FOGSI - ICOG

Good Clinical Practice Recommendations

GCPR

Hyperglycemia in Pregnancy: Optimizing Pregnancy Outcome

Convenor – Anju Soni Co-Convenor – Pikee Saxena

Mentors - Hrishikesh D Pai, Madhuri Patel, Laxmi Shrikhande

Advisors – Sanjay Gupte, Hema Divakar

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HIV & AIDS Committee

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Fogsi Good Clinical Practice Recommendations

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Disclaimer: These recommendations for *"FOGSI GCPR on Hyperglycemia in Pregnancy: Optimizing Pregnancy Outcome"* has been developed for the assistance of obstetricians, gynecologists, consulting physicians, and general practitioners providing guidance and recommendation for managing with women with hyperglycemia in pregnancy. The recommendation included here should not be viewed as being exclusive or as covering all legitimate strategies. The suggestions made here are not meant to dictate how a particular patient should be treated because they neither set a standard of care nor do they guarantee a particular result. To diagnose patients, choose algorithms for management, vaccination, and provide the best care possible while also taking the necessary safety precautions, clinicians must rely on their own experience and knowledge. The writers or contributors disclaim all responsibilities for any harm and/or damage to people or property resulting from the use or operation of any techniques, goods, guidelines, or ideas presented in this content.

SCOPE

GCPR is designed to be used as a ready reckoner by FOGSIANS for adopting screening, diagnosing, managing, and the follow-up of women with hyperglycemia in pregnancy in their day-to-day clinical practice.

TARGETED AUDIENCE

Obstetricians, general practitioners, nurses, midwives, medical students, and health professionals in charge of reproductive health of women and antenatal care.

METHODOLOGY

Extensive literature search of randomized controlled trials (RCTs), meta-analyses, and systemic review studies has been done by the core team and the document has been reviewed by national and international experts' group including obstetricians, diabetologists, endocrinologists, and neonatologists.

Grade Practice Recommendations

Grade	*Descriptor*	*Qualifying Evidence*	*Implications for Practice*
A	Strong recommendation	Level I evidence or consistent findings from multiple studies of levels II, III, or IV	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present
B	Recommendation	Levels II, III, or IV evidence and findings are generally consistent	Generally, clinicians should follow a recommendation, but should remain alert to new information and be sensitive to patient preferences
C	Option	Levels II, III, or IV evidence, but findings are inconsistent	Clinicians should be flexible in their decision making regarding appropriate practice, although they may set bounds on alternatives; patient's preference should have a substantial influencing role
D	Option	Level V evidence: little or no systematic empirical evidence	Clinicians should consider all options in their decision making and be alert to newly published evidence that clarifies the balance of benefit versus harm; patient's preference should have a substantial influencing role
1	Strong recommendation		Performance of the recommended action could be used as a quality criterion or performance indicator, unless the patent refuses
2	Weak recommendation		Decision aids may help patients make a management decision consistent with their values and preferences

Levels of Evidence

Level	*Type of Evidence*
I	High-quality prospective cohort study with adequate power or systematic review of these studies
II	Lesser quality prospective cohort, retrospective cohort study, untreated controls from an RCT, or systematic review of these studies
III	Case-control study or systematic review of these studies
IV	Case series
V	Expert opinion; case report or clinical example; or evidence based on physiology, bench research, or "first principles"
4+	High-quality evidence based on RCTs
3+	Moderate-quality evidence non-RCTs
2+	Low quality of evidence based on observational studies provide moderate, or
1+	Very low-quality evidence

PRE- AND PERICONCEPTIONAL CARE IN DIABETES: A WINDOW OF OPPORTUNITIES

Introduction

- Diabetes mellitus is one of the most common medical disorders in pregnancy and is emerging as a serious public health emergency all across the world.
- The prevalence of gestational diabetes mellitus (GDM) in India varies from 3.8% to 21% in different parts of the country depending on the geographical locations and diagnostic methods used.
- For a given population and ethnicity, the prevalence of GDM corresponds to the prevalence of impaired glucose tolerance (IGT), in nonpregnant adults within that given population (**LII**).
- Preconception care should be offered to all women with pre-existing diabetes to optimize blood sugar control and other comorbidities with aim to improve obstetrical outcomes (**LII-2**).

