# Overt Diabetes in Pregnancy

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## ABSTRACT

*Aims*: Overt diabetes in pregnancy is defined as hyperglycemia first recognized during pregnancy which meets the diagnostic threshold of diabetes in non-pregnant adults. This case-based narrative review aims to describe this unique condition and discuss the potential implications for its accurate diagnosis and management.

*Methods and Results*: We conducted a literature search in PubMed for relevant articles published in English language up to January 2022. Women with overt diabetes have a higher risk for adverse pregnancy outcomes and postpartum diabetes, compared to their counterparts with gestational diabetes mellitus (GDM). Such women often need aggressive management, including early and prompt initiation of insulin therapy, and a close follow-up during pregnancy and in the postpartum period. Not all pregnant women with overt diabetes have persistent diabetes in the postpartum period. Early diagnosis, especially during the first trimester, and fasting plasma glucose elevation ($\geq$ 126 mg/dl or 7 mmol/L) at the time of initial diagnosis are predictors of postpartum diabetes.

*Conclusions*: Both GDM and overt diabetes in pregnancy are hyperglycemic conditions first recognized during pregnancy, but the two conditions differ in severity; the latter is a more severe form of hyperglycemia associated with worse maternal and fetal outcomes, and a higher risk of postpartum diabetes.

**Keywords:** Overt diabetes; Overt diabetes in pregnancy; Hyperglycemia in pregnancy; Gestational diabetes; Pre-existing diabetes; Postpartum diabetes

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## Key Point Summary

Overt diabetes in pregnancy is defined as hyperglycemia first recognized during pregnancy which meets the thresholds of diabetes in non-pregnant adults.

The diagnosis can be made in a woman with fasting plasma glucose value $\geq$ 126 mg/dl (7.0 mmol/L) and/or 2-h plasma glucose $\geq$ 200 mg/dl (11.1 mmol/l) and/or random plasma glucose value $\geq$ 200 mg/dl (11.1 mmol/l) in the presence of symptoms, and/or HbA1c $\geq$ 6.5% (48 mmol/mol). As a result of its inherent limitations, HbA1c may not be a useful diagnostic test in the second and third trimesters of pregnancy.

Women with overt diabetes are at a higher risk for adverse pregnancy outcomes and postpartum diabetes compared to their counterparts with gestational diabetes.

Such women should therefore be identified as a high-risk group requiring early insulin therapy and a close follow-up during the course of gestation.

All women with overt diabetes should be followed in the postpartum period (6–12 weeks) with a 75-g oral glucose tolerance test. Subsequent testing may be performed at 3–6-month intervals during the initial 2–3 years, when the risk is high and less frequently thereafter.

## INTRODUCTION

Hyperglycemia in pregnancy (HIP) is a common medical condition, affecting about one in six pregnancies globally, and about one in four pregnancies in Southeast Asia [1]. This condition is associated with an increased risk of perinatal complications and future diabetes in both the mother and her offspring [2, 3]. Our understanding about this condition continues to evolve, and it is now clear that HIP is a heterogeneous entity in itself [4, 5]. In the previous classifications, the term "HIP" was used interchangeably with "gestational diabetes mellitus (GDM)", the latter broadly including women with any degree of hyperglycemia first identified during pregnancy [5]. In 2010, the International Association of Diabetes and Pregnancy Study Groups (IADPSG) proposed new diagnostic criteria for GDM, which were based on perinatal outcomes derived from a large multicenter study [6, 7]. These criteria, for the first time, recognized GDM as a milder form of hyperglycemia, distinct from a more severe form of hyperglycemia, i.e., "overt diabetes in pregnancy". In a similar vein, the recommendations by several other professional organizations, i.e., the World Health Organization (WHO) 2013 [8], Australasian Diabetes in Pregnancy Society (ADIPS) 2014 [9], International Federation of Gynecology and Obstetrics (FIGO) 2015 [4], and American Diabetes Association (ADA) 2020 [10] reinforced the importance of classifying overt diabetes in pregnancy separately from GDM (Table 1). Thus, both GDM and overt diabetes are hyperglycemic conditions first recognized during pregnancy; however, the latter represents a more severe form of hyperglycemia which is associated with worse maternal and fetal outcomes, and warrants an aggressive management and follow-up approach [11–14]. This case-based narrative review aims to describe this unique condition and discuss the potential implications for its accurate diagnosis and management. The article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

