Design and Development of Non Invasive Technique for Diagnosis of Thyroid Disorders.

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***Abstract**: Functional abnormality of Thyroid as a common day today problem in clinical practices. Laser based light absorption techniques and process used to create detection of thyroid diseases for clinical purposes. Laser plays a vital role in diagnosis status based on the reflectance [5] of skin surface. Presently blood test is being done to find out the presence of thyroid hormones and confirming the presence of two main thyroidism. The aim of this work is to classify thyroid status; Thyroid status is manifest in skin from the skin reflectance of the laser diode emission. From these reflectance's thyroid is classified into Hyper and Hypothyroidism. Hence patients are benefited by providing detection and classification of thyroid diseases prior to invasive lab test by puncturing the vein and collecting blood. As laser based technique has advantages of being non-invasive and low cost in comparison to other diagnostic methods and it can be performed in a normal environment without any restriction. It is an idle tool for mass screening to asses' thyroid status; this hypothesis was put forward by one of the authors namely K J.*

INTRODUCTION

Thyroid disease is due to the production abnormality of thyroid hormones. Two major types of thyroidism are Hyperthyroidism (over production) and Hypothyroidism (low production). The incident of Hypo thyroidism in the age group of 31-60yrs is 76.6%. the ratio of Female: male is 1:10. Hyperthyroidism is nearly 10 times more frequent in women than in men. The thyroid gland is located in the lower front part of the neck. It produces thyroid hormones that regulate the body's metabolism. It also plays a role in bone growth and development of the brain and nervous system in children. The pituitary gland controls the production of thyroid hormones. Thyroid hormones also help to maintain normal blood, regulation of heart rate, digestion, muscle tone, and reproductive functions. The controlling mechanism of endocrine system is the hypothalamus, pituitary, thyroid axis. The endocrine system is regulated by feedback in much the same way that a thermostat regulates the temperature in a room. For the hormones that are regulated by the pituitary gland, a signal is sent from the hypothalamus to the pituitary gland in the form of a "releasing hormone", which stimulates the pituitary to secrete a "stimulating hormone" into the circulation. The stimulating hormone signals the target gland to secrete hormones. As the level of this hormone rises in the circulation, the hypothalamus and the pituitary gland shut down secretion of the releasing hormone and the stimulating hormone, which in turn slows the secretion by the target gland, this sytem results in stable blood concentrations of the hormones that are regulated by the pituitary gland. Hypothyroid state is also known as Myxedema. Hyperthyroid is also known as Grave's disease and Normal/treated thyroid status is called as Euthyroid.

OVERVIEW OF THYROID

The thyroid gland is located in the lower part of the neck, below the Adam's apple, wrapped around the trachea (windpipe). It has the shape of a butterfly two wings (lobes) attached to one another by a middle part. The thyroid secretes the thyroid hormones as thyroxin (T_4) a tri-iodo-thyronine (T_3) . These hormones regulate the rate of metabolism [4] affect the growth and rate of function of many other systems in the body. The thyroid gland is controlled by the hypothalamus and pituitary gland. Hyperthyroidism can cause nervous, irritability, increased perspiration, intolerance to heat, fatigue, difficulty in sleeping, a fast heartbeat, irregular menstrual periods in girls, and muscle wasting weakness. People with hypoactive thyroids might feel depressed and sluggish lethargic and Myxedema. Teens with hypothyroidism also might have slow growth in height, slow sexual development and irregular menstrual periods in girls, muscle weakness, dry hair, poor memory, and difficulty in concentration. Thyroid stimulating hormone (TSH) promotes the growth of the thyroid gland in the neck and stimulates it to produce more thyroxin, when there is an excessive amount of thyroid hormones, the pituitary gland stops producing TSH, where by reducing thyroid hormone production. This mechanism maintains a relatively constant level of thyroid hormones circulating in the blood.

NEED FOR THE PROPOSED WORK

Classification of thyroid status involves laser based light absorption technique in a non invasive manner. Non invasive method of thyroid classification involves emission and reflectance of light. Most of this detection work is based on light absorption. Generally, Emission of light involves reflection, absorbance and scattering on the surfaces. Observation of light absorbance by the receiver from the emitted light classifies the hypo, eu & hyperthyroidism. The characteristics of the thyroidism. The characteristics of the thyroidism and its symptoms were important features of the skin surfaces which are highly evaluated and had been differentiated.

