

Edition 2024| English



**+** **TELEMEDICINE** **+**

*Can we all live up to 85 years in India?  
Not in 1950, but today in 2023. Yes, We can!!*

**Telemedicine To Live Up To 85 Years!**

**NEXT STEP LIVING LONGER BOOKS**

# HbA1c

A test for "sugar" / "Diabetes "  
A test with potential to add  
30 years to our life  
Can It! Yes , it can !!

Author:

(Prof.)Dr.S. Om Goel, MD/DM (USA)

From family of doctors

from AIIMS, MAMC & Delhi University

MD medicine, USA

DM/Fellowship, USA

**HbA1c**

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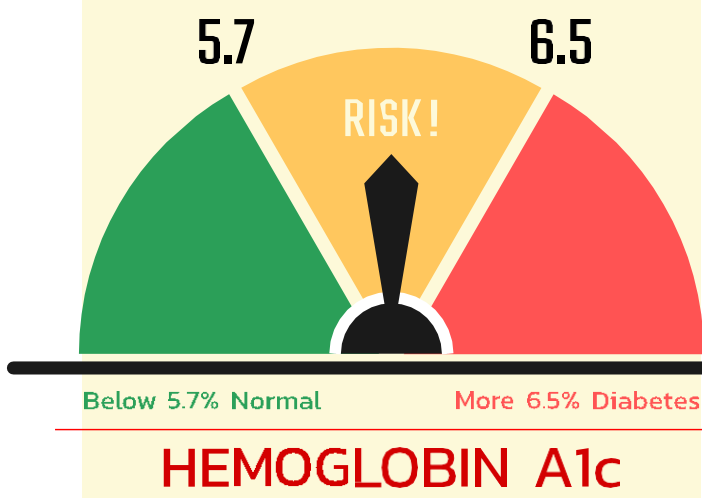
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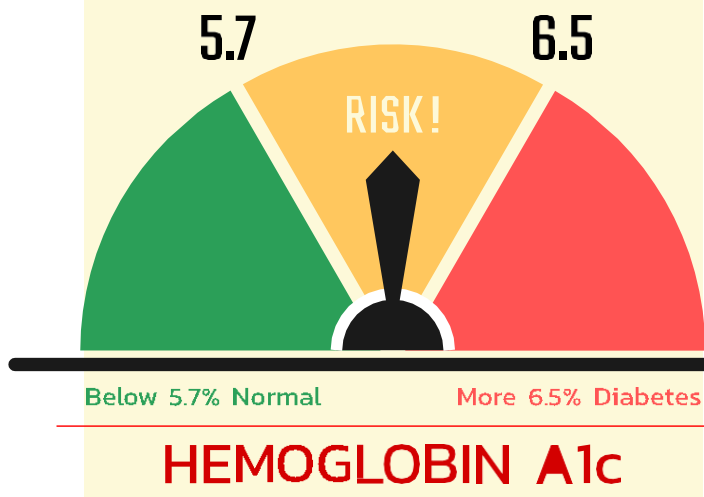
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important, what we call—  
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# Chapter 1

Simple “3-Month” test for “sugar” with power to add 30 years to our life span

**HbA1c** is also called **Glycated Hemoglobin**.

- It is a popular 3-month test to assess sugar/glucose level in body.
- It is called a 3-month test, because it’s done every 3 months or 12 weeks.
- It is regarded as **gold standard test for diagnosing diabetes**.
- It helps to check if someone is prediabetes,
- or is already at a higher risk of diabetes disease.



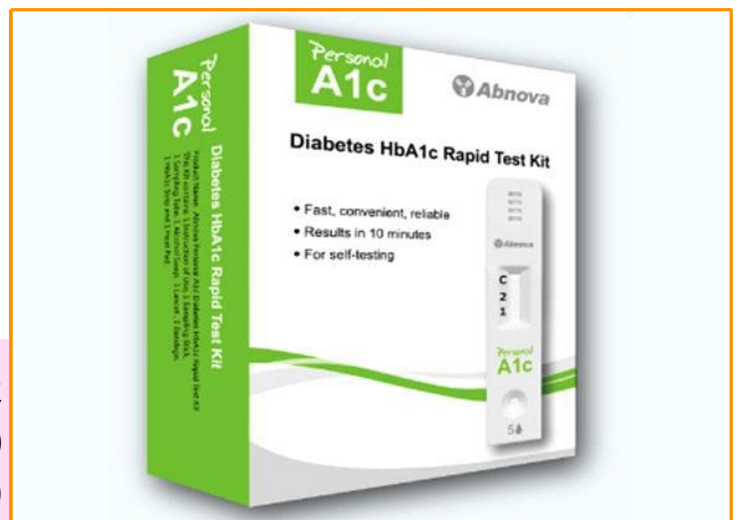
Chap1Fig1

## **Advantages of HbA1c:**

- You **do not have to fast** to get tested for HbA1c unlike blood sugar test.
- It is a **very stable test** while fasting blood sugar test and oral glucose tolerance tests may have some variability.
- HbA1c really **gives us a very good picture of glucose control** over last two to three months.

In good health people have a stable HbA1c every year. As long as our body maintains blood sugar level around 100, HbA1c will always remain around 5.5.

