

The Importance of a Postpartum 75 g Oral Glucose Tolerance Test in Women With Gestational Diabetes

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Abstract

Objective: To compare the ability of the fasting plasma glucose (FPG) level with the ability of the 2-hour oral glucose tolerance test (OGTT) to identify women with any form of glucose intolerance within the first six postpartum months.

Methods: In a retrospective, observational analysis, the predictive ability of the FPG level was compared with that of the 2-hour OGTT in 275 women followed for gestational diabetes who returned for postpartum testing.

Results: With use of the FPG level alone, 4.4% of the women were found to have an FPG \geq 7.0 mmol/L, identifying diabetes mellitus (DM); 2.5% had an FPG in the range 6.1–6.9 mmol/L, identifying impaired fasting glucose (IFG); and 93% had an FPG \leq 6.0 mmol/L, i.e., within the normal range. Using the 2-hour 75g OGTT, 5% of women were found to have either an FPG \geq 7.0 mmol/L or a 2-hour plasma glucose (PG) \geq 11.1 mmol/L, identifying DM; 2.5% had an FPG of 6.1–6.9 mmol/L, identifying IFG; and 32% had a 2-hour PG of 7.8–11.0 mmol/L, identifying impaired glucose tolerance (IGT). Of the women with any glucose abnormality postpartum, an FPG level alone detected 15.8%, the post-glucose load level detected 97.5%, and an OGTT detected 100% of the women. An FPG level alone in 39% of cases failed to detect either IGT or DM and in 54% of cases, type 2 DM.

Conclusion: In view of the potential for early, effective prevention of DM, the optimal method for detecting glucose abnormalities in women within six months post partum is a 2-hour OGTT.

Résumé

Objectif : Comparer la glycémie veineuse à jeun (GVJ) et l'épreuve d'hyperglycémie provoquée par voie orale (EHPVO) de deux heures, en ce qui a trait à la capacité d'identifier les femmes présentant quelque forme d'intolérance au glucose que ce soit au cours des six premiers mois post-partum.

Méthodes : Dans le cadre d'une analyse observationnelle rétrospective, la valeur prédictive de la GVJ a été comparée à celle de l'EHPVO de deux heures chez 275 femmes, faisant l'objet d'un

suivi en ce qui a trait au diabète gestationnel, qui s'étaient présentées de nouveau pour un test post-partum.

Résultats : Au moyen de la seule GVJ, on a constaté que 4,4 % des femmes présentaient une GVJ = 7,0 mmol/l, ce qui indique la présence d'un diabète sucré (DS); que 2,5 % présentaient une GVJ se situant entre 6,1 et 6,9 mmol/l, ce qui indique la présence d'une diminution de la glycémie à jeun (DGJ); et que 93 % présentaient une GVJ = 6,0 mmol/l, c.-à-d. se situant dans la normale. Au moyen de l'EHPVO de deux heures (75 g), on a constaté que 5 % des femmes présentaient soit une GVJ = 7,0 mmol/l ou une glycémie veineuse (GV) à deux heures = 11,1 mmol/l, ce qui indique la présence d'un DS; que 2,5 % présentaient une GVJ se situant entre 6,1 et 6,9 mmol/l, ce qui indique la présence d'une DGJ; et que 32 % présentaient une GV à deux heures se situant entre 7,8 et 11,0 mmol/l, ce qui indique la présence d'une diminution de tolérance au glucose (DTG). Le recours à la seule GVJ a permis le dépistage de 15,8 % des femmes présentant quelque anomalie glycémique post-partum que ce soit, tandis que la glycémie post-ingestion de la charge en glucose et l'EHPVO en ont permis le dépistage de 97,5 % et de 100 %, respectivement. Dans 39 % des cas, le recours à la seule GVJ n'a pas permis de dépister la présence d'une DTG ou d'un DS; dans 54 % de cas, il n'a pas permis de dépister la présence d'un DS de type 2.

Conclusion : Compte tenu de son potentiel précoce et efficace de prévention du DS, l'EHPVO de deux heures constitue la méthode optimale de dépistage des anomalies glycémiques chez les femmes, dans les six mois suivant l'accouchement.

