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Peripheral Blood Sampling: Are Measurements in Such Samples Always Meaningful?

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Clinical Investigation

One of the routine procedures during clinical investigation is to take a peripheral blood sample for various lines of clinical analysis. If organ function is a particular consideration (e.g. ovarian function), then the underlying assumption is usually made that the peripheral blood concentration, for example, of a steroid hormone is a valid reflection of the relevant organ's synthesis and secretion. Clinical decisions are based on the further assumption that a blood sample is representative for the body as a whole, and irrespective of from where the sample is taken. Practitioners need to be made aware that these assumptions are not always factually correct and that hormone measurements obtained in peripheral blood - usually from a cubital vein - is open to misinterpretation. A major reason for potential misinterpretation involves counter-current exchange mechanisms between intimately - apposed veins and arteries in the vicinity of a specific organ, the flow of such blood vessels coursing in opposing directions. The extent of counter-current exchange between an organ's venous drainage and corresponding artery will influence the systemic blood concentration of the hormone or molecule in question [1]. Not to be overlooked, lymphatic vessels are part of the local transfer system. Even though lymphatic flow is relatively slow, the hormone concentrations are high.

The overall extent of counter-current exchange may vary with time and can be influenced by diverse factors. These include posture of the body, heart rate, stage of the menstrual cycle and intrinsic diurnal rhythms [2]. Nonetheless, such a system of molecular redistribution generates increased concentrations of locally produced substances in the neighboring artery compared with aortic concentrations. Such increased concentrations may have influences on other cell groups within the given organ or in other organs supplied from the same local artery. Furthermore, they may act to influence the effectiveness of the exchange system itself. As to relevant details, diffusion in and out of blood vessels is mainly a passive process. Smaller molecules diffuse more effectively than larger ones, but substances with a molecular weight of 500 Daltons or more may be transferred. Lipophilic substances diffuse more readily than hydrophilic ones of similar molecular weight. A low blood velocity in capillaries will facilitate equilibrium of substances between extracellular fluid and plasma. Edema will delay diffusion to and from the capillaries and may disrupt normal capillary flow.

Many substances become bound to plasma proteins like albumin and diverse globulins. Only the non-bound fraction is physiologically active and transferred from venous to arterial blood. Locally-transferred hormones may have a huge impact, but plasma binding kinetics *in vivo* remain largely unexplored. Despite so much effort being devoted nowadays to molecular biology, it would be advantageous also to continue with classical investigative physiology [1]. In conclusion, experience shows that the concentration in cubital vein blood of endogenous substances provides an empirically useful tool to establish the functional state of the body in a clinical setting. However, if an exact description of the production of an organ is needed, samples from the local artery and vein must be used for the assessment.

References

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