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CRIME AND INSULIN: INTERESTING FACTS

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ABSTRACT

The discovery of insulin has completely revolutionised the management of diabetes. It is difficult to believe that such a wonderful item has also been used as a weapon over many years and continues to be misused in such an unacceptable way. The courts consider differentiating between hypoglycaemia as a natural defect in a diabetic person and hypoglycaemia as the result of weaponised use of insulin. In a crime situation, experts in hypoglycaemia cases come from a mix of disciplines, and meticulous analysis of laboratory parameters helps the court of law in getting the facts right. The use of insulin to commit a crime can be classified into two categories: suicidal and non-suicidal. Murder using insulin as a weapon by someone unknown to the victim is virtually unknown. The post-mortem measurement of blood glucose is of little or no value. A high index of suspicion is essential to point foul play as insulin is very commonly used medically worldwide and by the elderly who live alone or in community homes with poor physical and mental capacity.

Keywords: Crime, Diabetics, Insuline, etc.

CONTEXT

When I was in medical school about 36 years ago, I witnessed a case of an intentional insulin overdose in a nondiabetic patient with the intention to commit suicide. My professor, specialising in forensic medicine, further commented that it is difficult to gather evidence in the absence of witnesses. Additionally, if the insulin injection was administered on the scalp to conceal the injection mark, it raises doubts regarding whether it was a case of homicide or suicide. This sparked my interest in collecting facts and writing a concise article on the relationship between crime and insulin.

An overdose of insulin can result in severe hypoglycaemia, which can ultimately lead to death. Hypoglycaemia may be indicative of various medical conditions, including insulin overdose or the use of other oral or injectable agents for diabetes management. This review specifically focuses on insulin.

BACKGROUND

The discovery of insulin has completely revolutionised both the therapy and prognosis of diabetes. It is difficult to comprehend that such a beneficial drug has also been used as a murder weapon over many years and continues to be misused in such an unacceptable

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way [1]. Forensic hypoglycaemia encompasses the interactions between hypoglycaemia and the legal implications of intentionally administering insulin to induce undesirable effects. Hypoglycaemia, or more accurately, neuroglycopenia and the resulting temporary malfunction of the brain, can lead to a state of automatism, in which individuals are legally excused from responsibility for what would otherwise be considered a criminal offence.

Differentiating between hypoglycaemia as a natural defect in a person with diabetes and hypoglycaemia resulting from the deliberate use of insulin as a weapon is considered beyond the understanding of the average person and therefore requires an expert to explain the subtle differences and intricacies of each case [2].

The main disparities between investigating hypoglycaemia in clinical and forensic settings lie in the burden of establishing the crime in the latter, as courts demand a higher standard of proof for conviction. However, these prerequisites for evidence are often challenging to establish. Unreliable historical information, inadequate collection, preservation, or labelling of appropriate samples for analysis are common reasons for this difficulty. As a result, the specificity, validity, accuracy, and interpretation of analytical results are likely to be contested [3].

In criminal situations involving hypoglycaemia, experts from various disciplines are involved, including forensic pathology, toxicology, internal medicine, endocrinology, pharmacology, and clinical biochemistry. Forensic pathologists, endocrinologists, and clinical biochemists play pivotal roles. In forensic scenarios, it has been observed that if the occurrence of hypoglycaemia can be proven, it may be used as a defence against almost any criminal charge, provided it can be established that the perpetrator was in a state of neuroglycopenic automatism at the time of the offence. The lack of clear and conclusive differentiating markers for insulin overdose-induced neuroglycopenic automatism further contributes to the acquittal or reduced charges for the accused [4].

CASE BURDEN AND SCENARIOS

Insulin is an essential medicine and a lifesaving drug. It has also been implicated in many poisoning deaths - accidental, suicidal, and some with malicious intent [5]. Though cases of homicide with insulin may not be common, they can be seen in medico-legal, toxicological, and clinical practices. The first documented case of insulin homicide dates back to 4th May 1957 in the case of Kenneth Burlow, and since then, nearly 50 cases have been reported globally of insulin being used either to kill or try to kill [6]. Murder or manslaughter using insulin as a weapon is extremely rare. The use of insulin to commit harm can be classified into two categories: suicidal and non-suicidal cases, including accidental and weaponised use of insulin. In both suicide and non-suicide cases, the victim is often someone who is diabetic or is a close relative or friend with easy access to insulin. However, occasionally, it is someone who has obtained it illicitly. Murder using insulin as a weapon by someone unknown to the victim is virtually unknown, except in cases of mass or so-called “mercy” killing by one or more healthcare workers in a hospital or nursing home environment [2].

