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The utility of serum glucose measurement at 1 hour of the oral glucose tolerance test

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. It seems sensible to introduce a recommendation of such measurement as a routine practice. (Clin Diabetol 2016; 5, 4: 127–130)

Key words: prediabetic state, diabetes mellitus, oral glucose tolerance test, glucose intolerance, clinical cases

Introduction

The criteria for diagnosing diabetes are established. According to the current guidelines, a random plasma glucose ≥ 200 mg/dL (11.1 mmol/L) is sufficient enough to diagnose this disease [1, 2]. In 2003, the American Diabetes Association defined the threshold for the identification of IFG (impaired fasting glucose) at 100 mg/dL (5.6 mmol/L) — and those recommendations are still valid [3].

A recognition of other disorders is an indication for additional investigations. A basic test for identifying the level of glucose metabolism impairment is the oral glucose tolerance test (OGTT). The measurement of glycemia is carried out before the oral administration of glucose and then, based on the WHO recommendations from the year 1999, at 2 hours post-administration. The test has undergone modifications over the years and thus, for example, during pregnancy it is obligatory to perform three glucose measurements at 0, 60 and 120 minutes [2, 4].

In the case of special indications (simultaneous insulin secretion assessment), glycemia is also measured at 30 minutes post glucose administration. If reactive hypoglycemia is being diagnosed, the test is prolonged to 180 minutes. The OGTT is performed in patients with confirmed impairment of glucose metabolism or in whom such impairment is suspected — if the typical criteria for diagnosing diabetes are not met. This includes patients with IFG (impaired fasting glucose — glycemia in the 100–125 mg/dL or 5.6–6.9 mmol/L range) or IGT (impaired glucose tolerance — glycemia at 2 hours of OGTT in the 140–199 mg/dL or 7.8–11.1 mmol/L range) [5].

The American authors presented interesting research in which it was pointed out that the recognition of IFG in children can be considered a forecast of type 2 diabetes in adolescence [6].

OGTT is also routinely performed in states, in which concomitant glucose intolerance may be present (endocrine disorders, pancreatic diseases, genetic syndromes, use of medication known to impair glucose metabolism).

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In practice, it is more and more common to routinely measure glycemia also at the 60 minute mark of the OGTT [7]. This gives a more reliable basis for the assessment of glucose tolerance impairment. There have been reports to suggest, that such modification of the OGTT is useful especially in the prognosis of the development of type 2 diabetes [8–10]. The Authors, after analyzing data from 7–8 years, concluded that the measurement of glycemia at 1 hour of OGTT is a better predictor of type 2 diabetes risk that the classic assessment at 2 hours. Similar observations concerning the 1-hour post administration measurement were reported by different authors [11]. In particular, Italian authors studied the importance of early OGTT measurement for the prediction of diabetes development in children [12]. They set the 1-hour OGTT threshold for recognizing diabetes risk in juvenile obese patients at ≥ 132.5 mg/dL (≥ 7.4 mmol/L). The Chinese authors reported a higher risk of metabolic disorders if 1-hour OGTT value was ≥ 154.8 mg/dL (≥ 8.6 mmol/L) [13]. Similar prediction thresholds for 1-hour OGTT were reported by other researchers [14].

Recently, results have been published on the relationship between 1-hour OGTT values, the assessment of beta-cell function and insulin sensitivity [15].

Italian authors published research on the risk of renal dysfunction and its association with early OGTT measurement values [16].

The border 1-hour post-load value for recognizing increased risk of metabolic syndrome was recently established at 158.4 mg/dL (8.85 mmol/L) [17].

Clinical cases

Below are a few clinical examples which illustrate the importance of 1-hour post-load OGTT measurement for the prognosis of diabetes development (Tab. 1–6).

Discussion

An analysis of the cases presented above suggests an exceptional utility of 1-hour post-load OGTT measurement. It is important to notice that due to the lack of established reference values for such measurement, its results are often ignored which delays the introduction of adequate treatment [2].

It seems that the assessment of early OGTT values would, in many cases, provide an indication for the beginning of therapy.

