

# Effect of Streptozotocin on Glucose levels in Albino Wister Rats

Khaleel Nagarchi<sup>1</sup>, Saif Ahmed<sup>2</sup>, Anusha Sabus<sup>3</sup>, Shaik Hussain Saheb<sup>4</sup>.

<sup>1</sup>Assistant professor, Department of Anatomy & Cell Biology, College of Medicine, AL-IMAM MUHAMMAD IBN SAUD ISLAMIC UNIVERSITY, P.O Box: 7544, Riyadh 11393, SAUDI ARABIA.

<sup>2</sup>Assistant Professor of Physiology College of Medicine,

AL-IMAM MUHAMMAD IBN SAUD ISLAMIC UNIVERSITY, P.O Box: 7544, Riyadh 11393, SAUDI ARABIA.

<sup>3</sup>Assistant professor, Dept of Biochemistry, St Johns medical college and hospital, bangalore. India.

<sup>4</sup>Assistant professor of Anatomy, JJMMC, Davngere, India.

## Abstract

### Background

The objective of this study is to induce experimental diabetes mellitus by Streptozotocin in normal adult Wistar rats via comparison of changes in body weight, consumption of food and water and levels of glucose between normal and diabetic rats.

### Materials and Methods

Intraperitoneal injection of 40mg/kg dose of Streptozotocin in adult wistar rats, makes pancreas swell and at last causes degeneration in Langerhans islet beta cells and induces experimental diabetes mellitus in the 48-72 hours. Streptozotocin procured from SRL laboratories, Hyderabad. The diabetic and normal animals were kept in the metabolic cages separately and their body weight, consumption of food and water and the levels of serum glucose in all animals were measured and then these quantities were compared.

### Results

After one week of inducing diabetes by single rapid intraperitoneal injection 40mg/ kg BW, the blood glucose levels are measured with glucometer, in normal rats the glucose levels were 125±10mg/dl, in diabetic rats it was 386±45mg/dl.

### Conclusion

After Induction of diabetes, consumption of food and water and glucose increased in the diabetic animals in comparison with normal animals, but the weight of body decreased in the diabetic animals.

**Key words** Streptozotocin, Glucose levels, Induced diabetic, Bodyweight.

## INTRODUCTION

Diabetes mellitus, often simply referred to as Diabetes. Diabetes is a group of metabolic diseases in which a person has high blood sugar, either because the body does not produce enough insulin or because cells do not respond to the insulin that is produced. This high blood sugar produces the classical symptoms of polyuria, polydipsia and polyphagia. Diabetes mellitus is often called 'The silent killer', because it causes serious complications without serious symptoms and can affect many of major organs in the body[1]. It is a chronic disorder that affects the metabolism of carbohydrates, fats, proteins and electrolytes in the body, leading to severe complications which are classified into acute, sub-acute and chronic[2]. Acute complications include hypoglycemia, diabetic ketoacidosis, hyperosmolar and hyperglycaemic non-ketotic syndrome[3] while sub acute complications include thirst, polyuria, lack of energy, visual blurriness and weight loss[4]. Chronic hyperglycemia causes glycation of body proteins which in turn leads to complications that may affect the eyes, kidneys, nerves and arteries[5]. The management of diabetes involves both the non pharmacological and pharmacological approaches. The non pharmacological approach includes exercise, diet control and surgery, while the pharmacological approach includes the use of drugs such as insulin, and oral hypoglycemic agents. The present

conventional drugs are not only costly but also associated with lots of adverse effects. Many herbal medicines have been recommended for the treatment of diabetes. A variety of ingredients present in medicinal plants are thought to act on a variety of targets by various modes and mechanisms. They have the potential to impart therapeutic effect in complicated disorders like diabetes and its complications. Though different types of oral hypoglycemic agents along with insulin are available for the treatment of diabetes mellitus, healers heavily relied upon medicinal plants and herbs to treat diabetes[6,7,8,9].

According to Akbarzadeh article[10] the only simple, inexpensive, easy and available way is to refine the Langerhans islets and to graft them under the testis subcutaneous. Inducing experimental diabetes mellitus is indeed the first step in the plan for transplanting the pancreatic Langerhans islets under the testis subcutaneous. Experimental diabetes mellitus has been induced in laboratory animals by several methods. The generally effective method is to take the pancreas out of the body. However, to induce a notable form of diabetes, at least 90-95% of the pancreas has to be removed. Otherwise, the Langerhans islets in the remaining pancreas may undergo hypertrophy and secrete a sufficient amount of insulin for fulfilling the natural metabolic needs. The second method

for creating diabetes in animals is injecting drugs such as alloxan or Streptozotocin. These materials inflate and ultimately degenerate the Langerhans islets beta cells. A less reliable method for creating diabetes is injection of the anterior hypophysis extract. The final symptoms of insulin deficiency are clearly seen in rats afflicted with diabetes chemically by Streptozotocin.

