

Insulin in Post-mortem Blood*

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Summary. In 29 cases of sudden death the insulin concentration in blood from the right heart and the femoral vein was determined by a radioimmunological method. The concentrations in the femoral venous blood were below 60 $\mu\text{U/ml}$ serum (mean 23 $\mu\text{U/ml}$), i.e. in the same order of magnitude as in living persons. In right heart blood the insulin values were about 10 times higher, probably due to post-mortal diffusion of insulin via the portal vein. In suspected hyperinsulinism the measurements should therefore be made on peripheral venous blood.

Zusammenfassung. In 29 Fällen von plötzlichem Tod wurden die Insulinkonzentrationen mit einer radioimmunologischen Methode gemessen im Blut von der rechten Herzkammer und von der Femoralvene. Die Todesursachen waren Herzkrankheit in 20 Fällen, Lungenembolie in 3, Gehirnblutung in 2, Erhängung oder Erdrösselung in 2, traumatische Aortaruptur in 1 Fall und Vergiftung mit Desimpramine in 1 Fall. Die Konzentrationen im Femoralvenenblut waren unter 60 $\mu\text{U/ml}$ im Serum (Mittelwert 23 $\mu\text{U/ml}$): das ist die gleiche Größe wie bei lebenden Personen. Im rechten Herzkammerblut waren die Insulinkonzentrationen ungefähr 10mal höher, wahrscheinlich von postmortaler Diffusion des Insulin verursacht via der Portalvene. In verdächtigem Hyperinsulinismus müssen die Messungen deshalb an peripherem Venenblut vorgenommen werden.

Key words: Insulin, in postmortem blood — Sudden death, insulin concentration in blood.

Determination of the insulin concentration in blood at autopsy should have its value in the diagnosis of insulin overactivity with hypoglycemic death. This condition might be caused by an accidental overdose of insulin by a diabetic, a suicidal or homicidal injection of insulin or an insulin producing insulinoma. Only occasional reports have been made of determination of the insulin concentration in the blood post-mortem (Stofer, 1970), and normal values are lacking. In the present investigation the insulin concentration in blood from the right heart and the femoral vein was determined in cases of sudden death in order to establish the normal range of insulin in post-mortem blood.

Material and Methods

Autopsy Material. 29 cases of sudden death (19 men and 10 women) autopsied at the Department of Forensic Medicine, Uppsala, Sweden were investigated. The causes of death were cardiac failure in 20 cases, pulmonary embolism in 3, cerebral haemorrhage in 2, hanging or suffocation in 2, traumatic aortic rupture in 1 and intoxication with desimpramine (a tricyclic antidepressive) in 1 case. The age range was 23—85 years (mean 65 years). The interval

* Part of this study has been reported at the second meeting of the Swedish Society for Forensic Medicine, Lund, 1972 (Lindquist, 1973).

between death and autopsy was 39—144 hrs (mean 68 hrs). In no case were there signs of more than slight putrefaction. Cases with notes referring to diabetes in the police report or signs of advanced liver disease were not included in the study.

Blood was collected from the right atrium and the femoral vein. Glucose in serum was determined within 1 hr by the glucose oxidase method. After centrifugation the serum was deep frozen (-40°C). Within 1 month insulin in serum was determined in duplicate by the Phadebas Insulin Test (Pharmacia AB, Uppsala, Sweden), based upon the radioimmunosorbent technique described by Wide *et al.* (1967). To increase the sensitivity of the assay, the serum sample (0.1 ml) was preincubated with the Sephadex-coupled antibodies for 3 hrs before the labelled insulin was added. The incubation was then continued at room temperature for about 24 hrs. The limit of sensitivity was 1—2 $\mu\text{U/ml}$.

