Glucose Tolerance Testing

PROTOCOLS FOR PERFORMING GLUCOSE TOLERANCE TESTS

INTRODUCTION

Described in this section are the sample requirements, patient preparation instructions, dosages of substances to be administered, protocols for collecting specimens, time intervals for collecting specimens, etc., for Tolerance tests. The performance and accuracy of these tests is directly dependent upon the protocols herein described. Therefore it is extremely important that the integrity of these protocols be maintained. The best analytical procedures and techniques cannot compensate for poor patient preparation or deviation from the standard operating procedure. By not following the protocols and directions described will lead to inaccurate results at best or harm to the patient at worst.

The protocols for performing tolerance tests outlined in this manual are considered by the Department of Pathology to be the standard procedures. If a physician wishes to modify these protocols to suit his own needs, he may do so at his discretion. However, if the physician does make some modifications in a particular protocol, it is in his and the patient's best interest that the physician describe these changes as clearly as possible, in writing, so that the laboratory is well informed of the changes and is thus able to respond without confusion as to the physician's wishes. The proper communication between the physician and the laboratory is of paramount importance if the test is to be conducted properly and in accordance with the physician's wishes.

Standard Glucose Tolerance Test (Oral): 2, 3, 4, 5, or 6 Hour

Rationale:

Patients with mild or diet-controlled diabetes may have fasting blood glucose levels within the normal range, but be unable to produce sufficient insulin for prompt metabolism of ingested carbohydrate, have an auto-immunity to insulin, or have an insulin resistance at the cellular level. As a result, blood glucose rises to abnormally high levels and the return to normal is delayed. In other words, the patient has decreased tolerance for glucose. Therefore, glucose tolerance tests are most helpful in establishing a diagnosis of a mild case of diabetes. When a standard dose of 75 grams of glucose is given orally, absorption occurs rapidly and the blood glucose concentration increases. The increased blood glucose level stimulates the pancreas to produce more insulin with the result that after 30 to 60 minutes, the blood glucose level begins to decrease. Under normal circumstances, there now exists more insulin than necessary, and the blood glucose tends to drop below the fasting level after 90 minutes to 2 hours, and then returns to normal levels by approximately three (3) hours. Response to the glucose load varies from normal to hyperglycemic or hypoglycemic states of different severity. In a normal response, the fasting level of serum glucose is within normal limits; the peak concentration is reached by 30 or 60 minutes and does not exceed 160 mg/100 ml; and the 2-hour level drops below 100 mg/ml.

Patient Preparation:

The patient is to be placed on a diet containing 1.75 gm of carbohydrate per kilogram of body weight for three (3) days before the glucose tolerance test. If the carbohydrate intake has been too low preceding the test, a false diabetic type curve may be obtained. The patient is to be fasting for 10 ? 12 hours prior to the test. The patient is to be informed that the glucose tolerance test is to begin between 0700 and 0800 on the morning following the three days of preparation.

Procedure:
This test must be made by appointment with the laboratory and must be confirmed before 2:00 p.m. on day prior to the test. The standard, oral glucose tolerance test of 2 hours duration will be performed unless otherwise requested by the physician. The patient should be on a normal mixed diet three days prior to the test (1.75 grams of carbohydrate per kilogram body weight per day). The patient is to remain fasting from 8:00 p.m. on day prior to test until its completion. Water is allowed in moderation. The person administering the tolerance test will bring the chilled glucose preparation to the Outpatient Area (Glucola, 75 grams glucose). See Notes, below, for glucose preparations of different concentrations for pediatric patients or at the request of the physician. The person administering the tolerance test will perform a finger stick glucometer reading on the patient to insure that the patient's fasting glucose is less than 140 mg/dL. If the fasting glucose exceeds 140 mg/dL or is less than 50 mg/dL, the person administering the test will wait for the fasting laboratory glucose result before administering the glucola drink or canceling the test. The fasting blood specimen is now drawn. Personnel administering the test are to give the 75 gm glucola drink to the patient and instruct the patient to drink the glucose preparation within 10 minutes. Personnel administering the test must note the time that the patient finishes consuming the glucola. The test begins at this time. Subsequent blood specimens are to be drawn at precisely 30 minutes, 1 hour, and 2 hours from the time that the test begins. When the final specimen at 2 hours has been drawn, remove a drop of blood for a glucometer reading. If the glucometer reading is <50 mg/dL or >250 mg/dL, contact the patient's physician for further instructions. If the glucose level is within these limits, discharge the patient with the instructions that they can now have breakfast or lunch.

