

# Increased Plasma Glucose Level after 1 Hour of Challenge in The Oral Glucose Tolerance Test (OGTT) as an Indicator of Pre-Diabetes

Grzyb K<sup>1\*</sup>, Jainta N<sup>1</sup>, Otto-Buczowska E<sup>2</sup>

<sup>1</sup>Medical University of Silesia in Katowice, Poland

<sup>2</sup> Medical Specialist Centre in Gliwice Poland

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\*Corresponding author: Grzyb Karolina, Medical University of Silesia in Katowice, Poland, Tel: 792018912, E-mail: karolinaagrzyb@wp.pl

## Abstract

The oral glucose tolerance test (OGTT) is performed in patients in whom abnormalities of glucose metabolism are suspected, but the criteria for diagnosing diabetes are not yet met. It is also routinely carried out in the management of diseases associated with a more or less pronounced disturbance of glucose intolerance. According to the current guidelines, during OGTT glycemia is measured before and two hours after the administration of glucose. In pregnancy, three measurements are obligatory (0', 60', 120'). When additional indications are present, glycemia is assessed also 30 minutes after the administration of glucose and when reactive hypoglycemia is suspected, the test is extended to 180 minutes. As of late, it is becoming a more and more common practice to measure blood glucose also 60 minutes post-administration. This technique is more reliable for the assessment of glucose tolerance disturbance. Self-observations also indicate this. It seems sensible to introduce a recommendation of such measurement as a routine practice.

**Keywords:** Prediabetic State; Diabetes Mellitus; Oral Glucose Tolerance Test; Glucose Intolerance; NGT 1 H-High

## Introduction

Diagnostic criteria of diabetes are established. According to currently obligatory rules, noting blood glucose level greater than or equal 200 mg/dl (11,1 mmol/l) at any time, entitles to recognition of diabetes [1,2]

In 2003 the lower limit of fasting glucose level to identify IFG (impaired fasting glucose) was set at the point of 100 mg/dl (5,6 mmol/l) and such values are continually in force. [3]

Stating disorders of other kind indicates deepening of diagnosis. Such basic test designed to determine glucose metabolism impairment is called oral glucose tolerance test (OGTT). [4]

Denomination of blood glucose level is done before application of glucose solution and then- in accordance with 1999 WHO criteria- 2 hours after glucose load. This test has been modified over the years and so, during pregnancy, it is obligatory to take measures 3 times (0'; 60'; 120'). [5,6]

If specially indicated (simultaneous denomination of insulin secretion), glucose level is also noted 30 minutes following oral administration and in the case of reactive hypoglycemia diagnosis- the test is prolonged up to 180 minutes.

OGTT is performed among patients with recognition or suspicion of glucose disturbances, without basis to diagnose clinically apparent diabetes. It is related to those with impaired fasting glucose (IFG) level- that is 100-125 mg/dl (5,6-6,9 mmol/l) or with impaired glucose tolerance state (IGT), which means that glucose level measured in 120 minute of OGTT stands at 140-199 mg/dl (7,8-11,1 mmol/l). [2]

Interesting researches were presented by American authors who pointed out that recognition of IFG among children may be treated as a prelude to occurrence of diabetes type 2 during adolescence. [7]

As a routine precaution, OGTT is also carried out in case of diseases in course of which various glucose disturbances are acknowledged (endocrine or pancreatic disorders, genetic syndromes, medical drugs disrupting glucose tolerance).

In current practice, marking glucose level 60 minutes after imposition as well, is increasingly recommended on a routine basis. [8]

It gives more reliable basics to assess glucose intolerance conditions. There were some reports published which claim that such marking is particularly helpful to predict development of type 2 diabetes. [9,10,11] Those authors, after conducting 7-8 years lasting analysis, stated that assessment of serum glucose level 1 hour after glucose load is a better sign of type 2 diabetes risk than measurement after 2 hours.

