

Oral glucose tolerance test for Diabetes Mellitus (DM) and insulin resistance

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Indication:

- Obese children with clinical signs of insulin resistance (acanthosis nigricans) and / or a family history of diabetes
- The oral glucose tolerance test (OGTT) is used to clarify borderline elevation in fasting plasma glucose
- The OGTT is usually used to exclude/confirm a diagnosis of Glucose intolerance or Type 2 Diabetes Mellitus (DM) i.e. an equivocal result for the diagnosis of diabetes with blood glucose levels $<7.0 \text{ mmol/L}$.
- The test is unnecessary if a child has characteristic symptoms of diabetes (e.g. weight loss, thirst, polyuria) and either a random venous plasma laboratory glucose concentration of $\geq 11.1 \text{ mmol/L}$, or a fasting concentration of $\geq 7.0 \text{ mmol/L}$.
- Refer to the CFRD modified OGTT (available in cystic fibrosis guidelines on microguide) if testing in a child with CF

Principle

In children with normal pancreatic function insulin secretion maintains blood glucose within a tight concentration range following an oral glucose load. Failure of insulin secretion, or resistance to insulin action, will result in an elevation in blood glucose.

Obesity in childhood leads to an increased risk of developing insulin resistance which can lead to hyperinsulinaemia and eventually type 2 DM. In contrast to the diagnostic assessment of diabetes, the diagnosis of insulin resistance is less clear, depending on the given situation of an individual. There are no clear criteria to define insulin resistance in children at present.

Precautions

- ! Do not perform glucose tolerance tests on patients with uncontrolled thyroid dysfunction or patients who are under physical stress e.g. post-surgery, trauma or infection or extreme psychological stress as these may give misleading results due to altered insulin sensitivity in these circumstances.
- ! Do not perform this test on patients with hypokalaemic periodic paralysis.
- ! Do not perform this test at the same time as a Synacthen test. It may however, be performed **after** the Synacthen test, even on the same day.

Side Effects

Some patients feel nauseated and may have vasovagal symptoms during this test.

Preparation

- ⌚ Ensure that the child has had an adequate diet (minimum of 150 g/day of carbohydrate) for at least 5 days before the test.
- ⌚ Fast the patient overnight (4 hours for infants) but avoid more prolonged fasting. Drinks of water (no sweet drinks) are allowed during this period. Physical exercise is not allowed in morning prior to and/or during the test
- ⌚ Test should be performed in the morning

Protocol

Time Points:

Time (min)	Procedure	Blood Samples
0	Take blood then administer glucose load	Glucose, Insulin, POCT glucose
120	-	Glucose, Insulin, POCT glucose

1. Ensure the patient's fasting blood glucose level on a glucometer is ≤ 7 mmol/L before proceeding with the test. If the result is higher, take a venous blood sample and send it to the lab to confirm the glucometer result.
2. Prepare the glucose load using the following:

Rapilose: contains 75g anhydrous glucose in 300 ml. For children weighing less than 43kg, give 7 ml/kg (1.75g/kg anhydrous glucose). Total dose should not exceed 75g anhydrous glucose. If the volume is less than 200ml, add water to make up to 200 ml.

NB. If Rapilose is unavailable, other options include:

- **POLYCAL®** (Nutricia Clinical) liquid (contains 0.66g anhydrous glucose per mL; 1.51 mL = 1g anhydrous glucose): Dose of POLYCAL must be adjusted for the weight at a dose of 2.64 mL POLYCAL/kg body weight (maximum dose 113 mL POLYCAL, equivalent to a 75g glucose load). Add water to make up to a volume of 200 mL.
- **Anhydrous glucose:** Dose 1.75 g/kg body weight (maximum dose 75g diluted in 200 mL water).

3. Take a basal sample for glucose and insulin ($t = 0$). Write $t = 0$ on the tube. In addition, **take a capillary blood glucose level ('POCT glucose')** and record result in the notes.
4. Give the child the Rapilose after the basal sample. **They should drink the glucose load over a period of no more than 5 min.**
5. Take a further blood sample at +120 minutes (2 hours) after finishing the glucose drink. Write " $t=120$ " on the tube of blood and time of sampling.

In addition, **take a capillary blood glucose level** ('POCT glucose') and record result in the notes.

Samples

Glucose 1 mL venous blood in fluoride oxalate (grey top).

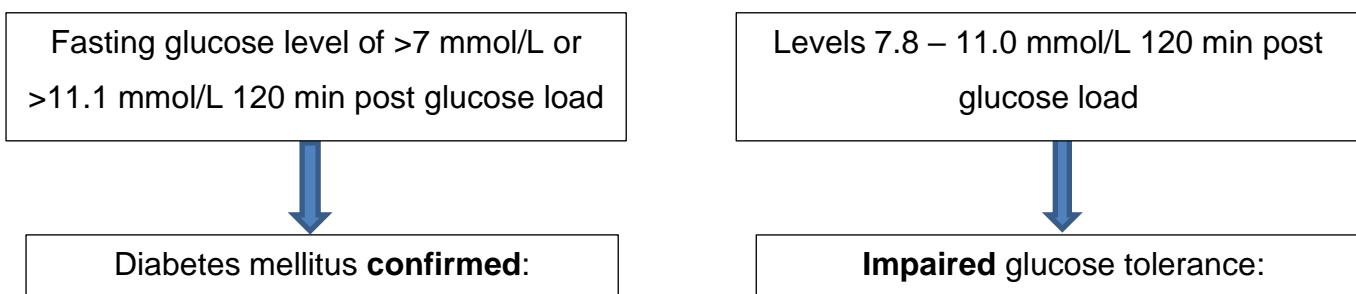
Insulin 1 mL clotted blood (yellow / gold top). Must be taken to lab immediately **on ice**

Record actual sample collection times on the printed labels.

If it is not possible to collect a venous sample, then 0.5 mL (minimum) capillary blood in a fluoride tube may be substituted but the result interpretation is different (see table below). Samples taken at 0 and 120 min must always be of the same type.

Interpretation

Diagnostic criteria for Diabetes mellitus in venous plasma:



Use values in the table below for diagnosing diabetes using different sample types:

	Glucose Concentration (mmol/L)		Glucose Concentration (mmol/L)	
	Whole blood		Plasma	
	Venous	Capillary	Venous	Capillary
Diabetes Mellitus				
Fasting	≥6.1	≥6.1	≥7.0	≥7.1
120 min post-glucose	≥10.0	≥11.1	≥11.1	≥12.2
Impaired glucose tolerance				
120 min post-glucose	≥6.7 and <10.0	≥7.8 and <11.1	≥7.8 and <11.1	≥8.9 and <12.2
Impaired fasting glycaemia				
Fasting	≥5.6 and <6.1	≥5.6 and <6.1	≥6.1 and <7.0	≥6.1 and <7.0

The 2010 consensus statement recommends there is no clear cut-off to define insulin resistance in children and surrogate measures such as fasting insulin are not ideal.

The following cut-off values taken from SPEG2 provide useful guidance:

- Fasting insulin is <60 pmol/L in pre-pubertal children or children younger than 10 years or <120 pmol/L in children post pubertal children.
- Peak during the test is normally <600pmol/L.
- Fasting insulin of 120 - 300 pmol/L or peak insulin of 600 - 1800 pmol/L is suggestive of mild to moderate insulin resistance.
- Fasting insulin of >300 pmol/L or peak insulin of >1800 pmol/L is suggestive of severe insulin resistance.

References

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