**Glucagon Stimulation Test for Growth Hormone**

**ICE Test Name:** Child Glucagon: GH (-30m)

**Principle**
This test is commonly used for the evaluation of growth hormone deficiency (GHD). Glucagon causes blood glucose to increase leading to insulin release and therefore indirectly stimulating GH and ACTH release through provocation of the hypothalamic-pituitary axis.

**Indication**
- See *Diagnosis of Growth Hormone Deficiency*

**Precautions**
- The test should not be performed on a patient with phaeochromocytoma or insulinoma as it may provoke an attack.
- The test should not be carried out following starvation of >48 hours or in the presence of a glycogen storage disease. The inability to mobilise glycogen may result in hypoglycaemia.
- The test should not be carried out in patients with severe hypocortisolaemia (9 am level <100 nmol/L)
- Thyroid function must be normal as thyroxine deficiency may reduce the GH response.

**Side Effects**
- Nausea and abdominal pain are common (30%) and patients may rarely vomit.

**Preparation**
- Thyroid function and cortisol must be checked to rule out panhypopituitarism
- GH should be stopped for at least 4 weeks prior to the test.
- Patients must fast for 8 hours prior to the test (water only is allowed).
- Sex steroid priming may be necessary, see *Diagnosis of Growth Hormone Deficiency*

**Protocol**

*Children can become hypoglycaemic after glucagon administration, usually 90 – 120 minutes post dose. Children <8 yrs of age are at particular risk. Check glucose levels (by glucose meter) at the time of every sample. Check that the child is responsive at the time of every sample. If they do not respond then follow instructions for the emergency management of hypoglycaemia.*

1. Insert an indwelling 22 gauge, blue, cannula and take a basal blood sample (t = -30). Wait 30 minutes before taking the baseline (t = 0) sample for growth hormone as cannulation may cause GH to rise.

2. Check glucose level by meter.
   - If glucose < 2.6 mmol/L do not administer glucagon.
   - If glucose level > 2.6 mmol/L then administer glucagon i.m. using a dose of 30 µg/kg of body weight up to a maximum dose of 1 mg.

3. Take further blood samples for growth hormone at 60, 90, 120, 150 and 180 min post glucagon administration.

4. Observe for signs of hypoglycaemia throughout the test and record in patient’s notes

5. Remember to check the child’s glucose level by meter and the responsiveness at every sample.

6. A sweet drink and a full meal must be eaten and tolerated after the test and the child should be observed for 1 hour after the test. Blood glucose (by meter) must be >4 mmol/L before discharge.
Time Points:

<table>
<thead>
<tr>
<th>Time post glucagon (min)</th>
<th>Procedure</th>
<th>Blood Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>-30</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>0</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>60</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>90</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>120</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>150</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>180</td>
<td>Check blood glucose using meter</td>
<td>Growth hormone</td>
</tr>
</tbody>
</table>

**Samples**

**Growth Hormone** 1 mL clotted blood (white top)

Record actual sample collection times on the printed barcodes. SEND ALL SAMPLES TO THE LABORATORY TOGETHER

**Interpretation**

- A peak plasma GH concentration of ≥7 µg/L indicates a normal response to the test and no further investigations are required.
- A peak plasma GH concentration of <5 µg/L is diagnostic of growth hormone deficiency but requires a second GH provocation test to confirm the diagnosis.
- A peak plasma GH concentration of 5–7 µg/L may still be indicative of GH deficiency and requires further investigation.
- In adults, a peak plasma GH concentration of <3 µg/L is diagnostic of growth hormone deficiency.
- Peak GH responses are also highly dependent on both short term nutritional status and on BMI – higher peak GH levels after short term fasting and in those with lower BMI.

**References**

1. Basildon and Thurlow University Hospitals NHS Foundation Trust Clinical Biochemistry Department paediatric department Glucagon Stimulation test Paediatric protocol