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INTRODUCTION

Gestational diabetes mellitus (GDM) affects 3% to 15% of pregnancies, depending on the population studied.^{1–4} Since the initial research of O'Sullivan and Mahan in 1964, GDM has been recognized as a risk factor for the development of type 2 diabetes mellitus (DM), as well as for other pregnancy complications.⁵ A recent study on the recognition and treatment of GDM showed that both mother and baby benefit from treatment.⁶ In addition, evidence in favour of early prevention strategies for those with “pre-diabetes” has been published in several randomized controlled trials of pharmacological and

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Table 1. Patient characteristics

Fasting plasma glucose/ 2-hr OGTT plasma glucose	Normal/normal n = 155	Normal/IGT n = 87	Normal/DM n = 14	IFG/± normal n = 7	DM/± normal n = 12	<i>P</i>
Mean age (years) ± SD	32 ± 4.9	32 ± 5.4	35 ± 3.7	33 ± 5.1	29 ± 4.6	0.058
BMI (kg/m ²) ± SD	25 ± 5.2	26 ± 6.4	23 ± 2.9	28 ± 5.8	29 ± 6.4	0.109
Family history DM	(89) 57%	(58) 67%	(10) 71%	(3) 43%	(9) 75%	0.33
Required insulin	(76) 49%	(64) 74%	(10) 71%	(6) 86%	(12) 100%	< 0.0001

OGTT: oral glucose tolerance test; IGT: impaired glucose tolerance; IFG: impaired fasting glucose; DM: diabetes mellitus; SD: standard deviation; BMI: body mass index.

lifestyle interventions.⁷⁻⁹ By identifying women at highest risk for the development of type 2 diabetes, physicians will be better able to provide these interventions.

According to the Society of Obstetricians and Gynaecologists of Canada (SOGC) guidelines released in 2002, postpartum testing should be performed using a 2-hour 75 g oral glucose tolerance test (OGTT).¹⁰ However, in 2003, the Canadian Diabetes Association released new guidelines stating that “the diagnosis of postpartum glucose intolerance (and therefore an increased risk of type 2 diabetes) can be made by either a fasting plasma glucose (FPG) or a 2-hour oral glucose tolerance test (OGTT).”¹¹ If a fasting level alone were sufficient to identify those patients most at risk, this would have a significant effect on practice, in terms of both health care costs and patient convenience.

The present study compared the ability of a fasting glucose level alone with the ability of the 75 g OGTT to identify those women with abnormal glucose tolerance post partum.

MATERIAL AND METHODS

All women followed for GDM at the antenatal clinic of the McGill University Health Centre in Montreal are advised to return for a follow-up 2-hour OGTT at six to eight weeks post partum. They are also given written instructions clearly explaining where and when to return for the test, as well as how to obtain their results. During their antenatal visits, they are also counselled about their future risk of developing type 2 diabetes.

Since 1988, information from women who presented at between six weeks and six months post partum for a 2-hour 75 g OGTT has been entered into a database. The database contains test results, pregnancy outcomes, family history, and personal medical history. Only data collected during the first five years were used in this analysis because data entry was less consistent after that time. The criteria used for the diagnosis of diabetes were an FPG \geq 7.0 mmol/L or a

plasma glucose (PG) \geq 11.1 mmol/L after a 75 g 2-hour OGTT. Impaired glucose tolerance (IGT) was defined as a PG of 7.8–11.0 mmol/L at 2 hours after the 75 g glucose load. Impaired fasting glucose (IFG) was defined as an FPG of 6.1–6.9 mmol/L. Normal glucose tolerance was identified by an FPG \leq 6.0 mmol/L and PG $<$ 7.8 mmol/L at 2 hours in the OGTT.¹¹ The McGill Obstetric and Neonatology Database indicated that there were 23 601 births between 1988 and 1993. Of those, 1350 pregnancies were followed for GDM.¹² Unfortunately, only 279 women returned for postpartum testing. Complete information was available for 275 of these women. We used SAS (SAS Institute Inc, Cary, NC) to perform chi-squared analysis of variance between the fasting and 2-hour OGTT.

RESULTS

The characteristics of the population are summarized in Table 1. The mean age of the subjects was 32 years, and there was a trend towards increasing glucose intolerance as age increased, except in those women diagnosed with diabetes post partum by an elevated FPG. The average pre-pregnancy body mass index (BMI) of the population was 25.6 kg/m². Women with an abnormal FPG tended to be heavier (BMI 28–29 kg/m²) than those with normal FPG (BMI 23–26 kg/m²). The mean BMI of women whose diagnosis of diabetes was based on a post-glucose load value was normal. The prevalence of family history of diabetes was high (61% of women). In total, 168 women (61%) were treated with insulin; in the remainder, diabetes was controlled by diet alone. Women with abnormal FPG were more likely to require insulin during pregnancy, and an apparent trend towards increasing insulin needs related to the degree of abnormality. Women with both normal FPG and post-glucose load PG were the least likely to need insulin.

