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Oxygen Glucose and Heart rate Monitor: An non Invasive approach

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ABSTRACT

The parameters such as Heart rate, Oxygen in blood and Glucose are few among the vitals that has to be monitored for patients on requirement. There are cases like during a surgery or Post operative progress when these vitals should be monitored continuously to ensure the coping of the patient. There are medical procedures that produce accurate results, but the only disadvantage is that they are invasive thereby comes with a pain factor. This non invasive method is based on the working principle of pulse oximeter and combining the principle of glucose meter called the OGH monitor that computes oxygen saturation, glucose and heart beat of an individual without actually depending upon the parameters such as blood samples, urine samples. This meter is based on the principle of differential absorption of light which is considered as the input parameter to produce three different parameters such as percentage of oxygen saturation, glucose and heart beat rate.

Keywords: Non invasive, heart rate, glucose, oxygen, differential absorption.

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INTRODUCTION

The OGH monitor uses two different wavelengths of light such as red light of wave length 660 nm and IR light of wavelength of 940 nm. The oxygenated hemoglobin cells and the deoxygenated hemoglobin absorbs light in a differential manner. The oxygenated hemoglobin cells absorbs more of IR light and less of red light whereas the deoxygenated hemoglobin cells absorbs more of red light and less of IR light.

Using this principle, the differential absorption of light is considered as the input parameter to produce three different parameters such as percentage of oxygen saturation, glucose and heart beat rate. A photo detector in the sensor perceives the non-absorbed light from the LEDs. Once these absorption levels are detected from the finger the ratio of absorption at different wavelengths can be obtained. The glucose is calibrated with deep analysis of the waveform developed by the absorption of light.

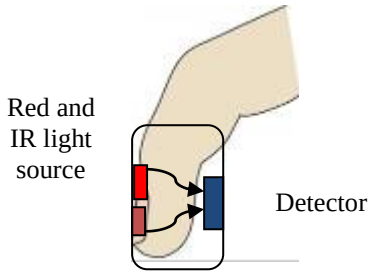

Fig 1: The red and infrared light being shone through the finger

METHODOLOGY

The working principle of the OGH monitor is based on BEER LAMBERT's law. This law states that the "light intensity will decrease logarithmically with the path length".

A bi-colored LED is used to produce two different wavelengths of light namely red light and IR light which is of 660nm and 900 nm wavelength of lights. The light radiations are produced alternatively according to a specific time period. The radiations of light is controlled by the driving circuit which uses a crystal oscillator. The red and IR light are produced alternatively. The input radiations are detected by the photo detector after passing through the finger tip which would have hemoglobin and de-oxy hemoglobin cells. The amount of radiations that are not absorbed are realized by the detector.

The light radiations would then be converted to electric signals which would correspond to the display unit. The electric signals are then sent to a multiplexer where two inputs are present and then a single parameter is received as the output. The analog signals are then converted to digital signals which is then represented as three different outputs.

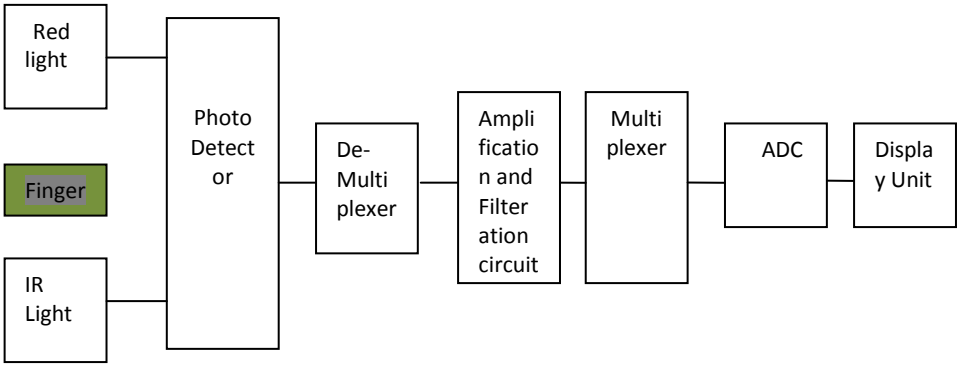

Fig 2: A schematic diagram of a OGH monitor

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GENERAL STUDY OF VARIOUS PARAMETERS:

Oxygen saturation is a term referring to the concentration of Oxygen in the blood. The human body requires and regulates a very precise and specific balance of oxygen in the blood. With 90-99% marked as a Normal Oxygen Saturation. Heart rate refers to the number of heartbeats per unit of time. The heart rate is typically expressed as beats per minute (bpm). A blood sugar test is a simple procedure that measures the amount of glucose in the blood. It is performed by obtaining a small sample of blood and analyzing it. Blood can be obtained from a vein puncture or through a finger stick.

OBSERVATION OF PATIENTS

Each patient had to wear two probes from the OGH monitor and the probe from the pulse oximeter in their left hand. The probe from the OGH monitor was connected to the ring finger and the probe form the oximeter was connected to the fore finger. The readings of oxygen saturation and the heart beat rate readings were noted. Later the blood sample was tested using a one touch glucometer (invasive) giving instantaneous values.

S NO	PATIENT'S NAME	GENDER	AGE	PULSE OGH/(Conventional)	SPO_2 OGH/(Conventional)	GLUCOSE OGH/(Conventional)
1	Ramadevi	F	32	76 (72)bpm	98%(95%)	85gm/dl (97gm/dl)
2	Vasudevan	M	24	89(87) bpm	98%(94%)	176gm/dl (185gm/dl)
3	Parimala	F	45	99(89) bpm	93%(94%)	103gm/dl (115gm/dl)
4	Kottiswaran	M	31	109(114) bpm	96%(90%)	154gm/dl (179 gm/dl)
5	Ganesh	M	28	74(69) bpm	96%(91%)	111gm/dl (116gm/dl)
6	Varalakshmi	F	39	109(111) bpm	98%(94%)	138gm/dl (152gm/dl)
7	Senthil	M	26	76(72) bpm	96%(92%)	126gm/dl (141gm/dl)
8	Subash	M	21	78(76) bpm	98%(94%)	109gm/dl (112gm/dl)
9	Gajendran	M	56	112(120) bpm	98%(94%)	217gm/dl (240gm/dl)
10	Govindan	M	60	68(70) bpm	98%(95%)	118gm/dl (120gm/dl)

Table 1: Observation using OGH monitor

After a comparative study from both the tables we can find that there are minimal percentage of variations in the values of parameters.

ANALYSIS OF DATA

The graphical representations shows the comparison of the graph using the observations from the conventional method (invasive- accurate) and the observations from the OGH monitor.

Graphical Comparison of OGH meter and Conventional method

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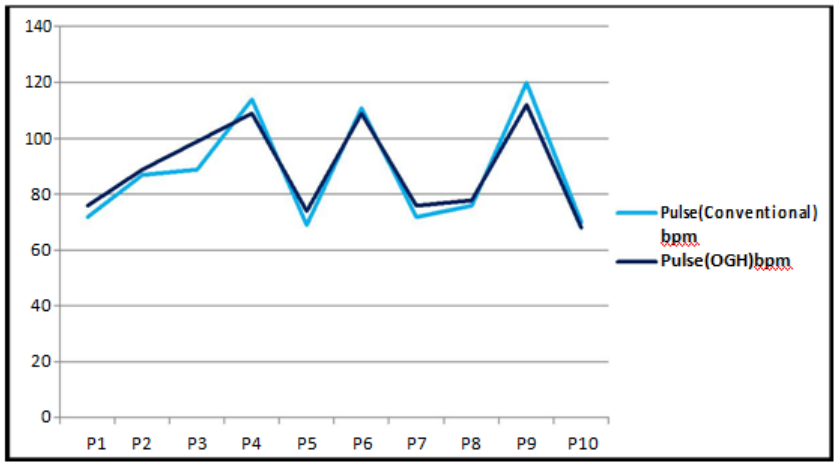

Fig 3: Graphical representation (pulse)