**HbA1c Test Cost**  
**In USA - \$10 - \$20**  
**In India – Rs. 250 – Rs. 350**



Chap1Fig2

# Chapter 2

## HbA1c—3 Months Test (Based on duration or life span of red blood cells)

### **Think About It!**

*We all know by our observation over last 30 to 40 years that the incidence of diabetes or high blood sugar is increasing in population. It is now happening more and more in younger population.*

*It is a fact that, all over the world, almost 50% of the people do not even know that they have diabetes.*

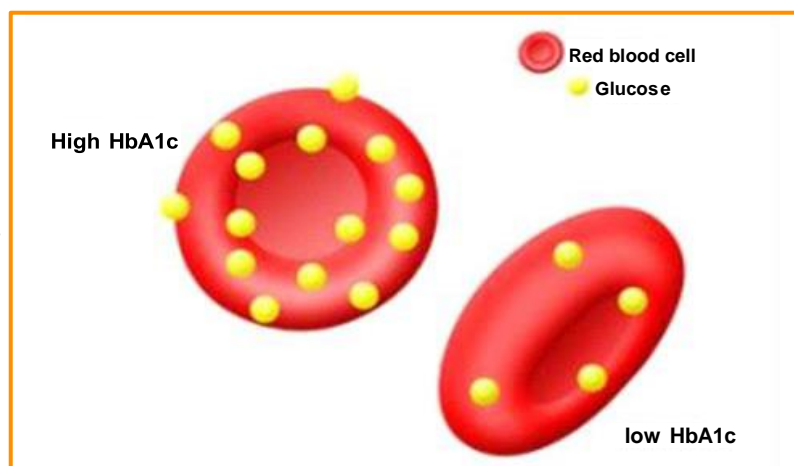
We have both glucose and the red blood cells in the circulating blood.



Chap2 Fig1

- **Red blood cells** also known as **erythrocytes** contain a protein called hemoglobin which gives its characteristic red color.
- The red blood cells have affinity to glucose in the blood circulation and are freely permeable to glucose.

- As glucose enters the red blood cells, it irreversibly binds with hemoglobin. This action depends on the concentration of glucose in blood.



Chap2 Fig 2

- We know that the life span of red blood cells is usually about **120 days (or 4 months)** (HbA1c test is best suited when done in every 3 months).
- So, the HbA1c test result depends on how long the red blood cells have been in circulation in your body.
- **The hbA1c test, therefore reflects the mean blood glucose concentration over the life span of the red blood cells which is 4 months but we do test every 3 months.**
- When we do HbA1c, it best reflects the blood glucose level over the past three months or 12 weeks.

### **Think About It!**

*In 1980s, when I was in a medical college in New Delhi, India, we used to do the 2-hour glucose tolerance test.*

*The patient was required to fast overnight. The patient would be given a glucose (sugar) solution and we would take his blood sample to check sugar at 1 hour, 2 hours intervals approximately. In a normal person, sugar level goes back to normal within 2 hours.*

*This test was very cumbersome (still is), with the time taken, multiple samples being drawn and fasting required by patient.*

**HbA1c** is a much **easier test** in comparison.

- It just required a blood sample,
- which can be taken any time,
- with no requirement of fasting.



Chap 2 Fig3

It also helps us **to diagnose or indicate if we may be moving towards developing diabetes, but we do not have diabetes yet.**

One has to understand that it is very important from public health point of view for government to know how much percent of population had diabetes and analyze what they can do to keep the population healthy.

# Chapter 3

## If you have symptoms, you already have diabetes for more than 5 years

**Diabetes does not cause any symptoms for several years (usually no symptoms for more than 5 years).**

### **Think About It!**

*By the time we wait for symptoms, sugar starts spilling in urine and we already have diabetes for more than 5 years.*

### **Symptoms of advanced diabetes (which we don't see anymore):**

1. Feeling very thirsty,
  - a. and you will end up drinking lot of water.
  
2. You will feel very hungry. Despite eating a lot, you will still lose weight because your body cannot effectively utilize sugar.
  
3. And you pee a lot.  
Reason is because you are passing sugar in your urine which acts like a diuretic and therefore pulls a lot of water along with it and fills up bladder quickly.

**Drink a lot**

**Eat a lot**

**Pee a lot**



# Chapter 4

## HbA1c — A revolutionary blood test

### **Think About It!**

*If our temperature is 99 or 100°F, we are running fever. We have to figure out why our temperature is not normal and it is true for each one of us, no matter whether we live in India, US, Japan, or China*

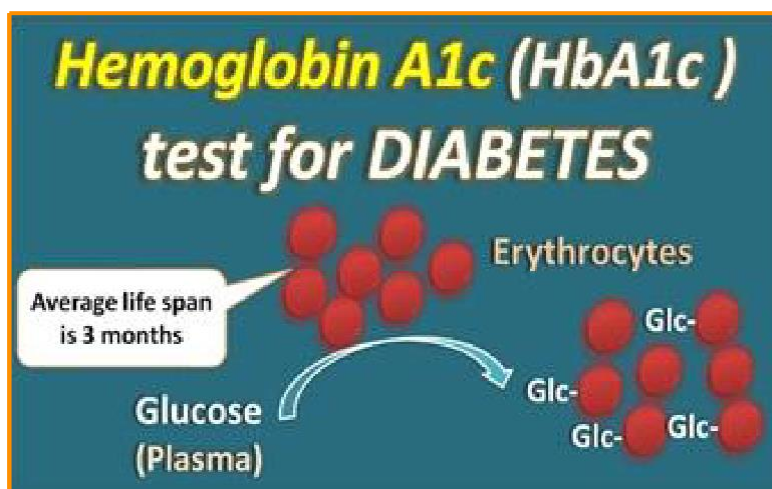
*In our time back in 1980s gold standard test was,*

*either fasting blood sugar,*

*or glucose tolerance test which is still available,*

*but now gold standard test has changed to hemoglobin A1c.*

*In a normal healthy person, blood sugar returns to normal about 2 hours after eating.*



Chap4Fig1

*If blood sugar does not come back to baseline within 2 hours which is 100 mg%, then glucose metabolism is abnormal and we really have to verify,*

*either we have diabetes,*

*or we tend to develop diabetes,*

*or we can develop diabetes in coming months and years (unless we do something about it).*

In the field of medicine and diabetes, **HbA1c is one of the gold standard tests.** Blood test numbers are literally cast in stone for all of us human beings, and our body maintains those numbers very constantly year after year.

