FUNCTIONAL EXPLORATION OF ENDOCRINE PANCREAS

The main hormones secreted by the endocrine pancreas are represented by insulin and glucagon and the most frequent pathology encountered in practice is related to the disorder of insulin secretion. Functional exploration is obtained through the following tests:
- specific – with the determination of which hormone, hormone precursor and hormone metabolic product is achieved
- unspecific - which reveals the metabolic effects of hormones

1. SPECIFIC TESTS (DIRECT TESTS)
1. **Insulin blood level.** It represents the circulating level of insulin and is measured by radioimmunological method (RIA).
   Normal values: 2-20 µI.U./ml.
   Pathological variations:
   - is decreased in diabetes mellitus (DM) type 1 with polyuria, polydipsia, polyphagia
   - is normal, decreased or increased in DM type 2
   - is increased → hyperinsulinism (isles Langerhans adenomas) with hypoglycemia – sweating, tremor, tachycardia, anxiety, hunger, dizziness, headache, clouding of vision, confusion, abnormal behavior, convulsions and loss of consciousness

2. **C peptide.** It is secreted in equimolecular quantities with insulin.
   Normal values: 0.5–2 ng/ml.
   Pathological variations. Its plasma level enables the differential diagnosis of hypoglycemias from diabetes mellitus and hyperinsulinism.
   - a low concentration of peptide C corresponds to hypoglycemia from overdose exogenous insulin injection (drug)
   - an increased level of peptide C corresponds to hypoglycemia from hypersecretion of endogenous insulin (hyperinsulinemia).

2. TESTS THAT REFLECT THE EFFECTS OF INSULIN ON GLUCOSE METABOLISM
1. **Fasting blood glucose level.** It is accomplished by colorimetric method or with the blood glucose monitoring system (strips used to determine blood glucose).
   Normal values: fasting blood glucose level=70-110 mg/dl (0.7–1.1 g/l).
   Pathological variations:
   - a fasting blood glucose level above 126 mg/dl often indicates diabetes mellitus.
   - a fasting blood glucose level below 50 mg/dl indicates the presence of hypoglycemia.

2. **Urinary glucose:** Is accomplished through Benedict method or with rapid tests.
   Normal value: the absence of glucose in urine.
   Pathological variations: urinary glucose occurs at a blood glucose value above 180 mg/dl. Patients with diabetes mellitus have urinary glucose depending on the severity of the disease and the carbohydrate intake.

3. **Urinary ketone bodies:** is accomplished through Legal-Imbert method or with rapid tests.
   Normal value: the absence of ketone bodies in urine.
   Pathological variations: in case of ketone bodies in urine, a violet ring between the two media is formed.
   The identification and quantity of urinary ketone bodies is important in determining the severity of the diabetes mellitus.

4. **Glycosylated hemoglobin.** It is a valuable indicator of glucose metabolism control in time. It represents glycoHb resulting from fixing glucose on the NH2 groups of Hb. Blood glucose can bind to a ketamine stable form with β chain of hemoglobin, with the formation of HbA1 subtype, which has three fractions (a, b and c). The fraction c of HbA1 is the glycosylated fraction. It is used to assess glucose control in the last 6-8 weeks.
Normal values: 4-6% of total Hb.
Pathological variations: values >6.5 mg/dl indicate a high blood sugar level and an unsatisfactory glucose balance.

5. Oral glucose tolerance testing (OGTT)
Indications:
- in patients with multiple border-line fasting serum glucose levels (110-125 mg/dl)
- in patients with symptoms that may be clearly related to diabetes mellitus
- in subjects who manifest pathology that may be a complication of diabetes mellitus
Method:
- 3 days before an intake of 150 g carbohydrate/day
- the test is conducted in the morning, after 10-12 hours of fasting, without ingestion of caffeine or nicotine during this period
- are administered 75 g (or 1 g/kg) glucose dissolved in 250-300 ml water (in children 1.75 g kg, exceeding 75 g glucose, with glucose determination at 0, 0.5, 1; 1.5 and 2 hours. For the diagnosis of reactive hypoglycemia the duration extends at 3, 4 or 5 hours.

Table I. OGTT interpretation Glucose tolerance

<table>
<thead>
<tr>
<th>Glucose level venous blood</th>
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<tbody>
<tr>
<td><strong>Diabetes mellitus</strong></td>
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<tr>
<td>Fasting blood glucose</td>
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<tr>
<td>Two hours after glucose administration</td>
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<tr>
<td><strong>Impaired glucose tolerance</strong></td>
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The test is influenced by the following factors:
- age → fasting blood glucose increases with 1 mg/dl/10 years
- pregnancy → in the case of pregnant women, fasting glucose level is 90 mg/dl, after 1 h is 170 mg/dl and after 2 h is <145 mg/dl
- diet → a reduced ingestion of carbohydrates before the test induces an increase of the glucose blood levels during the test
- exercise → untrained individuals present a lower glucose tolerance
- medication → hyperglycemic drugs (diuretics, glucocorticoids and estrogens) may modify the test

3. TESTS THAT REFLECT THE EFFECTS OF INSULIN ON FAT AND PROTEIN METABOLISM
Diabetes mellitus
- lipids, cholesterol, LDL cholesterol, triglycerides, ketone bodies-increase
- HDL cholesterol, proteins decrease

4. OTHER TESTS
• Computed tomography (CT) and abdominal ultrasound are used especially for diagnosis of insulin secreting tumors (to help locate the tumor in retroperitoneal or abdominal cavity).