MATERIAL AND METHODS

This prospective study was carried out in 95 patients between the age of 5-75 years in the department of endocrine and out patients list in MMC & GH and KJH respectively from January to May 2010. The thyroid diseases were classified into Hyperthyroid, Eu thyroid and Hypothyroid. The Hyperthyroid age ranged from 35-42 years. All patients were carefully assessed as regards history, general condition, systemic examination and conventional thyroidism evaluation was done. Preliminary assessments were performed at KJH, Egmore with the patient's informed consent. Those unwilling patients, Diabetics and Uraemic patients were excluded from the study. The patients were divided into 3 groups. In group I, Hypo patients of 20 were selected. In group II nearly 25 hyper patients were selected and in group III 30 Eu thyroid patients were selected.

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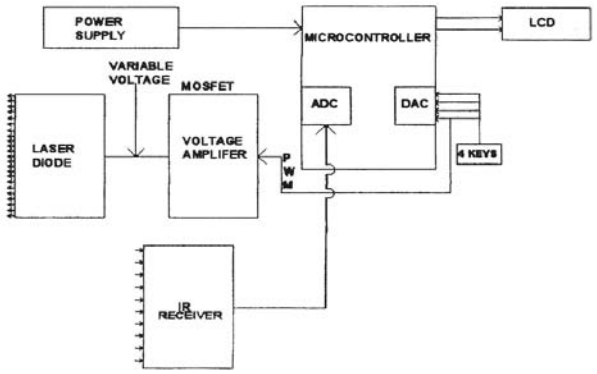
In each group, patients were investigated as BMI, age; T3, T4, TSH and results are tabulated. In our work it was identified by the skin surface reflectance [5] of the emitted laser diode. Laser Diode and six photo diodes were arranged in the cuff, in order to prevent the escape of the reflected radiation. Depending on the characteristics of skin and tissue around the absorption and reflection vary.

In our functional block diagram in figure A the characteristics of each block is well known labeled and its operation is performed by the PIC microcontroller for the analog and digital conversions for our input and output data transmission. The output is displayed by the Liquid crystal Display under programming of the microcontroller. Laser diode is used to emit the light and the reflected light absorption is detected by the infrared detectors, its particular value is displayed in LCD based on the count value the classification is done.



PlateA. Functional Block Diagram

Detected outputs were classified as Hyper/EU/Hyper thyroid's [2]. The entire setup was tried at room temperature. The cuff with the laser diode and detectors fixed on the distal, anterior aspect of the foreman. The reading is measured within 2 seconds.

The emitted light from the laser was incident on the skin, their may be absorbance, reflectance and scattering due to blood connective tissues, epidermis and perilymph layer. The reflected light was captured by the detectors and their value is displayed in the LCD. Based on the displayed count is shown in plate B.

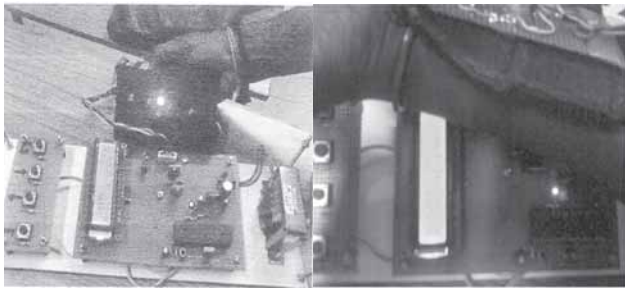


Plate B: Display of LCD

The entire setup was tried on normal/hypo/hype/persons as pilot study and the readings are tabulated. More than 75 subjects were taken and their counts are tabulated.

RESULTS AND DISCUSSIONS

The results acquired during the experimental setup are tabulated in table I for Eu Thyroid Subjects.