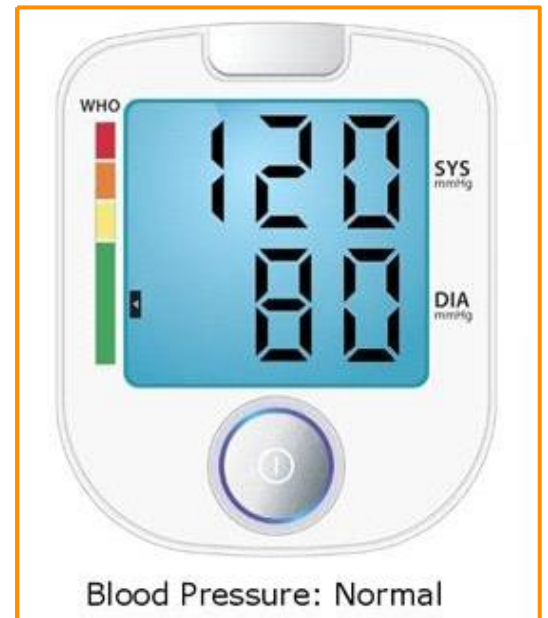


Chap4 Fig2

Practically speaking, diabetes is very common now especially in younger population.  
I absolutely recommend doing HbA1c test at age 18 and every year religiously after that.

**For example,**

- We have to maintain our blood pressure around 120/80.



Ch ap4 Fig 3

- Body has to maintain a pH of 7.4.
- We have to maintain our blood sugar at 100.

- We have to maintain our body temperature at 98.6 o F.



Ch ap4 Fig4

# Chapter 5

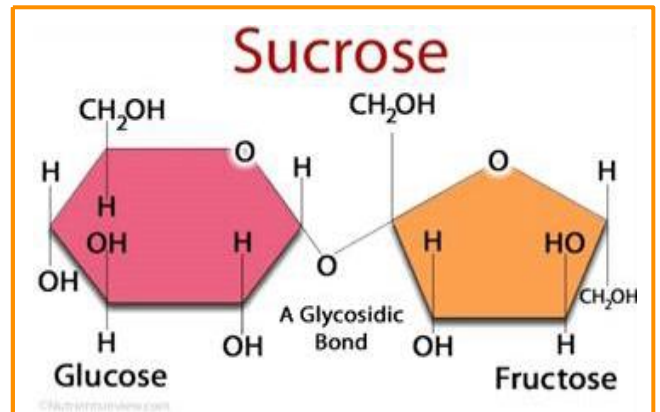
Can we live without sugar? No, we cannot!

## **Think About It!**

*Our brain can only use sugar for energy (and, it needs lots of it).  
It cannot use any other food or source of energy like protein, or fat.*

