J Cell Mol Anesth. 2024 December; 9(4): e154384 https://doi.org/10.5812/jcma-154384

Published Online: 2024 October 28 **Letter**

Biosensors Are a Vital Tool in the Optimization of Anesthesia

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Received: 10 September, 2024; **Revised:** 25 September, 2024; **Accepted:** 29 September, 2024

Keywords: Biosensors, DNA Biosensors, General Anesthesia (GA)

Dear Editor,

Biosensors are biological analyzers used to detect molecules and identify electrical and biological pathways. Initially, they should provide rapid, continuous, and reagent-free responses, followed by effective action. Biosensors are highly versatile interdisciplinary tools, not confined to a single field of application. The concept of biosensors has been defined and developed in various ways by different researchers. Some consider biosensors as independent sensing systems capable of providing specific biological responses to particular types or concentrations of chemicals. In this concept, the initial signal from physical or chemical agents is detected by the first layer and transferred to subsequent layers. The second signal is typically an electrical signal and can be converted into various types of electrochemical, thermal, optical, or mass-related responses. Biosensors have extensive applications across numerous medical procedures (Figure 1) (1).

The design of biosensors typically involves a data storage platform developed with software and a controller module connected to a computer. In recent years, biosensors have been applied in infusion anesthesia systems that utilize the pharmacodynamics and pharmacokinetics of drugs to maintain optimal anesthetic concentrations in plasma (2). Additionally, algorithms developed with biosensor technology enable the selection of the optimal drug concentration based on the drug's half-life and bioactive properties, significantly contributing to achieving the desired depth of anesthesia while monitoring blood and plasma concentrations (3).

Historically, anesthesiologists faced challenges in determining the exact level of propofol in the body, necessitating a standardized system for monitoring drug levels. Recently, a measuring catheter system has been designed with advanced hardware and software architecture that facilitates accurate, real-time measurement of propofol concentrations in the blood by integrating laboratory data analysis and electrochemical quantification of propofol. These intelligent systems offer the ability to package and deliver medicinal compounds independently, ensuring optimal propofol levels.

One of the most compelling areas of research in smart electrochemical systems is the study of drug and DNA interactions (4). Recent advancements in intelligent systems allow for in-depth examination of the mechanisms, interactions, and pathways of medicinal molecules through electrochemical studies. DNA biosensors, also known as gene sensors, detect target DNA by forming target sequences through hybrid probe formation (5). These gene sensors consist of single-stranded DNA (ssDNA). Another application of DNA hybrid biosensors includes detecting infectious agents in various environments (6). Recently, carbon paste electrodes (CPEs), made from a mix of conductive graphite powder and pasting liquid, have been used to create genosensors. Carbon paste electrodes are selected due to their ease of preparation, low cost, and non-toxic properties (7). Studies using carbon paste electrodes as information conversion systems have been successful in identifying the electrostatic interactions between ketamine and DNA, as well as determining the relationship between ketamine/dsDNA and groove binding interaction (4).

Thus, it is evident that the development of biosensors can reveal the status of anesthetic drugs during and after procedures, assisting anesthesiologists in determining dosages and methods of drug

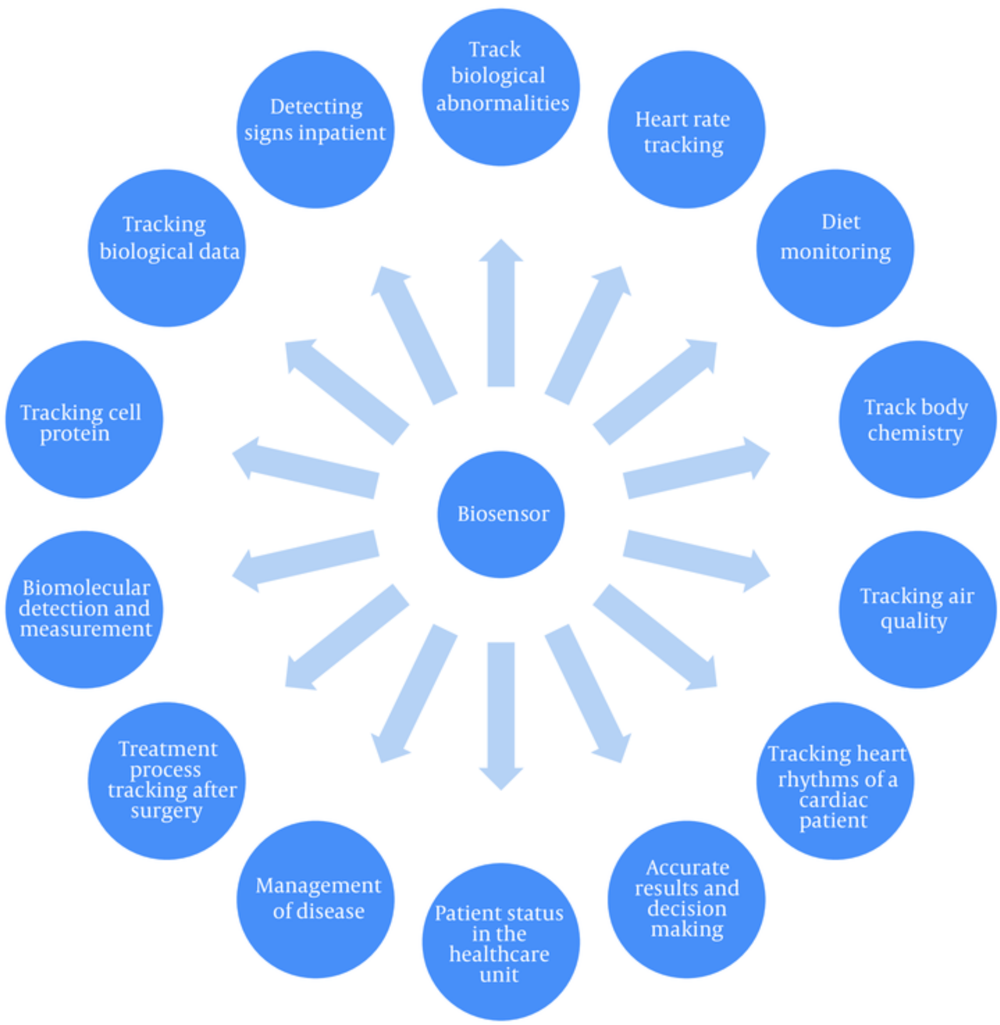

Figure 1. Use of biosensors in medicine

administration. This capability is essential for predicting potential risks and implementing preventive measures. It is recommended that researchers and anesthesiologists focus on the design and application of biosensors across various functional areas in anesthesia. Developing or inventing methods based on biological index detectors that deliver rapid, real-time results presents an exciting opportunity in the field.

Footnotes

Authors' Contribution: M. D.: Writing; M. V.: Review.

Conflict of Interests Statement: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding/Support: The authors declare there is no funding support was included in the study.

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