BMI-Weight/Height* Height

Table.1: *Subjects with EU Thyroidism*
SUBJECTS between 1001 to 1021 count

COUNT	AGE	T3	T4	TSH	BMI
	Yrs				Kg/m2
1019	31F	130	7.8	2.03	24.7
1018	28M	129	8.6	0.41	19.5
1014	39F	98	6.54	4.54	22.9
1020	29F	158	10.11	1.9	26.52
1014	33F	94	8.3	2.89	27.5
1014	25M	89	10.54	1.22	16.82
1020	33F	21	4.32	3.04	22.48
1020	31M	164	7.6	3.01	21.1
1015	29F	112	8.8	2.47	21.51
1017	30M	134	9.6	3.01	18.8
1016	44F	131	7.3	0.01	21.6
1017	50M	123	6.4	<0.01	19.8
1018	32F	132	7.8	3.2	24.5
1018	36M	6.6	1.99	<0.01	27.63
1017	34M	0.8	52	20	28.02
1018	39F	1.0	130	0.48	27.55
1020	35M	3.3	0.61	<0.01	21.32
1020	31M	148	4.79	2.89	27.3
1017	45F	113	10.3	0.05	36.5
1017	17F	116	5.4	0.32	28.89
1018	38M	125	9.6	0.78	32.11
1006	84M	108	7.37	0.79	26.24

Hypo Thyroid Subjects

Table. 2: *Subjects with Hypo thyroidism*
HYPO SUBJECTS ≤1000

COUNT	AGE	T3	T4	TSH	BMI
	Yrs				kg/m^2
1000	55F	156	7.4	24.3	29.6
999	18F	61	3.31	100	14.88
1000	30M	129.2	7.82	13.92	23.19
999	46M	130	5.9	13.37	25.59
1000	45F	120	7.6	24.5	36.1
999	33M	122	7.2	44.6	31.56
999	25M	153.9	10.2	89.4	25.33
1000	17F	142.3	9.8	18.4	28.76
1000	35F	148.3	8.3	22.7	40.7
1000	28F	165	8.2	26.5	30.2
999	23F	167	4.2	101	43.2
1000	65M	112	8.3	76	32.1
999	66M	139	7.5	15.63	34.3
1000	45M	123	9.8	29.1	52.3
999	33F	156.8	8.8	46.7	43.2
1000	76M	166.1	9.9	91.2	57.3
1000	22F	163.2	8.8	22.4	33.7
1000	36M	159.3	7.6	23.6	42.8

In the table I and fig I represents the displayed outputs in terms of count for the hypo patients during the work.

When TSH value increases and the count decreases. It is 1000 and less.

X Axis: TSH datas & Y Axis: output count values

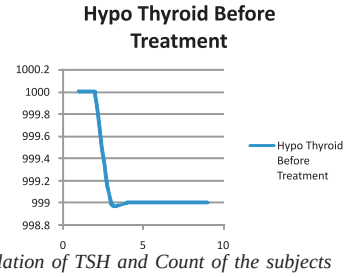


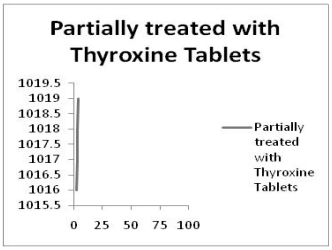
Fig 1: Correlation of TSH and Count of the subjects

Table. 3 Hypo Subjects On Treatment

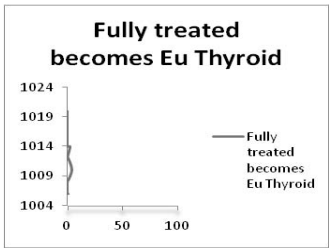
SUBJECTS COUNT	Partially corrected (Thyroxine) COUNT	Fully corrected (Thyroxine) COUNT
999	1019	1012
1000	1018	1006
1000	1017	1014
1000	1016	1020
1000	1016	1010
1000	1019	1014
999	1018	1014
999	1019	1006
999	1017	1008
1000	1018	1017
999	1016	1012

The tabular column represents the patient status on treatment with drugs thyroxine becomes Eu thyroid.
X Axis: TSH datas & Y Axis: output values

Fig 2 & 3 represents the flow for the patients on treatments by the Thyroxine drugs.
X Axis: TSH datas & Y Axis: output count values