After we eat food, it gets digested, and broken down into the

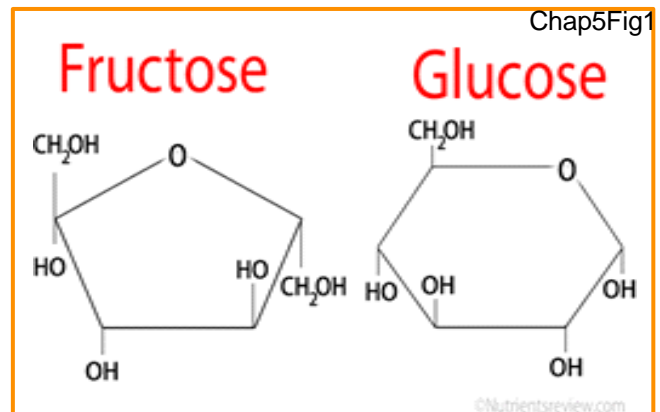
i. Sugars,



Chap5Fig1

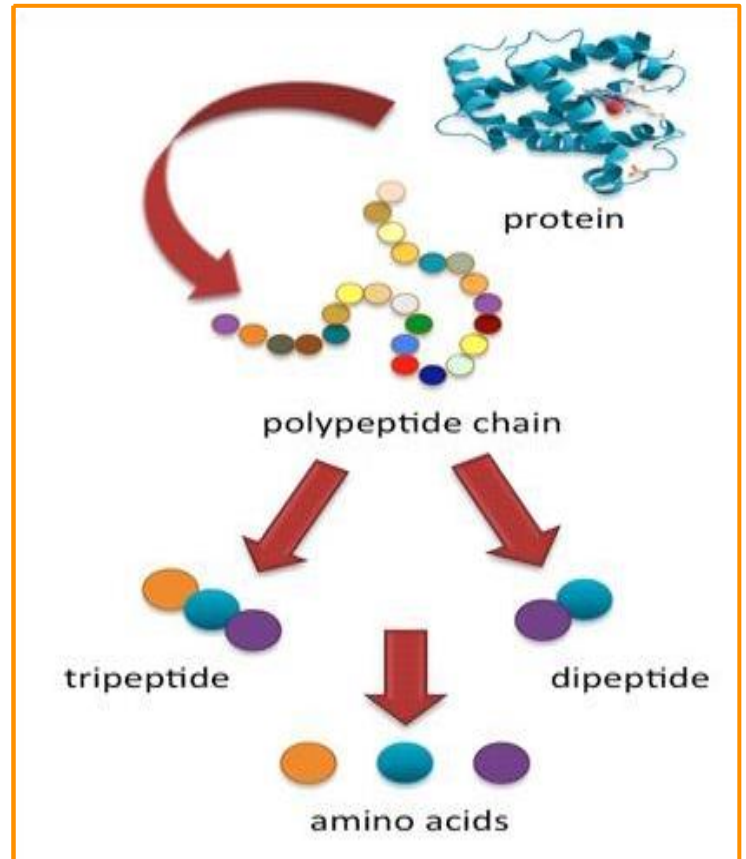
The sugars are

- absorbed in our body,
- and the glucose is released into the blood.
- As the blood sugar goes up, a gland called pancreas synthesizes insulin, and the signal is given to beta cells in pancreas to release insulin in blood,
- Which eventually brings down the blood sugar back to 100.



Chap5 Fig 2

ii. Proteins,

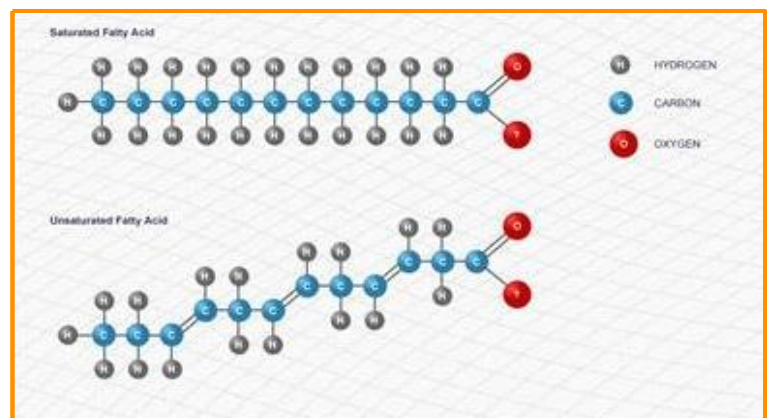


Chap5 Fig 3

iii. and lipids (fats)

- a. Commonly known as fats.
- b. Includes oils, waxes, and steroids.
- c. Contain C.H.O (no 2:1 ratio)
- d. Hydrophobic (water fearing molecules).
- e. Main functions

- Long term storage of energy
- Insulation
- Protection
- From membranes
- Hormones (steroids)



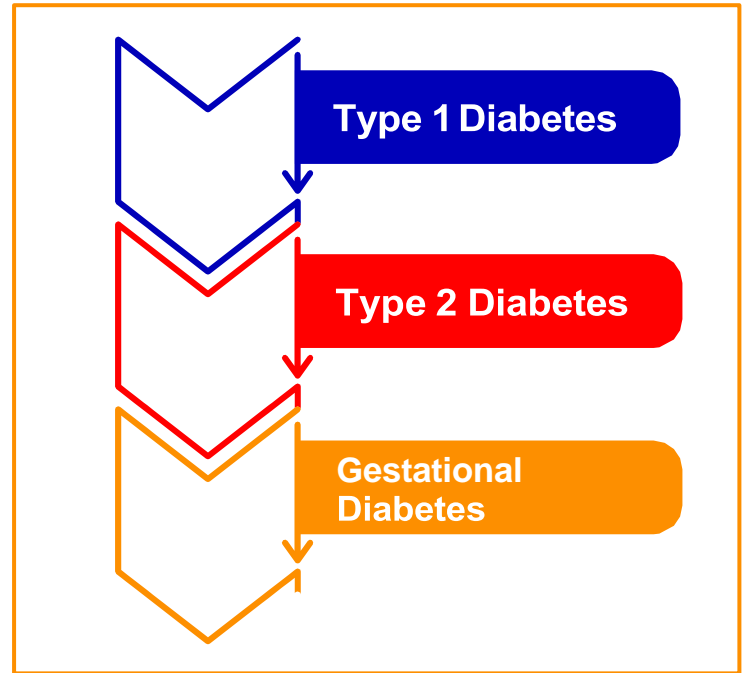
Chap5 Fig4

# Chapter 6

## Diabetes when young, grown up or pregnant

We all talk about diabetes in

- either children Diabetes in children is called Type 1.
- or grown-ups  
Diabetes in grown-ups is called Type 2.
- or during pregnancy.  
Diabetes during pregnancy is called Gestational diabetes.



Chap6 Fig1

# Chapter 7

## Type 1 Diabetes is always insulin dependent

### Type1 Diabetes:

- A. Type 1 diabetes occurs in very young children, teens and young adults.
- B. These children do not produce enough insulin in their body. They need insulin throughout their life.



Chap7 Fig1

- C. Type 1 diabetes is usually seen in very small percentage of population, about 5% compared to Type 2 diabetes.



Chap 7Fig2

# Chapter 8

We have different steps or medicines to prevent high blood sugar

## Type2 Diabetes:

- A. Almost **95% people have type 2 diabetes** which is also called adult-onset diabetes.
- B. In Type 2 diabetes, body does make insulin, just not in enough amount.



Chap8Fig1

- C. In this case, it takes many years for us to develop overt diagnosis.

- D. We are now seeing type 2 diabetes more and more in younger population.



Chap 8Fig2

# Chapter 9

## Diabetes during pregnancy (not before pregnancy, not after pregnancy)

### Gestational diabetes

- A. Often pregnant women develop diabetes.
- The diabetes goes away after delivering the baby. Hence, it is called gestational diabetes.