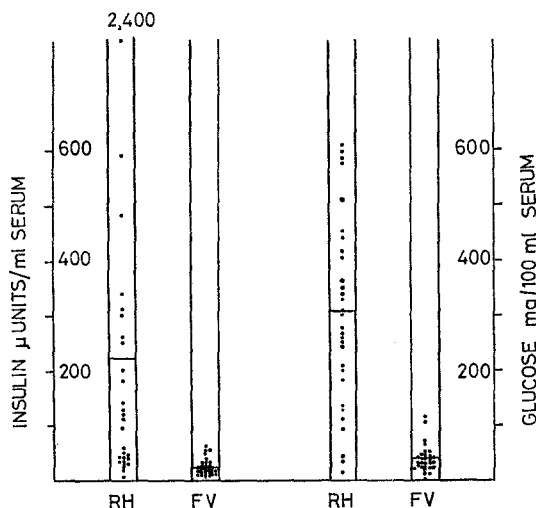


Fig. 1

Results

The results are shown in Fig. 1. The insulin concentrations in femoral venous blood ranged from 5 to 60 $\mu\text{U/ml}$ serum, with a mean value of 23 $\mu\text{U/ml}$, while the insulin values in blood from the right heart were scattered over a much wider range. The sample from the case with desimpramine intoxication contained 2400 $\mu\text{U/ml}$. In this case the concentration in femoral venous blood was 49 $\mu\text{U/ml}$. The mean insulin concentration in serum from right heart blood was 222 $\mu\text{U/ml}$, *i.e.*, about ten times than of femoral venous blood. The glucose concentration was 0—113 mg/100 ml serum (mean 37 mg/100 ml) from femoral venous blood, and 14—605 mg/100 ml serum (mean 300 mg/100 ml) from right heart blood. When plotting the time course of the insulin values, no tendency to an increase or decrease was observed during the second to fifth day after death.

Discussion

The insulin values in femoral blood in this autopsy study were of the same magnitude as those found in patients *in vivo*. Although the autopsy was not

performed until several days after death this observation indicates that the changes in insulin concentration during this period are not large, at least in the absence of putrefaction. In blood from the right heart, on the other hand, much higher insulin values were obtained. The same finding, although less pronounced, has been made in patients (Erwald *et al.*, 1971) where both the basal values and the response to tolbutamide or glucose administration are higher in blood from the portal and hepatic veins than in that from a peripheral vein. This difference may possibly be explained by diffusion of insulin from the pancreas via the portal circulation to the right heart.

Stofer (1970) has described a case of suicide by subcutaneous injection of about 1100 U of Novo lente insulin. He analysed blood from the heart and also from the site of injection for the presence of insulin, and found high insulin concentrations (2600—2900 μ U) in the heart blood. As it is not stated from which side of the heart the blood was collected, however, this report may be of little value in the present connection. As shown in the present study, high values of insulin normally occur in blood from the right heart at autopsy.

It is recommended that in cases of suspected insulin intoxication blood samples for insulin determination should be collected from a peripheral vein together with samples from the suspected injection site. Peripheral venous blood and cerebrospinal fluid should also be taken as soon after death as possible for glucose determination. For a positive diagnosis of hyperinsulinism not only should the insulin values be high but the sum of the glucose and lactic acid concentrations in the cerebrospinal fluid should also be low (Traub, 1969). It should be noted that in diabetic patients high insulin concentrations in peripheral blood are often found without concomitant hypoglycemia.

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References

- Erwald, R., Hed, R., Nandorf, R., Nygren, A., Röjdmarm, S., Sundblad, L., Wiechel, K. L.: Immunoreactive insulin in portal, hepatic, and peripheral venous blood, and some of its clinical applications. *Opusc. med. (Stockh.)* **16**, 313—358 (1971)
- Lindquist, O.: Determination of insulin and glucose post mortem. *Forens. Sci.* **2**, 55—56 (1973)
- Stofer, A. R.: Suicid mit Insulin und Nachweis des Insulins an der Leiche. *Arch. Toxicol.* **26**, 1—7 (1970)
- Traub, F.: Methode zur Erkennung von tödlichen Zuckerstoffwechselstörungen an der Leiche (Diabetes mellitus und Hypoglykämie). *Zbl. allg. Path. path. Anat.* **112**, 390—399 (1969)
- Wide, L., Axén, R., Porath, J.: Radioimmunosorbent assay for proteins. Chemical couplings of antibodies to insoluble dextran. *Immunochemistry* **4**, 381—386 (1967)

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