



**ORIGINAL RESEARCH PAPER**

**Ophthalmology**

**TEAR GLUCOSE IN DIABETICS**

**KEY WORDS:**

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**ABSTRACT**

**INTRODUCTION**

This study was evaluate the tear glucose estimation and relationship between tear and plasma glucose concentration and to evaluate the role of tear glucose as indicator of plasma glucose level.

**METHODOLOGY**

95 Patients were divided in 4groups. 30 patients on oral antidiabetics drugs,30 on inj. insulin , 5 uncontrolled diabetics and 30 in control group.The determination of glucose concentration was carried out in tear by an semiautoanalyser or in blood by autoanalyser- using glucose-oxidase peroxidase method

**RESULT**

Statistical analysis revealed that in the diabetics on oral antidiabeticdurgs, on inj. insulin and in the control group ,the magnitude of correlation between blood and tears glucose values is statically significant (i.e.P<0.05)

**CONCLUSION**

Tear glucose estimation is a simple and more efficacious method for detection of diabetes . it is simple screening procedure for diabetes mellitus and rapid indirect measurement of hyperglycemia not only ophthalmologist but also for a physician

**INTRODUCTION**

Diabetes is an "iceberg" disease. According to recent estimates, the prevalence of diabetes mellitus has risen dramatically over the past two decades, from an estimated 30 million case in 1985 to 382 Million in 2013(1-7) Based on current trends International Diabetes Federation project that 592 million individual will have diabetes by year 2035.

Chronic hyperglycemia from whatever cause leads to number of complications- cardiovascular, renal, neurological, ocular and other such as intercurrent infection.

Mass screening programmes have used glucose measurements of fasting or postprandial sample. The fasting value alone was less reliable since true fasting cannot be assured. Therefore, 2 hour value after 75 mg oral glucose may be used either alone or with fasting value. This was invasive method and being little cumbersome, it required expertise in sampling of blood. Million of diabetes patients have to prick their finger for a drop of blood 4-5 time a day to check blood glucose level – Almost 1800 time annually this is strong need to have other noninvasive, easy and safe method and device for help patient to manage to disease easily & painlessly. One such method is tear glucose estimation and efforts were made to sort out the relationship between tear and plasma glucose concentration and to evaluate the role of tear glucose as indicator of plasma glucose level.

**MATERIALS AND METHODS**

The study was conducted in Department of Ophthalmolgy, GMC and group of Hospitals Kota.

**Study Subjects:** Classified as 4 groups

1. Uncontrolled diabetics are the newly diagnosed diabetic patients who have not yet started their treatment of diabetes. (5 cases)
2. Diabetic patients already on treatment in the form of oral antidiabetic drugs(30 case)
3. Diabetic patients already on treatment in the form of insulin therapy (30 cases)
4. Control group which included persons having no history of

diabetes nor any manifestations of diabetes (30 cases)

**Study Design:**Cross sectional study

**Sample Size:**95

**METHOD –** Venous blood was drawn just prior to measurement to tear glucose concentration. For measurement of tear glucose, the patient was asked to look up and the lower lid was gently drawn downward. The patient was asked not to blink for upto a minute or so. The stimulation was done by liquid ammonia. Reflex lacrimation was kept to a minimum by avoiding the induction of lacrimation by any method. The tears were collected from the temporal side of tear strip of right or left eye by means of a capillary tube. For collection of blood samples, venous blood was drawn into 2 ml disposable syringe after all aseptic precautions and then emptied into another vial. Glucose concentration in both tears and blood will be determined by an spectrophotometer/ semiautoanalyser/autoanalyser using glucose oxidase peroxidase method or GOD-POD method.

**PROCEDURE**

(i)Three test tubes will be taken and marked as blank (B) standard (S) and Test (T) and the solution were pipetted out into, the test tube as follows.