## HYPOTHETICAL CASE SCENARIOS

Hypothetical Case 1. A 38-year-old woman, G3P0A2, with spontaneous conception, presented for evaluation of her abnormal oral glucose tolerance test (OGTT) results. She has been married for 6 years, and has had regular menstrual cycles. Her previous two pregnancies ended in first trimester miscarriages. Her pre-

**Table 1** Diagnostic criteria of overt diabetes in pregnancy

| Criteria | FPG | 2-h PG[a] | RPG | HbA1c[b] | Definition |
|---|---|---|---|---|---|
| IADPSG consensus panel criteria (2010) [6] | ≥ 126 mg/dl (7 mmol/L) | – | ≥ 200 mg/dl (11.1 mmol/L) plus confirmation | ≥ 6.5% (48 mmol/mol) | One or more abnormal value |
| WHO criteria[c] (2013) [8] | ≥ 126 mg/dl (7 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) plus symptoms | – | One or more abnormal value |
| ADIPS criteria[c] (2014) [9] | ≥ 126 mg/dl (7 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) plus symptoms | – | One or more abnormal value |
| FIGO criteria[c] (2015) [4] | ≥ 126 mg/dl (7 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) plus symptoms | – | One or more abnormal value |
| ADA criteria[d] (2020) [10] | ≥ 126 mg/dl (7 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) | ≥ 200 mg/dl (11.1 mmol/L) plus symptoms | ≥ 6.5% (48 mmol/mol) | One or more abnormal value |

*2-h PG* 2-h post-load plasma glucose, *ADA* American Diabetes Association, *ADIPS* Australasian Diabetes in Pregnancy Society, *FPG* fasting plasma glucose, *FIGO* International Federation of Gynecology and Obstetrics, *IADPSG* International Association of Diabetes and Pregnancy Study Groups, *RPG* random plasma glucose, *WHO* World Health Organization

[a]Measured following administration of 75 g glucose load

[b]Measured in a laboratory using a method that is certified by National Glycohemoglobin Standardization Program (NGSP) and standardized to the Diabetes Control and Complications Trial (DCCT) assay

[c]WHO, ADIPS and FIGO define this condition as 'Diabetes in pregnancy'

[d]ADA defines this condition as 'Diabetes complicating pregnancy'

pregnancy body mass index (BMI) was 28.4 kg/m² and routine tests done before the current conception were unremarkable. She is normotensive, and her father has type 2 diabetes. She was tested for hyperglycemia in the first trimester (at 8 + 3 weeks of gestation) with a 75-g OGTT, the results of which are fasting plasma glucose 90 mg/dl (5.0 mmol/L), 1-h post 75-g load plasma glucose 153 mg/dl (8.5 mmol/L), 2-h post 75-g load plasma glucose 150 mg/dl (8.3 mmol/L). She was advised to follow with a repeat 75-g OGTT at 24–28 weeks of gestation. The results of her OGTT performed at 28 + 3 weeks of gestation (which prompted the current presentation) are fasting plasma glucose 122 mg/dl (6.8 mmol/L), 1-h post 75-g load plasma glucose 252 mg/dl (14.0 mmol/L), and

2-h post 75-g load plasma glucose 216 mg/dl (12.0 mmol/L). Glycated hemoglobin (HbA1c) is 6.3% (45.4 mmol/mol). Her gestational weight gain till 28 weeks was 10.5 kg [expected weight gain as per Institute of Medicine (IOM) recommendation is around 5.0 kg].