Unless there is suspicion, an unexplained death is likely to go undetected. Conversely, the long-time lag between the administration of a lethal dose of insulin and the death of the victim ensures that the victim is often found in a comatose state before death and can be rescued or left with severe brain damage. This is especially the case in people who attempt suicide with insulin, which is the most common cause of death from malicious insulin use. The recurring trend in cases related to death by insulin globally points to an equal distribution of deaths into two major categories: murder by medical professionals and suicide by overdose. Serial murder by healthcare professionals has been little studied but is being uncovered with increasing frequency. A variety of methods have been used, about 13 percent of which can be attributed to insulin causing death by prolonged hypoglycaemia if severe enough. A 2009 investigation identified 66 cases of suspected or proven homicide with insulin from 10 countries, and more cases have been added since then. A few healthcare perpetrators are physicians, but the vast majority are nurses [1].

Amongst the cases of murder by insulin in the 21st century, the “Stockport murders” reflect a different kind of serial killer in healthcare, with victims seemingly chosen at random. Victorino Chua, a nurse, injected insulin into saline bags and ampoules in 2011 while working in two acute care wards at Stepping Hill Hospital in Stockport. He left these contaminated products in the treatment rooms without knowing who would fall victim to his actions. They were then unknowingly used by other nurses on the unit, leading to a series of insulin overdoses. In 2015, he was convicted by a jury at

Manchester Crown Court of murdering two patients and 22 counts of attempted grievous bodily harm, as well as other charges [1].

Now, after the Mental Health Care Act, 2017, specifically Section 115 of the act, in cases of failed attempted suicide, the Indian Courts under Section 309 of the Indian Penal Code have moved from a punitive perspective towards a rehabilitative perspective. In 2017, the accused is essentially seen as a victim in need of counselling and care, not punishment. However, the charge of abetment of suicide may be applied under Section 306 in cases of assisted suicide, as euthanasia is still not acceptable under the constitutional morality regime.

The law also recognises the fundamental requirement of Mens rea or wilful intent as an essential element to charge any accused guilty for the act of culpable homicide amounting to murder, and this intent is very difficult to establish as per the evidence in cases of death by insulin overdose [2]. The interval between the injection and it taking effect (usually between 10 and 30 minutes) is sufficient to dispose of the evidence. As a result, the realisation that a person's death was due to suicide or murder using insulin as the weapon may be delayed for so long that realistic laboratory investigation of the cause has disappeared [2]. The collection and consolidation of evidence are difficult and time-sensitive and are often overlooked if no circumstantial evidence, which is self-evident to induce the realisation of the case being insulin overdose for murder, presents itself.

In the case of death by insulin overdose or any other murder by poisoning, the reliance on evidence and high standards of the burden of proof needs to be met for the accused to be charged as guilty. However, the conditions of concrete and direct evidence, along with the series of objective tests devised by the Indian Courts to "prove the guilt beyond the reasonable doubt," are often met incompletely. The accused is usually discharged or charged with a lesser criminal offence due to incomplete evidence or correlation of it to the accused, broken chain of events, improper evidence collection, etc.

CLINICAL AND LABORATORY SUPPORT

Normally, beta pancreatic cells release equimolar quantities of insulin and Cpeptide into portal venous circulation. The plasma concentration ratio of insulin/Cpeptide is less than one under physiological circumstances. A high insulin/C-peptide ratio in the plasma of a poisoned patient provides strong proof that an exogenous insulin source was used, which does not include C-peptide [2].

When the alleged victim is initially taken to medical care, he or she may be dead or alive. The assessment in the case of a victim alive is largely the same as in any case of spontaneous hypoglycaemia. A forensic pathologist must collaborate with a clinical biochemist or a toxicologist to gather evidence in investigating a death caused by hypoglycaemia.

Clustered hypoglycaemia, the occurrence of three or more occurrences of unanticipated hypoglycaemia within a short period of time in a restricted setting, may be spontaneous or malevolent in nature. Deliberate poisoning of patients raises a variety of issues, including identifying the offender and determining, in hindsight, which individuals died from hypoglycaemia as a result of poisoning, and which died from natural causes. Jurists must frequently make life-changing choices based on untrustworthy information [2].

In the case of nurse Colin Norris, who was convicted of murdering four elderly patients and attempting to murder a fifth at two Leeds hospitals by poisoning them with insulin. In 2008, he was sentenced to 30 years in jail. Experts convinced the jury in Norris' initial trial to believe that a cluster of hypoglycaemic episodes among older persons who were not diabetic was nefarious. At the time, it was thought that such hypoglycaemic episodes in people who were not diabetic were "vanishingly rare" (as the trial judge put it), but more recent research has shown that spontaneous hypoglycaemia in sick, elderly, and frail patients is not as uncommon as previously thought. Raised insulin levels may be the result of a rare medical disease such as insulinoma rather than a crime, or the evidence may be ambiguous [1].

