Electronic Mosquito: A semi-invasive glucose analysis device

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Diabetes currently affects 346 million people worldwide, and the numbers are continuously climbing [1]. Frequent self-monitoring of their glucose levels have been proven to reduce the risk of long-term complications and cost [2], but current methods suffer from low compliance, inaccuracy, or short periods of usability [3].

The electronic mosquito is an innovative design that is painless, minimally invasive, and it can automatically monitor blood glucose levels. The aim is to have a disposable 3cm x 3cm patch that can sample and analyze blood on a regular basis; it will be composed of hundreds of single-use microneedles. The patient merely has to replace the patch when needed; the replacement frequency has yet to be determined. It will have the ability to communicate wirelessly with an external processor, artificial pancreas, insulin injector, etc. The glucose sensor will consist of a micropotentiostat and an analog digital converter. A potentiostat consists of three electrodes: working, reference and counter (or auxiliary); it measures the current created by a chemical reaction at a working electrode. In this case, the current is caused by a reaction between glucose oxidase (GOx) and glucose. By maintaining the voltage between a reference electrode and the working electrode, the current flowing from the working electrode is directly proportional to the 'resistance' or the glucose concentration. The glucose concentration can be calculated using Michaelis-Menten kinetics.

Currently a prototype of the e-Mosquito is being developed; it contains the needle and its actuator, and a wireless transceiver. Work on the glucose sensor is in progress. This device has the potential to significantly impact a diabetic's quality of life, initially removing the need to manually test their own blood, to having an artificial pancreas that can automatically inject insulin when needed.

References

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