Similar observations regarding the issue of marking blood glucose level after 1 hour during OGTT were also accomplished by some other authors [8,12]

On the basis of comparing 1 h-PG (plasma glucose) and 2 h-PG as predictors of type 2 diabetes mellitus, Paddock et al. concluded that the 1 h-PG is an alternative method of identifying individuals with an elevated risk of type 2 diabetes mellitus [13] Similar

results based on 12-year prospective cohort study were obtained by Korean authors, who stated that 1-h post load plasma glucose concentration was an independent predictor of future diabetes mellitus [14]

Observations on the importance of the blood glucose assessment 1 hour after the load for predicting the development of diabetes in children, were presented by the Italian authors, who- as a threshold value for such a risk in juvenile obese patients - recognized glucose level in 1hPG during OGTT  $\geq 132.5$  mg/dl (7,4 mmol/l). [15]

### Recently presented research

In overweight/obese NGT Caucasian youth have shown that a 1hpg  $\geq 132.5$  mg/dl was able to identify those with impaired insulin sensitivity and secretion and a trend towards a worse cardio-metabolic profile. [16]

Bardini et al. Stated that elevated 1hpg in subjects with NGT and pre-diabetes is associated with subclinical inflammation, high lipid ratios, and insulin resistance. Therefore, 1hpg  $>155$  mg/dl ( $\geq 8.6$  mmol / l) could be considered a new “marker” for cardiovascular risk. [17]

When assessing the risk of metabolic disorders, Chinese authors identified an increased risk of their occurrence at the glucose level  $\geq 154.8$  mg / dl ( $\geq 8.6$  mmol / l) after 1 hour. [18] Similar values of glucose concentration after an hour in OGTT for prognosis of complications were presented by other authors. [19]

Recently, the results of tests on the determination of blood glucose after 1h in the OGGT for the assessment of  $\beta$ -cell function and sensitivity to insulin have been presented. [20]

Results of research on the occurrence of a risk of kidney dysfunction at elevated 1hpg level during OGTT were presented by Italian authors. [21]

The authors decided that research results suggest that a cutoff point of 155 mg/dl ( $\geq 8.6$  mmol /l) for the 1hpg during OGTT may be helpful in the identification of individuals who are at increased risk for chronic kidney disease (CKD).

Recently, a research based on retrospective studies, established the level of plasma glucose concentration at 158,4 mg/dl (8.85 mmol/l) at 1h during OGTT as a limit value for the risk of metabolic syndrome. [22]

Recently, there have been reports of the usefulness of labeling plasma glucose concentration at 1h during OGTT for prediction of type 2 diabetes and cardiovascular events. [23,24] It was shown that plasma glucose concentration  $\geq 155$  mg/dl at 1h (NGT 1 h-high) during an oral glucose tolerance test exhibited an atherogenic lipid pattern qualitatively and quantitatively similar to that observed in individuals with IGT and newly diagnosed type 2 diabetes.

These authors also showed positive relation between blood viscosity and 1-h post-challenge plasma glucose. [25] It was suggested that a subgroup of NGT 1 h-high have increased blood viscosity comparable to that observed in subjects with IFG and/or IGT. Japanese authors confirmed association between 1-h PG levels and serum lipid profiles in individuals with NGT. [26]

In order to illustrate the usefulness of the assessment in 1 hour OGTT results were presented in 7 patients with NGT – 1h high (case 1-7) and in 2 patients with IGT -1h high (case 8,9) (Table 1) The table shows the results of the plasma glucose during oral glucose tolerance test (OGTT). Patients 1-7 presented normal fasting plasma glucose (FPG) and the 2-h plasma glucose (2-h PG) value after GOTT and 1-h glucose  $>155$  mg/dl ( $> 8,6$  mmol/l). Patients 8,9 presented impaired glucose tolerance (IGT) with 1-h high value.

**Table 1:** FPG- fasting plasma glucose, PG- plasma glucose, OGTT- oral glucose tolerance test

No.	Patient age [years]	Plasma glucose concentration mg/dl (mmol/l) during OGTT:		
		FPG	1hPG	2hPG
1.	54	94(5,2)	257(14,3)	84(4,7)
2.	25	90(5,0)	213(11,8)	134(7,4)
3.	34	97(5,4)	203(11,3)	121(6,7)
4.	28	90(5,0)	208(11,6)	122(6,8)
5.	33	96(5,3)	225(12,5)	150(8,3)
6.	50	99(5,5)	194(10,8)	135(7,5)
7.	31	92(5,1)	176(9,8)	131(7,3)
8.	31	97(5,4)	229(12,7)	180(10,0)
9.	58	99(5,5)	237(13,2)	198(11,0)

### Conclusion

More and more authors point out to the utility of 1 hour post-load OGTT glucose measurement in prognosing the development of type 2 diabetes, cardiovascular diseases, renal failure and other disorders in patients who do not fulfill the criteria for diagnosing diabetes. The literature on this subject is abundant.

In this situation it would seem reasonable to include an obligatory 1 hour post-load glucose measurement in every case when OGTT is performed.

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