Hypothetical Case 2. A 28-year-old woman, G2P1L1A0, with spontaneous conception, presented for routine antenatal check-up. She has been married for 4 years, and has a 2-year-old healthy male child. Her previous pregnancy was complicated by pre-eclampsia, and gestational diabetes, requiring institution of antihypertensive and insulin therapy. She was not tested for blood glucose in the postpartum period. There were no tests performed in the pre-conception period either. Her prepregnancy BMI was

32.4 kg/m$^2$. Given her high-risk characteristics, she was tested at the first antenatal visit (7 + 3 weeks of gestation) with a 75-g OGTT, the results of which are fasting plasma glucose 182 mg/dl (10.1 mmol/L), 1-h post 75-g load plasma glucose 312 mg/dl (17.3 mmol/L), 2-h post 75-g load plasma glucose 264 mg/dl (14.7 mmol/L). Her HbA1c is 8.8% (73 mmol/mol).

# METHODS AND RESULTS

## Literature Search

We searched PubMed with the search terms "overt diabetes in pregnancy" or "diabetes in pregnancy" or "diabetes complicating pregnancy" and "antenatal management" or "maternal outcome" or "fetal outcome" or "neonatal outcome" or "perinatal outcome" or "postpartum diabetes" or "postpartum care" to identify relevant articles. Articles published in English language up to 18 January 2022 were selected. The abstracts were evaluated for relevance and subsequently full texts were obtained. We also reviewed reference lists of selected articles to identify additional studies relevant to our review. Articles that focused exclusively on other forms of HIP such as GDM and pre-existing diabetes were excluded.

## Overt Diabetes in Pregnancy: Definition vis-à-vis Gestational Diabetes

Gestational diabetes mellitus is the most common form of HIP, accounting for approximately 80–85% of all cases (the other two forms of HIP, i.e., overt diabetes and pre-existing diabetes, account for about 15–20% of all cases) [1, 15, 16]. The criteria for diagnosis of GDM have been a matter of intense debate and constantly evolved over the past few decades [17–23]. At present, most global bodies recommend the use of IADPSG criteria, which define GDM as the presence of one or more of the three abnormal values ($\geq$ 92 mg/dl (5.1 mmol/L), 180 mg/dl (10.0 mmol/L), or 153 mg/dl (8.5 mmol/l) at 0, 1, and 2 h, respectively) on a 75-g oral glucose tolerance test (OGTT) performed in a fasting state during pregnancy [6]. On the other hand, overt diabetes in pregnancy is defined as hyperglycemia first recognized during pregnancy which meets the diagnostic threshold of diabetes in non-pregnant adults, i.e., fasting plasma glucose value $\geq$ 126 mg/dl (7.0 mmol/L) and/or 2-h plasma glucose $\geq$ 200 mg/dl (11.1 mmol/l) and/or random plasma glucose value $\geq$ 200 mg/dl (11.1 mmol/l) in the presence of symptoms, and/or HbA1c $\geq$ 6.5% (48 mmol/mol) (see case scenarios 1 and 2, and Table 1) [4, 6, 8–10]. As a result of its inherent limitations, HbA1c may not be a useful diagnostic test in the second and third trimesters of pregnancy [24–26].

Broadly speaking, the definition of overt diabetes in pregnancy includes (a) women who were tested before pregnancy, had blood glucose values in normal or prediabetes range, but progressed to a state of overt diabetes as a result of progressive insulin resistance and beta cell decompensation induced by the stress of pregnancy [27], and (b) women who were not tested before pregnancy, and either had pre-existing undiagnosed diabetes or had normal/prediabetes range blood glucose values, but progressed during the course of pregnancy. Since pre-conception blood glucose values are not available in the latter, and hyperglycemia is first recognized during pregnancy, such women would be classified as having overt diabetes according to the current definition. However, we cannot determine whether diabetes existed prior to the pregnancy or was related to the metabolic stresses of pregnancy. Similarly, in the absence of early antenatal testing, it is not possible to characterize whether overt diabetes detected at 24–28 weeks of gestation is a carryover effect or a fresh development induced by the gestation. Nevertheless, there are significant implications for this demarcation, as detailed below (see "Overt Diabetes: Postpartum Outcomes vis-à-vis Gestational Diabetes"). Clearly, there are pitfalls in the current definition, and future recommendations should focus on teasing out pre-existing diabetes from the rather broad umbrella of overt diabetes in pregnancy.

