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Healthcare Laboratory

Patient's Name	: Mahendra Rai	Ref.No.	: HL-16484-21
Age/Sex	: 73 Years /Male	Reg. Date	: 26/01/2022 09:31
Referred by	: C/o. Dr At Doorstep	Collection. Time	: 26/01/2022

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Hb A1c - Fact file

Glycohaemoglobin is being used with increasing frequency to monitor long term blood glucose control and compliance in patient with diabetes mellitus. It provides an index of mean concentration of blood glucose (eAG - estimated average glucose) during the preceding two to three months. It complements more traditional measures of glucose control such as blood and urine glucose level.

The term " Glycohaemoglobin / Glycosylated haemoglobin / Hb A1c " refers to a series of minor haemoglobin components that are **stable adducts formed by haemoglobin with various sugars.** The reaction between haemoglobin and sugar is an example of a nonenzymatic condensation of glucose with free amino groups on the globin (NH2 terminal valine of B chain). The process is slow , continuous and irreversible.

Human erythrocytes are freely permeable to glucose , **Within each erythrocyte GHb is formed from haemoglobin at the rate which depends on the ambient concentration of glucose. Higher the prevailing ambient level of blood glucose , higher the GHb**

The level of Hb A1c at any point of time is contributed to by all circulating erythrocytes , from oldest (120 days) to the yongest RBCs. Hense Hb A1c is a **" weighted average " of glucose during the preciding three months** , mear preceding 30 days contributes substantiallly more to the level of Hb A1c than do glucose level 90 -120 days erlier..

There is very predictable relationship between Hb A1c and eAG (estimated average glucose / weighted average glucose).
A formula based on linear regression analysis sponsered by ADA , EASD , IDF is eAG (mg / dl) = (28.7 * Hb A1c) - 46.7 replacing the older one eAG (mg / dl) = (35.6*Hb A1c) - 77.3 recommended by DCCT .
Post lunch and bedtime glucose correlate well with Hb A1c (data of full 7 point glucose profile by capillary blood). Fasting glucose correlates less well and with increasing Hb A1c and average glucose (eAG) from 7 point profile , it underestimate both the values.

Any cause of shortened red cell survival will reduce exposure of red cells to glucose with consequent decrease in GHb values e.g. haemolytic anaemias like Hb S , Hb C Harlem , Hb E , Hb D . Chronic blood loss , Acute recent blood loss , etc.
A falsely low GHb test results are also be noted in c/o high Hb F samples . Thalassemia major , HPFH and othe conditions. (Hb F > 10 %) . Glycated Hb F is not detected by assay as it does not contain the glycated B chain that characterizes Hb A1c.

A falsely elevated GHb test results can be caused by " labile GHb " - an acutely generated reversible nonenzymatic linked glucose intermediary product present after heavy meal .
Few medical condition may cause falsely eleveted Hb A1c , like uremia , chronic excessive alcohol intake and hypertriglyceridemia.
Thalassemia minor causing imbalance between the synthesis or a and b chain causes falsely eleveted values.
Chronic iron deficiency anaemia in which there is an increased erythrocyte life span can raise GHb falsely.
Gestational diabetes may falsely increase or decrease Hb A1c
Studies even relate Hb A1c values with temperature / seasonal variation . Values are higher in cooler months and lower in warmer months (June - July).

IS SPECIFIC PATIENT PREPARATION IS NECESSORY ?

In any case , **no fasting sample is required at all . Avoid alcohol intake and heavy meal before the assay**
Hb A1c results are to be reported by clinical laboratories world wide in SI units (mmol / mol - no decimals) or derived NGSP units (% - one decimal). using IFCC - NGSP master equation,

An international expert committee that includes representatives from American Diabetes Association (ADA) , International

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Diabetes Federation (IDF) , and European Association for the Study of Diabetes (EASD) has **officially endorsed the Hb A1c as the Diagnostic test for the Diabetes . Cut off is >= 6.5**

WHY HB A1c IS CLINICALLY IMPORTANT

According to DCCT , a linear relationship is documented between the lowering Hb A1c / eAG and prevention of chronic complications . If Hb A1c is mainained at or about the upper level of normal , it can reduce app. 75 % retinal (eye) 60 % neuronal (nervous system) and 35 % renal (kidney) complications.