X Axis:TSH datas; Y Axis:output count values
Fig. 2: Correlation of TSH and Count of the Subjects



X Axis:TSH datas; Y Axis:output count values
Fig. 3: Correlation of TSH and Count of the Subjects(reached margin level)

HYPER THYROID SUBJECTS

Table.4 Subjects with Hyper thyroidism
SUBJECTS>=1022

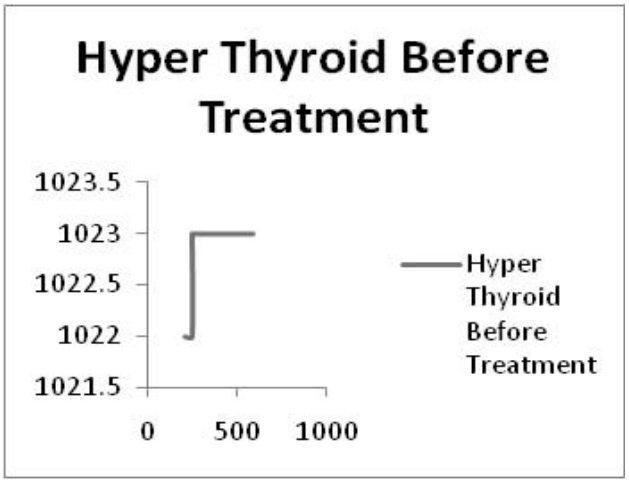
Table.4 Subjects with Hyper thyroidism SUBJECTS>=1022

COUNT	AGE T3 yrs	T3	T4	TSH	BMI kg/m^2
1023	46f	590	>24	0.01	21.63
1023	36f	10	4.2	0.04	20.78
1022	32M	18	4.35	<0.01	25.9
1022	34m	0.3	3.2	7.8	18.03
1023	35F	15	1	<0.01	27.23
1023	41F	444	8.9	<0.01	21.46
1023	55F	256	27.7	<0.01	27.3
1023	53F	489	>24	0.01	31.63
1023	42M	12	3.2	0.04	21.78
1022	35M	27	4.25	<0.01	26.9
1022	37M	2.3	2.2	7.5	23.03
1023	39F	4.5	1.8	<0.01	28.23
1023	48F	421	7.9	<0.01	27.46
1023	59F	352	6.7	<0.01	28.3
1023	42F	610	>22	0.01	29.63
1023	37M	9.9	5.2	0.04	28.78
1022	38M	21	4.23	<0.01	24.9
1022	31M	0.7	3.32	8.2	19.03
1023	25F	18	1.8	<0.01	26.23
1023	31F	433	7.9	<0.01	22.46
1023	59F	356	28.7	<0.01	28.3

When there is increase in the T3/T4 value the response is increases in the observing count value. In the table.4 lab values and the output were displayed in terms of count for the hyper patients during the work.

X Axis: T3/T4 datas & Y Axis: output count values

In the table 4 and fig 4 represents the displayed outputs in terms of count for the hyper patients during the work



X Axis:T3/T4 datas ; Y Axis:output count values
Fig. 4: Correlation of T3/T4 and Count of the Subjects

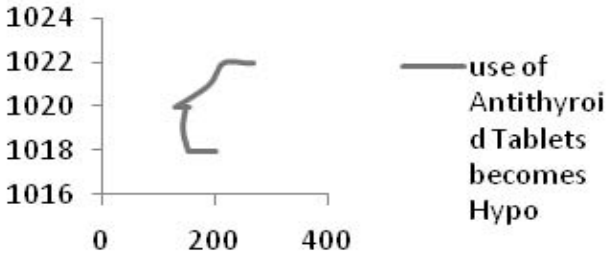
Fig 5 represents the count for the hyper patients after treatrment with Antithyroid tablets and the flow represents the patient conditions on treatment by the 6month were partially corrected .

