All Wales Clinical Biochemistry Audit Group

Performance of the Oral Glucose Tolerance Test

INTRODUCTION

A survey of protocols used by laboratories in Wales for the performance of oral glucose tolerance test (OGTT) for the diagnosis of diabetes mellitus in non-pregnant subjects, presented at an audit meeting in March 1997, showed significant deviations from previous recommendations of the World Health Organisation (WHO) Study Group on Diabetes Mellitus.

The following standards have been prepared in the light of the presentation and discussion at the audit meeting and the latest report from the WHO (1999), which has recently accepted by the British Diabetic Association (BDA). These standards will be reviewed in the light of any further WHO or BDA reports on the diagnosis of diabetes.

STANDARDS

1. Patient Selection

a) It is inappropriate to undertake an OGTT for the diagnosis of diabetes mellitus in:

(i) a patient who has significant clinical symptoms of diabetes and whose fasting or random glucose concentration fulfils the WHO criteria for diabetes mellitus (Table 1).

(ii) a patient who has no or minimal symptoms and in whom at least two fasting and/or random glucose concentrations are unequivocally within the diabetic range (Table 1). These values should not be obtained during acute intercurrent illness, shortly after major surgery/trauma or during short term treatment with drugs known to affect glucose tolerance (Appendix 2).

b) The OGTT should NOT be performed during acute illness, shortly after major surgery or if there is short-term treatment with drugs known to impair glucose tolerance (Appendix 2).

c) If the fasting or random glucose is less than 4.4 mmol/L (whole blood) or less than 5.6 mmol/L (plasma) in a non-pregnant individual, a diagnosis of diabetes mellitus is unlikely and an OGTT may not be required.

d) It is recommended that all patients with impaired fasting glycaemia should have an OGTT performed to exclude the diagnosis of diabetes.

e) Laboratories are strongly advised not to perform an OGTT until a written request signed by a medical practitioner has been received.

2. Patient Preparation

a) A patient information sheet (Appendix 1) should be given to the patient at least 3 days before the test. This should include a brief outline of the reason for the test and the procedure that is used. Advice regarding exercise, diet and fasting (see below) should be given. It is useful to ask the patient to bring a list of their current medications.

b) The patient should follow an unrestricted diet (containing at least 150g carbohydrate daily) and usual physical activity for at least 3 days before the test.

c) The patient must fast for 10-16 hours before the test is administered. Water may be drunk during the fast.

d) Any long-term drug treatments should be taken as usual on the morning of the test. If the patient is receiving a drug known to affect glucose tolerance (Appendix 2) this should be noted. A current drug history should be obtained.

3. Test Protocol

a) The test should be performed in the morning.

b) Smoking is not allowed during the test.

c) The patient should be instructed to avoid excessive exercise during the test. A comfortable waiting area should be provided for the duration of the test.

d) Unless the glucose concentration can be determined immediately, blood samples should be collected in fluoride/oxalate containers.

e) A blood sample should be collected for measurement of fasting glucose before the test is undertaken. If the fasting glucose is unequivocally (at least 1 mmol/L) greater than the WHO fasting diagnostic value (Table 1) the test should be discontinued.

f) A glucose load equivalent to 75 g anhydrous glucose should be given in a total fluid volume of 250-300 mL. Children should be given 1.75 g anhydrous glucose per kg body weight up to a total of 75 g glucose. The glucose solution should be at room temperature (20-25ºC). Glucose may be given as partial hydrolysates of starch (e.g. Polycal, Maxijul), but the amount given should be equivalent to 75 g anhydrous glucose (113 mL Polycal is equivalent to 75 g anhydrous glucose) and the total volume administered should be 250-300 mL. It is recommended that preparations containing caffeine are avoided. Lucozade is NOT suitable.

g) The glucose drink should be consumed over a 5 minute period. Timing for the rest of the test starts at the beginning of ingestion. The test (other than the fasting sample) is invalid if the patient vomits.

h) A further blood sample should be collected two hours after the glucose load has been given and the glucose concentration measured.

i) It is not necessary to measure urine glucose for the diagnosis of diabetes.