After injection of the insulin, the chances of the victim's survival depend upon several factors: the insulin type, its method of injection, the anatomical site chosen for injection, and the time interval since injection to help. Insulin overdose impact and symptomatology could be as per its sympathomimetic effects or low glucose in the brain. A person can have nausea, vomiting, sweating, a high pulse, fluctuating blood pressure, and hyperventilation. Importantly, neuroglycopenic effects could cause abnormal behaviour, altered level of consciousness, lethargy, cerebral oedema, exaggeration of reflexes, and coma. Insulin overdoses can occur for a number

of reasons. Some common situations could be as follows: miscalculating the carbohydrate content of a designated meal, missing out or delaying a scheduled meal after having injected the insulin dose, accidentally injecting twice for the same meal consumed, accidentally injecting the wrong insulin – for example, injecting fast or rapid-acting insulin in place of slow or long-acting insulin. Sometimes, there is difficulty seeing the numbers or gradation on an insulin pen or syringe. These situations could lead to accidental overdose and may be masquerading as suicide or rarely homicide if no robust witness evidence is available.

Research was conducted over a 20-year period in South Australia to investigate rates and features of insulin-related fatalities among insulin-dependent diabetics and non-diabetics for all causes of death. The National Coronial Information System and Forensic Science South Australia databases were searched. The study found that insulin-assisted suicides among insulin-dependent diabetics are just as common, if not more common, than fatal accidental insulin overdoses. This is primarily due to insulin-dependent diabetics having access to a potentially fatal drug in life-threatening amounts [7]. From the legal and forensic point of view, it is important to analyse the victim's case in a state of partial consciousness which is known as a result of low brain sugar level. Clinical alertness is very important in such suicidal, homicidal, or accidental cases, which helps in the diagnosis of an overdose of insulin administration with the intention and a motive.

The detection of exogenous insulin in biological materials is of particular importance in some post-mortem examinations. Toxicological study of these chemicals is difficult due to their high molecular weight, insulin's poor stability in whole blood, and the complexity connected with sample preparation and instrumental testing. Interpretative challenges, such as the frequent absence of anatomical evidence, concentration interpretation in known insulin users, and addressing the influence of chemical instability and post-mortem redistribution, further complicate forensic death examination [8]. The post-mortem measurement of blood glucose is of little or no value in the investigation of hypoglycaemia, whereas detection and quantification of the pancreatic hormone insulin, C-peptide, and proinsulin, preferably by liquid chromatography/mass-spectrometry (LCMS), is essential. Vitreous humour is the most useful fluid for analysis as all three hormones remain measurable for several days after death from insulin poisoning unlike in serum from peripheral blood. Biochemical and immune-histological analysis of tissue surrounding a suspected injection site, if identified, is also valuable [2]. Researchers 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 the hippocampus and caudo-putamen. The assessment of white matter degeneration was analysed in the globus pallidus, internal capsule, and corpus callosum. The higher score of each brain region for each parameter indicates a more significant pathological condition [6]. Typically, there are no morphological features that identify a corpse as due to insulin poisoning. A thorough search of the body may reveal the site of one or more injection sites. But the part may be obscured by being in such unlikely sites as the genital areas, vagina or scrotum, that are easy to inject but difficult to find. On finding a possible site of insulin injection, then a generous sample of the surrounding tissue should be excised at autopsy and sent for immuno-histological examination and chemical analysis for insulin. Samples of venous blood from a peripheral blood vessel, cerebrospinal fluid, both eyes' vitreous humour, and urine should be collected for later analysis in the laboratory. Blood must be separated immediately and the serum frozen and kept at –200 °C until analysed for insulin, Cpeptide, and proinsulin. Haemolysed blood is very unlikely to yield positive results when assayed by immunoassay but may contain fragments of insulin analogues that are recognised by LC-MS [2]. The analysis of insulin and C-peptide was traditionally done by immunoassay methods (RIA and/or ELISA), although high-resolution LCMS/MS (liquid chromatography-tandem mass spectrometry) is more suitable for forensic purposes and permits the identification of insulin analogues [5].