Table. 5 Hyper Subjects On Treatment

Table.5: *Subjects with Hypo thyroidism HYPO SUBJECTS <=1000*

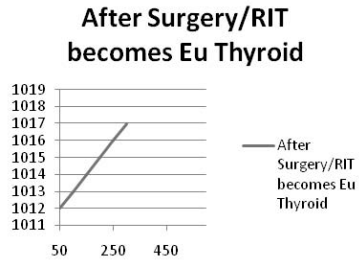
SUBJECTS COUNT	Partially corrected (Thyroxine) COUNT	Fully corrected (Thyroxine) COUNT
999	1019	1012
1000	1018	1006
1000	1017	1014
1000	1016	1020
1000	1016	1010
1000	1019	1014
999	1018	1014
999	1019	1006
999	1017	1008
1000	1018	1017
999	1016	1012

Use of Antithyroid Tablets causes Hypo



X Axis: T3/T4 datas & Y Axis: output count values
Fig.5: *Correlation of T3/T4 and subjects Count*

Fig 5 represents the flow for the hyper patients after treatment with Antithyroid drugs



X Axis: T3/T4 datas & Y Axis: output count values
Fig.6: Correlation of T3/T4 and Count of the Subjects (reached margin level)

Fig 6 represents the count flow for the hyper patients on treatment with thyroxine after Thyroidectomy and Radio ablation Therapy (RAT) becomes Eu Thyroid.

CONCLUSION

Based on complexion we have undertaken readings to find out whether the pigment status, alters the reflectance value. The parameters age, sex, BMI and complexion has got no role in reflection of the laser photo emission. But the TSH, T3 and T4values have a direct reflection on the values.

ACKNOWLEDGEMENT

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A Milestone in The Service of The Community by The Rotary Club of Delhi Chanakyapuri (RI District 3010)

In the year 1978, I was given the charge of the Physically Handicapped Committee of Rotary Club of Delhi Chanakyapuri as its Chairman by the then President of the Club, Rtn. Raj Khullar. I comprehended that the term Physically Handicapped embraces a very vast array of challenging conditions like visual, hearing, mobility etc., and therefore it would have been a futile attempt to address all of them. Therefore, it occurred to me that a dreaded disease called Poliomyelitis was causing havoc to infants and children in Delhi resulting in large number of deaths and permanent paralytic disorders of the limbs in the surviving children. Although, there is, even to date, no medical cure available for this awful condition, an excellent oral vaccine had been invented in Russia which offers total immunity from the disease. As a doctor, the dictum 'Prevention is better than the Cure', is always in the forefront of the mind. Thus I approached the then largest children's hospital in Delhi, the 'Kalawati Saran Children's Hospital' and I was told that the Institution gets nearly 8,000 cases of Poliomyelitis every year from a nearby area in Pahargunj, New Delhi called Nabikarim. I proposed to offer the services on behalf of the Community Service Avenue of the Rotary Club of Delhi Chanakyapuri in vaccinating the infants and children in the above mentioned area which was the hotbed of poliomyelitis. This offer was immediately accepted by the authorities of the hospital who even provided some staff to help us conduct this marathon vaccination programme by going from door to door to motivate and vaccinate the infants and children. As is the case with all new drives, we met with resistance and suspicion. This did not deter us and we completed our job in 2–3 days.The result, a year later in 1979, the hospital reported only one case of Poliomyelitis from the same Nabikarim from where earlier thousands of cases used to come every year. On further enquiry we found that the affected baby's mother had hidden the infant from us when we came for administering the oral vaccine as she was apprehensive that it may cause some fatal side effects.

The Rotary International District 309 in 1980 recognised the efforts and awarded 'Outstanding Rotarian' award to me during the District Conference held at Srinagar, Kashmir in the year 1980. The Union Ministry of Health and Family Welfare also took cognizance of our efforts and appointed me the Honorary Advisor to the Ministry for their Polio Eradication Project for the year 1979–80. A point to highlight, if I may call it so, is that the Rotary Club of Delhi Chanakyapuri thought of and executed the Polio Eradication years before the Rotary International Conceived the Idea. No doubt our effort was in a mini scale but it was a small beginning. I take this opportunity to thank the authorities of the Kalawati Saran Children's Hospital for the assistance extended to us.

PP Rtn ***Dr. Sandip Mukerjee,*** *President (1985–86), Rotary Club of Delhi Chanakyapuri, RI District 3010.*