Assessment of Risk Factors and Complications

- Detailed evaluation including **history, examination, relevant investigations, and concerned specialist referrals,** is recommended at regular intervals to assess the duration and type of diabetes mellitus, presence of risk factors, and acute or chronic complications, and timely interventions (**Table 1**).

Table 1 Practice points

Complication	*Investigation/Risk factor*
Retinopathy	**Retinal assessment (fundus examination)** is offered at the first preconceptional visit unless assessed in the previous 6 months
Nephropathy	**Renal assessment** (renal function tests) is offered at the first preconceptional visit unless assessed in the previous 6 months
Cardiovascular disease	ECG and echocardiography
GDM recurrence	**Risk factors** include high parity, previous macrosomic baby, family history of diabetes; obesity (BMI >30 kg/$m^{2)}$; increased weight gain (≥15 pounds) after index pregnancy, shorter interval from index pregnancy (≤24 months), requirement of insulin in the index pregnancy, and early onset of GDM

Abbreviations: BMI, body mass index; ECG, electrocardiograph; GDM, gestational diabetes mellitus

Assessment of Glycemic Status

In Women with Diabetes Mellitus

- The preferred target includes HbA1C <6.5% **(LI).**
- HbA1C is recommended monthly in diabetic woman planning to conceive.

In Women with Gestational Diabetes Mellitus

- Those who have normal postpartum glycemic screen at 4–12 weeks, are advised re-screen every year.
- The 2-hour postprandial results after 75 gm oral glucose tolerance test (OGTT) are interpreted as <100 gm/dL euglycemic, 140–199 gm/dL prediabetic, and ≥200 gm/dL overt diabetic.

Implementing Interventions

Pre- and Periconceptional Counseling

Counseling is recommended regarding the adverse results of interaction between diabetes and pregnancy, need for surveillance, and the importance of glycemic control in reducing fetal complications **(LI).**

Contraception

- In women without any vascular complications, any contraceptive method may be prescribed (category 1/ 2).
- Woman having pregestational diabetes mellitus (Type 1 or Type 2) for >20 years or having vascular complications, combined hormonal contraceptives and injectable progestin-only contraceptives are medical eligibility criteria (MEC) category 3 or 4.

Lifestyle Modifications

- Lifestyle behavioral change is the corner stone of the management of GDM, which includes medical nutrition therapy (MNT), weight management, and physical activity.

Monitoring Glycemic Control and Diabetes Self-management Skills

- **Self-monitoring** of blood glucose and ketones prior to conception is advised using plasma calibrated glucometers and ketone strip**.**

Reviewing Medicines for Diabetes and for Complications of Diabetes for Safety

- Discontinue and substitute oral hypoglycemic agents with insulin**.**
- Metformin may be used as an adjunct or oral alternative to insulin in the preconception period and during pregnancy, only if the likely benefits outweigh the potential risk for harm**.**
- Discontinue angiotensin-converting enzyme (ACE) inhibitors and angiotensin-II receptor antagonists for hypertension, replace them with safer alternatives such as labetalol, alpha-methyldopa, and nifedipine.
- Discontinue statins in periconceptional period.

Folic Acid Supplementation

- To reduce the risk of neural tube defects in diabetes 400 µg/day of folic acid is recommended.

DIAGNOSING GESTATIONAL DIABETES MELLITUS

Screening and Diagnosis

- Universal screening is essential, as it is generally accepted that the women of Asian origin and especially ethnic Indians, are at a higher risk of developing GDM and subsequent type 2 diabetes mellitus (T2DM).