On the basis of the results of the fasting glucose levels, 12 (4.4%) of 275 women had outright type 2 diabetes

Table 2. Postpartum testing results

	2-hour post-load plasma glucose normal	2-hour post-load plasma glucose abnormal	Total
Fasting glucose level normal	155	101	256
Fasting glucose level abnormal	3	16	19
Total	158	117	275

GDM: gestational diabetes mellitus; OGTT: oral glucose tolerance test.

(i.e., FPG \geq 7.0 mmol/L); 7 (2.5 %) had impaired fasting glucose (FPG 6.1–6.9 mmol/L), and 256 (93%) had a normal FPG level (\leq 6.0 mmol/L). Of these 256 women, 101 (39%) had abnormal 2-hour OGTT results: 14 of these (5.5%) had type 2 diabetes, and 87 (34%) had IGT. A total of 26 women had type 2 diabetes based on the entire GTT (FPG + post-glucose load levels). These results are shown in Table 2.

As shown in the Figure, only 19 women (15.8%) out of the 120 women who had glucose abnormalities post partum had abnormal FPG, compared with 101 women (83%) who had an abnormal 2-hour level on the OGTT. Only three out of 120 women had a normal 2-hour level but an abnormal FPG. When we compared the ability of a single FPG level to identify women with abnormal glucose tolerance with the gold standard 2-hour OGTT, the sensitivity of the FPG level was only 13.7%, but the specificity was 98.1%. The positive predictive value was 84.2%, and the negative predictive value was 60.5%. The high specificity of the abnormal FPG points to the possibility that those women with abnormal glucose tolerance identified in the postpartum period by an abnormal FPG represent a subgroup of women with unrecognized type 2 diabetes.

DISCUSSION

The 2003 guidelines of the Canadian Diabetes Association suggest that an FPG may be adequate to evaluate women in the postpartum follow-up period because there are no data to suggest otherwise.¹¹ This study shows that testing FPG alone would miss 39% of women with a postpartum glucose abnormality. Of those with any abnormality on glucose testing, only 15% would be identified by an FPG, compared with 83% with the 2-hour value. Since the OGTT includes the fasting value, the three women with an abnormal FPG but normal post-load glucose would have been identified as well, thus 100% of women with abnormal glucose tolerance immediately post partum would have been identified. Cypruk et al. published similar findings in an evaluation of 141 women with GDM carried out in Poland and found that the 2-hour OGTT identified an additional 4% of

women with diabetes and 16% with IGT who were not identified by the FPG level.¹³ This is not surprising: studies in the non-pregnant population indicate that use of FPG alone for diagnosis will miss a significant proportion (up to one quarter) of people with diabetes.¹⁴

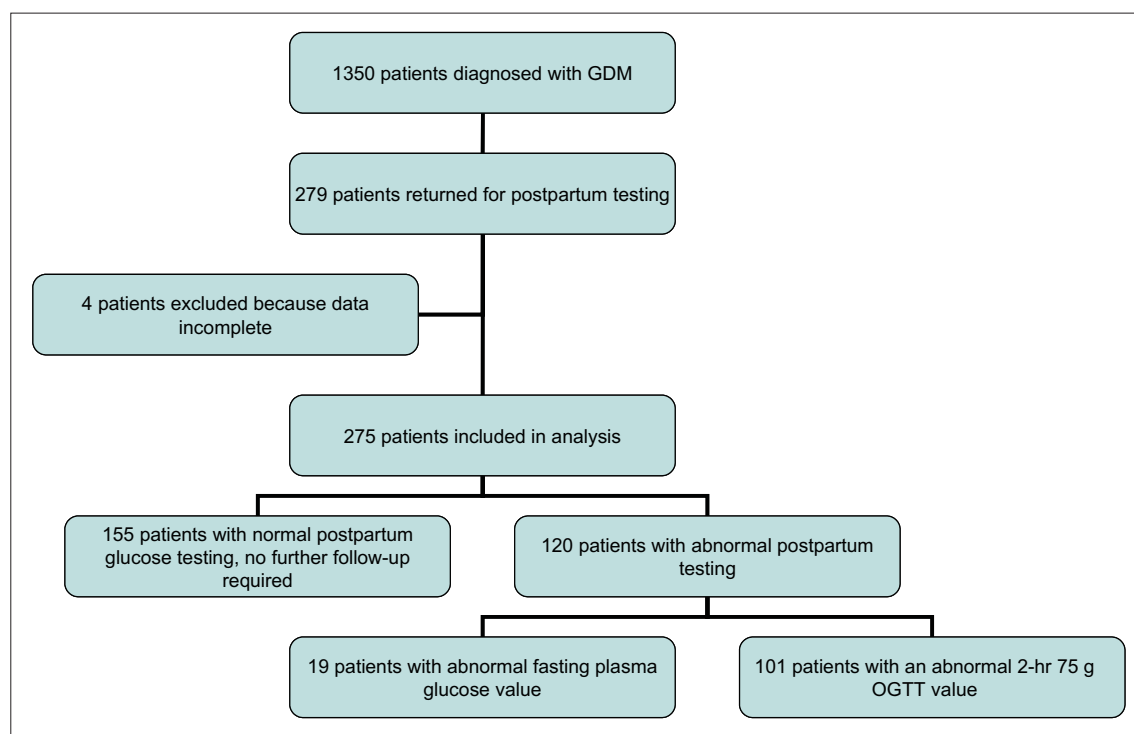
The results shown in Table 1 suggest that age, positive family history, and BMI did not affect the OGTT results in a statistically significant manner. In multiple regression analysis performed on this population, an association between BMI and DM was shown.¹² Similar associations have been seen by some authors,^{15,16} but not all.¹⁷