**Table 2** Studies on overt diabetes in pregnancy

| References | Country | Design | Population | Results, pregnancy outcomes | Results, postpartum outcomes |
|---|---|---|---|---|---|
| Wong et al. [11] | Australia | Retrospective audit, single hospital | 1579 women with GDM and 254 with OD | Women with OD had a higher risk of adverse perinatal outcomes, including LGA (25.9% vs. 15.0%), neonatal hypoglycemia (11.7% vs. 7.3%), shoulder dystocia (6.9% vs. 0.7%), and composite of one or more adverse outcome (42.8% vs. 30.7%), compared to GDM | 133 women with OD evaluated at 6–8 weeks postpartum, of whom 41% reverted to NGT, 38% had IFG or IGT, and 21% had diabetes. Antenatal FPG elevation best predicted postpartum diabetes |
| Sugiyama et al. [28] | Japan | Retrospective cohort, multicenter | 1267 women with GDM and 348 with OD | Higher prevalence of retinopathy (1.2% vs. 0%) and pregnancy-induced hypertension (10.1% vs. 6.1%) among women with OD, compared to GDM | NR |
| Mañé et al. [29] | Spain | Retrospective cohort, single hospital | 572 women with GDM and 50 with OD | Increased premature birth (23.1% vs. 6.7%), emergency caesarean section (41.0% vs. 19.5%), preeclampsia (22.0% vs. 3.7%), and LGA (40.0% vs. 14.8%) among women with OD, compared to GDM | NR |
| Sampaio et al. [30] | Brazil | Retrospective cohort, single hospital | 176 women with GDM and 48 with OD | Women with OD had a higher need for insulin therapy (60.4% vs. 38.1%), and a higher initial (mean 0.53 vs. 0.17 IU/kg) and final dose of insulin (mean 0.55 vs. 0.19 IU/kg). Insulin-treated women had a higher rate of caesarean delivery (85.9% vs. 66.0%) | NR |

**Table 2** continued

| References | Country | Design | Population | Results, pregnancy outcomes | Results, postpartum outcomes |
|---|---|---|---|---|---|
| Milln et al. [31] | Uganda | Prospective cohort, multicenter | 276 women with HIP and 2961 with NIP. HIP: 237 with GDM and 39 with OD | Higher prevalence of hypertensive disorder in pregnancy (20.5% vs. 8.0%), perinatal mortality (5.1% vs. 2.1%), LGA infant (32.4% vs. 24.7%), and preterm birth (24.3% vs. 12.4%) in women with OD than GDM | NR |
| Park and Kim [43] | Korea | Retrospective cohort, single hospital | 1781 women with GDM and 71 with OD | Women with OD underwent aggressive glycemic management and did not differ from GDM in terms of adverse pregnancy outcomes, with the exception of LGA | 73% women with OD had persistent diabetes at 6–8 weeks postpartum |

*GDM* gestational diabetes mellitus, *HIP* hyperglycemia in pregnancy, *FPG* fasting plasma glucose, *IFG* impaired fasting glucose, *IGT* impaired glucose tolerance, *LGA* large for gestational age, *NIP* normoglycemia in pregnancy, *NR* not reported, *OD* overt diabetes in pregnancy

## Overt Diabetes: Pregnancy Outcomes vis-à-vis Gestational Diabetes

Both GDM and overt diabetes share risk factors, such as advanced age, physical inactivity, overweight/obesity, polycystic ovary syndrome, excessive weight gain during pregnancy, a history of diabetes in the first-degree relative, and a history of GDM in previous pregnancy. However, the greater degree of hyperglycemia places women with overt diabetes at an increased risk of adverse pregnancy outcomes, compared to their counterparts with GDM (Table 2).

