



# Basic biochemical examination in endocrinology

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**Diabetes mellitus**

**Endocrinology of reproduction**

# Endocrinology



# Hormones - definition

Hormones are endogenous substances produced by specialized cells

Secretion:      continuous (thyroid hormones)  
                    with diurnal rhythm (cortisol)  
                    with monathial rhythm (menstrual cycle hormones)  
                    seasonal rhythm (parathormon)

# Hormones - types

Proteohormones and peptides

Steroid hormones

Low molecular weight hormones derived from modified amino acids

Prostanoids



# Action of hormones

Autocrine

Paracrine

Endocrine

# Diabetes mellitus

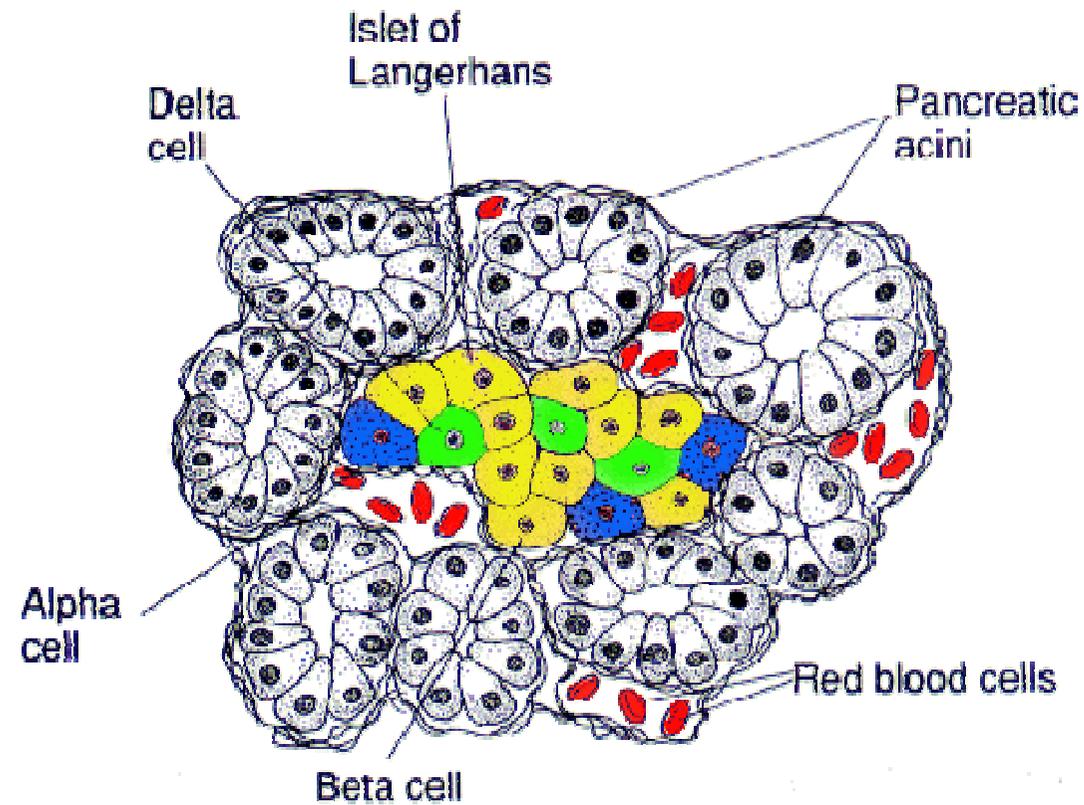


# DM definition

WHO 1985

Status characterized by chronic elevation of blood glucose, that could be connected with clinical syndromes and could lead to death without proper care.