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.

Table 1. Case 1 — male patient with symptoms of metabolic syndrome; age 59 years

Time of measurement	Pre-load OGTT [mg/dL (mmol/L)]	1 hour post-load [mg/dL (mmol/L)]	2 hours post-load [mg/dL (mmol/L)]	Subsequent therapy
Baseline	78 (4.3)	194 (10.8)	142 (7.9)	No treatment
After 9 years	136 (7.6)	244 (13.6)	147 (8.2)	No treatment
After 11 years	149 (8.3)	338 (18.8)	280 (15.6)	Treatment: diet, increased physical activity, metformin, liraglutide
After 3 months of therapy	94 (5.2)	181 (10.0)	150 (8.3)	Continued liraglutide, metformin

Table 2. Case 2 — male patient with symptoms of metabolic syndrome; age 48 years

Time of measurement	Pre-load OGTT [mg/dL (mmol/L)]	1 hour post-load [mg/dL (mmol/L)]	2 hours post-load [mg/dL (mmol/L)]	Subsequent therapy
Baseline	100 (6.1)	211 (11.7)	85 (4.7)	No treatment
After 1 year	103 (5.7)	209 (11.6)	161 (8.9)	No treatment
After 3 years	122 (6.8)	224 (12.4)	169 (9.4)	Treatment: diet, increased physical activity, metformin, incretin mimetic

Table 3. Case 3 — female patient with symptoms of metabolic syndrome; age 46 years

Time of measurement	Pre-load OGTT [mg/dL (mmol/L)]	1 hour post-load [mg/dL (mmol/L)]	2 hours post-load [mg/dL (mmol/L)]	Subsequent therapy
Baseline	100 (5.6)	227 (12.6)	135 (7.5)	No treatment
After 6 months	104 (5.8)	227 (12.6)	119 (6.6)	Treatment: diet, body weight reduction, metformin, incretin mimetic
After 6 months of therapy	92 (5.1)	213 (11.8)	81 (4.5)	Problems with achieving adequate physical activity level due to knee joint degenerative disorder

Table 4. Case 4 — male patient with diabetes of unidentified type; suspicion of monogenic diabetes; age 32 years

Time of measurement	Pre-load OGTT [mg/dL (mmol/L)]	1 hour post-load [mg/dL (mmol/L)]	2 hours post-load [mg/dL (mmol/L)]	Subsequent therapy
Baseline	109 (6.0)	247 (13.7)	146 (8.1)	No treatment
After 2 years	157 (8.7)	348 (19.3)	270 (15.0)	Treatment: diet, increased physical activity, metformin, dapagliflozin
After 1 year of therapy	100 (5.5)	165 (9.2)	145 (8.1)	–

Table 5. Case 5 — female patient with diabetes of unidentified type; suspicion of monogenic diabetes; age 38 years

Time of measurement	Pre-load OGTT [mg/dL (mmol/L)]	1 hour post-load [mg/dL (mmol/L)]	2 hours post-load [mg/dL (mmol/L)]	Subsequent therapy
Baseline	89 (4.9)	178 (9.9)	119 (6.6)	No treatment
After 1 year	116 (6.5)	181 (10.0)	108 (6.0)	Treatment: diet, increased physical activity, metformin, dapagliflozin

Table 6. Case 6 — female patient with hypothyroidism and signs of metabolic syndrome. Recognized increased level of triglicerides (398 mg/dL), increased HbA_{1c} (6.7%) with correct fasting glucose (92 mg/dL, 5.1 mmol/L); age 58 years

Time of measurement	Pre-load OGTT [mg/dL (mmol/L)]	1 hour post-load [mg/dL (mmol/L)]	2 hours post-load [mg/dL (mmol/L)]	Subsequent therapy
Baseline	96 (5.3)	237 (13.1)	170 (9.4)	Therapy: diet, increased physical activity, liraglutide, metformin

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

Conflict of interest

The Authors declare no relevant conflict of interest concerning this paper.