Chap9 Fig1

- B. During pregnancy if you develop diabetes, you are at higher risk of developing type II diabetes later in life.
- C. Genetics also play a role. If diabetes runs in your family, you and your siblings are certainly at a higher risk.
- D. So, if you become diabetic during the pregnancy and even if it goes away, **down the road chances are you will eventually develop diabetes.**

- E. Reality is **your child will also be at the risk of developing diabetes because of the genetic factors (type 2 diabetes)** later in the life.



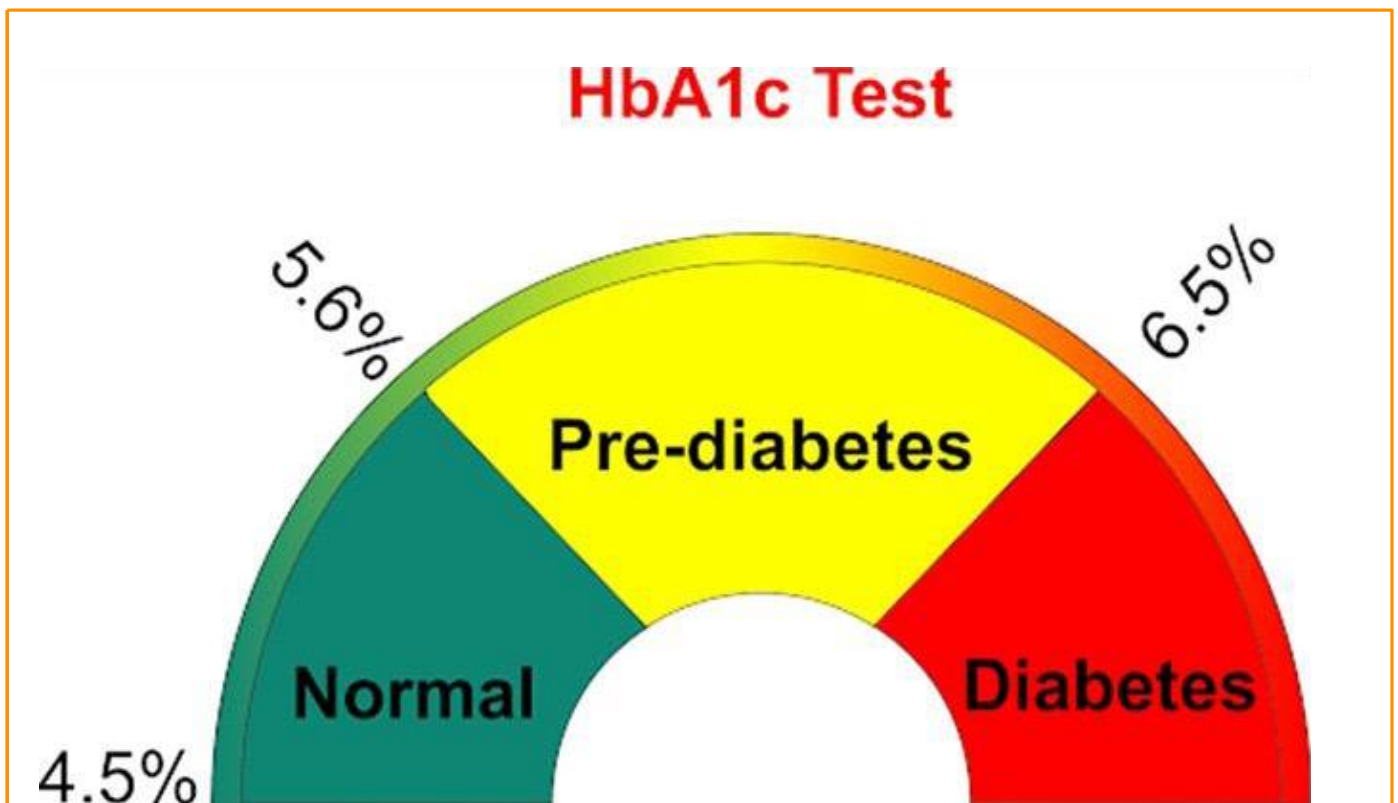
Chap9Fig2



# Chapter 10

Between NO diabetes and diabetes is a situation, very-very important, what we call—Prediabetes