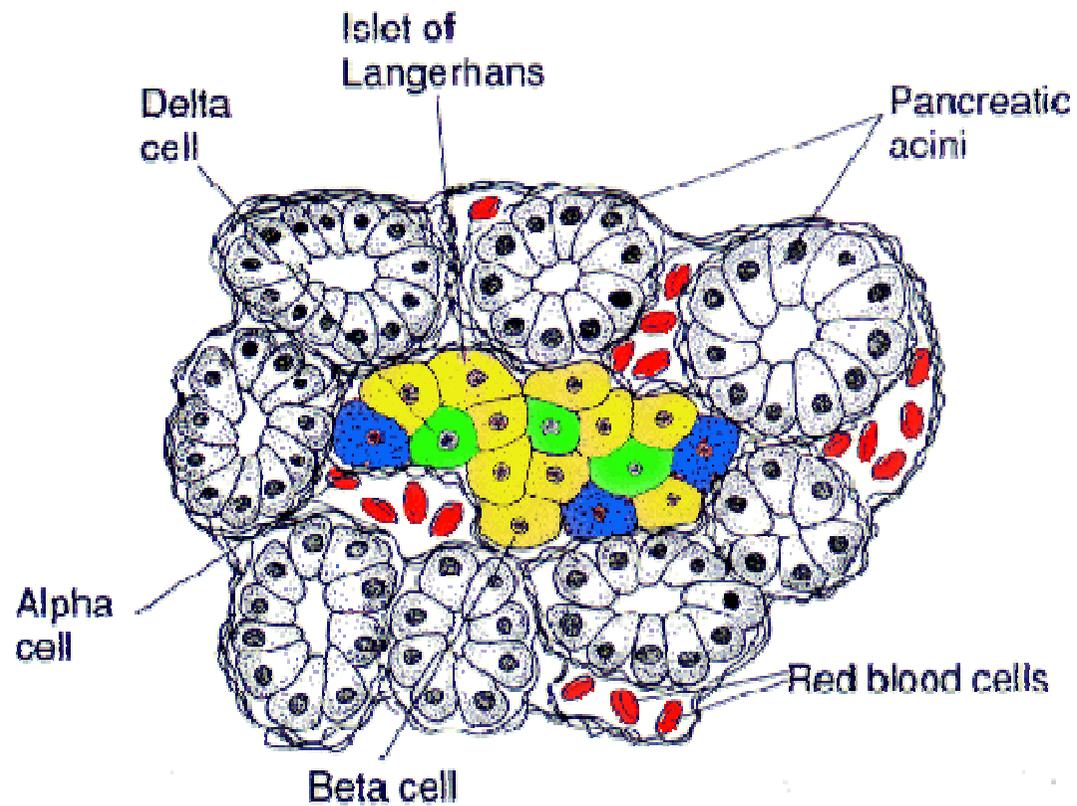
# Langerhans islets



# B (beta) cells

70%

Produce insulin

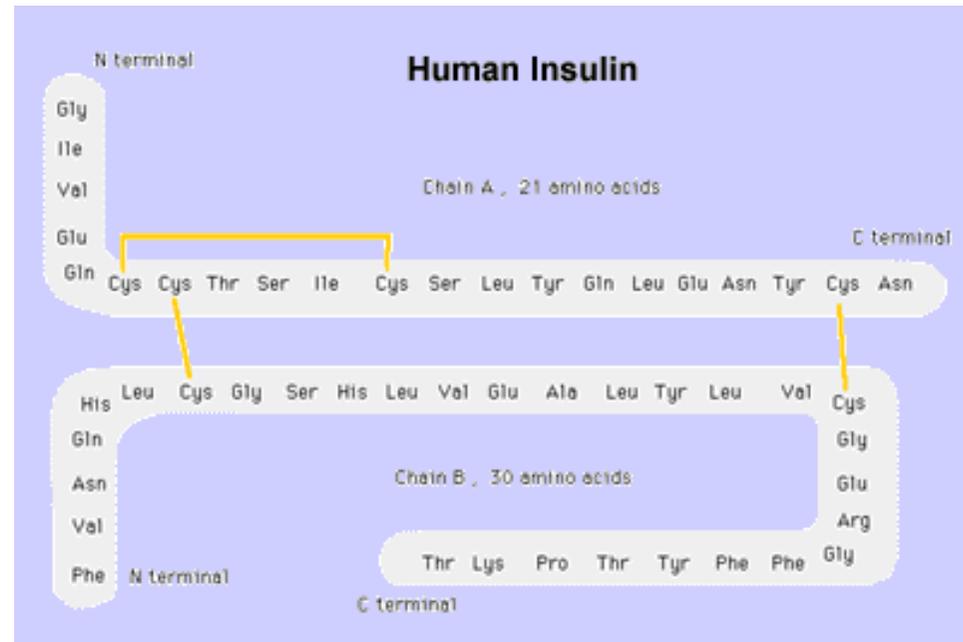


# Insulin

Men and other mammals  
1 gen on chromosome 11

(rodents, 2 genes)

51 AA, 2 strands



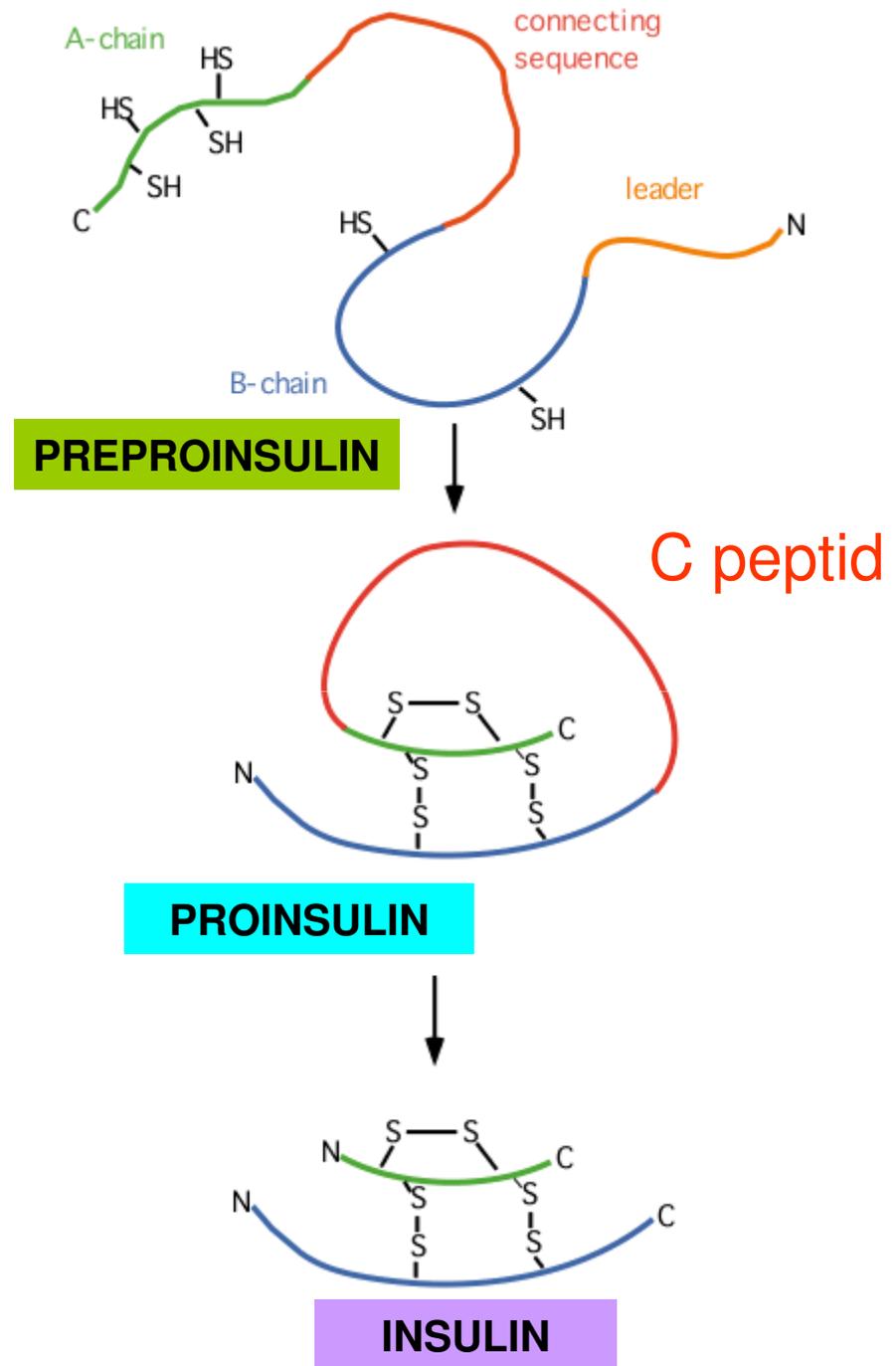
Homology between species high:

pig, dog, hare 1 AA; cow 3 AA; sheep, horse 4 AA.

