

# Forensic Aspects of Insulin Abuse: An Overview

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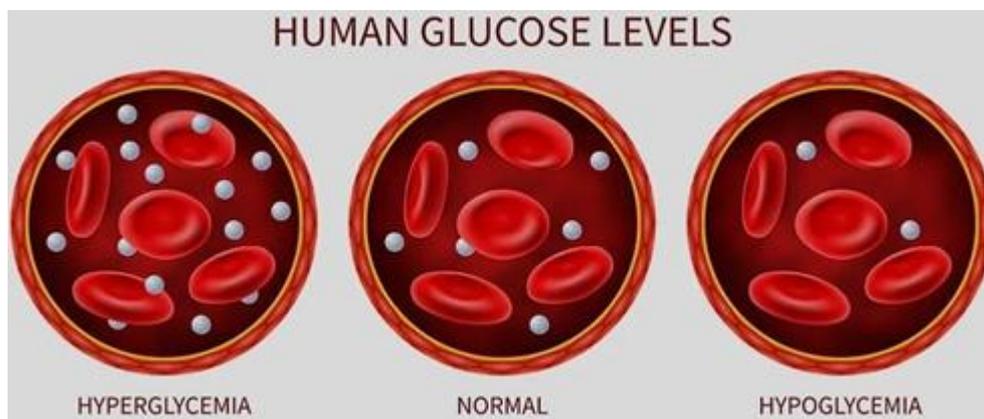
**Abstract:** In this paper we would like to draw your attention on “Insulin Abuse” and its Forensic Aspects. We’ve discussed about ‘Hypoglycemia’ and death cases related to it; it can be basically of three types – 1. Suicidal, 2. Homicidal, 3. Accidental. Most of the cases of Hypoglycemia are mainly accidental cases. The normal insulin level for insulin level for serum is <25MIU/ml and if its increases from 18 to 276MIU/ml then it could be diagnosed to hyperinsulinemia. Here, we’ve also shown the methods of how to diagnose hypoglycemia and what are the symptoms of it, how to treat a hypoglycemic patient in case of emergency and to save his/her life. Some people also take Insulin for sports purposes and to gain muscle which also cause harm to the health and sometimes leads to hypoglycemia. We hope that this paper can help the future researchers and students to gain some knowledge about this topic and for further reference.

**Keywords:** Insulin, poison, diabetes, hypoglycemia, suicide, homicide, coma.

## 1. Introduction

Insulin is an anabolic naturally occurring peptide hormone, secreted by the  $\beta$ -cells of the pancreatic islets of Langerhans. It was discovered in the year 1921 and considered as one of the greatest invention in the history of medical science. It is a boon for patients with diabetes mellitus which not only increases their lifespan but also

quality of their life, but overdose in patients or in non-diabetic person can causes “hypoglycemia”. People with hypoglycemia with a period of time can also leads to ‘neuroglycopenia’, which refers to the shortage of glucose in the brain resulting in alteration of neuronal function. This can causes mischievous behaviour and offences ranging abusive language in public places to murder.

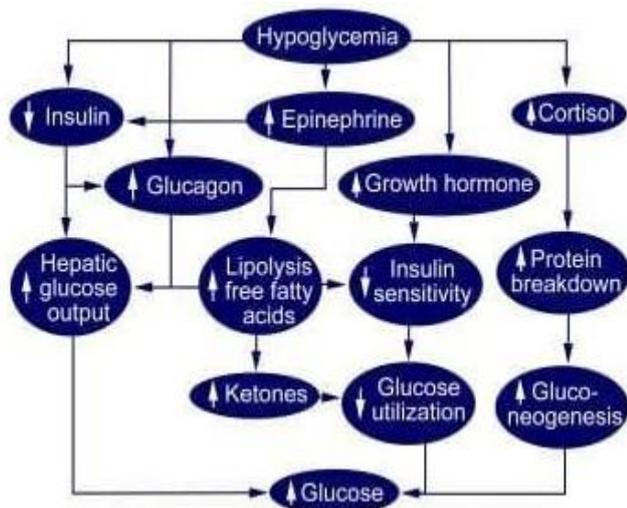


An IR (insulin receptor) consists of two types of covalently linked heterotetrameric glycoproteins consisting of two extracellular  $\alpha$  subunits and two transmembrane  $\beta$  subunits linked together by disulphide bond. On binding of insulin with the  $\alpha$  subunits there is an activation of tyrosine kinase [the  $\alpha$  subunit carries the binding site and the  $\beta$  subunit has the tyrosine kinase]. The plasma half-life of insulin is 5-9 minutes.

The result of a casual or intentional overdose of insulin can leads to hypoglycemic coma and in some severe cases death of the users. Insulin is not only used as a choice of drug to treat patient with diabetes mellitus but also used as a doping agent by athletes and also for different criminal purposes like suicide, homicide. Though the cases of homicide with insulin are may not be so common but can be seen in the medicolegal, toxicological and clinical practices. The first

documented case of insulin homicide dates back to 4<sup>th</sup> may, 1957 [Kenneth Burlew Case] and since then there has been nearly 50 cases reported globally of insulin being used either to kill or try to kill.

