

# DIABETES MELLITUS IN CHILDREN

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- T1DM insulin def. due to beta cell damage
- T2DM insulin resistance + various degrees of beta cell impairment

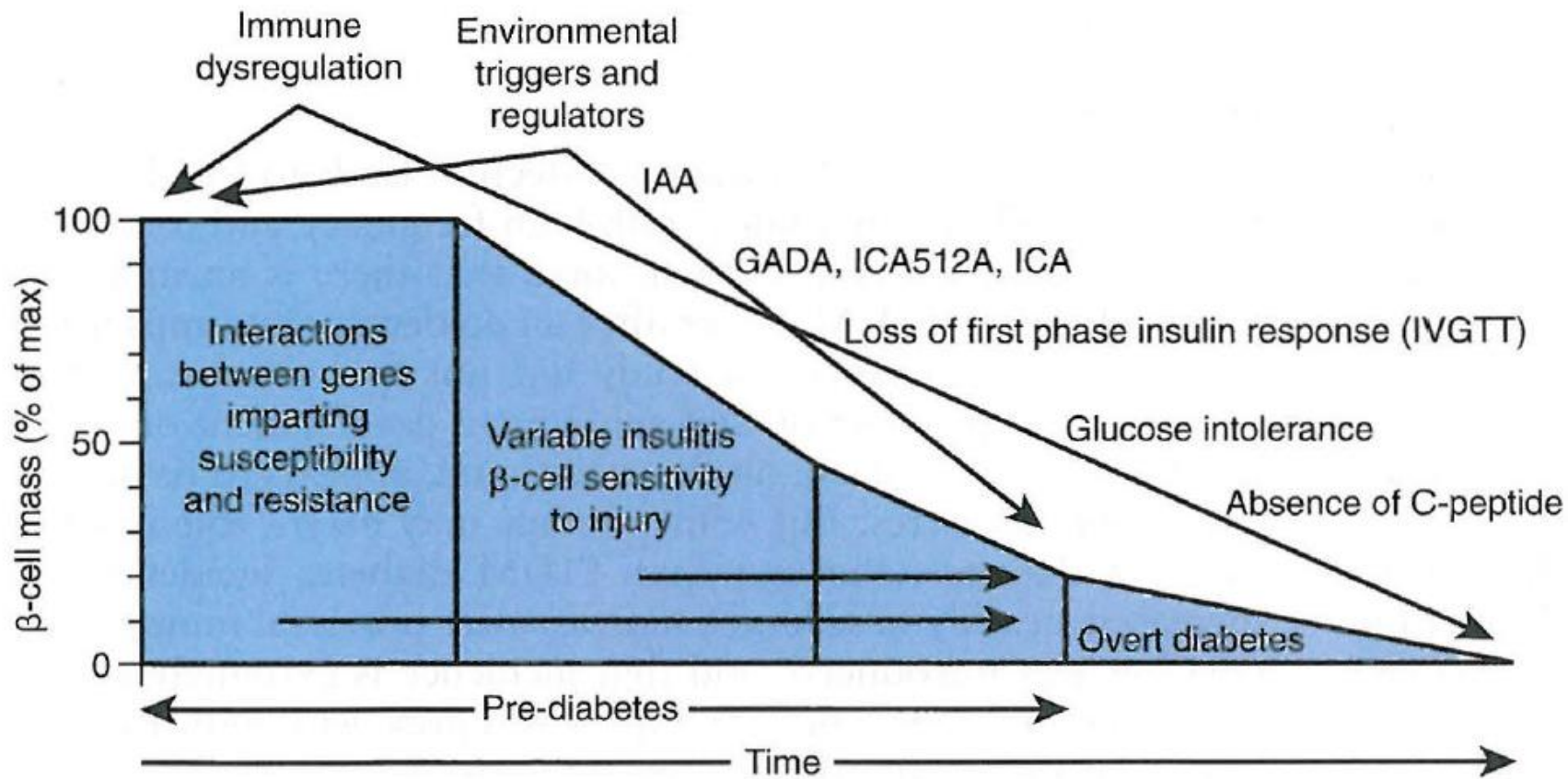
# **Type 1a Diabetes Mellitus (Immune Mediated)**

- T1DM accounts for about 10% of all diabetes.
- Thus it is estimated that of the 400,000 total new cases of type 1 diabetes occurring annually in children under age 14 yr in the world, about half are in Asia

# T1DM ***IS DYSASTER***

CHILDREN with T1DM **confront serious lifestyle alterations** that include :

1. absolute daily requirement for exogenous insulin
2. need to monitor their own glucose level
3. the need to pay attention to dietary intake.



