Review Article
Volume 14:03, 2023

Journal of Forensic Research

ISSN: 2157-7145 Open Access

A Microwave Technique: As a Forensic Tool to Identify Amount of Insulin in Biological Fluids

Ritika Verma*

Department of Forensic Science, Central Forensic Science Laboratory, Directorate of Forensic Science Services, Ministry of Home Affairs, Government of India, Ramanathapur, Amberpet Post, Hyderabad- 500013, Telangana, India

Abstract

Even though drugs can cure disease and reduce pain, they can also be a means of murder. Forensic scientists can examine blood and tissue to uncover cases where death is not as natural as it may seem – from slow arsenic poisoning to quick cocaine overdose. Besides this, there are many instances of insulin overdose poisoning in suicide and murder cases all over the world. Insulin poisoning seems a perfect weapon to criminals because according to them it cannot be detected after death. Moreover, instrumental methods are the foundation of modern forensic physics and toxicology investigations. In this paper we will discuss an innovative Microwave Technique and diagnostic methods of insulin, which can be applied in forensic science for detection and quantification of insulin as a toxin in biological fluids. A short description of the theory, inherent potency and limitations of its methodology is presented. Goal of this paper is to promote novelty to develop our technological capabilities and use of new diagnostic techniques in forensic science practice.

Keywords: Microwave sensors • Forensic physics • WGM resonator • Insulin poisoning

Introduction

Think of murder and the chances are your mind will spring to guns or knives, maybe even arsenic or strangling. Few would consider the diabetes treatment insulin as a weapon, but over the last 100 years that is just what it has become in a few, often high-profile cases. Insulin, a hormone is required to prevent the levels of sugar in the bloodstream getting too high. People with diabetes cannot produce enough of the hormone or are unable to respond to it properly, and need more [1]. Insulin was also being used to kill. Too much of the hormone can reduce the amount of glucose in the blood to a level where the brain is unable to function properly and leads to seizures death. This condition is called hypoglycaemia [2] . Since then there have been about a number of cases globally of insulin being used either to murder, or to try to murder mostly by medical staff who find the drug easier to get. In this paper we will discuss in short some of the famous cases of Insulin poisoning and murder.

Foundation of applied or modern forensic physics are instrumental methods. In case of hypoglycemia plasma insulin concentration generally much more than 400 pmol/L, most commercial insulin assays fail to detect recombinant insulin analogues and Serum Glucose measurements are valueless in victims found dead [3-7]. Longer wavelengths and non-ionizing nature of microwave radiation has attracted the focus of researchers for developing biosensors in microwave range. In this paper we will discuss a new highly sensitive Microwave WGM Technique and diagnostic methods of insulin, which can be applied in forensic science for detection and quantification of insulin as toxin in biological fluids. Moreover, we will give a short description on its theory, inherent potency and limitations of its methodology. Objective behind this paper is to promote novelty to develop Forensic Physics technological capabilities and use of new diagnostic techniques in forensic science practice.

Case study

Case 1st: In May 1957, a 32-year-old pregnant woman was found murdered in Bradford, Yorkshire in England. The death of Elizabeth Barlow was believed to be the world's first documented insulin homicide murder case.

Case 2nd: Claus Von Bulow was twice tried for attempting to murder his wife, Sunny - once in 1982 and then again in 1985with insulin injections. Sunny von Bulow fell into a coma for 28 years then died.

Case 3rd: Beverly Allitt, a nurse, was given 13 life sentences for murdering and attacking children in her care by giving them insulin. Allitt, dubbed the "Angel of Death" was detained at Rampton High Security Hospital, Nottinghamshire, in 1993 and was told she would serve a minimum tariff of 40 years.

Case 4th: Colin Norris, 37, of Glasgow, was found guilty in 2008 of injecting the four with a fatal dose of insulin, and trying to murder a fifth old woman, at two hospitals in Leeds.

Case 5th: An Australian doctor who gave his wife a fatal injection of insulin has been found guilty of murder. Brian Crickitt, 63, killed Christine Crickitt, 61, with the fast-acting hormone at their home in Sydney. He did an internet search for "intentional insulin overdose" two days before the murder. Crickitt obtained the insulin by using a prescription he had written for a diabetic patient earlier on 31 December 2009.

Case 6th: Elizabeth Wettlaufer, 49, of Woodstock, Ont., is suspected of administering deadly doses of a drug to patients at two nursing homes. The victims were between the ages of 75 and 96 and died from 2007 to 2014 in Woodstock and London, Ont.

Case 7th: A man who stabbed his friend through the heart was allowed to walk free from court after a judge cleared him of murder because of his diabetes. Medical reports showed Alasdair Padmore, 37, a diabetic since the age of nine, had too much insulin in his body and suffered a three-hour black-out during which he killed Nicholas Trent and attacked police officers.

Case 8th: At Lucknow Some incidents set precedents in crime investigations and death of Ritu Kapoor, the 32-year-old pregnant woman who died of hypoglycaemia (insulin overdose) in May 2012 is one such instance for the state. Kapoor's death is the first documented murder by insulin in UP. The

***Address for Correspondence:** Ritika Verma, Department of Forensic Science, Central Forensic Science Laboratory, Directorate of Forensic Science Services, Ministry of Home Affairs, Government of India, Ramanathapur, Amberpet Post, Hyderabad- 500013, Telangana, India; E-mail: ritika.cfsl@gov.in*

Received: 26 April, 2023; Manuscript No. jfr-23-97095; Editor Assigned: 28 April, 2023; PreQC No. P-97095; Reviewed: 03 May, 2023; QC No. Q-97095; Revised: 09 May, 2023, Manuscript No. R-97095; Published: 16 May, 2023, DOI: 10.37421/2157-7145.2023.14.565

blood sample collected from cardiac cavity showed larger value of insulin than the highest standards. According to deceased's relatives, Ritu was not diabetic and was never induced insulin before she was admitted to the hospital. The forensics reports too noted subsequently that only intravenous infusion (external infusion) can lead to such extraordinarily high insulin levels and deceased's husband was booked under IPC section 302 (murder charges).

