THE USE OF BIOSENSORS IN CLINICAL LABORATORY

Essay

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BY

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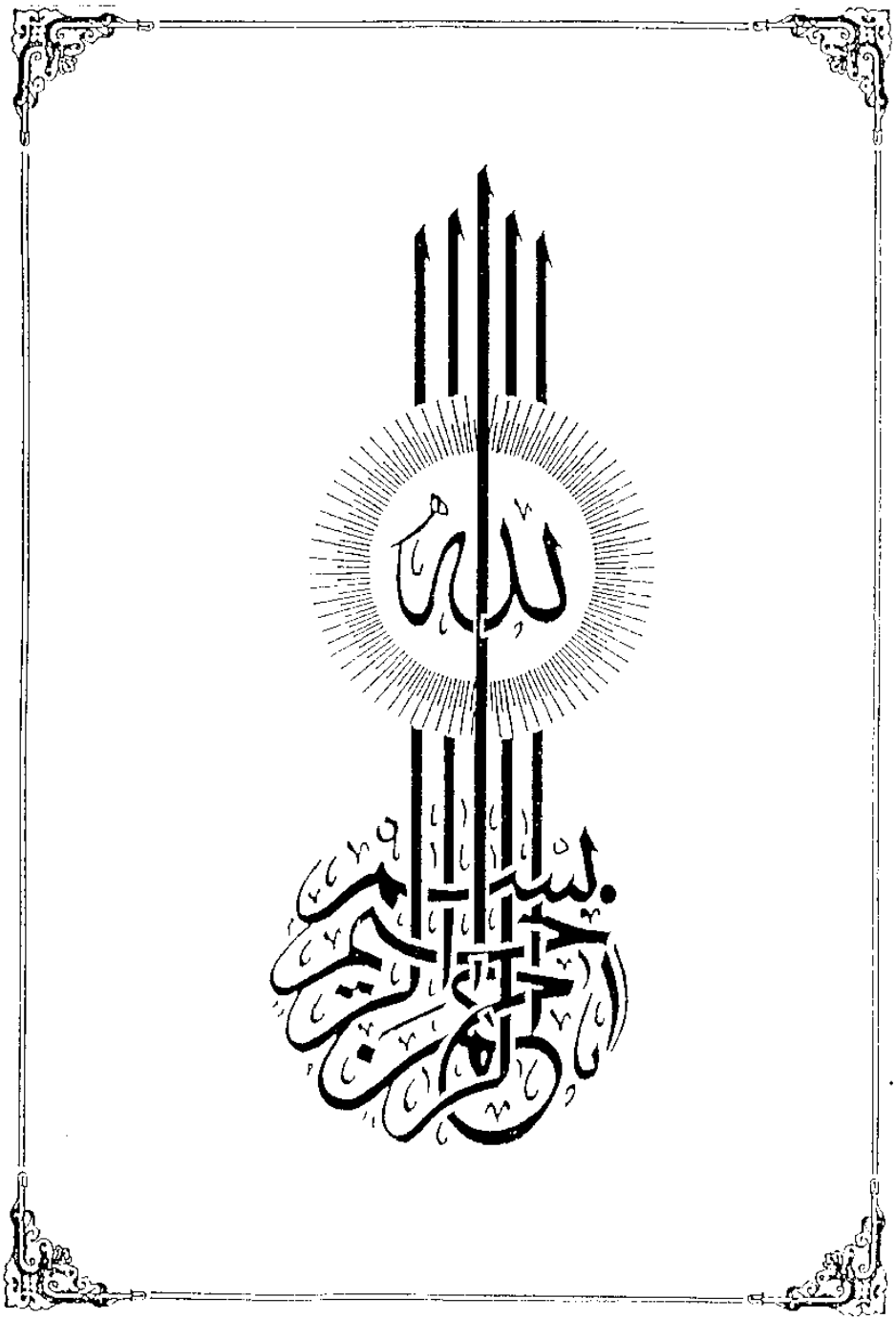

INTRODUCTION

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The living human is a dynamic system with a multiplicity of finely tuned homeostatic mechanisms , some of which are perturbed in disease. These often predictable variations from the normal condition Caused by the specific pathologic processes are used by physicians for diagnostic purposes (**De, Young , 1983**) .