REFERENCES

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2012; 35 (Suppl 1): S64–S71.
2. Zalecenia kliniczne dotyczące postępowania u chorych na cukrzycę na rok 2015 PTD. Diabetologia Kliniczna 2015; 4 (Suppl A).
3. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Follow-up report on the diagnosis of diabetes mellitus. Diabetes Care 2003; 26: 3160–3167.

4. Committee of the Japan Diabetes Society on the Diagnostic Criteria of Diabetes Mellitus, Seino Y, Nanjo K, Tajima N et al. Report of the committee on the classification and diagnostic criteria of diabetes mellitus. J Diabetes Investig 2010; 1: 212––228.
5. Cypryk K, Lewandowski K, Szosland K, Skowrońska-Jóźwiak E, Lewinski A. Ocena czynności wewnątrzwydzielniczej trzustki. In: Pietrzyk JJ, Szajewska H, Mrukowicz J (ed). ABC zabiegów w pediatrii. Medycyna Praktyczna, Kraków 2010: 129–142.
6. Nguyen QM, Srinivasan SR, Xu JH, Chen W, Berenson GS. Fasting plasma glucose levels within the normoglycemic range in childhood as a predictor of prediabetes and type 2 diabetes in adulthood: the Bogalusa Heart Study. Arch Pediatr Adolesc Med 2010; 164: 124–128.
7. Jarosz-Chobot P, Otto-Buczkowska E. Wybrane procedury diagnostyczne w zaburzeniach gospodarki węglowodanowej. In: Pietrzyk JJ, Szajewska H, Mrukowicz J (ed). ABC zabiegów w pediatrii. Medycyna Praktyczna, Kraków 2010: 195.
8. Abdul-Ghani MA, Abdul-Ghani T, Ali N, Defronzo RA. One-hour plasma glucose concentration and the metabolic syndrome identify subjects at high risk for future type 2 diabetes. Diabetes Care 2008; 31: 1650–1655.
9. Abdul-Ghani MA, Lyssenko V, Tuomi T, DeFronzo RA, Groop L. Fasting versus postload plasma glucose concentration and the risk for future type 2 diabetes: results from the Botnia Study. Diabetes Care 2009; 32: 281–286.
10. Abdul-Ghani MA, Stern MP, Lyssenko V et al. Minimal contribution of fasting hyperglycemia to the incidence of type 2 diabetes in subjects with normal 2-h plasma glucose. Diabetes Care 2010; 33: 557–561.
11. Oh TJ, Min SH, Ahn CH et al. Normal Glucose Tolerance with a High 1-Hour Postload Plasma Glucose Level Exhibits Decreased β-Cell Function Similar to Impaired Glucose Tolerance. Diabetes Metab J 2015; 39: 147–153.
12. Manco M, Miraglia Del Giudice E, Spreghini MR et al. 1-Hour plasma glucose in obese youth. Acta Diabetol 2012; 49: 435–443.
13. Wu X, Chen H, Wang Y, Li H. The relationship between coronary risk factors and elevated 1-h postload plasma glucose levels in patients with established coronary heart disease. Clin Endocrinol (Oxf) 2013; 78: 67–72.
14. Su JB, Chen T, Xu F et al. Glycemic variability in normal glucose regulation subjects with elevated 1-h postload plasma glucose levels. Endocrine 2014; 46: 241–248.
15. Priya MM, Amutha A, Pramodkumar TA et al. β-Cell Function and Insulin Sensitivity in Normal Glucose-Tolerant Subjects Stratified by 1-Hour Plasma Glucose Values. Diabetes Technol Ther 2015 Oct 22 [Epub ahead of print].
16. Succurro E, Arturi F, Lugarà M et al. One-hour postload plasma glucose levels are associated with kidney dysfunction. Clin J Am Soc Nephrol 2010; 5: 1922–1927.
17. Kuang L, Huang Z, Hong Z, Chen A, Li Y. Predictability of 1-h postload plasma glucose concentration: A 10-year retrospective cohort study. J Diabetes Investig 2015; 6: 647–654.