- HbA1C is not possible to perform in the less resource countries, cost, and standardization being issues for consideration (**III**).
- India follows "One Nation, One Test" diagnostic criteria recommended by the Ministry of Health and Family Welfare 2018, Government of India (GOI), which is the Diabetes in Pregnancy Study Group of India (DIPSI) criteria, where 2-hour post 75 gm glucose value ≥140 mg% is used to diagnose GDM and a value >120 mg% and <140 mg/dl is defined as gestational glucose intolerance (GGI).
- It is preferable to perform the diagnostic test at the first visit and if negative at 24–26 weeks. In high-risk women, the same test may be offered at 32–34 weeks of gestation.

Procedure

- The pregnant women is given 75 gm oral glucose irrespective of whether she is in the fasting or nonfasting state and without regard to the time of the last meal.
- A venous blood sample is collected at 2 hours for estimating plasma glucose by the glucose oxidase-peroxidase (GOD-POD) method. GDM is diagnosed if 2-hour plasma glucose (PG) is ≥140 mg/dL (7.8 mmol/L).
- A standardized plasma calibrated glucometer may be used as a point of care test.

Advantages of the DIPSI Procedures

- Pregnant women need not be fasting.
- Most feasible, practical, and cost-effective test based on evidence.
- Causes least disturbance in a pregnant woman's routine activities.
- Diagnosis of GDM with 2-hour PG ≥140 mg/dL and treatment are worthwhile with a decreased macrosomia rate, fewer emergency cesarean sections, and serious perinatal morbidity and may also improve the women's health-related quality of life.
- 2-hour PG values between 120 mg/dL and 139 mg/dl, needs follow-up (**III**).
- The DIPSI test recommended by the Ministry of Health and Family Welfare, GOI, is adopted by the Federation of Obstetric and Gynaecological Societies of India (FOGSI), Association of Physicians of India (API), Research Society for the Study of Diabetes in India (RSSDI), Endocrine Society of India (ESI).
- The DIPSI test is also recommended by the World Health Organization (WHO, International Federation of Gynecology and Obstetrics (FIGO), and International Diabetes Federation (IDF).

ANTENATAL FETOMATERNAL SURVEILLANCE IN DIABETIC PREGNANCY

- The clinical management should focus on both the short-term fetomaternal complications and the long-term risks of T2DM and cardiometabolic disorders in mother and child pair.

Antenatal Fetal Surveillance

- Eight antenatal visits (4 additional visits) ensuring at least one visit per month are recommended **(2+).**
- Dating scan, nuchal translucency and nasal bone scan, and uterine artery Doppler for pre-eclampsia are recommended in the first trimester**.**
- **Aneuploidy screening:** Double marker test [serum pregnancy-associated plasma protein-A (s-PAPP-A) and serum beta-human chorionic gonadotropin (s-βHCG)] is recommended at $11–13^{+6}$ weeks.
- **Level 2 anomaly scan:** It is recommended at 18–20 weeks of gestation to rule out the structural abnormalities of spine, skull, kidney, and heart with 4-chambered view and outflow tract.
- **Fetal echocardiography:** Recommended in all cases of pregestational diabetes mellitus at 20–24 weeks (all the four chambers of the heart).
- **Growth scans and amniotic fluid index (AFI):** These are recommended at 28 weeks and onwards at intervals of 3–4 weeks as fetal growth velocity and amniotic fluid volume serve as objective end-points for assessing maternal glycemic control. Fetal abdominal circumference is the most important parameter for assessing fetal growth restriction (FGR) or macrosomia (**II**).

- **Doppler flow studies:** These are recommended if indicated as in pre-eclampsia and FGR (umbilical artery and fetal middle cerebral artery Doppler assessment) **(II-2A).**
- **Nonstress test and biophysical profile:** These are recommended weekly from 36 weeks onwards in pregestational diabetes mellitus and in GDM either alone or in combination. (**III-A**)
- Women with well-controlled GDM on diet (A1GDM) do not require any special fetal monitoring; may be performed based on local practices (**III-A**).
- Fetal surveillance may need to begin early (32 weeks) along with increase in frequency (twice a week) in the case of diabetes mellitus (DM) on medications (A2GDM/ pregestational DM) associated complications/comorbidies **(II-2A).**
- **Daily fetal movements' assessment**: Beginning at 32 weeks **(1+).**