4. Interpretation

a) The most recent WHO guidelines should be used when interpreting the results. The current guidelines are those published in the 1999 WHO Consultation Report, as shown in Table 2. The appropriate set of figures should be applied to the particular sample type used.

b) If the patient is asymptomatic and only one of the glucose values from the OGTT is in the diabetic range, another glucose value in the diabetic range, obtained on a separate occasion, is desirable before a diagnosis of diabetes mellitus is confirmed.

c) Advice should be given if a patient fulfils the criteria for impaired glucose tolerance or impaired fasting glycaemia. Annual follow-up, with fasting glucose measurements, is recommended.

5. Laboratory Procedures

a) Every laboratory undertaking oral glucose tolerance tests should have the following written protocols which have been approved by the Head of Department:
   (i) a laboratory standard operating procedure;
   (ii) a patient information sheet (Appendix 1);
   (iii) a “ward” procedure sheet for non-laboratory health care staff performing OGTTs.

b) Both the laboratory standard operating procedure and the “ward” procedure sheet should include a list of common drug groups known to affect glucose tolerance (Appendix 2).

c) Each laboratory report for an OGTT should specify the sample type used and include the appropriate WHO reference ranges for that sample type (Table 2).

d) The glucose assay used for diagnostic measurements should have acceptable accuracy and precision, with a between-batch coefficient of variation <5%. Appropriate internal quality control and external quality assessment procedures should be in operation.

TABLE 1 Glucose concentrations which confirm a diagnosis of diabetes mellitus in the symptomatic patient (WHO, 1999)

	Glucose concentration, mmol/L			
	Whole blood		Plasma	
	Venous	Capillary	Venous	Capillary
Fasting sample	≥ 6.1	≥ 6.1	≥ 7.0	≥ 7.0
Random sample	≥ 10.0	≥ 11.1	≥ 11.1	≥ 12.2

TABLE 2 Diagnostic glucose concentrations for the oral glucose tolerance test (WHO, 1999)

	Glucose concentration, mmol/L			
	Whole blood		Plasma	
	Venous	Capillary	Venous	Capillary
Diabetes mellitus:				
Fasting	≥ 6.1	≥ 6.1	≥ 7.0	≥ 7.0
and/or				
2 hours after load	≥ 10.0	≥ 11.1	≥ 11.1	≥ 12.2
Impaired glucose tolerance:				
Fasting	< 6.1	< 6.1	< 7.0	< 7.0
and				
2 hours after load	6.7 – 10.0	7.8 - 11.1	7.8 - 11.1	8.9 - 12.2
Impaired fasting glycaemia:				
Fasting	5.6 – 6.0	5.6 - 6.0	6.1 – 6.9	6.1 – 6.9
and				
2 hours after load	< 6.7	< 7.8	< 7.8	< 8.9
Normal results:				
Fasting	≤ 5.5	≤ 5.5	≤ 6.0	≤ 6.0
and				
2 hours after load	< 6.7	< 7.8	< 7.8	< 8.9

ACKNOWLEDGEMENT
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REFERENCE
World Health Organization. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Part 1: Diagnosis and Classification of Diabetes Mellitus. Report of a WHO Consultation, Geneva: WHO, 1999.

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APPENDIX 1 SPECIMEN PATIENT INFORMATION SHEET

Glucose Tolerance Test Patient Information Sheet

Your doctor has asked you to have a glucose tolerance test. This information sheet tells you what the test is and how you need to prepare for the test.

What is a glucose tolerance test?

Some people's bodies are unable to use glucose (sugar) properly. Usually this is obvious from someone's random blood glucose level but occasionally it has to be checked in a formal test. This can be done by drinking glucose and measuring how quickly it disappears from blood.

How do we do the test?

You will have had nothing to eat overnight and a sample of your blood will be collected when you arrive at the laboratory to measure glucose. If your glucose concentration is above a certain level it is unnecessary for the test to continue. Otherwise we give you a drink containing glucose and will take another blood sample two hours later. The blood samples are usually taken by pricking your finger or thumb. During the test you will be asked not to smoke or eat but you can drink water.

When will I get the result?

The result will be sent to the doctor who asked for you to be tested. We are not allowed to give the result to you.

What will it mean to me if the test is abnormal?

Most people have a normal result.