At the present time , with few exceptions , biochemical parameters in humans can only be measured in laboratory from discrete speciemens . The results of such analysis represent only a point source or window on the often rapidly changing biochemical microenviroment (**Hunter, 1987**) .

Our inability , to continously monitor critical biochemical parameters in the living human, has prevented acquisition of a wealth of additional analytic information about the rate of change of a particular substance in blood . It is generally appreciated that the frequent measurment of biochemical parameters such as blood cations , gases and metabolites is an essential prerequisite for the delivery of patient care (**Lowe , 1987**) .

The need for rapid analyte test results in the emergency room & even on the wards is not met by many of the presently available laboratory Procedures . The Capital cost of instrumentation , personel ,time consumpation , nature of sample collection and data reporting contribute to high cost of many laboratory tests (**Thompson & Krull, 1984**) .

Laboratory tests are performed by variety of techniques , some are rapid & simple but most require complex instrumentation & highly trained technologists & therefore have low through out . These problems have prompted the search for new techniques that provide more rapid , convenient & yet equally accurate & precise quantitive analytic results **(Hunter, 1989)** .

In recent years clinical laboratory instrumentation has achieved a high degree of sophistication with the ability to process hundered of samples routinely in a day . In addition , new technology is evolving that has the potential of improving patient managment while substentially reducing the overall cost of health care (**Hunter, 1989**) .

This new technology is biosensors . The major impetus for development of biosensors has undoubtly come from rapid advances in health care technology .

A Biosensor is a microelectronic device that recognizes an analyte in an appropriate sample & interprets its concentration as an electrical signal , via a suitable combination of biological recognition systems & an electrochemical transducer (**Lowe et al., 1990**) .

Atransducer turns one form of energy into another , at present there is no strict definition of a biosensor , It may be defined as a sensor incorporating biological mioety such as an enzyme , an antibody or a whole cell for determining the concentration of a specific analyte in tissue or body fluids (**Pickup , 1989**) .

However , this definition is considered to be too narrow since it would exclude ion selective electrodes polographic oxygen electrode and dye based fibre optic sensors . Biosensors should be defined as any device that can measure the concentration of a specific substance (ion , element or compound) without the need for the addition of reagents . (**Pickup , 1985**).

Thus cheap and reliable in vitro sensors are required for monitoring key metabolities in the ward , surgery , home out patients & laboratory samples derived from tissue fluids as sweat , saliva & urine . (**Lowe , 1985**) .

From the clinical point of view biosensors are needed for two reasons:

First : for continous in vivo monitoring of certain substances whose concentration can change so actually & frequently , as its in vitro analysis would be inadequate to follow its time course . **(Claremont , 1987)** .

Secondly : for rapid , simple & cheap in vitro analysis of discrete samples by relatively unskilled persons ie (an untrained analyst) at the patients bed side or in the general practioners surgery providing instant data to aid diagnosis . **(Claremont , 1987)** .

Biosensors will form the basis of simple cheap devices for acquiring chemical information & bringing the sophosticated analytical capabilities to the non specialist & general public alike **(Regnault & Picciolo , 1987)** .

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A Comprehensive review of a new device , used in measurment of different analytes & body fluids known as Biosensors . Its general structure , different modes of action and applications will be discussed .

PRINCIPLE & ELEMENTS OF A BIOSENSOR

Principle and Elements of a Biosensor

Principle of a Biosensor :

In general , a biosensor must possess the following minimum characteristics :-

1- A means of introducing the test matrix e.g (urine serum , cerebrospinal fluid) to microenviroment of sensor surface .

2- A biological detector molecule (e.g antibody , enzyme receptor protien) with binding affinity for a particular target substance in the matrix .

3- A transduction mechanism that reliably generates an electrical signal upon interaction of the biological detector molecule & the target substance .

4- Appropriate amplification processing & Storage of the generated signal data .

5- A means of data output (e.g digital display) (**Lowe , 1989**) .