In a retrospective audit of hospital-based data, Wong et al. [11] compared Australian women with overt diabetes in pregnancy [$n = 254$, defined as fasting plasma glucose $\geq$ 126 mg/dl (7.0 mmol/l), or a 2-h glucose level $\geq$ 200 mg/dl (11.1 mmol/l), or HbA1c $\geq$ 6.5% (48 mmol/mol)] and GDM [$n = 1579$, defined as fasting plasma glucose $\geq$ 100 mg/dl (5.5 mmol/l), or a 2-h glucose level $\geq$ 144 mg/dl

(8.0 mmol/L)]. Women with overt diabetes were diagnosed earlier in the gestation (mean 26.8 vs. 28.0 weeks), had a higher pre-pregnancy BMI (mean 28.2 vs. 26.0 kg/m$^2$), were more likely to require insulin (49.2% vs. 25.1%), and had a higher maximum insulin dose (mean 57.1 vs. 29.5 units per day), compared to those with GDM. The risk of adverse perinatal outcomes, namely, large for gestational age (LGA) infant (25.9% vs. 15.0%), neonatal hypoglycemia (11.7% vs. 7.3%), shoulder dystocia (6.9% vs. 0.7%), and composite of one or more adverse outcome (42.8% vs. 30.7%) was also higher in such women. Similarly, in a multi-institutional retrospective cohort study from Japan, Sugiyama et al. [28] reported an earlier gestational age at diagnosis (mean 22.0 vs. 23.5 weeks), greater need for insulin therapy (85.6% vs. 34.1%), and a higher prevalence of retinopathy (1.2% vs. 0%) and pregnancy-induced hypertension (10.1% vs. 6.1%), among

women with overt diabetes in pregnancy (*n* = 348) than those with GDM (*n* = 1267).

A retrospective cohort study by Mañé et al. [29] found increased rates of premature birth (23.1% vs. 6.7%), emergency caesarean section (41.0% vs. 19.5%), preeclampsia (22.0% vs. 3.7%), and LGA infant (40.0% vs. 14.8%) among Spanish women with overt diabetes (*n* = 50) compared to those with GDM (*n* = 572). In a retrospective study from Brazil, Sampaio et al. [30] reported that women with overt diabetes in pregnancy (*n* = 48) were more likely to require insulin therapy (60.4% vs. 38.1%), and had a higher initial (mean 0.53 vs. 0.17 IU/kg) and final dose of insulin (mean 0.55 vs. 0.19 IU/kg), compared to those with GDM (*n* = 176). Furthermore, a higher proportion of insulin-treated women (85.9% vs. 66.0%) delivered by caesarean section. Finally, a multicenter prospective study by Milln et al. [31] reported perinatal outcomes in 2917 women in Uganda. Of these, 276 women had HIP (237 with GDM and 39 with overt diabetes in pregnancy). The authors found that adverse pregnancy outcomes, including LGA infant (relative risk [RR] 1.30), caesarean delivery (RR 1.34), and neonatal hypoglycemia (RR 4.37), were significantly higher in women with HIP than normoglycemia in pregnancy, and were overall predominant in the subgroup with overt diabetes in pregnancy (Table 2).

Therefore, these data suggest that women with overt diabetes are at higher risk for adverse pregnancy outcomes, necessitating aggressive management and a close follow-up during the course of gestation.

## Overt Diabetes: Postpartum Outcomes vis-à-vis Gestational Diabetes

The risk for postpartum diabetes is also higher among women with overt diabetes (Table 2). In the study by Wong et al. [11], of 133 women with overt diabetes in pregnancy tested at 6–8 weeks postpartum, 41% reverted to normal glucose tolerance (NGT), 38% had impaired fasting glucose (IFG) or impaired glucose tolerance (IGT), and 21% had diabetes. These estimates compare with 74.9% NGT, 22.8% IFG or IGT, and 2.3% diabetes, among the cohort of 993 women with GDM. Thus, conversion to postpartum diabetes was higher; however, normoglycemia/intermediate hyperglycemia was still reported in a large proportion (approximately 80%) of women with overt diabetes. It can therefore be concluded that not all women with this condition have persistent diabetes in the postpartum period.