Secretion increased: elevation of blood sugar, aminoacids, parasympaticus system action, glukagon, glucocorticoides, growth hormone, placental lactogen,estrogenes, gestagenes (during pregnancy)

Secretion decreased: fats, sympaticus action, somatostatin, adrenalin

# Insulin



# Insulin

Daily production:

40-50 units

(15-20% of pancreatic depot)

50% basal secretion

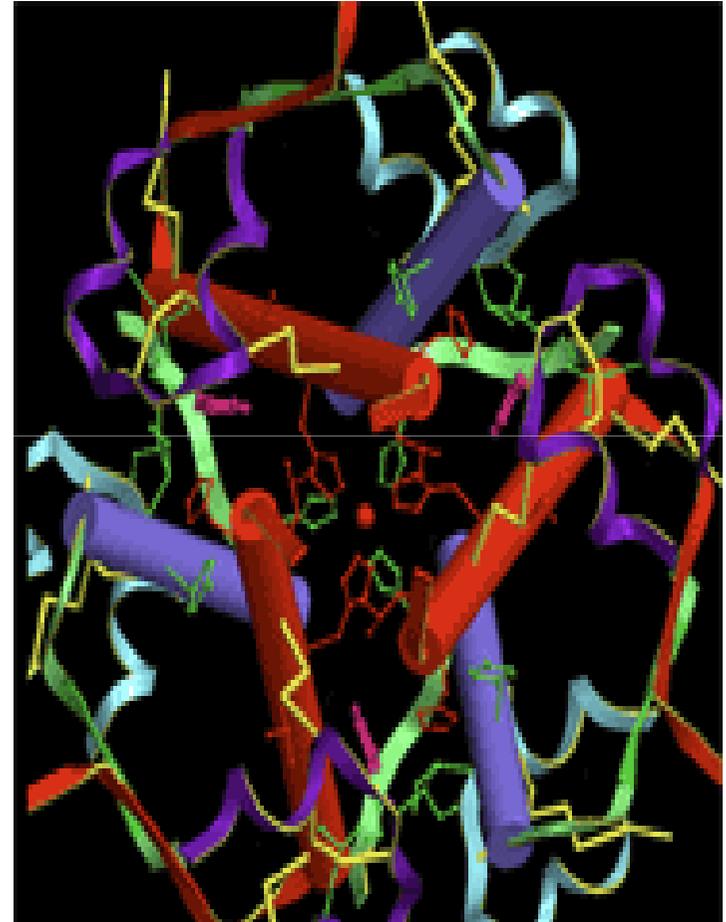
50% postprandial secretion

Plasmatic halftime:

3-5 minutes, no transport protein

First-pass effect:

50% used during first passage through liver



# C peptid

Function unknown

Variable length

Used as marker of endogenous insulin production  
(produced in equimolar proportion, can be used in patients  
on insulin therapy as well)

No first-pass effect

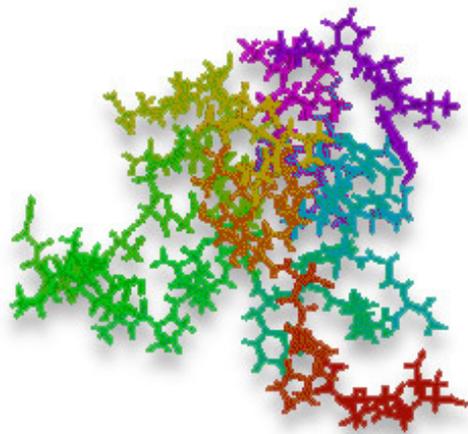
# Insulin like growth factors

IGF-I  
70 AMK

62 % homology (IGF-I and IGF-II)  
50 % homology with insulin

IGF-II  
67 AMK

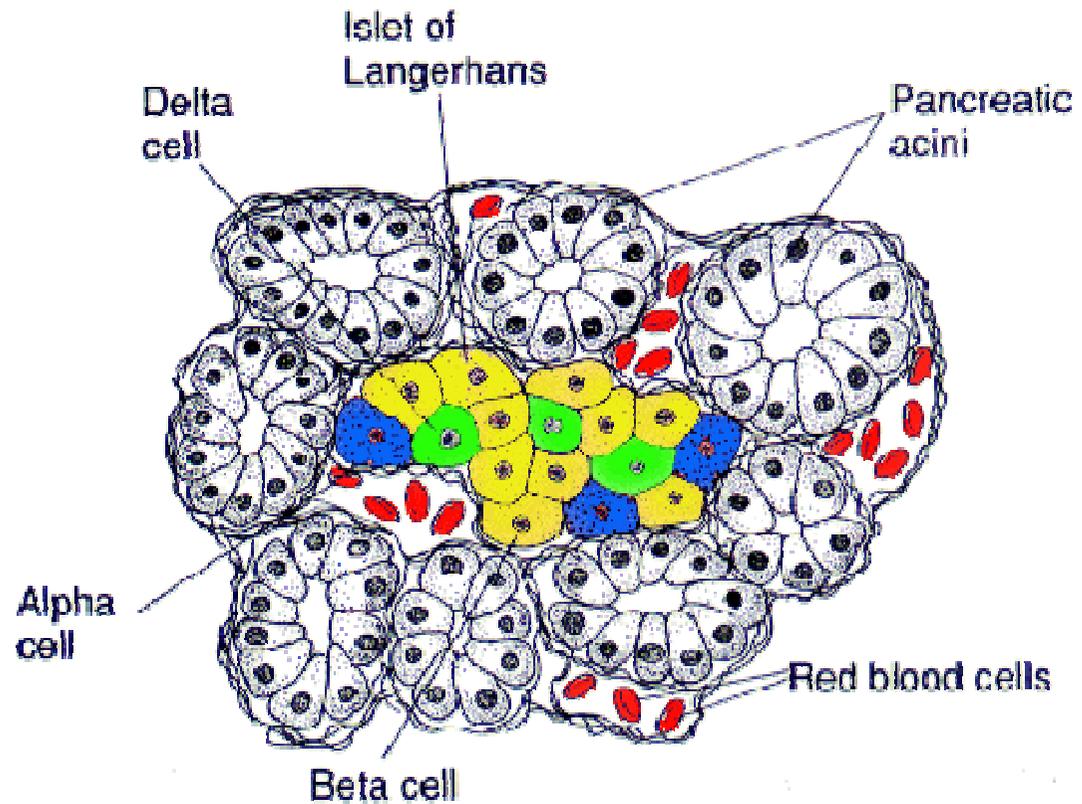
More stimulate growth than insulin  
Have less metabolic effect than insulin