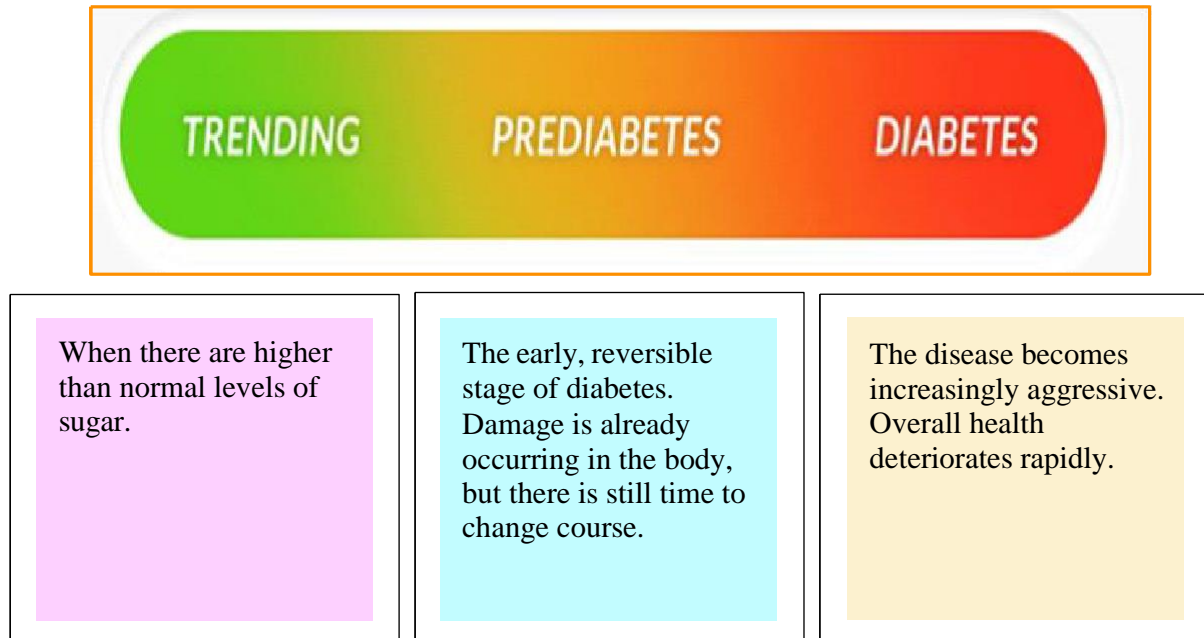
Prediabetes is a health condition where blood sugar levels are higher than normal, but they are not high enough yet to diagnose as type 2 diabetes.



Chap10Fig1

When your HbA1c starts rising up from standard 5.5 to 6.5, we call this phase as prediabetes.

It means that unless we intervene to control, we are going to develop diabetes.



Chap10Fig2

Let me be honest with you, rising the HbA1c from 5.5 to 6.5 may take a long time.

It just does not happen overnight,

So, once we become aware that our HbA1c is rising, then we can take appropriate measures to delay it

or bring it back to normal

and prevent from development of the diabetes.

# Chapter 11

## More about Prediabetes

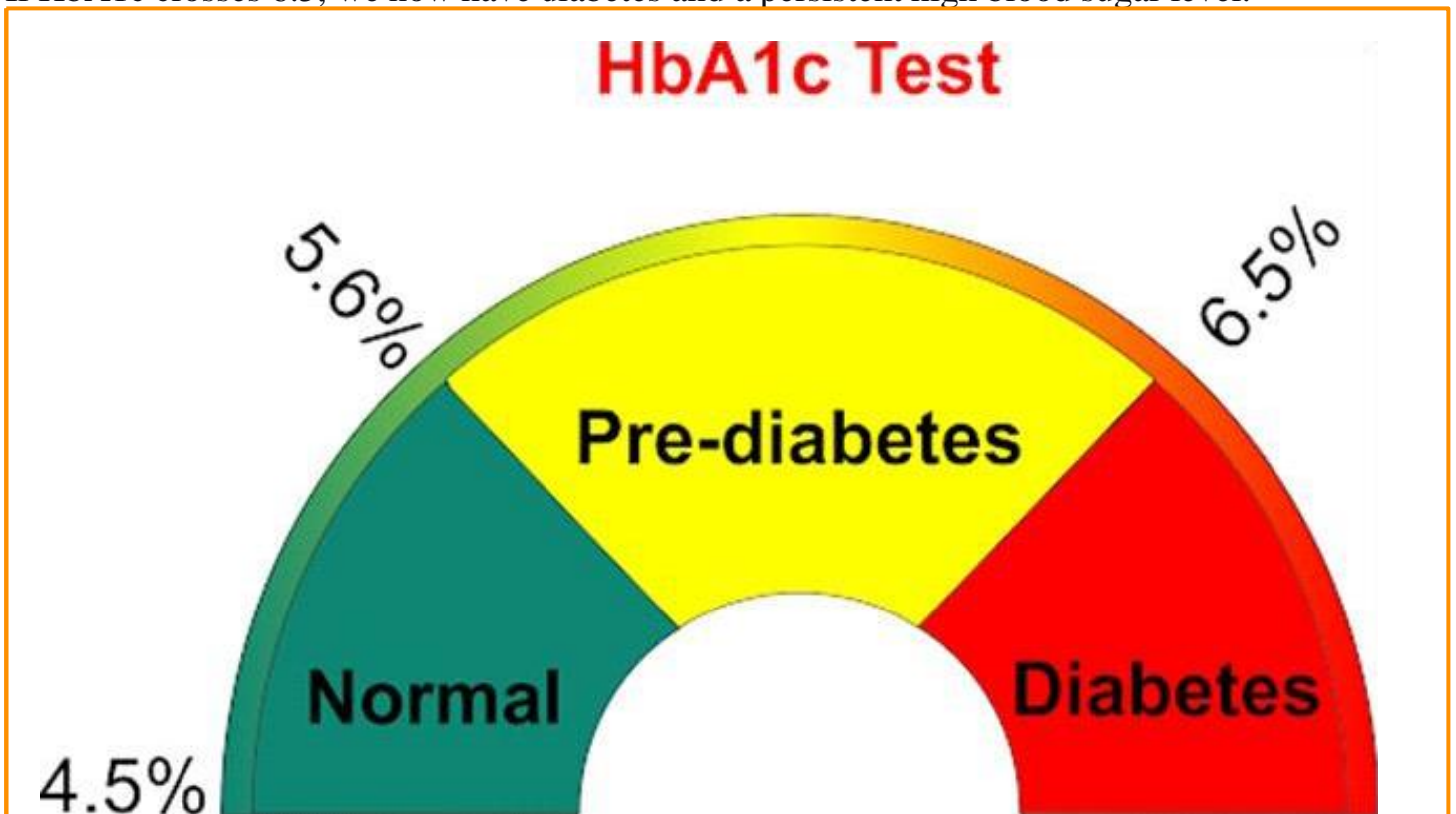
**Normal number of HbA1c is 5.4 or less.  
If more than 5.5 then it is Prediabetes.**

Anytime you see number 5.5 or more than that, we need to take it seriously.