Antenatal fasting plasma glucose elevation [≥ 126 mg/dl (7.0 mmol/l)] had the highest predictive ability (area under the curve 0.726, 95% CI 0.604–0.847), while post-load 2-h plasma glucose elevation [≥ 200 mg/dl (11.1 mmol/l)] had the lowest predictive ability (area under the curve 0.476, 95% CI 0.318–0.674) for postpartum diabetes [11]. An early diagnosis of overt diabetes, especially in the first trimester of pregnancy, is likely to reflect a state of undiagnosed pre-existing diabetes and is also predictive of postpartum diabetes [9]. Therefore, even within the group of overt diabetes in pregnancy, a significant heterogeneity exists with regard to the postpartum glycemic status, depending upon when the condition was diagnosed, and which glycemic variables were abnormal at the initial diagnosis.

The risk for postpartum dysglycemia and abnormal cardiometabolic profile is reportedly higher among women with GDM belonging to South Asian ethnicity [32–40]. The distinct South Asian phenotype, characterized by increased visceral fat, lower muscle mass, and accelerated beta cell decline, plays an important role towards this observation [41, 42]. A similar differential trend is expected for South Asian women with overt diabetes in pregnancy. However, there is a paucity of data on this subject, and it remains a potential area of research in future studies.

## Overt Diabetes in Pregnancy: Management Strategies vis-à-vis Gestational Diabetes

The evidence presented clearly highlights the need to identify and manage overt diabetes in pregnancy as a hyperglycemic condition distinct from the more common GDM. In a

retrospective study from Korea, Park and Kim [43] reported that women with overt diabetes in pregnancy (*n* = 71, 24–28 weeks of gestation, fasting plasma glucose ≥ 126 mg/dl, or HbA1c ≥ 6.5%) and managed aggressively for glycemia (insulin treatment 91.3%) do not experience adverse pregnancy outcomes (with the exception of LGA infant). We briefly discuss the various aspects of management of overt diabetes in this section [44].

Basic principles of medical nutrition therapy (MNT) should be imparted to all patients, preferably by an expert dietician. Basal-bolus insulin regimen is the most preferred and frequently employed form of insulin therapy; however, a minority of women, especially those with unexplained glycemic variability, difficult blood glucose control, and personal preference can be offered continuous subcutaneous insulin infusion (CSII) via insulin pump. Various aspects of initiation and titration of insulin therapy are similar to that in non-pregnant adults (although blood glucose targets are stricter during pregnancy) and the reader is directed to good reviews on this subject [45–47]. Among oral antihyperglycemic drugs, metformin (dose range 500–2000 mg/day; usual dose 1000 mg/day) is used mainly as an adjuvant to insulin; its use as a primary antihyperglycemic therapy is usually associated with a high secondary failure rate, approximately 46%, as reported in the Metformin in Gestational Diabetes (MiG) study [48]. Patients should be educated to self-monitor blood glucose using a glucose meter, and maintain a blood glucose log (with remarks for any variations) for periodic review by the physician. Blood glucose targets in overt diabetes are similar to GDM: pre-meal < 95 mg/dl (5.3 mmol/L), 1 h post-meal < 140 mg/dl (7.8 mmol/L), and 2 h post-meal < 120 mg/dl (6.7 mmol/L) [49]. All efforts should be made to achieve these targets without causing undue hypoglycemia. Continuous glucose monitoring system (CGMS)-based targets for pregnant women with type 1 diabetes are (a) time in range (TIR) 63–140 mg/dl (3.5–7.8 mmol/L) > 70%, (b) time above range (TAR) > 140 mg/dl (7.8 mmol/L) < 25%, and (c) time below range (TBR) < 63 mg/dl (3.5 mmol/L) < 4% and < 54 mg/dl (3.0 mmol/

L) < 1% [50, 51]. For pregnant women with type 2 diabetes and overt diabetes/GDM, target range is similar; however, the percentage of time in range has not been defined because of the lack of adequate evidence [50].