Streptozotocin (STZ) is a naturally occurring nitrosourea with molecular weight of 265 and empirical formula of C<sub>14</sub>H<sub>27</sub>N<sub>5</sub>O<sub>12</sub> [11]. It is widely used to induce insulin-dependent diabetes mellitus in experimental animals because of its toxic effects on islet beta cells [12]. The diabetogenic action of STZ is the direct result of irreversible damage to the pancreatic beta cells resulting in degranulation and loss of capacity to secrete insulin [13]. The effects of STZ on different organs have been extensively studied. STZ has various biological actions, including the production of acute and chronic cellular injury, carcinogenesis, teratogenesis and mutagenesis [14]. STZ is a nitrosourea compound which generally shares similar fate of disposition with other nitrosoureas and is a drug of choice in islet cell carcinoma and malignant carcinoid tumors. It is diabetogenic, hepatotoxic, nephrotoxic and also causes gastric ulceration [15]. STZ given intravenously or intraperitoneally to laboratory mice in multiple sub-diabetogenic doses, induces pronounced pancreatic insulinitis with eventual destruction of insulin-secreting beta cells and diabetes mellitus. In an experimental study in rats, streptozotocin given intraperitoneally in a dose of 45 mg/kg body weight of animals, effectively produced hyperglycaemia [16,17]. In another study in rats, STZ injected in a dose of 65 mg/kg body weight effectively produced hyperglycemia and gastric mucosal ulcerations. The incidence and severity of lesions produced by STZ in pancreas, liver, kidney and GIT, progressively increased with time from one to six weeks post treatment [18]. The present study is concentrated on effect of STZ on glucose levels in albino wistar rats.

#### MATERIALS AND METHODS

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#### RESULTS

After one week of inducing diabetes by single rapid intraperitoneal injection 50mg/ kg BW, the blood glucose levels are measured with glucometer, in normal rats the glucose levels were 125±10mg/dl, in diabetic rats it was 386±45mg/dl (Table 1).

**Table no 1: Showing the glucose and body weight parameters of normal and control rats.**

Group	Glucose	Body weight
Control rats	125±10mg/dl	267±18 gm
Diabetic rats	386±45mg/dl(p<0.01)	203±11gm(p<0.01)

#### DISCUSSION

Streptozotocin prevents DNA synthesis in mammalian and bacterial cells. In bacterial cells, it renders special reaction with cytosine groups, resulting in degeneration and destruction of DNA. The biochemical mechanism results in mammalian cell death. Streptozotocin prevents cellular reproduction with a much smaller dose than the dose needed for inhibiting the substrate connection to the DNA or inhibiting many of the enzymes involved in DNA synthesis [19]. Although Streptozotocin prevents entry of cells into mitosis but no special phase of the cellular cycle is especially sensitive to its mortal effects. Streptozotocin, which is used in intravenously form by rapid injection or constant short diffusion, stimulates the tissues. Metabolically, a slight deviation of the glucose-bearing pain from the normal limit has been seen in patients treated with a certain dose of Streptozotocin, which is generally reversible. However, the insulin shock, which is one of its other effects, is irreversible [20].

In the present study observed the clinical manifestations, glucose, body weight, organ weight using a 50 mg/kg dose of Streptozotocin ensured induction of diabetes in rats. Hyperglycemia, hypoinsulinemia, polyphagia, polyuria and polydipsia accompanied by weight loss were seen in adult rats within three days of Streptozotocin treatment and, within one week the amounts of the relevant factors were almost stable, which indicates irreversible destruction of Langerhans islets cells moreover. There are many previous research studies that have used streptozotocin to create experimental diabetes because it is a simple, inexpensive and available method [19,20]. The present study results in agreement with Akbarzadeh A et al study [10] but they have used 60mg/kg BW streptozotocin, the similar results were found in studies of Elias [21] and Ikebukuro [22].

Previous Studies have shown an association between hyperglycemia and decreased body weight of diabetic animals. The present study aim was to observe the effects of streptozotocin (STZ)-induced diabetes and to find an association between the reduction in the weights of animals and glucose levels in albino rats. In the present study streptozotocin dose was as 50mg/kg body weight In study of Zafar [16], M et al used 50mg/kg BW STZ dose, in study of Mozaffari et al [23] used 90 mg/kg body weight intraperitoneally in rats, Kang et al [24] used 70 mg/kg body weight intravenously in rats and Oscika et al [25] used STZ

in a dose of 50 mg/kg body weight intravenously in rats for producing hyperglycaemia. The present study selected the lower dose because as present strain of rats could not tolerate and survive with the dose used by previous investigators. The observations and results of the present study demonstrated that streptozotocin was effective in producing severe hyperglycaemia in experimental animals[26,27,28]. The animals treated with STZ appeared very weak with loss of their body weights because of injurious effects of STZ which caused alkylation of DNA and produced hyperglycaemia and necrotic lesions. Present observations are in agreement with the findings of Zafer M[17] Piyachaturawat et al[18], Habibuddin et al[27] and Lee et al[28]. The present study concludes that streptozotocin at 50mg/kg Bw weight induces the diabetes and the rats are shown higher glucose levels and reduced body weight and organs weight.

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