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Continuous, Real-Time Monitoring of Biomolecules in Live Animals

Researchers at Stanford have developed methods for the continuous real-time monitoring of biomolecules in live subjects.

Real-time biosensors that can continuously measure circulating biomolecules in vivo would revolutionize the healthcare system by enabling truly personalized medicine – providing valuable insights into a patient's health status and their response to therapeutics, allowing clinicians to tailor therapeutic regimens to consistently deliver maximum efficacy with minimal side effects. Unfortunately, current real-time biosensors are limited to a handful of analytes and low sensitivity. Further, with current technologies, understanding individualized therapeutic response kinetics is laborious and most treatment decisions are made with a combination of representative population data combined with trial and error.

Stage of Research
The inventors have developed methods for the continuous and simultaneous monitoring of multiple analytes with picomolar sensitivity and sub-second temporal resolution. Their methods and microfluidic device function together as a biosensor which constantly processes samples and integrates several steps, such as purification, incubation and washing. The inventors demonstrate real-time continuous detection of glucose and insulin in live diabetic rats using a fluorescence sandwich immunoassay. Their device can measure transient changes in glucose and insulin levels. Further, they demonstrate the capacity to resolve inter-individual differences in pharmacokinetic responses to therapeutics.

Applications

- Real-time in vivo detection and concentration measurements of multiple analytes using sensors within microfluidic devices

- Treating a disease or disorder via continuous or intermittent administration of a therapeutic based on determined concentration(s) of one or more analytes associated with the disease or disorder

Advantages

- Sensor exhibits sufficient sensitivity, specificity, and dynamic range in measuring low abundance molecules directly in whole blood to resolve temporal fluctuations over short timescales
- Device incubation time of 30 seconds, drastic improvement to traditional ELISA-based detection technologies
- Core components can be applied for in vivo, multiplexed, and continuous measurement of any target molecule of interest

Publications

- Poudineh M, Maikawa CL, Ma EY, Pan J, Mamerow D, Hang Y, Baker SW, Berirami A, Yoshikawa A, Eisenstein M, Kim S, Vuckovic J, Appell EA, Soh HT. A fluorescence sandwich immunoassay for the real-time continuous detection of glucose and insulin in live animals. *Nat Biomed Eng.* 2021.

Patents

- Published Application: WO2021146612
- Published Application: 20230061218

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