## Overt Diabetes in Pregnancy: Postpartum Follow-up

Women with overt diabetes should be followed in the postpartum period (6–12 weeks) with a 75-g OGTT to identify persistent diabetes or prediabetes. Owing to pregnancy-related increased red cell turnover, and blood loss at delivery, HbA1c may be falsely low in the first 12 weeks following delivery, and should not be relied upon [49]. Subsequent testing, using a varying combination of fasting plasma glucose, 75-g OGTT, and glycated hemoglobin, may be performed at 3–6-month intervals during the initial 2–3 years, when the risk is high, and less frequently thereafter. The ABCDEFG approach, i.e., *A*ssessment for abnormal glucose tolerance at regular intervals, *B*reastfeeding to reduce risk of diabetes and overweight/obesity in woman and her offspring, *C*ontraception to delay pregnancy and reduce metabolic and fetal-maternal risks associated with unplanned conception, *D*iet, and *E*xercise, implying adoption of healthy dietary habits and regular physical activity to achieve ideal body weight and optimal cardiometabolic health, *F*amily, implying support and motivation of family members, especially the spouse and female household members, and *G*oals, implying setting up predefined goals against which performance is assessed, can be helpful in follow-up [52, 53].

## DISCUSSION: HYPOTHETICAL CASE SCENARIOS

Hypothetical Case 1. The patient has abnormal OGTT result (elevated 2-h post-load plasma glucose) that suggests a diagnosis of overt diabetes in pregnancy. Since pre-conception and early pregnancy glycemic parameters were normal, it seems that progression towards overt diabetes was induced by the metabolic stresses

of pregnancy, and excessive gestational weight gain. She underwent detailed dietary counselling by a trained dietitian, and was started on basal-bolus subcutaneous insulin therapy [4 units each of regular insulin 30 min before meals and 4 units of neutral protamine Hagedorn (NPH) insulin 2 h after dinner]. She was educated regarding insulin injection technique, site rotation, self-dose adjustment, self-monitoring of blood glucose, and hypoglycemia recognition, prevention, and management. On a follow-up visit 2 weeks later, her premeal and 2-h post-meal blood glucose values varied between 90 and 97 mg/dl (5.0 and 5.4 mmol/L) and 107 and 124 mg/dl (5.7 and 6.9 mmol/L), respectively. There was no documented hypoglycemia episode, and she was advised to continue the same treatment. A close follow-up during the course of the remaining pregnancy and in the postpartum period is warranted for her.

Hypothetical Case 2. The patient has elevated blood glucose values (both fasting and 2-h post-load), which meet the threshold of diabetes in non-pregnant adults. An elevated HbA1c ($\geq$ 6.5% or 48 mmol/mol) suggests that she possibly has a pre-existing undiagnosed diabetes. However, since she was not tested in the pre-conception period, and hyperglycemia was first recognized during pregnancy, she would be labeled as having overt diabetes in pregnancy according to the current definition. She needs aggressive glycemic management with insulin, monitoring for vascular complications, and close surveillance in the postpartum period.

## CONCLUSIONS

Overt diabetes in pregnancy represents a distinct hyperglycemic condition, which falls at the severe end of the spectrum of HIP. This condition is associated with a high risk of adverse pregnancy outcomes and postpartum diabetes. Women with overt diabetes need aggressive management, including early and prompt initiation of insulin therapy, and a close follow-up during pregnancy and in the postpartum period. Distinction between overt

diabetes and pre-existing diabetes may be blurred, especially when pre-conception and early antenatal glucose tests are not available. This pitfall should be addressed in future recommendations on this subject. Women diagnosed with overt diabetes during the first trimester of pregnancy are likely to have more severe hyperglycemia (and its resultant implications), and persistent diabetes in the postpartum period, compared to those diagnosed later. Similarly, women diagnosed on the basis of antenatal fasting plasma glucose elevation ($\geq$ 126 mg/dl or 7.0 mmol/L) are more likely to have postpartum diabetes, compared to those with 2-h plasma glucose elevation ($\geq$ 200 mg/dl or 11.1 mmol/L). These issues highlight the heterogeneity of this condition and should be explored further in future research studies.

## ACKNOWLEDGEMENTS

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