Hypoglycemia can be generated naturally in our body while fasting for a long period of time. It’s known as the basal insulin, which secretes in the absence of exogenous stimulation to maintain our body’s metabolism in an anabolic state. Around 50% of the total insulin secreted by a healthy pancreas is secreted under basal condition.

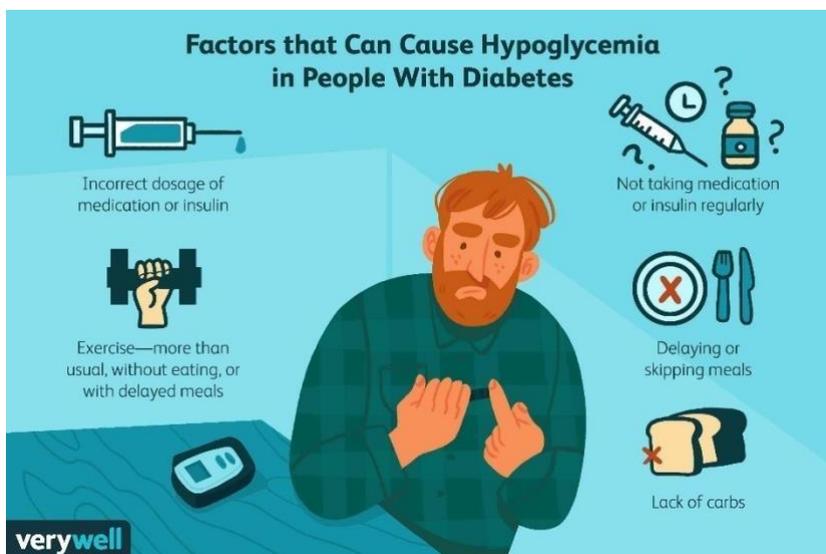


## 2. Discussion

Insulin can be detected from blood liver and plasma the symptom sources like nerve damage, kidney damage, eye problem and high blood glucose induces excessive thirst and frequent urination.

Insulin can be tested with glucose and c- peptide test. Insulin levels are also sometimes used in glucose tolerance test (GTT) in this situation blood glucose and insulin are measured at pre-established time intervals to evaluate insulin resistance.

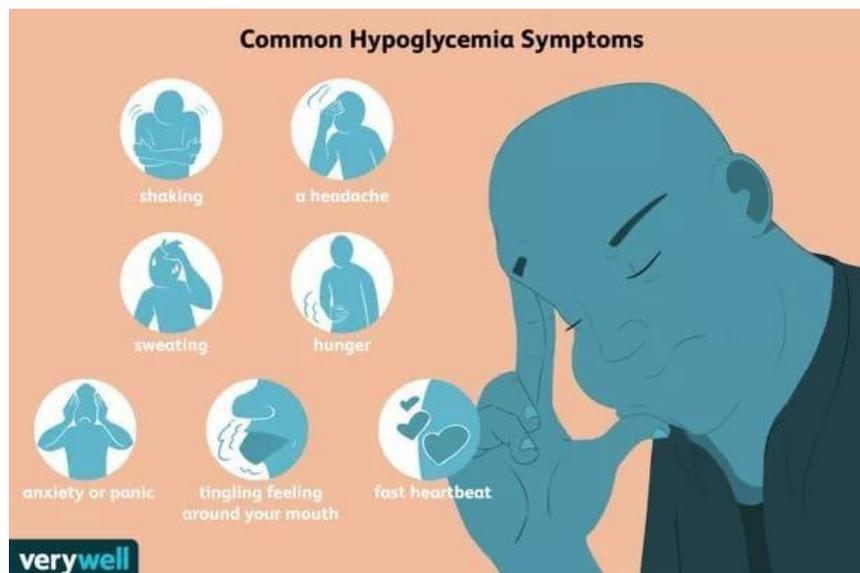
From the forensic point of view, it is essential; to analyse the events performed in a state of limited consciousness which is known as a result of hypoglycaemia. There are few known cases of the insulin abuse as a doping agent by the athletes for body building and muscles gaining purposes. It is also seen in the case of Manhausen syndrome that people



Intake insulin in the thought of that they are ill, which can also causes hypoglycemia, so for that we need to take some precautions by counselling the patients as much as possible. Nowadays insulin is also used for various other purposes rather than maintaining the euglycemia. Some other fields where insulin has been used as a wound healing activity in athletes as an anti-aging agent.

Clinical alertness is very important in such suicidal, homicidal or accidental cases which help in diagnose of overdose of insulin administration with the intention.

Clinical diagnosis is mainly based on symptomology.