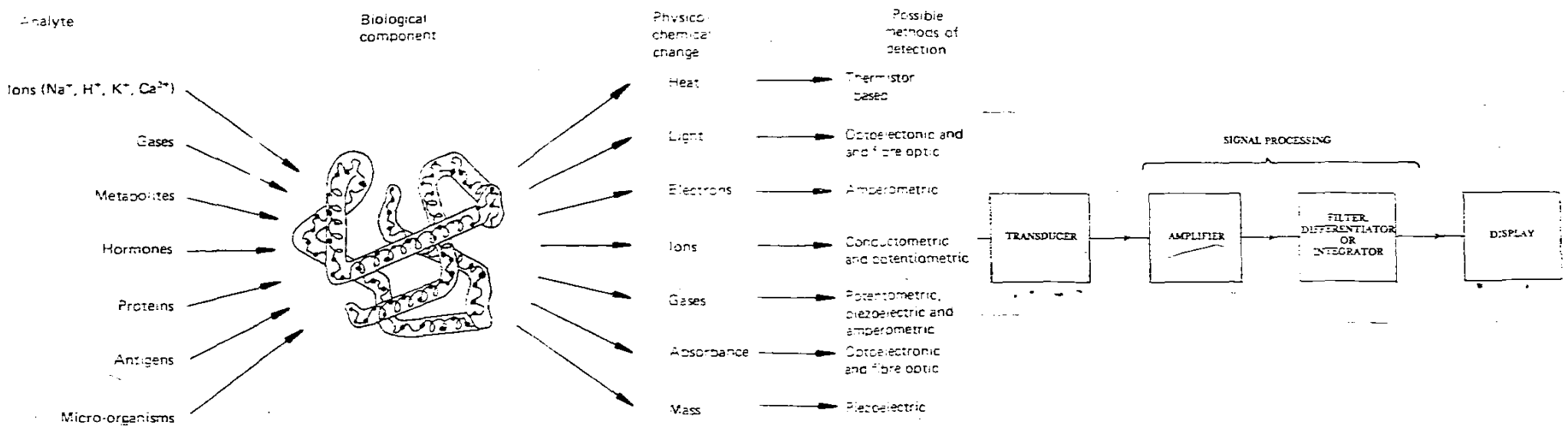

Fig. 1 :

Schematises the general principle of a Biosensor and the importance of producing the biological signal in close proximity to a transducer which converts it into an electrical signal

(Lowe ,1989)

The Elements That Comprise a Biosensor are :-

I. The analyte :

The material to be assayed .

II. Selective Receptor :

Could be an enzyme such as glucose oxidase in glucose sensor . An antibody for immunosensor or a selective membrane for an ion selective electrode .

III.Transducer :

Transforms one form of energy into another .

IV. Processor :

Play a role in appropriate amplification , processing & storage of the generated signal data .

V. Display :

A means of data Output e.g digital display . **(Newman et al., 1986) .**

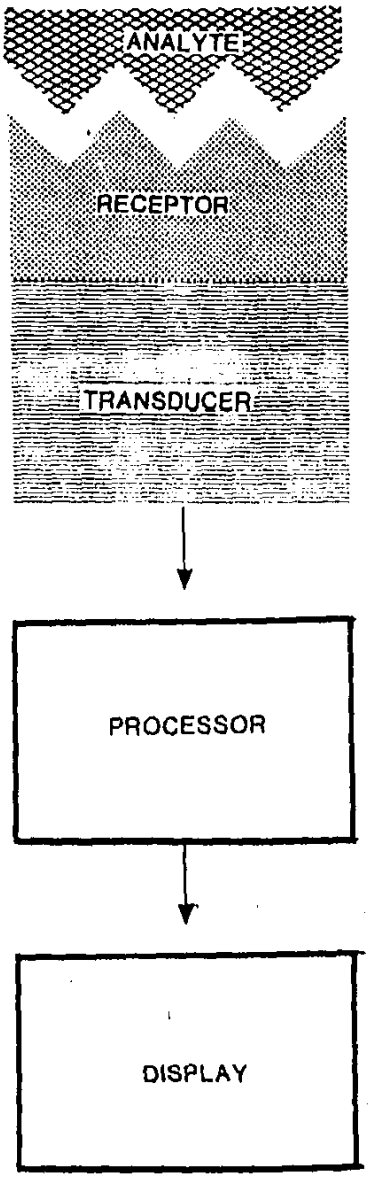

Fig. 2 :

Digramatic Representation of a Biosensor Showing its Components.
(Claremont, 1987)

PRINCIPLE AND ELEMENTS OF A BIOSENSOR