1. Pipette into 3 test tubes	Blank (ml)	Standard (STD)(ml)	Test (ml)
Working Reagent	1	1	1
Standard	-	.01	-
Sample	-	-	.01

- (ii) Mix well Incubate for 15 minutes at 37°C
- (iii) Read the O.D. (Optical density) of the Test and Standard against Blank at 500nM (480-520nM) or green filter.

**RESULTS**

$$\text{Glucose in mg/dl} = \frac{\text{O.D.Test}}{\text{O.D.STD}} \times 100$$

$$\text{Glucose in mg/dl} = \frac{\text{O.D.Test}}{\text{O.D.STD}} \times 5.55$$

**Table -1 DISTRUBUTION OF PATIENTS IN EACH GROUP ACCORDING TO SEX**

S. No.	Sex Distribution	Uncontr ol Group	Diabetes on oral antidiabetic drug	Diabetics on Inj. Insulin	Control Group
1	Male	3	20	14	15
2	Female	2	10	16	15

**Table -2 RELATIONSHIP BETWEEN BLOOD GLUCOSE AND TEAR GLUCOSE VALUES (FASTING AND POST PRANDIAL) IN UNCNTROLLED DIABETICS**

S. No.	Fasting Blood glucose (mg/dl)	Fasting Tear Glucose (mg/dl)	PP Blood Glucose (mg/dl)	PP Tear Glucose (mg/dl)
1	300	40	525	60
2	350	42	500	64
3	450	100	-	-
4	250	30	400	50
5	537	109	-	-

**Table -3**

**Table -3 RELATIONSHIP BETWEEN BLOOD AND TEAR GLUCOSE VALUES (FASTING AND PP )IN DIABETICS ON ORAL ANTIDIABETICS DRUG**

S. No.	Fasting Blood glucose (mg/dl)	Fasting Tear Glucose (mg/dl)	PP Blood Glucose (mg/dl)	PP Tear Glucose (mg/dl)
1	120	15	192	31
2	90	15	105	25
3	100	5	140	9
4	250	25	360	30
5	149	6	170	12
6	100	6	250	15
7	140	14	400	22
8	154	12	200	24
9	138	11	200	26
10	124	8	196	24
11	140	14	212	20
12	134	14	226	21
13	78	7	124	12
14	134	12	216	27
15	128	13	228	21
16	134	14	236	24
17	128	12	210	18
18	132	14	228	23
19	130	15	227	19
20	124	13	217	18
21	108	9	138	14
22	110	9	134	14
23	124	12	198	18
24	139	12	232	24
25	104	5	128	12
26	96	7	130	15
27	125	15	205	18
28	144	13	232	23
29	153	10	255	26
30	123	13	210	18

**Table -4 COMPARISON OF AVERAGE BLOOD AND TEAR GLUCOSE VALUES (FASTING AND PP )IN DIABETICS ON ORAL ANTIDIABETICS DRUG**

	Blood glucose (mg/dl)	Tear Glucose (mg/dl)
Fasting	128.43	11.66
Post Prandial	206.63	20.10

**Table -5 RELATIONSHIP BETWEEN BLOOD GLUCOSE AND TEAR GLUCOSE VALUES (FASTING AND POST PRANDIAL) IN DIABETICS**

DIABETICS ON INJECTION INSULIN				
S. No.	Fasting Blood glucose (mg/dl)	Fasting Tear Glucose (mg/dl)	PP Blood Glucose (mg/dl)	PP Tear Glucose (mg/dl)
1	75	5	135	7
2	140	18	300	32
3	84	3	124	10
4	180	19	324	25
5	120	5	280	18
6	138	16	244	30
7	125	8	213	11
8	82	4	118	6
9	130	9	185	13
10	146	13	313	27
11	138	14	241	37
12	131	13	235	34
13	94	8	140	19
14	101	9	134	18
15	112	11	210	24
16	138	14	222	31
17	94	7	188	20
18	141	12	232	34
19	120	11	214	28
20	128	11	217	28
21	123	11	210	27
22	125	13	220	28
23	122	10	213	27
24	108	9	134	14
25	100	4	130	14
26	97	9	126	19
27	133	13	254	28
28	124	11	223	21
29	114	10	201	20
30	127	12	234	24