Some commonly observed symptoms are:

- 1) Anxiety
- 2) Confusion
- 3) Fatigue
- 4) Extreme hunger
- 5) Irritability
- 6) Sweating or clammy skin
- 7) Trembling hands.

### 3. Case Study

A 53 year old man who is a diabetic patient and used to consume insulin at a mild dose which was required for his body, but just before the day of the incident, he took the doses of insulin at night and didn't follow the proper diet, so due to basal insulin formation he got early morning drowsiness and after that he got unconscious then, after that, Dr. came and a glucose solution has been infused to his body, when he got stabilised he was released from the hospital then after some time he again got fainted and got drowsiness repeatedly, then the Dr. gave him oral glucose solution and complex carbohydrate to maintain the glucose balance in his body and released from the hospital.

### 4. Forensic Aspects

#### A Detailed Histopathological & Immunochemical Examination:

For the detection of hypoglycemia IHS (insulin human serum) is usual by the expert. In which if there is any suspicion of suicidal or homicidal case by consuming or injecting insulin at a high dose. Then the presence of insulin in the blood can be tested with the help of immunoradiometric assays (IRMA kit immunotech) we can observe the insulin in human serum and plasma by in vitro process. It lead to an excessive surge of insulin in the vitreous humor, this is found in most of the suicidal cases similarly there is another process for the detection of insulin in the vitreous humor, which is LC-MS/MS (liquid chromatography tandem mass spectrometry). This is a much more advanced method used in analytical chemistry and it produces the confirmation of insulin poisoning.

We also used histopathological and immunochemical parameters to objectively assess the degree of neuronal necrosis and white matter degeneration. The assessment of neural necrosis was analysed in the neocortex hippocampal dentate gyrus, CA1 of hippocampus and caudoputamen. And the assessment of white matter degeneration was analysed in the globus pallidus internal capsule and corpus callosum. The higher score of the each brain region for each parameter indicates the more significant pathological condition.

#### Biochemical Studies:

From the forensic medico-legal point of view the elucidation of insulin levels in the postmortem and to extract the biological materials from the body is very difficult and the result will be still in doubt. After the consumption or injection of the insulin, the chances of survival depends upon the timing and also several different factors; such as –

- a) Type of insulin
- b) Method of administration
- c) Anatomical localization of the injection sites on the body
- d) Time interval after consumption

A post-mortem biochemical investigation was done immediately after the autopsy. Any kind of preservatives such as sodium fluoride has not been used in the examination. The result shows that low glucose level in the body fluids and blood (1-5mg/dL), there will be no increase of insulin (1.34-10.4µg/mL) or C-peptide (0.25-1.41mg/mL) along with the decrease of slight to moderate level of glucagon and the glucose and lactate levels were 1mg/dL and 1mmol/L in vitreous humor and cerebrospinal fluid respectively, and also the level of serum chloride will be found low. Otherwise there will be no changes in the electrolyte disorders aldosterone and serum renin will remain normal but angiotensin I and II can show dissociation in the concentration. The Brain Natriuretic Peptide (BNP) level in PCF can be at a low amount but the Atrial Natriuretic Peptide (ANP) can show a slight increase in the concentration level.

#### Molecular Aspects

Insulin overdose's effects and symptoms can be divided into two groups –

- 1) Sympathomimetic effect: This causes nausea, vomiting, sweating, hyperventilation, tachycardia, labile blood pressure, and hyperventilation.
- 2) Neuroglycopenic effect: This causes abnormal behaviour, altered level of consciousness, lethargy, coma, cerebrum oedema, hyper reflexia etc.

In the identification we used to find out first the molecular structures of the insulin through which we can identify that whether it was fast acting or short acting insulin. Actrapid<sup>R</sup> is a fast acting and short acting insulin which is used to maintain the diabetes and hyperglycaemia state. But sometimes it generates a toxic effect on the body which leads to hypoglycemia. In the case of Actrapid<sup>R</sup> the overdose can be detected by Whipple's triad, which can identify the-

- a) Symptoms of hypoglycemia
- b) Symptom of low plasma glucose
- c) Symptoms of resolution after plasma glucose rectification.

So by understanding the types of insulin Dr. can treat the patients and if the patient is dead then the forensic experts can find out evidences to investigate the case as, this hypoglycemia has an exaggerated effect on the body. So, the molecular aspects are very needy in this type of cases.

## 5. Conclusion

It is important to develop the effective system that can quickly diagnose and identify the overdose of insulin in the body. By acquiring the knowledge and giving proper idea of insulin abuse to the patients can decrease this kind of case. In this field mostly the accidental case are found so by counselling them and by providing a little bit of training can some millions of life from insulin overdose. In our paper we've tried to bring some major highlight of hypoglycemia we've discussed the major symptoms and factors and also the forensic aspects and here we also inputted a real life case study of an accidental case study of an accidental case of insulin overdose. We must take the major precautions is which more required for the improvement of such situation we also focus on the technical methods and matters for further more analysis and for examination and to get the undoubtful results.

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