# Clinical manifestations

- Polyuria , polydipsia ,diuresis,hyperphagia ,nocturnal enuresis,monilial vaginitis,weight loss  
and some times FLU like
- About 20-40% of children with new onset diabetes progress to DKA before diagnosis

# Diagnosis

- Sign& symptoms with random glucose more than 200mg/dl
- GTT    BS more than 200
- FBS   more than 126
- HBA1c more than 6.5%

# GENETICS

- There is a clear familial clustering of T1DM.
- prevalence in the general population in the US is 0.4%.
- prevalence in siblings approaching 6% .  
the risk is 2% if the mother has diabetes  
7% when the father has diabetes.

Monozygotics: 30-65%      dizygotics: 6-10%

the genetic susceptibility for T1DM in the parents  
Of a child with diabetes is estimated at 3%.



## ...genetics

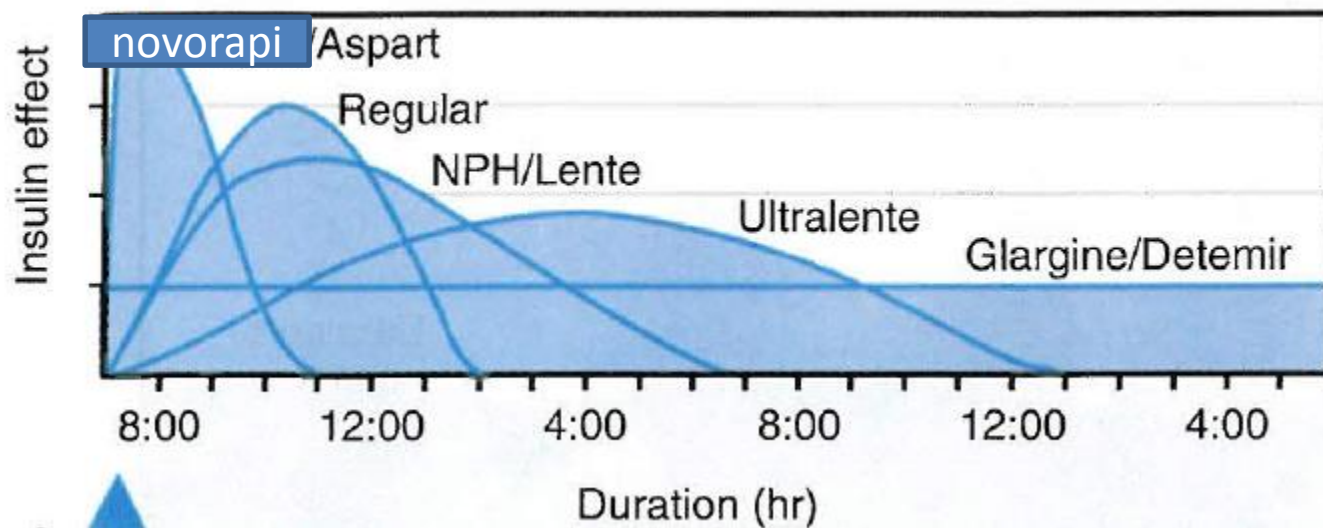
- It should be kept in mind that although there is a large genetic component in T1DM, 85% of patients do not have a family member with T1DM.

# **Primary Prevention of Type 1 Diabetes Mellitus**

- Delaying introduction of cow's milk protein, delaying introduction of cereals, and increasing the duration of breast-feeding.
- supplementing omega-3 fatty acids and vitamin D, and taking cod liver oil during pregnancy.

# ***Basal-bolus*** regimen

- **slow-onset, long-duration** background insulin for between-meal glucose control
- and **rapid onset** insulin for each meal.



# Insulin therapy

- 0.5 U/kg/day if prepubertal,
- 0.75 U/kg/day at midpuberty,
- 0.5 U/kg/day post pubertal.