# A (alpha) cells

25%

Produce glucagon



# Glucagon

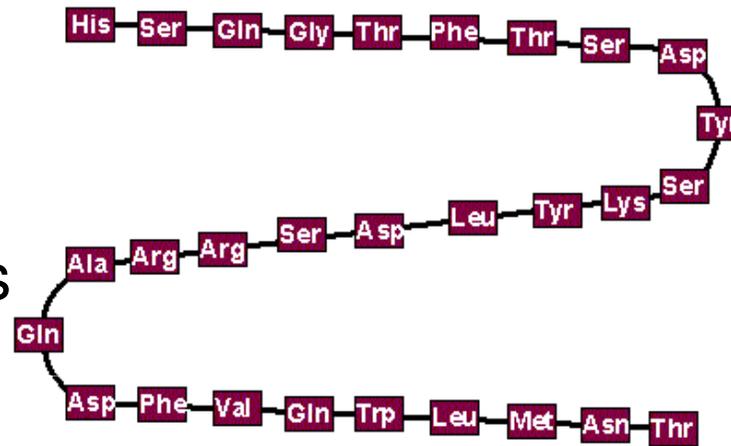
29 amino acids

Synthesized as proglucagon

Plasmatic halftime 5 minutes

No transport protein

Inactivation in liver

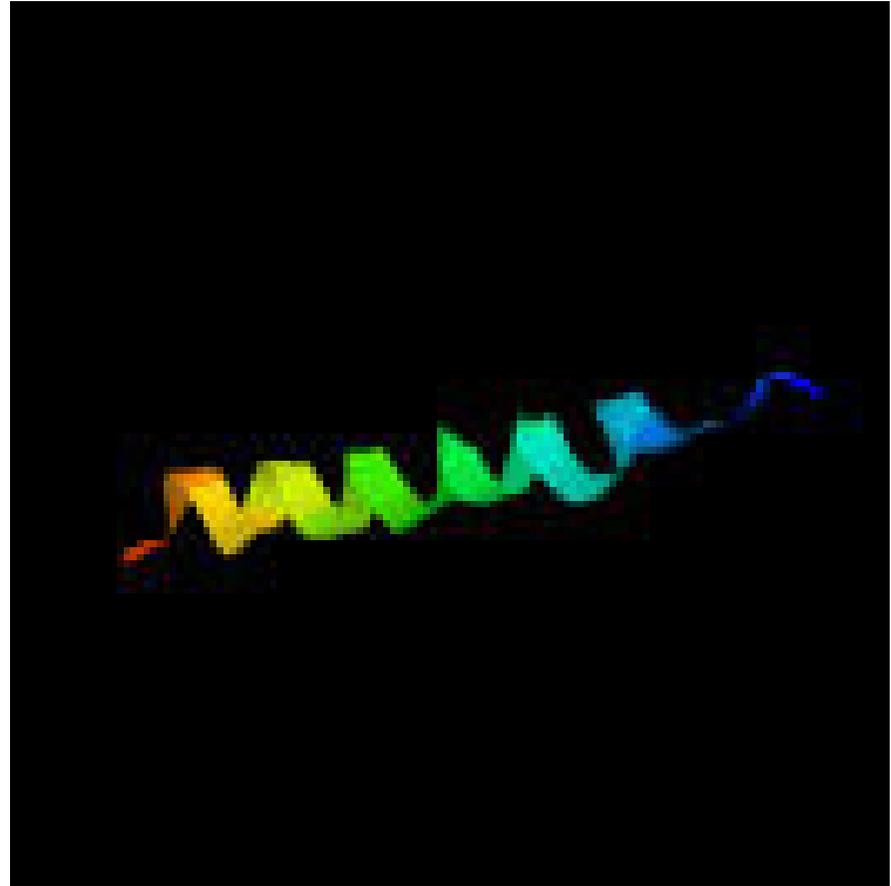


# Glucagon

Enhances

glycogenolysis  
lipolysis  
gluconeogenesis  
ketogenesis

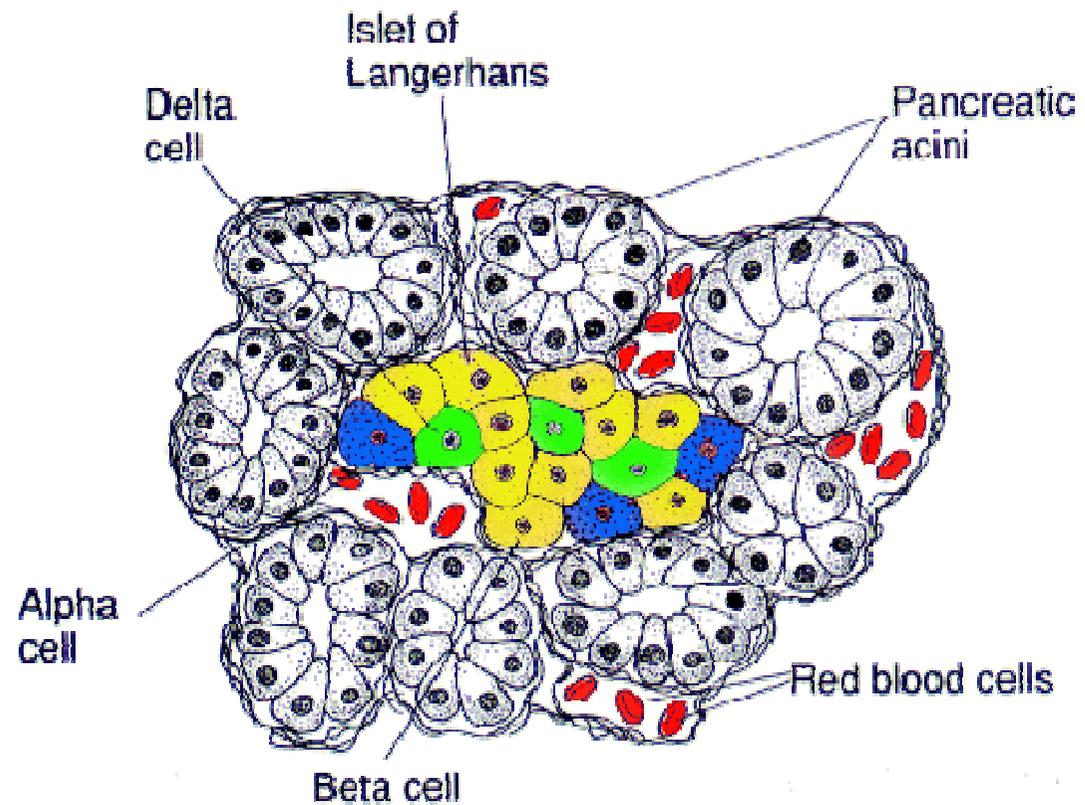
Receptors mainly in liver



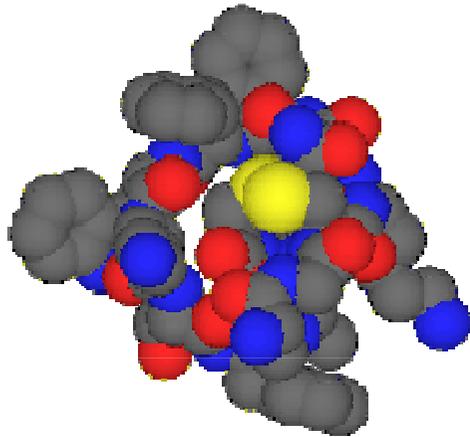
# D (delta) cells

5%

Produce somatostatin



# Somatostatin



cyclic peptide, 14 amino acids

in CNS – neurotransmitter function

synthesized also in other places in GIT

Inhibition of insulin and glucagon secretion

Slows gastric emptying, lowers gastrin secretion,  
pancreatic exocrine secretion, ...