The need for insulin therapy during pregnancy was found to predict postpartum abnormalities. This makes sense, because women who need insulin are likely to have more severe abnormalities of glucose tolerance. Women who have DM diagnosed prior to 24 weeks' gestation are also more likely to have postpartum abnormalities.^{12,15}

The incidence of type 2 DM in postpartum women is related not only to the incidence of DM in that population, but also the length of time post partum that these women were followed; with up to 28 years of follow-up, the incidence can range from 2.6% to 70%.¹ The duration of follow-up in our study was between six weeks and six months post partum, and the rate of DM (19/275, or 6.9%) in the population we studied may eventually be even higher.

The small percentage of patients returning for postpartum testing was a limitation of our study. Because only a relatively small percentage of women assessed over the five-year period actually returned for postpartum testing, there is the possibility of selection bias. The women who did not return were more likely than those who did to have been diagnosed as having GDM prior to 24 weeks, to have a stronger family history of diabetes, and to have required insulin for therapy.¹² Thus, they were most likely a self-selected higher risk group. The low sensitivity of a fasting test alone in such a high-risk group is likely to be even lower if the analysis is carried out on the entire average risk population initially instructed to return for testing.

Another limitation of our study was its retrospective nature, although the data were collected prospectively. The

Figure 1. Gestational diabetes follow-up testing results

GDM: gestational diabetes mellitus; OGTT: oral glucose tolerance test.

reproducibility of the FPG and 2-hour OGTT results has been questioned by some authors,¹⁴ although Albareda et al. recently demonstrated a reproducibility of 100% when women who had abnormal fasting and 2-hour values repeated the OGTT.¹⁸ De Vegt et al. repeated the OGTT after two to six weeks in 1109 non-pregnant subjects and found an agreement of 74% to 77% for diabetes and an even lower reproducibility for IGT and IFG.¹⁹ Nevertheless, in most studies of reproducibility, repeat testing usually confirmed at least IGT, if not DM. Thus, although the repeat test was not always accurate, at least those at risk were identified and could be followed more closely by their physicians.

It is important to identify women with “pre-diabetes” (IFG or IGT) because of the future risks of DM and the increased cardiovascular risks seen in this population.^{20,21} Identification of this population is essential in order to apply known preventive strategies.⁷⁻⁹ Although the specificity of the FPG alone is high, its sensitivity is unacceptably low. The FPG identified only 12 out of 26 women (46.2%) with diabetes and 7 of 94 women (7.4%) in the pre-diabetes range. If the OGTT had not been performed, then 14 of 26 women with DM (54%) and 87 of 94 with pre-diabetes (92.6%) would not have been identified. Thus, performing FPG alone would overlook more than half of those women

who already have DM and require immediate treatment, as well as the majority of women with pre-diabetes. It is therefore crucial to identify them with a simple and accurate test.

CONCLUSION

This analysis indicates that in a relatively high-risk group of self-selected women who returned for postpartum testing, use of FPG alone would have failed to identify a significant number of women with glucose tolerance abnormalities. The use of a 2-hour OGTT would have detected all of the women with abnormal glucose tolerance. The FPG has an unacceptably low sensitivity, although it has very high specificity if abnormal. If only FPG had been used, 93% of women would have been considered to have normal glucose tolerance, although only 56% were truly unaffected. Despite the limitations of our study, its findings support the use of the 2-hour OGTT for postpartum follow-up, as recommended by both the SOGC and the American College of Obstetricians and Gynecologists.

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