabetes, and this difference is due to the data with a higher mean, as shown in the tables and graphs above

3.7. Conclusions

1- High blood sugar level in people with diabetes during and after the operation as a result of giving general anesthesia.
2- The patient with diabetes delayed recovery after the operation as a result of anesthesia, compared to healthy people.
3- There is a positive, direct correlation between diabetes and anesthesia.

References

1. Robertshaw HJ, Hall GM. Diabetes mellitus: anaesthetic management. Anaesthesia. 2006; 61:1187–90.
2. Gu W, Pagel PS, Warltier DC, Kersten JR. Modifying cardiovascular risks in diabetes mellitus. Anesthesiology. 2003; 98:774–9.
3. McAnulty GR, Hall GM. Anaesthesia for the diabetic patient. Br J Anesth. 2003; 88:428–30.
4. Coursin DB, Connery LE, Ketzler JT. Perioperative diabetic and hyperglycemic management issues. Crit Care Med. 2004; 32(Suppl 4):116–25.
5. Doenst T, Wijeysundera D, Karkouti K, Zechner C, Maganti M, Rao V, Borger MA. Hyperglycemia during cardiopulmonary bypass is an independent risk factor for mortality in patients undergoing cardiac surgery. J Thorac Cardiovasc Surg. 2005; 130:1144–50.
6. Van den Berghe G, Wouters P, Weekers F, Verwaest C, Bruyninckz F, Schetz M, Vlasselaers D, Ferdinande P, Lauwers P, Bouillon R. Intensive insulin therapy in critically ill patients. New Engl J Med. 2001; 345:1359–67.
7. Yuji Kadoi. Anesthetic considerations in diabetic patients. Part I: preoperative considerations of patients with diabetes mellitus. J Anesth (2010) 24:739–747.
8. Fragen RJ, Shanks CA, Molteni A, Avram MJ. Effects of etomidate on hormonal responses to surgical stress. Anesthesiology. 1984; 61:652–6.
9. Miller RD (2010). Erikson LI, Fleisher LA, Wiener-Kronish JP, Young WL (eds.). Miller's Anesthesia (Seventh ed.). US: Churchill Livingstone Elsevier. 236.
10. Saedi E, Gheini MR, Faiz F, Arami MA (September 2016). "Diabetes mellitus and cognitive impairments". World Journal of Diabetes. 7 (17): 412–422.
11. Shoback DG, Gardner D, eds. (2011). "Chapter 17". Greenspan's basic & clinical endocrinology (9th ed.). New York: McGraw-Hill Medical.
12. Picot J, Jones J, Colquitt JL, Gospodarevskaya E, Loveman E, Baxter L, Clegg AJ (September 2009). "The clinical effectiveness and cost-effectiveness of bariatric (weight loss) surgery for obesity: a systematic review and economic evaluation". Health Technology Assessment. 13 (41): 1–190, 215–357, iii–iv.
13. Cash J (2014). Family Practice Guidelines (3rd ed.). Springer. p. 396.
14. Sarwar N, Gao P, Seshasai SR, Gobin R, Kaptoge S, Di Angelantonio E, et al. (June 2010). "Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies". Lancet. 375 (9733): 2215–2222.

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Date of Publication: 21-08-2022

15. Rother KI (April 2007). "Diabetes treatment--bridging the divide". The New England Journal of Medicine. 356 (15): 1499–1501.
16. Shoback DG, Gardner D, eds. (2011). "Chapter 17". Greenspan's basic & clinical endocrinology (9th ed.). New York: McGraw-Hill Medical.
17. Soldavini J (November 2019). "Krause's Food & The Nutrition Care Process". Journal of Nutrition Education and Behavior. 51 (10): 1225.
18. Saydah SH, Miret M, Sung J, Varas C, Gause D, Brancati FL (August 2001). "Postchallenge hyperglycemia and mortality in a national sample of U.S. adults". Diabetes Care. 24 (8): 1397–1402.
19. Gelb AW, Morriss WW, Johnson W, Merry AF, Abayadeera A, Belîi N, et al. (June 2018). "World Health Organization-World Federation of Societies of Anaesthesiologists (WHO-WFSA) International Standards for a Safe Practice of Anesthesia". Anesthesia and Analgesia. 126 (6): 2047–55.
20. Hirsch, I. B., & McGill, J. B. (1990). Role of insulin in management of surgical patients with diabetes mellitus. Diabetes Care, 13(9), 980-991.