# Blood glucose regulation



FOOD INTAKE

-

INSULIN

glucagon like peptid  
utilization in CNS  
muscle work

+

GLUCAGON

catecholamins  
glucocorticoides  
growth hormone

# Blood glucose regulation



-

INSULIN

glucagon like peptid

utilization in CNS

Muscle work

+

GLUCAGON

catecholamins

glucocorticoides

growth hormone

# DM diagnosis

Fasting glycemia (venous and capillary blood)

<5,6 mmol/l	no DM
5,7-7,0 mmol/l	impaired fasting glycemia
>7 mmol/l	DM present

Glycemia in random sample

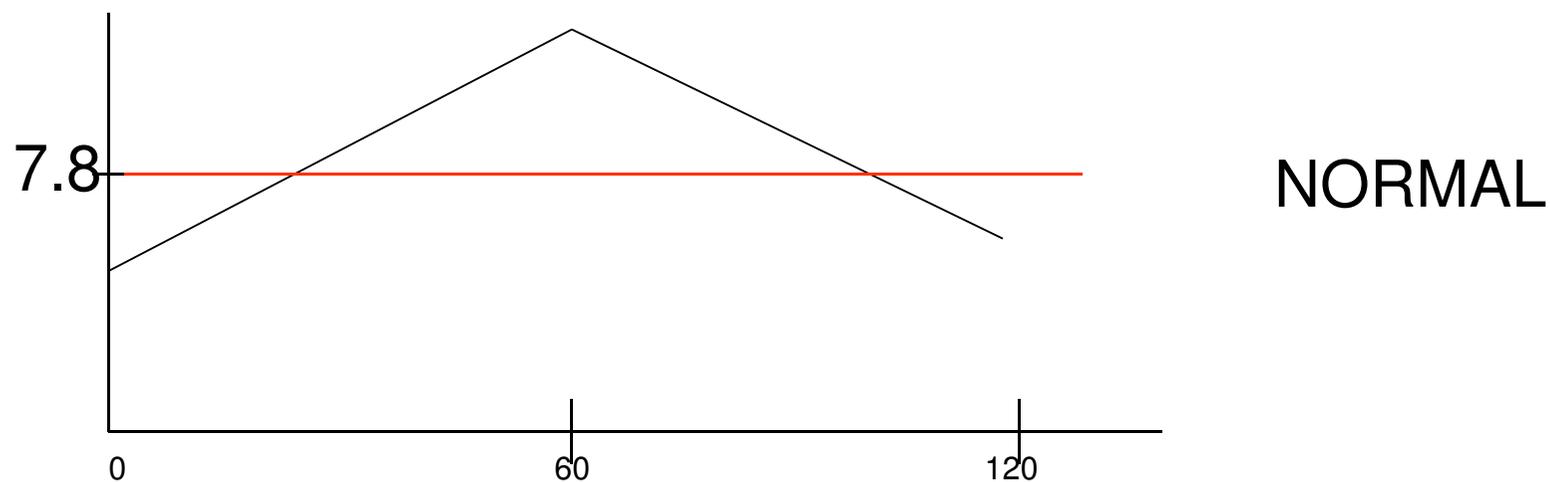
Several times >10mmol/l    DM present

# DM diagnosis

OGTT (oral glucose tolerance test)

75 g of glucose in 400 ml water (tea)

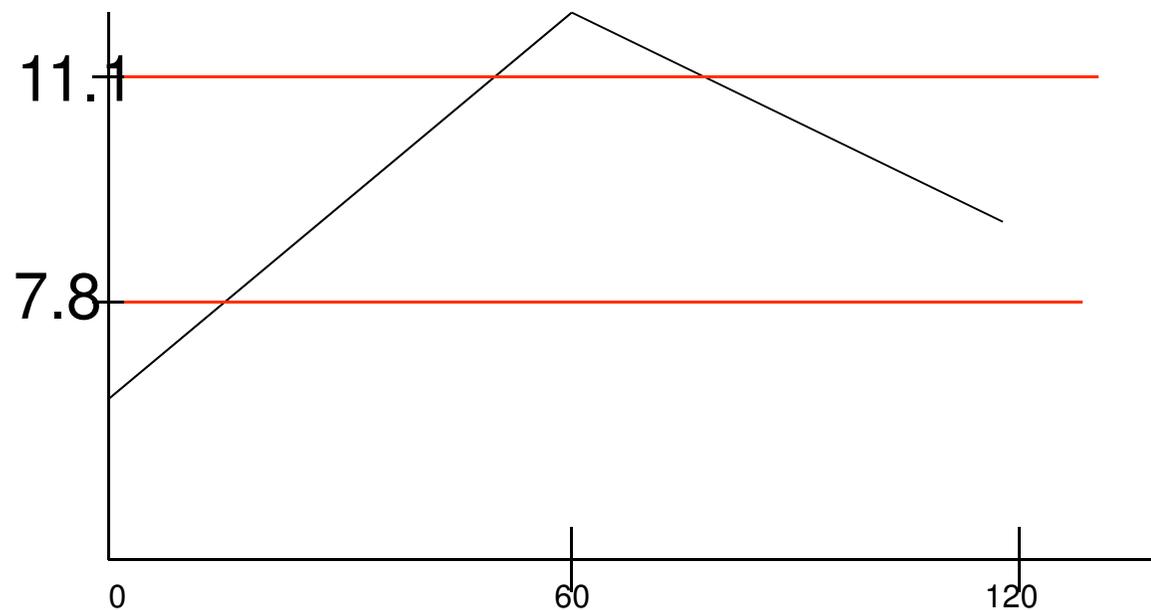
Measurement at time 0 and 120 min (60 min and 180 min sometimes added)