***The optimal insulin dose can only be determined empirically.***

- All preanalog insulins are hexamers, which must dissociate into monomer subcutaneously before being absorbed into the circulation. Thus, a detectable effect for regular (R) insulin is delayed by 30-60 min after injection.
- NPH don't create a peak less background
- *the composite insulin profile poorly mimics normal endogenous insulin secretion*

# ***NOVORAPID*** aspart (A), insulin analogs

absorbed much quicker because they do not form hexamers. They provide discrete pulses (with little if any overlap) and short tail effect.

This allows better control of post-meal glucose and

reduces between-meal or nighttime hypoglycemia

- The long-acting analog glargine (G) creates a much flatter 24-hr profile, making it easier to predict the combined effect of a rapid bolus on top of the basal insulin, producing a more physiologic pattern of insulin effect .

*Postprandial* glucose elevations are better controlled, and *between-meal and nighttime* hypoglycemia are reduced.



- **Glargine** may be given every 12 hr in young children if a single daily dose of **Glargine** does not produce complete 24-hr basal coverage.
- The basal insulin glargine should be 25-30% of the total dose in toddlers and 40-50% in older children.

**Table 583-3 SUBCUTANEOUS INSULIN DOSING**

AGE (yr)	TARGET GLUCOSE (mg/dL)	TOTAL DAILY INSULIN (U/kg/day)*	BASAL INSULIN, % OF TOTAL DAILY DOSE	BOLUS <sup>†</sup> INSULIN	
				Units Added per 100 mg/dL Above Target	Units Added per 15 g at Meal
0-5	100-200	0.6-0.7	25-30	0.50	0.50
5-12	80-150	0.7-1.0	40-50	0.75	0.75
12-18	80-130	1.0-1.2	40-50	1.0-2.0 <sup>‡</sup>	1.0-2.0

\*Newly diagnosed children in the "honeymoon" may only need 60-70% of a full replacement dose. Total daily dose per kg increases with puberty.

# TARGET GLUCOSE

- approximately 80 mg/dL in the fasting state to 140 mg/dL after meals. In practice, however, a range of 60-220 mg/dL is acceptable, based on age of the patient

# Pattern adjustment

# Insulin Pump Therapy=csii

- The patient can enter his or her blood glucose level and the carbohydrate content of the meal, and the pump computer will calculate the proper insulin bolus dose.
- Reduction in severe hypoglycemia(increase in DKA )
- **Closed loop glucose control** using an external sensor and insulin pump provided a means to achieve near-normal glucose concentrations during the overnight period.

# Physiology of GLP & AMYLIN

- Glucagon like peptide(GLP 1&2) normally comes from L CELL OF SMALL INTESTINE , this secretes insulin =so called INCRETIN & inhibits glucagon, loose function by DDP4
- *AMYLIN comes from beta cells with insulin,*  
*in* brain induces satiety , inhibits glucagon
- Both reduce appetite & delay of stomach emptying

# amylinomimetic

- *PRAMLINTIDE=symilin*
- It is a amylinomimetic
- Side effect: hypoglycemia
- So insulin must be reduced by 50%

# Amylin-Based **Adjunct** Therapy

- Pramlintide , a synthetic analog of amylin, may be of therapeutic value combined with insulin therapy. In adolescents it has been shown to decrease postprandial hyperglycemia, insulin dosage, gastric emptying, and HbA1c levels. It is given as a subcutaneous dose before meals.



# Nutritional Management

- The caloric mixture should comprise approximately
  - 55% carbohydrate,
  - 30% fat,
  - 15% protein.
  - Approximately 70% of the carbohydrate content should be derived from complex carbohydrates such as starch;
- intake of sucrose and highly refined sugars should be limited.

**Table 583-5 CALORIE NEEDS FOR CHILDREN AND YOUNG ADULTS**

AGE	kcal REQUIRED/kg BODY WEIGHT*
<b>CHILDREN</b>	
0-12 mo	120
1-10 yr	100-75
<b>YOUNG WOMEN</b>	
11-15 yr	35
≥16 yr	30
<b>YOUNG MEN</b>	
11-15 yr	80-55 (65)
16-20 yr	
Average activity	40
Very physically active	50
Sedentary	30

- The total daily caloric intake is divided to  
20% at breakfast,  
20% at lunch,  
30% at dinner,
- leaving 10% for each of the midmorning,  
midafternoon, and evening snacks.