**Table -6 COMPARISON OF AVERAGE BLOOD AND TEAR GLUCOSE VALUES (FASTING AND PP )IN DIABETICS ON INJECTION INSULIN**

	Blood glucose (mg/dl)	Tear Glucose (mg/dl)
Fasting	119.6	10.4
Post Prandial	207.6	22.4

**Table-7 RELATIONSHIP BETWEEN BLOOD GLUCOSE AND TEAR GLUCOSE VALUES (FASTING AND POST PRANDIAL) IN CONTROL**

Control group				
S. No.	Fasting Blood glucose (mg/dl)	Fasting Tear Glucose (mg/dl)	PP Blood Glucose (mg/dl)	PP Tear Glucose (mg/dl)
1	124	9	154	19
2	130	10	155	20

3	120	8	140	18
4	110	6	145	16
5	88	0	118	10
6	128	9	158	19
7	130	9	160	18
8	105	4	135	15
9	99	2	129	12
10	114	6	144	15
11	124	8	154	19
12	125	8	155	18
13	109	4	139	14
14	105	4	135	12
15	117	6	147	18
16	109	5	139	14
17	110	6	140	17
18	119	8	149	19
19	110	6	140	15
20	117	7	147	17
21	115	6	145	15
22	102	4	132	15
23	98	0	128	11
24	101	4	131	15
25	122	8	152	18
26	124	8	153	19
27	98	2	128	11
28	117	7	145	18
29	108	5	139	13
30	119	6	148	16

**Table -8 COMPARISON OF AVERAGE BLOOD AND TEAR GLUCOSE VALUES (FASTING AND PP) IN CONTROL GROUP**

	Blood glucose (mg/dl)	Tear Glucose (mg/dl)
Fasting	113.2	5.6
Post Prandial	142.6	15.4

**RESULT**

**STATISTICS: by Paired t test**

Compariosn Mean±SD of Blood and tear Glucose Values (Fasting And Post Prandial) in Diabetics On oral Antidiabetic Drug.

	Blood Glucose (mg/dl)	Tear Glucose
Fasting	128.43±29.95	11.66±4.08
Post Prandial	206.63±62.89	20.10±5.6
t value, df	9.14, 29	11.60,29
P Value	0.001*	0.001*

\*\*Paired t Test

Statistical analysis revealed that in the diabetics on oral antidiabetic drugs, the magnitude of correlation between blood and tears glucose values (fasting) is 0.708 and it is statically significant (i.e.P<0.05) magnitude of correlation between blood and tears glucose values (Postprandial) is 0.704and it is statically significant (i.e.P<0.05)

**Comparison of average blood and tear glucose value (Fasting and Post Prandial) in diabetics on Injection Insulin**

	Blood Glucose (mg/dl)	Tear Glucose (mg/dl)
Fasting	119.6±22.22	10.4±3.93
Post Prandial	207.6±57.28	22.4±8.30
t value, df	12.198	11.659
P Value	0.001	0.001

Statistical analysis revealed that in the diabetics on inj. insulin, the magnitude of correlation between blood and tears glucose values (fasting) is 0.877 and it is statically significant (i.e.P<0.05)

magnitude of correlation between blood and tears glucose values (Postprandial) is 0.801 and it is statically significant (i.e.P<0.05)

**Comparison of average blood and tear glucose values (Fasting and Post Prandial) in control Group**

	Blood Glucose (mg/dl)	Tear Glucose (mg/dl)
Fasting	113.2±10.68	5.83±2.6
Post Prandial	142.8±10.28	15.8±2.8
T Value, df	70.88	56.98
P value	0.001	0.001

Statistical analysis revealed that **in control group**, the magnitude of correlation between blood and tears glucose values (fasting) is 0.977 and it is statically significant (i.e.P<0.05) magnitude of correlation between blood and tears glucose values (Postprandial) is 0.939 and it is statically significant (i.e.P<0.05)