Antenatal Maternal Surveillance

- Regular visits to the multidisciplinary team of obstetricians, endocrinologists, nutritionists, and physical instructors are recommended **(1+).**
- At each antenatal visit, evaluate for hypertension, proteinuria, macrosomia, and FGR **(1+).**
- Evaluate for end-organ involvement in pregestational DM at first antenatal visit unless assessed in the previous 3 months during pregnancy:
  - *Retinal assessment:* Fundoscopy, repeat assessment at 16–20 weeks and at 28 weeks in the case of diabetic retinopathy.
  - *Renal assessment:* Serum creatinine (<120 µmol/L), urinary albumin: creatinine ratio (<30 mg/mmol), total protein excretion (<0.5 g/day).
  - *Cardiovascular disease assessment:* ECG and echocardiography.
  - Neuropathy assessment.
- Infection surveillance for urinary tract infection (UTI) and vaginal candidiasis.
- **Thyroid profile:** Thyroid-stimulating hormone **(**TSH) is done due to the observed association of hypothyroidism in DM.
- Aspirin 150 mg should be started from 12th week onwards in all women with pregestational DM **(LII).**
- Thromboprophylaxis may be started in those with nephrotic range proteinuria (>5 g/day).

Optimizing Glycemic Control

- Optimization of glycemic control reduces the risk of pre-eclampsia, shoulder dystocia, and large for gestational age infants **(I).**
- In women with GDM, initially lifestyle changes (MNT and exercise) are introduced. If sugars remain uncontrolled, insulin or metformin is added**.**
- Metformin is advocated if women decline insulin, cannot afford, or cannot safely administer it. Counseling for the limitation of safety data with oral hypoglycemics is recommended**.**
- Real-time continuous glucose monitoring (rtCGM) is recommended for pregnant women with T1DM, and those without T1DM, who are on insulin therapy and have unstable glucose levels.
- Women with GDM should aim for 30 minutes of moderate-intensity aerobic exercise at least 5 days a week or a minimum of 150 minutes per week **(2+)**.
- Healthy diet with carbohydrate limited to 35–45% of total calories, distributed in three small-to-moderate sized meals and 2–4 snacks **(1+)**.
- Blood sugar profile: it is ideally recommended seven times a day by self-monitoring of blood glucose (SMBG) using a plasma calibrated glucometer. After achieving normoglycemia, SMBG is recommended for all pregnant women with diabetes 3–4 times a day; or at least one paired pre- and post-meal value daily, with documented relation to timing of meal by staggering or rotational approach (**2+**).
- Targets recommended for sugar control include fasting**/**preprandial blood glucose values <95 mg/dL and postprandial blood glucose values <140 mg/dL at 1 hour and <120 mg/dL at 2 hours. Blood sugar profile may be reviewed weekly or earlier based on the degree of sugar control (**1+**).
- HbA1C is not very useful during pregnancy due to a high turnover rate of red blood cells (RBCs) during pregnancy, prevalence of anemia, and hemoglobinopathies **(2+).**
- Educate to recognize and treat the signs of hypoglycemia. **(1+).**

- Educate the significance of maintaining target sugar levels to reduce the risk of maternal end-organ damage, congenital malformations, macrosomia, and stillbirths **(L1)**.

Preterm Labor

- The dose and the indications for antenatal corticosteroids is the same as nondiabetic pregnant women. **(III-B)**
- Dexamethasone 6 mg intramuscular (I/M) 12 hourly for 4 doses or betamethasone 12 mg I/M, 2 doses 24 hours apart is recommended.
- Due to the risk of hyperglycemia and diabetic ketoacidosis, close surveillance for the next 3–5 days with strict blood glucose and urinary ketones monitoring 4 hourly is recommended and insulin dosage titrated accordingly **(III-B)**.
- **Tocolytics:** Since beta mimetic drugs, such as terbutaline and ritodrine, may result in maternal hyperglycemia, nifedipine 10 mg every 20 minutes up to 4 doses followed by 20 mg TDS (maximum 180 mg) is recommended.
- Owing to the risk of worsening neonatal hypoglycemia beyond 34 weeks, the routine use of corticosteroids in the late preterm gestation in pregnant women with pregestational DM is not recommended. However, it should be a shared decision after explaining the risks and benefits (**1C**).