A reliable at-risk marker for assessing possible development of complications
An excellent mean to assess , encourage and reinforce individual patient compliance
An indicator for aditional diagnostic tests such as Urine Microalbumin
A meaningful Mean Blood Glucose (MBG) / estimated Average Glucose (eAG) relationship
An useful method to judge the efficacy and effectiveness of intervention strategies.

WHAT ARE THE ADA RECOMMENDATIONS TO PREVENT COMPLICATED DIABETES

* Perform the A1c test at least two times a year in patient who are meeting treatment goals and have stable glycemic control
* Perform the A1c test quarterly in patient whose therapy has changed or who are not meeting glycemic control.
* Use of point-of-care testing for A1c allow for timely decisions on therapy changes when needed.

GLYCEMIC GOAL IN ADULT BY ADA.

To reduce microvascular and neuropathic complications of type 1 and type 2 diabetic patients - **below or around 7 %**

REFERENCES (Data published by)

1. American Diabetic Association (ADA)
2. Internationa Diabetic Federation (IDF)
3. European Association for Study of Diabetes (EASD)
4. American Association of Clinical Endocrinologist
5. National Glycohaemoglobin Standardization Programme (NGSP)
6. Diabete Control and Complications Trial (DCCT)
7. A Journal of Disease metabolism

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Glycosylated Hb / Glycated Hb / Hb A1c

Method	Boronate affinity assay

Interpretation (% Glyco Hb)

> 8	Poor glycemic control
7 - 8	Fair glycemic control
6 - 6.9	Good glycemic control
< 6	Non-diabetic level / Near normal glycemia

Result	**5.9**
estimated Average Glucose (eAG)	**mg / dl**

Comment

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THYROID FUNCTION TESTS I

TESTS	RESULTS	UNITS	Biological Ref.Interval
S. TSH (THYROID STIMULATING HORMONE)	1.60	mcIU / ml	0.34 - 5.60

COMMENTS :

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SERUM HOMOCYSTEINE

METHOD CHEMILUMINESCENT IMMUNOASSAY

TEST	RESULT	UNIT	NORMAL
S. HOMOCYSTEINE	12.55	u mol / l	3.7 - 13.9

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LIPID PROFILE serum
APPEARANCE : Clear

TESTS	RESULTS	UNITS	BIOLOGICAL REF INTERVAL
CHOLESTEROL	158	mg / dl	< 200
TRIGLYCERIDES	74	mg / dl	< 200
HDL CHOLESTEROL (Direct)	54.4	mg / dl	45 - 85
Non HDL CHOLESTEROL	104	mg / dl	
LDL CHOLESTEROL	89	mg / dl	Less than 130
VLDL	15	mg / dl	upto 34
CHOL : HDL RATIO	2.9	%	2.5 - 4.5

NCEP RISK CLASSIFICATION

TESTS	DESIRABLE	MODERATE RISK	HIGH RISK
LDL CHOLESTEROL	< 130	130 - 160	> 160
HDL CHOLESTEROL	> 60	35 - 59	< 35
TOTAL CHOLESTEROL	< 200	200 - 239	> 240
CHOL / HDL RATIO	3.3 - 4.4	4.4 - 11	> 11
LDL / HDL RATIO	0.5 - 3.0	3.0 - 6.0	> 6.0
TRIGLYCERIDE	< 200	200 - 400	400 - 1000
APO A / APO B RATIO	> 1.2	-	< 1.3
APOLIPORPOTEIN (a)	< 30	-	>

Desirable levels	: Non-HDL cholestrol
Less than 100	Ideal for people at high cardiac risk
100 to 130	Ideal for people at low cardiac risk
130 to 159	Ideal - near ideal for healthy population
160 to 189	Mildly/borderline elevated
190 to 219	Intermediuate / moderately elevated
More than 200	Severly elevated / very high

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