Notes:

Unless requested by the physician, the standard glucose load (75 grams) will be administered to all adult patients (>16 years old). Some patients may become nauseous and vomit after drinking the glucose preparation. If this occurs before 60 minutes after the test has begun, the test is invalid and will have to be rescheduled. If this occurs after 60 minutes from the time the test has begun, continue with the test but note with a comment that the patient did vomit during the course of the test. Include the approximate time of the incident. For pediatric patients, a glucose solution will be prepared on the basis of 0.5 gm glucose per pound of patient weight up to 75 grams:

\[
\text{Pediatric Glucose Dose (gms) = 0.5 x Patient Weight (lbs)}
\]

The same protocol is used for longer tolerance tests (e.g. 3, 4, 5, or 6 hours), which may be requested by the physician. The protocol is exactly the same except that timed specimens are drawn at each of the additional hours. If this test is given to diagnose Gestational Diabetes Mellitus (GDM), and at least two values exceed the following values for the corresponding times during the course of the test, this is diagnostic for GDM.

- **Fasting:** >105 mg/dL
- **One Hour:** >190 mg/dL
- **Two Hour:** >165 mg/dL
- **Three Hour:** >145 mg/dL

Glucose Tolerance Test ? Intravenous

Rationale:

The rationale behind this test is the same as that behind the Oral Glucose Tolerance Test. The intravenous
approach for administering the glucose load is used when it is suspected or proven that the patient has an impaired mechanism for ilial absorption of carbohydrates due to disease or surgery. In such cases, the Oral Glucose Tolerance Test will result in a "flat" tolerance curve, which may be difficult to interpret. In the event that such a response is seen with the Oral Glucose Tolerance Test, or when poor carbohydrate absorption on the part of the patient is suspected, glucose may be given by I.V. infusion. Preparation of the Patient is exactly the same as for the Oral Glucose Test.

Procedure:

This test must be made by appointment with the laboratory and must be confirmed before 2:00 P.M. on the day prior to the test.

Inform the Pharmacy on day prior to test, giving the patients current weight.

Patient should be on normal diet three days prior to test. (1.75 gm carbohydrate per kilogram body weight per day).

Patient to remain fasting from 8:00 p.m. on day prior to test until its completion. Water is allowed in moderation.

The person administering the tolerance test will perform a finger stick glucometer reading on the patient to insure that the patient's fasting glucose is less than 140 mg/dL. If the fasting glucose exceeds 140 mg/dL or is less than 50 mg/dL, the person administering the test will wait for the fasting laboratory glucose result before administering the glu cola drink or canceling the test.

The fasting blood specimen is now drawn.

As soon as the fasting specimen has been drawn, nursing personnel are to begin an I.V. infusion of a 20% sterile glucose I.V. preparation at a flow rate that allows a total of 0.5 grams glucose per kilogram of body weight to be administered over a 30 minute interval. The calculation to determine mL (cc)/minute is as follows:

\[ mL/minute = 1.14 \times \text{wt (lb.)}/30 \]

At the end of 30 minutes, the I.V. is to be discontinued and the 30 minute specimen is to be drawn.

Additional specimens are collected at 1 hour, and 2 hours.

When the final specimen at 2 hours has been drawn, remove a drop of blood for a glucometer reading. If the glucometer reading is <50 mg/dL or >250 mg/dL, contact the patient's physician for further instructions. If the glucose level is within these limits, discharge the patient with the instructions that they can now have breakfast or lunch.

Two Hour Post-Prandial Glucose

Rationale:

Since the 2 hour specimen in a glucose tolerance test has the greatest significance in evaluating diabetes, the test may be shortened for screening purposes to a single determination. The patient consumes a breakfast, lunch, or glucose solution, containing 75 gm of carbohydrate. Two hours after the meal, blood is drawn for a glucose determination. The patient should be instructed to consume the required amount of carbohydrate and to remain at rest during the 2-hour period following the meal. Many physicians now request 2-hour postprandial glucose determinations routinely in lieu of fasting glucose levels as guides to insulin requirements. While the two-hour postprandial test is often done by having the patient consume a designated meal, it is often difficult to control the 2-hour interval very accurately since timing may start at the beginning, midway, or end of the test meal. To insure uniformity of carbohydrate intake and accurate
timing, it is recommended that 75 grams of glucose in solution be used routinely as a test meal for postprandial blood glucose determinations.

Recommended Protocol:

This test must be made by appointment with the laboratory and must be confirmed before 2:00 p.m. on day prior to the test.

The patient should be on a normal mixed diet three days prior to the test (1.75 grams of carbohydrate per kilogram body weight per day).

The patient is to remain fasting from 8:00 p.m. on day prior to test until its completion. Water is allowed in moderation.

The person administering the tolerance test will bring the chilled glucose preparation to the Outpatient Area (Glucola, 75 grams glucose). See Notes, below, for glucose preparations of different concentrations for pediatric patients or at the request of the physician.

The person administering the tolerance test will perform a finger stick glucometer reading on the patient to insure that the patient's fasting glucose is less than 140 mg/dL. If the fasting glucose exceeds 140 mg/dL or is less than 50 mg/dL, the person administering the test will wait for the fasting laboratory glucose result before administering the glucola drink or canceling the test.