**In the uncontrolled diabetic group** - the magnitude of correlation and the test of significance i.e., P value could not be estimated because of inadequate number of sample and patients attending eye OPD

**Discussion and conclusion**

Patients were divided in 4groups. 30 patients on oral antidiabetics drugs,30 on inj. insulin , 5were uncontrolled diabetics and 30 were of the control group. The determination of glucose concentration in both tears and blood was carried out by an autoanalyser or semiautoanalyser using glucose –oxidase peroxidase method Statistical analysis revealed that in the diabetics on oral antidiabeticdurgs, on inj. insulin and in the control group ,the magnitude of correlation between blood and tears glucose values (both fasting and postprandial) is statically significant (i.e.P<0.05)

Tear glucose estimation is a simple and more efficacious method for detection of diabetes .The ready accessibility of tears and the simplicity of method offers a simple screening procedure for diabetes mellitus and rapid indirect measurement of hyperglycemia not only ophthalmologist but also for a physician as tear glucose concentration is reliable indicator of blood glucose concentration.

**BIBLIOGRAPHY**

1. International Diabetes Federation, 2013.
2. WHO (2011) Global status Report on Non-communicable Disease
3. Dannis L. Kasper, A.S. Facui, Stephen L.Hauser, Dan L. Lungo, J.Larry, Jameson JosephLscalzo. HARRISONS PRINCIPLE OF INTERNAL MEDICINE 19THedition, Volume2, Pg. 2399 pg. 2401 (2015).
4. Giardini. A and Roberts J.R.E.: Concentration of glucose and total chloride in tears, British. J. Ophthal.: 34: 737, 1950.
5. Lewis J.G. and Stephens P.J.; Tear Glucose in Diabetics, British.J. Ophthal: 42,754, Pg 754-758, 1958.
6. Antonio R. Gasset and Lewis E. Braverman, Tear Glucose Detection of Hyperglycemia , Am J. Ophthal, Vol 65, No. 3, Pg 414-419, March 1968.
7. Motoji K. The glucose content of tear fluid in normal and diabetic patient. Jpn J ClinOphthalmol. 1971;25:1945-1950.
8. Sen DK and Sarin GS, Tear Glucose levels in normal people and in diabetic patients, British. J. Ophthalmol, Sept 64 (9): 693-5, 1980.
9. Romano A and Rolant F, A noninvasive method of blood glucose evaluation by tear glucose measurement for detection and control of diabetic states, MetabPediatrSystOphthalmol, 11 (1-2): 78-80, 1988.
10. Gaur MS and Sharma GK, Tear glucose in uncontrolled and chemical diabetics, Ind. J. OphthalmolVol 30 No. 4:367-369, July 1982.
11. Daum KM and Hill RM, Human Tear Glucose, Invest Ophthalmol Vis Sci, April, 22(4): 509-14, 1982.
12. Daum KM and Hill RM, ActaOphthalmol (Copenh), Aug 62(4): 530-6, 1984.
13. Desai B.M. and Lavingi B.C. Corneal thickness and tear glucose level in diabetics and normal persons, Ind. J. Ophthal, 35(5-6): 130-2, 198
14. White KM and Benjamin WJ, Human basic tear fluid osmolality: Importance of sample collection strategy, ActaOphthalmol (Copenh) Aug, 71(4): 524-9, 1993.
15. Das BN and Sengupta S, J. Indian Med. Association Oct 94 (10): 391, 1996.
16. Chen R and Jin Z, Analysis of tear fluid by CE/ LIF : A noninvasive approach for glucose monitoring, J. Capillary Electrophor, Sept-Oct, 3(5): 243-8, 1996.
17. Malik BH, Cote GL. Modeling the corneal birefringence of the eye toward the development of polarimetric glucose sensor. J Biomed. Opt. 2010;15(3): 037012-8.
18. Alexeev VL, Das S. Finegold DN. Asher SA. Photonic crystal glucose sensing material for noninvasive monitoring of glucose in tear fluid. Clin Chem. 2004;50(12):2353-2360.