LEGAL CONSIDERATION

Suicide prevention strategies should focus on insulin-dependent diabetics with a history of depression, particularly for those with access to rapid-acting insulin [7]. Suicide, and more commonly its attempt, is no longer a crime in most jurisdictions in the world but still carries opprobrium and shame in many communities. It may also jeopardise life insurance and other civil contracts [2]. In the Indian context, we see that generally, death due to overdose of any substance or drug is small in numbers compared to developed countries like the USA, and as it stands death by Insulin overdose or suicide by using insulin

is infinitesimally small globally with only a half a dozen cases ever reported in India linked to such. Sometimes it could be due to bizarre and abnormal thinking in wrongdoers, leading to homicide using insulin and fatal hypoglycaemia. As mentioned above, usually the person who is known to or has easy access to insulin could use this as a fatal weapon. In an interesting case of Reta Mays, a former nursing assistant in the USA was sentenced to life imprisonment for the murder of seven elderly patients at a US military veterans' hospital in West Virginia. Reta Mays murdered them by injecting them with insulin, producing hypoglycaemia which led to their deaths. While the deaths accumulated during her overnight shifts at the hospital in 2017 and 2018, Mays conducted internet searches on female serial killers and watched the Netflix series "Nurses Who Kill". She pleaded guilty in federal court to seven counts of seconddegree murder for intentionally injecting the men with unprescribed insulin. Murder by insulin, although rare, has been used by a variety of healthcare workers, ranging from nurse serial killers to doctors who want to conveniently eliminate their wives. Insulin has also been used as a murder weapon in fiction - for any readers who watched "Cardiac Arrest" many years ago [1].

Hypoglycaemia could reflect other conditions like some endocrine disorders (Addison's disease, insulinoma, etc.), oral hypoglycaemic medications or subcutaneous insulin secretagogues. Sometimes even some plants and toxins could cause this as a result of liver injury or insulin-like action in the body. The subject is complex, and accidental insulin overdose could happen as per poor vision, wrong calculation of the dose, and faulty devices like insulin pens or insulin pumps. So, when such an incident occurs, the expert witness's responsibility is to help the court, regardless of whether they are summoned by the prosecution or the defence. They are present to assist the court in comprehending the complexities of hypoglycaemia. They are not mainly there to describe evidence that they have elicited. In the instance of a defendant accused of a crime, the experts would be asked to render a judgment on whether the subject suffered from neuroglycopenia severe enough to create momentary incapacity to commit a crime; in other words, to behave as an automaton. In cases where insulin is suspected of being used as an offensive weapon, the expert would be expected to demonstrate to the court that it was or that it was not used in this way. They should not venture an opinion on who was or might have been responsible. Nor should they, in cross-examination, allow themselves to stray from their particular area of expertise as has been known to happen, and admitting to ignorance in response to a question is both more honourable and legally correct than attempting to bluff [2].

CONCLUSION

The discovery of insulin has completely changed and revolutionised the treatment of diabetes. It is difficult to imagine that such a useful chemical has also been used as a weapon for crime. Insulin overdose causes hypoglycaemia, if it can be proved, may be used as a defence against almost any criminal charge provided it can be established that the accused was in a state of neuroglycopenic automatism at the time of the crime. The use of insulin to commit crime can be classified into two categories, suicidal and non-suicidal. Murder using insulin as a weapon by someone unknown to the victim is virtually unknown. After injection of the insulin, the chances of the victim's survival depend upon several factors; the insulin type, the body part injected, the method used, and the time interval. Nevertheless, hypoglycaemia could reflect other conditions like some endocrine disorders, oral hypoglycaemic drugs or subcutaneous insulin secretagogues, for example, liraglutide, a GLP 1 inhibitor. So, in the case of suspected criminal use of insulin, experts' help from different fields and meticulous analysis of laboratory parameters are helpful. The post-mortem measurement of blood glucose is of little or no value. The detection and quantification of insulin, Cpeptide and proinsulin, preferably by liquid chromatography/ mass-spectrometry, is essential. Vitreous humour is the most useful fluid for analysis. In suspected crime conditions, the expert would be expected to demonstrate to the court that it was or that it was not used in this way. A high index of suspicion is essential to point foul play as insulin is very commonly used medically worldwide and by the elderly who live alone or in community homes with poor physical and mental capacity. In my search, I could not find a case reference where the insulin was injected into the scalp, my first query.

LEARNING BITES

1. Murder using insulin as a weapon by someone unknown to the victim is virtually unknown.
2. Neuroglycopenic automatism at the time of the offence may be used as a defence against almost any criminal charge.
3. A high insulin to C-peptide ratio in the plasma is

strong proof of an exogenous insulin source.

4. Vitreous humour is the most useful fluid for sample analysis.

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