The fasting blood specimen is now drawn. Personnel administering the test are to give the 75 gm glucola drink to the patient and instruct the patient to drink the glucose preparation within 10 minutes. Personnel administering the test must note the time that the patient finishes consuming the glucola. The test begins at this time.

Alternatively, the patient may consume a meal containing an equivalent amount of carbohydrate as recommended by the dietary department or the ordering physician. This mean is to be consumed within 20 minutes of the time that it is begun.

At the end of 2 hours from ingestion of a standard glucose solution or the prescribed meal, a second blood specimen is drawn. The phlebotomist or technologist drawing the specimen is to remove a drop of blood for a glucometer reading. If the glucometer reading is <50 mg/dL or >250 mg/dL, contact the patient's physician for further instructions. If the glucose level is within these limits, discharge the patient with the instructions that they can now have breakfast or lunch, particularly if they were given the glucose solution load.

Notes:

Unless requested by the physician, the standard glucose load (75 grams) will be administered to all adult patients (>16 years old).

Some patients may become nauseous and vomit after drinking the glucose preparation. If this occurs before 60 minutes after the test has begun, the test is invalid and will have to be rescheduled. If this occurs after 60 minutes from the time the test has begun, continue with the test but note with a comment that the patient did vomit during the course of the test. Include the approximate time of the incident.

For pediatric patients, a glucose solution will be prepared on the basis of 0.5 gm glucose per pound of patient weight up to 75 grams:

\[ \text{Pediatric Glucose Dose (gms)} = 0.5 \times \text{Patient Weight (lbs)} \]

One-Hour Glucose Tolerance Test (Screen for Gestational Diabetes Mellitus; GDM)

Rationale:
Gestational Diabetes Mellitus (GDM) is suspected when there is a strong family history of diabetes; a history of unexplained stillbirth or neonatal death from previous pregnancies; a history of a child from an earlier birth with congenital anomalies, a previous delivery in which the infant weighed more than 5000 grams (9 ? 10 lbs); or a previous history of infertility or difficulty in getting pregnant. Suspicious clinical signs include obesity, recurrent monilial infections, hydramnios, or glycosuria. Universal screening for GDM is recommended for at least the first pregnancy in all women who have not already been identified as glucose intolerant, either IDDM or NIDDM, and should be performed between the 24th or 28th week of gestation. While the symptoms of GDM are usually mild and not life threatening to the mother, GDM is associated with an increased incidence of congenital malformations in the neonate and perinatal death. GDM is also associated with a higher incidence of complications in pregnancy (e.g. toxemia), a high risk of GDM in subsequent pregnancies, and an increased risk of the mother developing diabetes five to ten years post partum. Early diagnosis and meticulous glycemic control during the first 8 weeks of pregnancy can significantly decrease the risk of congenital malformations in the fetus. Whenever GDM is suspected, the 1 hour glucose tolerance test should be performed as early in the pregnancy as possible.

Recommended Protocol:

This test must be made by appointment with the laboratory and must be confirmed before 2:00 p.m. on day prior to the test. The patient should be on a normal mixed diet three days prior to the test (1.75 grams of carbohydrate per kilogram body weight per day). The patient does not have to fast and the test supposedly may be given any time although a waiting period of at least two hours after the last meal is recommended. The person administering the tolerance test will bring the chilled glucose preparation to the Outpatient Area (Glucola, 50 grams glucose). The person administering the tolerance test will perform a finger stick glucometer reading on the patient to insure that the patient's fasting glucose is less than 140 mg/dL. If the fasting glucose exceeds 140 mg/dL or is less than 50 mg/dL, the person administering the test will wait for the fasting laboratory glucose result before administering the glucola drink or canceling the test. A fasting blood specimen to be sent to the laboratory is not required for this test. As soon as the screening test is complete, personnel administering the test are to give the 50 gm glucola drink to the patient and instruct the patient to drink the glucose preparation within 10 minutes. Personnel administering the test must note the time that the patient finishes consuming the glucola. The test begins at this time. At the end of one (1) hour after complete ingestion of a standard glucose solution, a blood specimen is drawn. The phlebotomist or technologist drawing the specimen is to remove a drop of blood for a glucometer reading. If the glucometer reading is <50 mg/dL or >250 mg/dL, contact the patient's physician for further instructions. If the glucose level is within these limits, discharge the patient.

Notes:

Unless requested by the physician, the standard glucose load (50 grams) will be administered to all adult patients (>16 years old). Some patients may become nauseous and vomit after drinking the glucose preparation. If this occurs before 45 minutes after the test has begun, the test is invalid and will have to be rescheduled. Patients with a one hour glucose level >140 mg/dL should be scheduled for a 3 hour glucose to confirm the diagnosis and determine the severity of the glucose intolerance.