Insulin detection method

The toxicity of insulin in overdose is primarily due to hypoglycaemia. Time period of the hypoglycaemic effect depends on the type of insulin used (duration of action), the amount and age, diabetes (insulin resistance) and other factors that may increase or decrease the patient`s sensitivity to insulin. Insulin may cause more effect in non-diabetics, who do not have insulin antibodies or insulin resistance. According to clinical data available, in healthy humans normal range of insulin found in human body in picomoles [8]. Beyond this higher insulin level may result in severe neurologic seizures or death if not quickly identified and treated.

Mortality in attempted suicidal overdose with insulin is 25%. Death has occurred after as little as 20 units but doses of 400 to 900 units or more are more common in fatal cases. Most of the commercial insulin assays fail to detect recombinant insulin analogues. The final diagnosis of death in hypoglycemic or diabetic coma should always be done as a synopsis of anamnestic response, morphology, biochemical (glucose, lactate, ketone bodies, insulin, and C-peptide) and toxicological findings. High glucose levels in vitreous humor [9].

Therefore, there is a requirement of a rapid detection technique of insulin concentration in blood plasma up to pmol concentration and from literature review it can be concluded that Microwave WGM tecnique can be the answer to this problem. In papers a composite WGM-DR method was used which can detect pmol concentration of Insulin in hepes buffer solution at Microwave frequency. Thus, this Microwave technique can be used as forensic tool to detect insulin in Biological fluids.

Discussion

Microwave WGM-DR method

WGM's are generally described as propagating mode, for which most of the energy confined closer to the rim of the DR and this makes it very sensitive in that region. Therefore, WGM resonators can be used for highly sensitive sensing applications. In the present research work WGM in DR technique is used for sensing pM concentration variation in liquid medium. This WGM-DR was found advantageous as modal fields confined within the small region near the resonator boundary of cylindrical DR at higher modes and makes it more sensitive in that region due to which only few microlitre volume is required for experimental analysis. Results of these research work indicate that change in concentration will not affect the shift in frequency and this result will lead to no change in real permittivity for such a lower concentration samples loaded in ring of SHD. But calculated imaginary permittivity of solution is sensitive to variation in pM concentration of Insulin. Moreover, small response time, low sample volume and its ability to sense losses in pM concentration of Insulin in liquid medium makes this method ideal insulin biosensor [10,11].

Conclusion

In this paper starting with short introduction to the present time scenario related to increase in Insulin poisoning is discussed followed by some case studies on Insulin poisoning & Insulin as murder weapon cases. Literature review suggests that at present screening of Insulin levels in bio samples is usually carried out by ELISA assay method but limitations like long turnaround time and high cost has compelled researchers to come up with alternative techniques to study the properties of Insulin in solution. It was observed that for developing biosensors, longer wavelengths and non-ionizing nature of microwave radiation make it better option. Therefore, in this paper we have discussed a new highly sensitive Microwave WGM Technique and diagnostic methods of insulin capable of testing up to pmol range in fluids. Thus, can be applied in forensic science for detection and quantification of insulin as toxin in biological fluids.

Acknowledgement

The author gratefully acknowledge the support given by, Director cum-CFS, DFSS, Delhi; Director CFSL Hyderabad and Shri P.N. Ramakrishna HOD Physics CFSL Hyderabad.

Conflict of Interest

The authors state no conflict of interest.

References

1. https://www.nobelprize.org/educational/medicine/insulin/discovery-insulin.html
2. Marks, Vincent and Caroline Richmond. "Kenneth Barlow: The first documented case of murder by insulin." *J Royal Soc Med* 101 (2008): 19-21.
3. http://news.bbc.co.uk/2/hi/americas/7769658.stm
4. http://news.bbc.co.uk/2/hi/health/6250172.stm
5. http://www.bbc.com/news/uk-30448325
6. http://news.bbc.co.uk/2/hi/health/567895.stm
7. Heald, A. H, B. Bhattacharya, H. Cooper and A. Ullah, et al. "Most commercial insulin assays fail to detect recombinant insulin analogues." *Ann Clin Biochem* 43 (2006): 306-308.
8. Manley, Susan E, Irene M. Stratton, Penelope M. Clark and Stephen D. Luzio. "Comparison of 11 human insulin assays: Implications for clinical investigation and research." *Clin Chem* 53 (2007): 922-932.
9. Verma, Ritika and K. S. Daya. "Microwave sensing of pM concentration of insulin in buffer solution using WGM-DR." *Seventh Int Conf Sensing Technol (ICST)* IEEE (2013).
10. Verma, Ritika and K. S. Daya. "Rapid detection of pM concentration of insulin using microwave whispering gallery mode." *IEEE Sensors J* 17 (2017): 2758-2765.
11. Verma, Ritika and K. S. Daya. "Understanding the decay of proteins: A method to study time dependent response of pM concentration of insulin at microwave frequencies." *MethodsX* 4 (2017): 35-41.

How to cite this article: Verma, Ritika. "A Microwave Technique: As a Forensic Tool to Identify Amount of Insulin in Biological Fluids." *J Forensic Res* 14 (2023): 565.