# Diet / meal plan

- **Each carbohydrate exchange unit is 15 g.**  
Patients and their families are provided with information regarding the carbohydrate contents of different foods and food label reading.
- Diets with high fiber content are useful in improving control of blood glucose.
- "glycemic index"
- Polyunsaturated fats from vegetable sources.

## NUTRIENT RECOMMENDATIONS AND DISTRIBUTION

NUTRIENT	(%) of CALORIES	RECOMMENDED DAILY INTAKE
Carbohydrate	Will vary	High fiber, especially soluble fiber; optimal amount unknown
Fiber	>20g per day	
Protein	12-20	
Fat	<30	
Saturated	<10	
Polyunsaturated	6-8	
Monounsaturated	Remainder of fat allowance	
Cholesterol		300 mg
Sodium		Avoid excessive; limit to 3,000-4,000 mg if hypertensive

# SMBG

- Daily blood glucose monitoring has been markedly enhanced by the availability of strips impregnated with **glucose oxidase** that permit blood glucose measurement from a drop of blood.
- A small, spring-loaded device (**lancing device**)
- **at least 4 times daily-before** breakfast, lunch, and supper and at bedtime.
- A minimum of 4 daily blood glucose measurements should be performed TO CHANGE THE DOSAGES

## ...HbA1c

- HbA1c, values may be spuriously elevated in thalassemia (or other conditions with elevated hemoglobin F) and
- lower in hemolytic, hemorrhagic anemia's , cirrhosis myelodysplasia, PRCA ,trans fusion, ESRD with erythropoietin.

## ...HbA1c

- the HbA1c fraction is usually less than 6%; in diabetics, values of 6-7.9% represent good metabolic control, values of 8.0-9.9%, fair control, and values of 10% or higher, poor control.



**Table 583-7 TARGET PRE-MEAL AND 30-DAY AVERAGE BLOOD GLUCOSE RANGES AND THE CORRESPONDING HEMOGLOBIN A<sub>1c</sub> FOR EACH AGE GROUP**

AGE GROUP (yr)	TARGET PRE-MEAL BG RANGE (mg/dL)	30-DAY AVERAGE BG RANGE (mg/dL)	TARGET HBA <sub>1c</sub> (%)
<5	100-200	180-250	7.5-9.0
5-11	80-150	150-200	6.5-8.0
12-15	80-130	120-180	6.0-7.5
16-18	70-120	100-150	5.5-7.0

# Treat

- A source of emergency glucose should
- be available at all times and places, including at school and during visits to friends.
- If possible, it is initially important to document the hypoglycemia before treating, because some symptoms may not always be due to hypoglycemia.( in mild hypo)

- It is important **not to** give too much glucose; 5-10 g should be given as juice or a sugar-containing carbonated beverage or candy, and the blood glucose checked 15-20 minutes later.

# If cant eat

- An injection kit should be kept at home and school. The intramuscular dose is 0.5 mg if the child weighs less than 20 kg and 1.0 mg if more than 20 kg.

# complications in diabetic children

- (Mauriac syndrome),
- osteopenia,
- syndrome of limited joint mobility
- growth impairment;
- maturational delay.

**Table 583-10 SCREENING GUIDELINES**

	WHEN TO COMMENCE SCREENING	FREQUENCY	PREFERRED METHOD OF SCREENING	OTHER SCREENING METHODS	POTENTIAL INTERVENTION
Retinopathy	After 5 yr duration in prepubertal children, after 2 yr in pubertal children	1-2 yearly	Fundal photography	Fluorescein angiography, mydriatic ophthalmoscopy	Improved glycemic control, laser therapy
Nephropathy	After 5 yr duration in prepubertal children, after 2 yr in pubertal children	Annually	Overnight timed urine excretion of albumin	24-hr excretion of albumin, urinary albumin/creatinine ratio	Improved glycemic control, blood pressure control, ACE inhibitors
Neuropathy	Unclear	Unclear	Physical examination	Nerve conduction, thermal and vibration threshold, pupillometry, cardiovascular reflexes	Improved glycemic control
Macrovascular disease	After age 2 yr	Every 5 yr	Lipids	Blood pressure	Statins for hyperlipidemia Blood pressure control
Thyroid disease	At diagnosis	Every 2-3 yr	TSH	Thyroid peroxidase antibody	Thyroxine
Celiac disease	At diagnosis	Every 2-3 yr	Tissue transglutaminase, endomysial antibody	Antigliadin antibodies	Gluten-free diet