If HbA1c number is between, 5.5 and 6.5,  
we say that a patient has prediabetes.

If number goes from 5.5 towards 6.5, I will recommend HbA1c every 3 months.

If HbA1c crosses 6.5, we now have diabetes and a persistent high blood sugar level.



Chap10Fig2

**HbA1c has an excellent statistical correlation with average blood sugar (over 3 months).**

As a big picture in your day-to-day life, you do not have to remember the exact number which is important for us (doctors).

Instead it is more important for you to remember that,

**if your HbA1c is high,  
your blood sugar will be high.**

Higher HbA1c is,  
sooner your kidneys will fail  
(Unless, diabetes is well managed).

<b>HbA1c test score (%)</b>	<b>Blood Sugar (mg/dl)</b>	
<b>5</b>	<b>80</b>	} Excellent
<b>5.5</b>	<b>100</b>	
<b>6</b>	<b>120</b>	} Okay
<b>7</b>	<b>150</b>	
<b>8</b>	<b>180</b>	} Need immediate attention
<b>9</b>	<b>215</b>	
<b>10</b>	<b>250</b>	} Need immediate attention
<b>11</b>	<b>280</b>	
<b>12</b>	<b>315</b>	
<b>13</b>	<b>350</b>	} Need immediate attention

# Chapter 12

## Time has come in 2020, we take Prediabetes very-very seriously

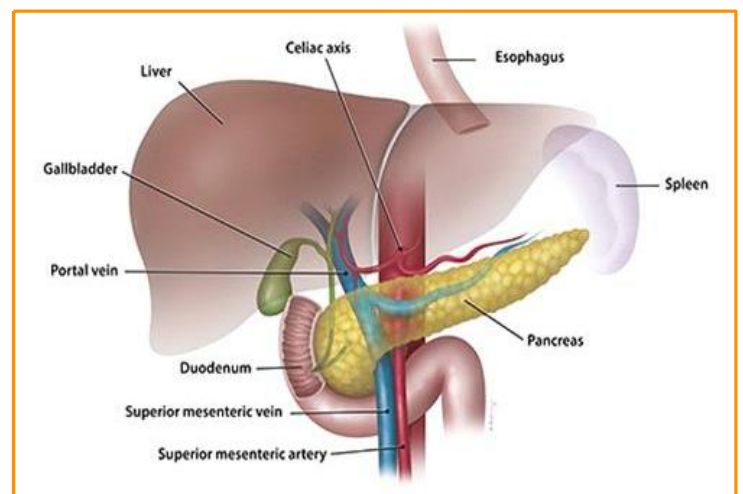
**Insulin** is a **hormone made by pancreas** that really acts as a **key**, a key which opens the door to glucose utilization.

In other words, it acts as a key to let the blood sugar into the cells which can use glucose as a source of energy.

### **In situation like prediabetes,**

our **pancreas** fails to release enough insulin and **fails to maintain normal blood sugar,**

so, our blood sugar slowly starts rising and we enter in the stage of prediabetes.



Chap12Fig1

### **One has to understand,**

Life is a very-very slow process.

we may remain in this prediabetes stage for years before we finally develop diabetes and also, we do not have any symptoms in prediabetes and early diabetic years.

### **“Diabetes” / “Sugar” has started dominating our life**

- i. In the last 20 years,
  - a. number of patients with diabetes in young adult people has dramatically increased.
- ii. I believe in 2020,
  - a. we should rather focus on prediabetes
  - b. because one in every 3 persons in the United States has Prediabetes.
  - c. I am sure the same is true in India too.

iii. **80% of population don't even know that they are prediabetic.**

iv. **These people do not have diabetes but their blood sugar is not normal.**

- a. They have higher than normal baseline of 100.
- b. They will eventually develop type 2 diabetes with time.

v. If they do not manage it well, they will develop the complications of the diabetes over years,

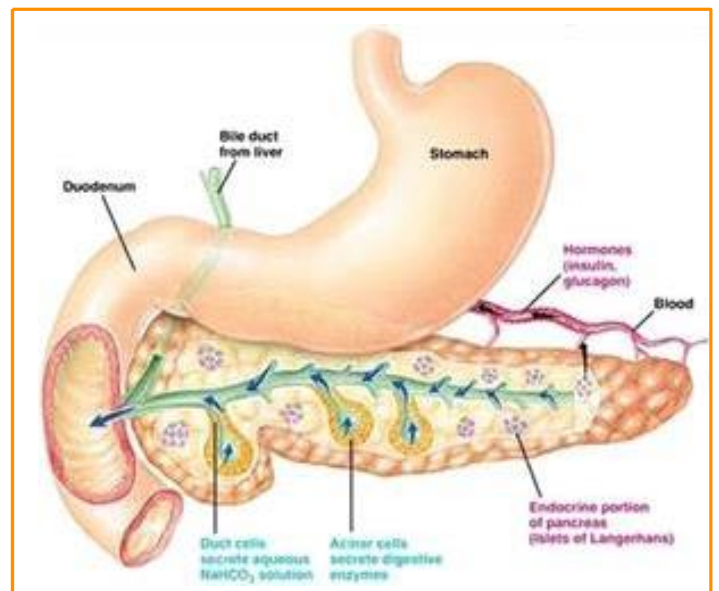
- Kidney failure/Dialysis
- Heart attack
- Blindness
- There is a long list.