# DM diagnosis

OGTT

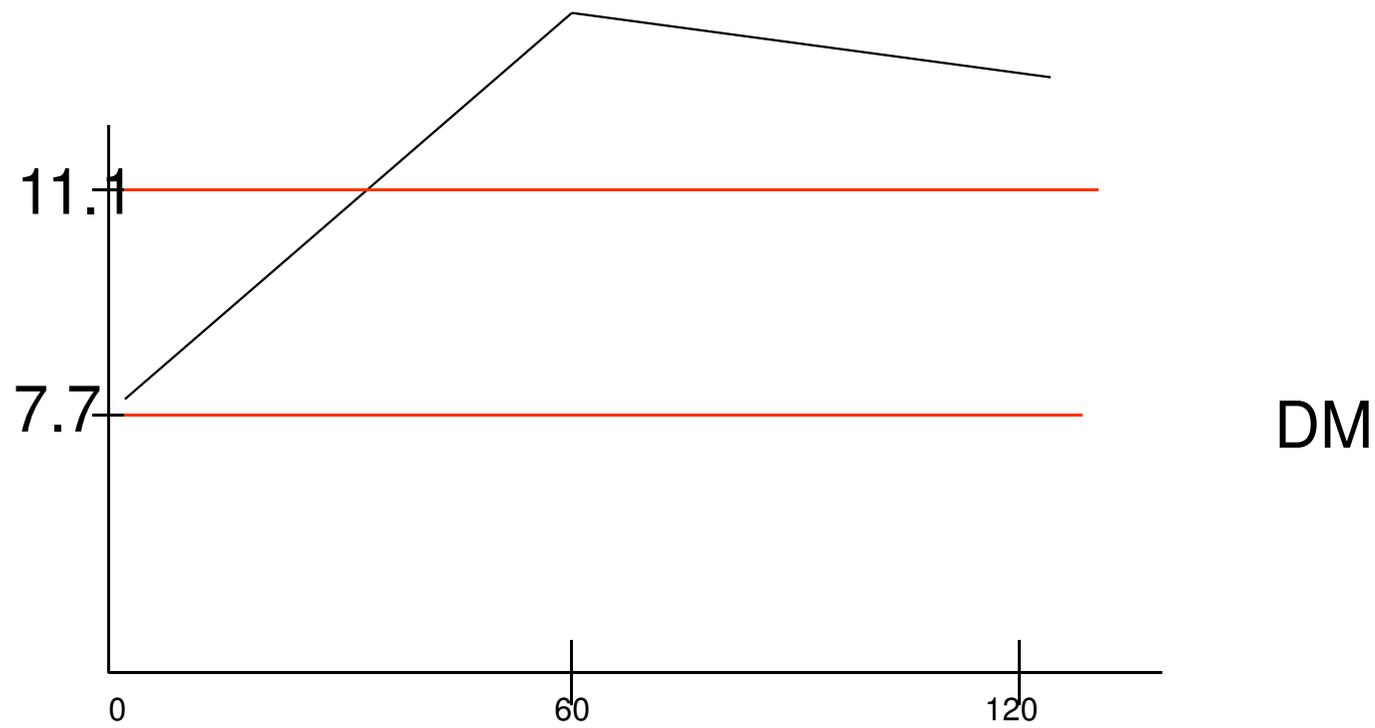
Impaired glucose tolerance



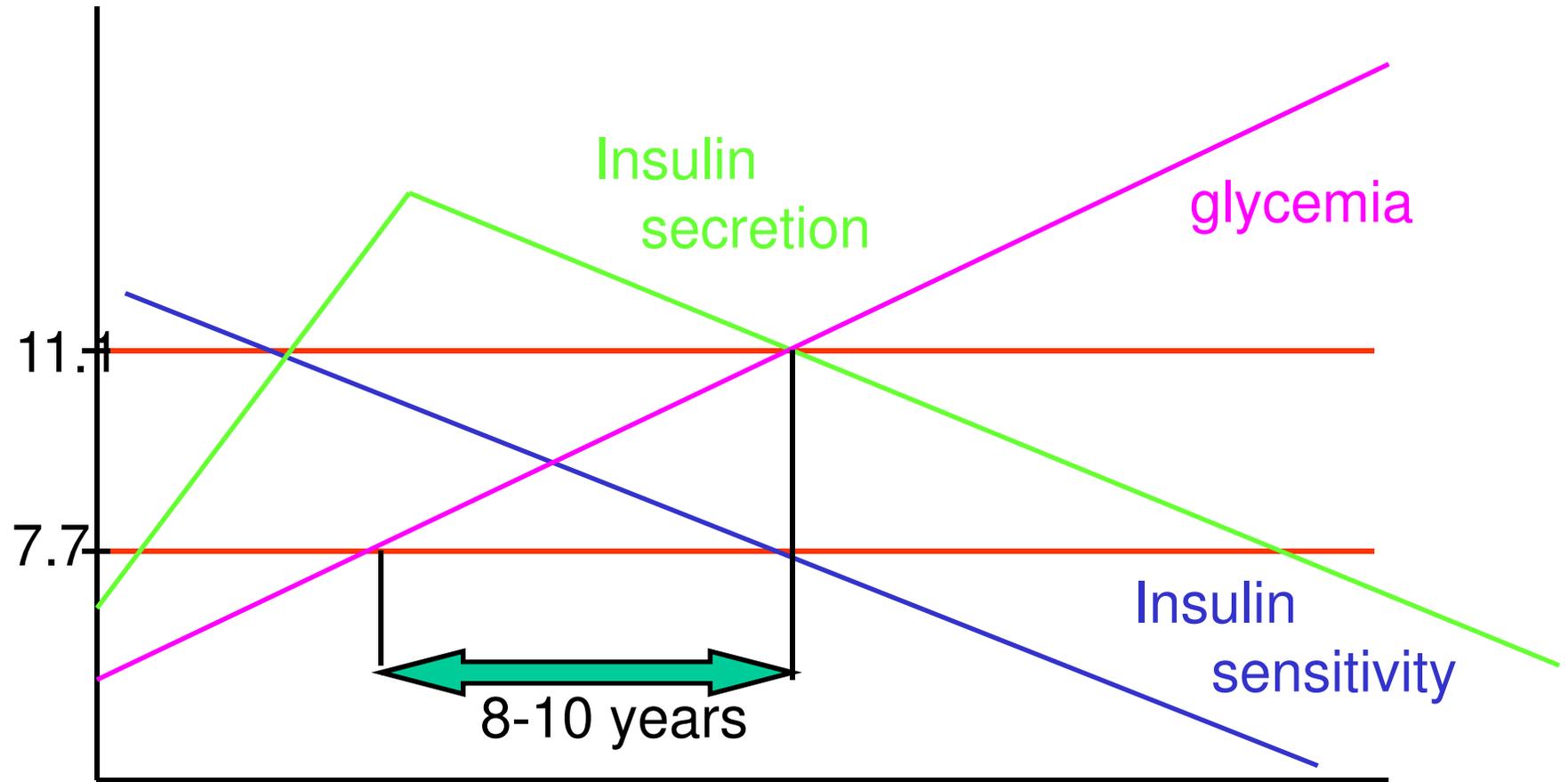
repeat OGTT  
every 2-3 years

# DM diagnosis

OGTT



# DM



# Lab tests in DM

## BLOOD GLUCOSE

fasting

random

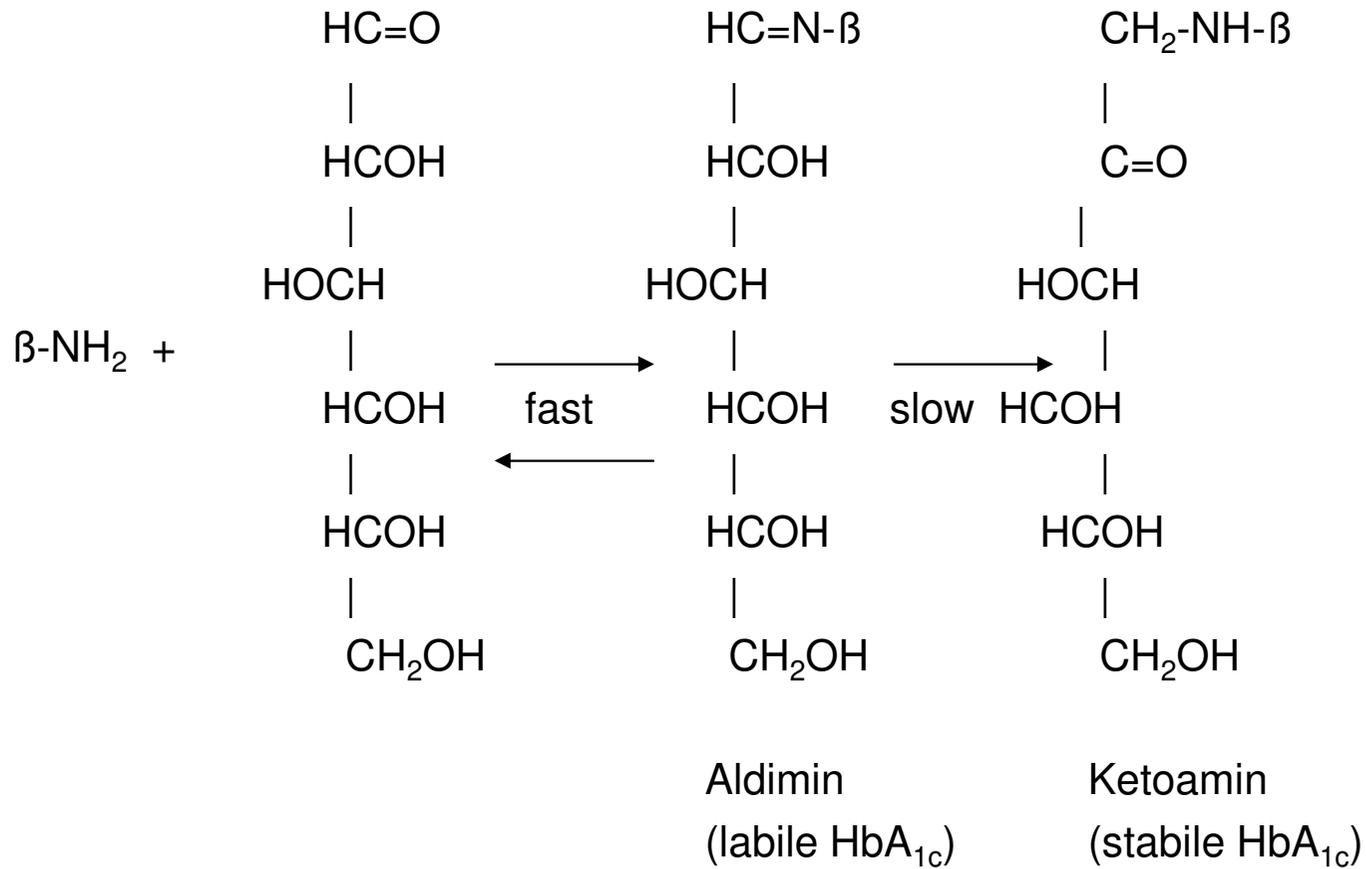
oral glucose tolerance test (OGTT)

glycemic profile

## GLYCATED HAEMOGLOBIN, PEPTIDES, AGEs

INSULIN, C PEPTID, anti-GAD antibodies, antibodies against insulin, antibodies against B cells (ICA, IA2)

# haemoglobin glycation



# Haemoglobin - types

Haemoglobin and derivatives	Subunits present	sugar	content
HbA <sub>0</sub>	$\alpha_2\beta_2$	-	> 90%
HbA <sub>2</sub>	$\alpha_2\delta_2$	-	2%
HbF	$\alpha_2\gamma_2$	-	0.5%
HbA <sub>1a1</sub>	$\alpha_2(\beta\text{-F-D-P})_2$	Fructose-1,6-diphosphate	<1%
HbA <sub>1a2</sub>	$\alpha_2(\beta\text{-G-6-P})_2$	Glucose-6-phosphate	<1%
HbA <sub>1b</sub>	?	?	<1%
→ HbA <sub>1c</sub>	$\alpha_2(\beta\text{-G})_2$	Glucose	<4%
HbA <sub>1d</sub>	?	?	traces
HbA <sub>1e</sub>	?	?	traces