If your test shows that your body does not clear glucose quickly enough you may have Diabetes Mellitus. Treatment could be a combination of diet, tablets and/or insulin injections. Your doctor will decide which is the best treatment for you and will then regularly monitor your progress.

Some people have partly abnormal results which is known as Impaired Glucose Tolerance and sometimes progress to diabetes. Your doctor will suggest how to treat this.

What do I need to do for the test?

1. For three days before the test you should eat normally. If your doctor or a dietician has prescribed a special diet you should discuss this with them.

2. Only take your usual amount of exercise during the three days before the test.

3. You should eat nothing from 10.00 p.m. the night before the test. You may only drink water.

4. If you regularly take medicines take these as usual. If any should be taken with food it may be advisable to delay taking them until after the test. If you are unsure about this please contact your doctor. **Please bring a list of any medicines that you take and give the list to the person who does the test.** A few medicines can affect the test.

5. Please come to ..... at 9.00 a.m. on the morning of the test. As you are likely to have to stay for about two and a half hours you may like to bring something such as a book to occupy yourself.

APPENDIX 2 DRUGS WHICH MAY AFFECT GLUCOSE TOLERANCE

The following drugs, listed by numbered category according to the British National Formulary (issue 39, March 2000) have been reported to affect glucose tolerance. The list is not exhaustive; if in doubt please consult the local Drug Information Centre. Substances which may cause analytical interference in glucose assays have not been included.

Drugs which increase glucose tolerance

6.1.2.2	Biguanides	Metformin
6.4.3	Anabolic Steroids	Nandrolone, Stanozolol
8.3.4.3	Hormone Antagonists	Lanreotide, Octreotide

Drugs which impair glucose tolerance

2.2.1	Thiazide Diuretics	Bendrofluazide (Bendroflumethiazide), Chlortalidone, Cyclopenthiazide, Hydrochlorothiazide, Indapamide, Mefruside, Metolazone, Polythiazide, Xipamide
2.2.2	Loop Diuretics (less effect than thiazides)	Bumetanide, Frusemide (Furosemide), Torasemide
2.2.4	Combination Diuretics: particularly those containing thiazides (2.2.1)	
2.2.8	Diuretics with Potassium: particularly those containing thiazides (2.2.1)	
2.4	β-Adrenoceptor Blockers (effect small, least with those marked ** which are cardio-selective)	Acebutolol, Atenolol**, Betaxolol**, Bisoprolol**, Carvedilol, Celiprolol, Esmolol, Labetalol, Metoprolol**, Nadolol, Nebivolol**, Oxprenolol, Pindolol, Propanolol, Sotalol, Timolol
2.4, 2.5, 2.6	Anti-hypertensive Combinations with thiazide diuretics (2.2.1)	
2.5.1	Anti-hypertensives	Diazoxide
2.12	Lipid-lowering drugs	Nicotinic acid (but not Acipimox)
4.8	Anticonvulsants	Phenytoin
5.1.13	Antibiotics	Nitrofurantoin
6.3.2	Glucocorticoid therapy (systemic)	Betamethasone, Cortisone Acetate, Deflazacort, Dexamethasone, Hydrocortisone, Methylprednisolone, Prednisolone, Triamcinolone
6.4.1.1, 8.3.1	Oestrogens (effects minimal if used just for hormone replacement therapy)	Conjugated Oestrogens, Diethylstilbestrol, Estradiol, Estriol, Ethinylestradiol, Fosfestrol Tetrasodium, Mestranol, Oestrone Sulphate, Piperazine, Polyoestradiol Phosphate, Raloxifene, Tibolone
6.4.2, 8.3.4.2	Anti-Androgens	Bicalutamide, Cyproterone Acetate, Flutamide
6.5.1	Human Growth Hormone (synthetic)	Somatotropin
6.7.2	Other Endocrine Drugs	Danazol, Gestrinone
7.3.1	Combined Oral Contraceptives containing Oestrogens (6.4.1.1)	
10.2.2	Skeletal Muscle Relaxants	Baclofen

Reference

Young, DS. Effects of Drugs on Clinical Laboratory Tests, 3rd Edition, 1990 and 1991 Supplement, AACC Press.