# Chapter 13

## Once, we have “diabetes” or “sugar” — we have it for life

- Fact of life in 2020 is, we are living longer and longer as compared to previous generations (Bless huge advances in medical knowledge and technology).
- If you ask me, diabetes (not controlled) is number one cause of heart attack (indirectly).
- Without proper control or management, diabetes is a number one cause of the kidney failure. We all know about diabetes leading to kidney failures, and people ending up on the dialysis.

- Please know that diabetes really reduces the blood supply in our legs and it becomes the number one cause of leg amputation.
- Also, please do realize this, diabetes all over the world is the number one cause of blindness.



Chap13Fig1

In India and rest of the world, earlier Vitamin A deficiency was the prime reason for blindness but now the number one cause of blindness is diabetes.

# Chapter 14

## Serum Fructosamine Test—a 2 week test for blood sugar

Another advance test in diabetes is Serum Fructosamine Test.

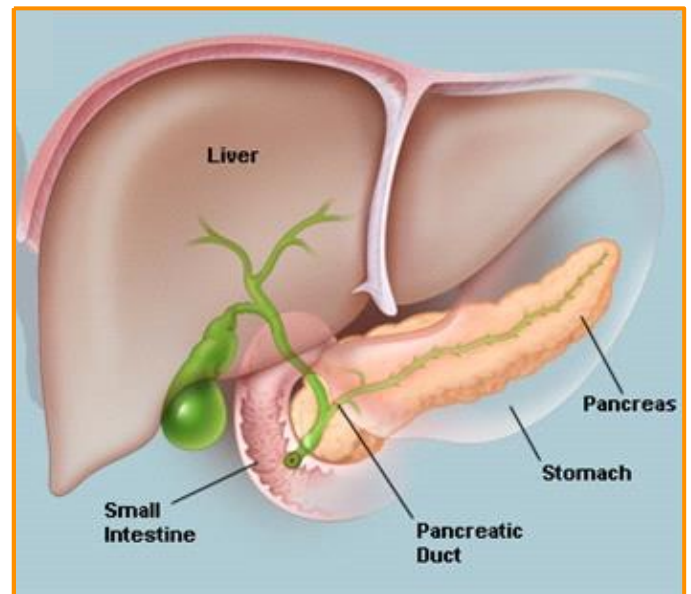
It makes sense as years go by, we will develop newer tests and technology for diabetes.

In Serum Fructosamine test, glucose is combined with the serum protein or albumin to check the sugar level in blood.

Serum albumin actually has more shorter life than the hemoglobin about 2 weeks.

HbA1c tells us 3 months previous blood sugar levels.

**Serum fructosamine** on the other hand, let us know about the **average blood sugar for last two weeks.**



Chap14Fig1



# Chapter 15

## Situations leading to risk of developing Diabetes

### **Think About It!**

*Once while practicing in US, I was posted in Indian reservation in US. There I observed that almost 100% of American-Indians had diabetes.*

*Only logic that comes to my mind is that as per history of American-Indians, they used to be very active in past. Now, suddenly their American Indian tribe has become very prone to obesity and diabetes due to unhealthy food habits and lack of exercise.*

1. **Being overweight**, especially after 40 to 45 years of age.
2. **History of diabetes** in family also puts you at risk of becoming diabetic.
3. Leading a **sedentary life and not exercising**.
4. Pregnant woman can develop diabetes **during the pregnancy**. We call it gestational diabetes. Also, if she is giving birth to a healthy baby whose weight is more than 9 pounds, then again, she is at risk of developing diabetes down the lane.
5. **Polycystic ovary syndrome** also makes you prone to diabetes.
6. There is a **genetic effect** too.

# Chapter 16

## Treatment for diabetes

- I. Firstly, if we tend to develop diabetes or prediabetes; we have to adopt major lifestyle changes. It will have a dramatic influence on our course of diabetes.
- II. Secondly, a very effective medicine – **Metformin** is available which can also help us to delay diabetes along with our lifestyle changes.

### Metformin:

- I. It is one of a very good medicine and very safe medicine.
- ii. It DOES NOT cause hypoglycemia or lower blood sugar than the normal.



Chap16Fig1

I can assure everyone that by making major lifestyle changes and taking metformin can delay or prevent development of the type 2 diabetes for several years.

Also, good control on diabetes can help in achieving lifespan of 80-85 years with proper functional kidneys and minimal complications of diabetes.

**Think about it seriously!**

# Chapter 17

## Major lifestyle changes to prevent Diabetes

1. **Maintain your weight as per your BMI.** Lose weight if you are overweight or obese.

**Maintain  
Your BMI**

2. **Workout regularly.** Exercise daily for 1-2 hours daily. You can walk, play any sport like tennis or basketball, do yoga or even dancing helps.

**Workout  
Regularly**

3. **Consult a dietitian for diet** modification where they adjust calories and saturated fat. Cut sugar and refined carbs from your diet.

**Consult a  
Dietician**

4. **Quit smoking and alcohol.**

a. Smoking and diabetes do have a correlation.

**Quit Smoking  
& Alcohol**

5. **Improve sleeping habits.**

a. Lack of sleep leads to obesity and tendency for diabetes.

**Improve  
Sleeping Habits**

6. **Drink lot of water.**

**Drink lot of  
water.**

7. **Avoid sedentary behaviors.**

**Exercise  
Regularly**