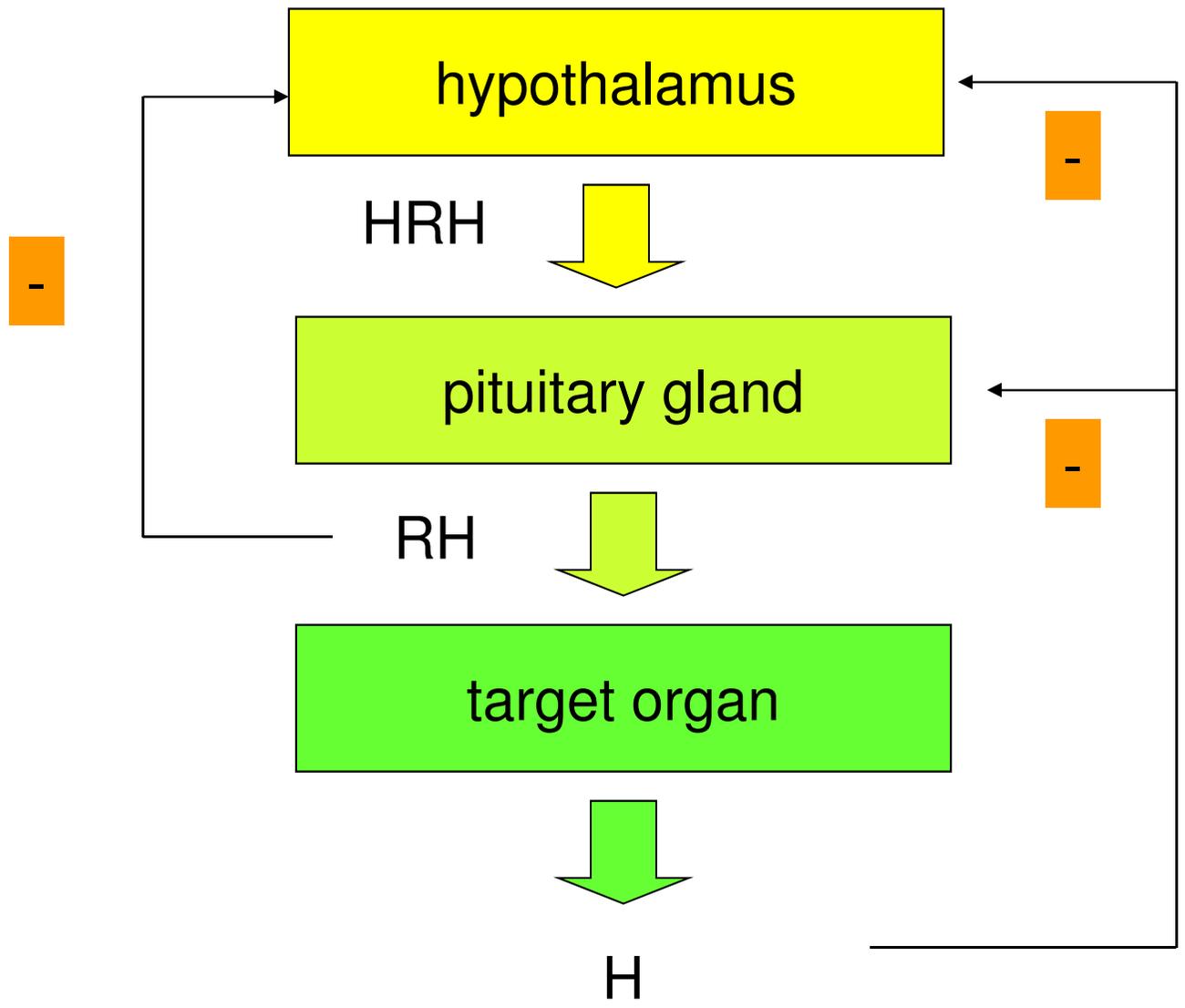
# Haemoglobin A<sub>1c</sub>

***Reference values 28 – 40 (95 % interval)***

<b><i>DM compensation</i></b>	<b><i>Values given by IFCC applicable from 1. 1. 2004</i></b>
<i>excellent</i>	<i>&lt; 45</i>
<i>good</i>	<i>45 – 60</i>
<i>bad</i>	<i>&gt; 60</i>



# Endocrinology of reproduction



# Female hormonal system

## Gonadotropic hormones

FSH

LH

prolactin



# Female hormonal system

Gonadotropic hormones

## **FSH**

function: follicles growth, stimulation of estrogens secretion

structure: proteohormon, 207 amino acids,  
subunits alpha and beta

Lab assessment: immunoanalysis



# Female hormonal system

Gonadotropic hormones

**LH**



function: peak precedes ovulation, afterwards stimulation of both estrogen and gestagen secretion

structure: proteohormon, 205 amino acids, alpha and beta subunits

lab: immunoanalysis

# Female hormonal system

Gonadotropic hormones

**prolaktin**



function: mainly milk production, acts also on ovaries

structure: proteohormon, 198 amino acids, 1band

lab: immunoanalysis

# Female hormonal system

## Native estrogens

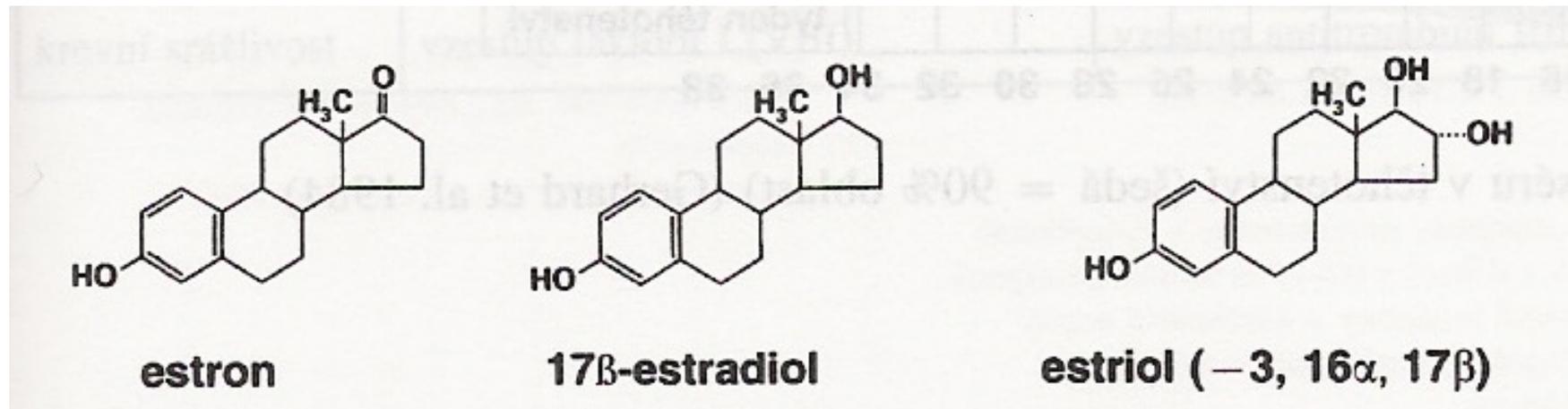
structure: 18C steroids  
aromatic A circle

lab: immunochemistry



# Female hormonal system

## Native estrogens



# Female hormonal system

## **Native gestagens**

structure: 21C steroids

Lab: immunochemistry



## **Native gestagens**



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OFFENDING COMMAND: ~  
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