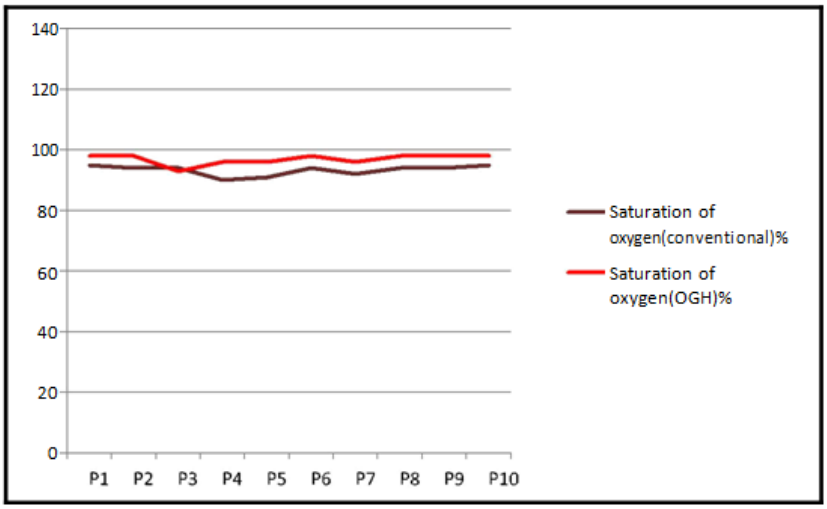

Fig 4: Graphical representation (oxygen saturation)

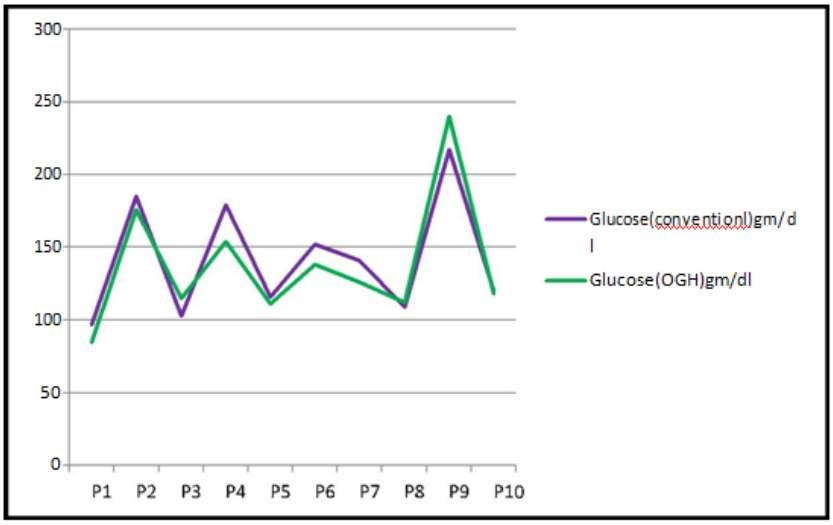

Fig 5: Graphical representation (Glucose)

From the above graph it is seen that the graph represented using the readings of the OGH monitor do show a slight variations from the readings of the conventional method. Thereby this non invasive technique

could be apt for measuring the pulse rate.

Error Percentages

The OGH monitor is subject to error depending on installation conditions. The sensor is prone to noise pick-ups, if over exposed to light. The error percentages are calculated and presented as follows.

Parameters	Error Percentages
Oxygen Saturation	3.565 %
Glucose	4.629 %
Heart Rate	1.862 %

The error percentages are calculated with reference to the 10 patients under study. This value is likely to vary with the sample size. After detailed analysis of the variation of data and an effective calibration should be necessary to bring down the error percentages considerably.

CONCLUSION

Overall, the OGH monitor can be described as a non-invasive biomedical instrument which depends on the absorption of red and IR frequencies, by oxy-hemoglobin and de oxy-hemoglobin cells. The OGH monitor is designed to receive the input of arterial flow of blood through a finger tip for which a finger probe is used. For the accuracy of the OGH monitor we conducted tests for a random number of 10 patients using a conventional and the non-invasive OGH monitor.

The measured parameters from the OGH monitor closely corresponds to the values of the conventional methods, with minimal variations.

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