Macrosomia: Management Dilemmas

- In the Western countries, birth weight more than 4000 gm or 4,500 gm regardless of gestational age, while in India birth weight >3.45 kg at term would be termed as macrosomia.
- Ultrasonography is no better than clinical examination, in estimating fetal weight for suspected macrosomia, prediction being imprecise by both.
- Ultrasonography, like clinical examination, is an effective tool to rule out macrosomia.
- Controlling maternal hyperglycemia in antenatal period; and aerobic and strength training exercises are recommended for risk reduction.
- In morbidly obese patients, preconceptional counseling regarding bariatric surgery benefits and risks is recommended.

MEDICAL NUTRITION THERAPY

Introduction

- All pregnant women, who test positive for GDM for the first time, should be started on MNT and physical exercise (minimum 30 minutes a day) for 2 weeks to achieve euglycemia. When GDM is diagnosed in the third trimester, only one week of trial with MNT may be given.
- If target sugars are not achieved with MNT and physical exercise, pharmacotherapy is added.
- Nutrition assessment in GDM is based on the BMI and physical activity.
- For calculating energy requirement, the level of activity in pregnancy and BMI have to be taken into consideration (**Annexure 1**).
- In a busy outpatient department (OPD) without a registered dietician, it is important to counsel regarding the diet with the thali concept (**Annexure 2**).

Carbohydrates

Women with GDM should consume a minimum of 135 gm/day, representing 35–45% of the total calorie intake, distributed into 3 main meals (breakfast 15%, lunch 35%, and dinner 35%, and 3 small snacks 5% each [Indian Council of Medical Research-National Institute of Nutrition (ICMR–NIN) 2020].

Complex carbohydrates from low glycemic foods, such as non-starchy vegetables, whole fruits, dairy products, whole pulses, and sprouts, and whole grain cereals, such as rolled/steel cut oats, and millets, are recommended. (ICMR-NIN 2020).

Snacks should consist of fruits, nuts, clear soups, and sauteed vegetables.

Fats

Saturated fat intake (sources – butter oil (*ghee*), butter, coconut oil, palm oil, red meat, organ meat, full cream milk, etc.) should be less than 10% of total calories.

- Women with GDM who are overweight or obese are recommended to reduce fat in their diet.
  - Use less fat in cooking and avoid frying of foods.
  - Choosing low fat snacks, such as fresh fruit and salads, and baked and steamed food items for high-fat snacks such as cakes, biscuits, chocolates, pastries, *samosas*, and *pakoras*, etc.
  - Using lean meat in place of red meat.

Proteins

- Protein requirement in pregnancy is increased to 1.5 gm/kg/day to allow for fetal growth.
- Main sources of protein in the Indian diet are the *dals*, sprouts, egg, soya, nuts, seeds, and meat.
- Including adequate protein in every meal also makes the meal more filling, which is essential to the carbohydrate-controlled meal plan of GDM.

Fibers

- High-fiber foods, especially soluble fiber, may help control blood sugar by delaying gastric emptying, retarding the entry of glucose into the blood stream, and lessening the postprandial rise in blood sugar.
- Recommendation for daily fiber intake is about 30–40 gm, which can be met by eating 400 gm of colored nonstarchy vegetables and 200 gm of fruits every day.

PHARMACOTHERAPY

Introduction

- After 2 weeks on MNT and physical exercise, pharmacotherapy is added if target sugars are not achieved.

Metformin

- Although insulin is the first drug of choice for managing GDM, metformin is also recommended for use by the National Technical Guidelines for management of hyperglycemia in pregnancy, DIPSI, National Institute for Health and Care Excellence (NICE), and FIGO.
- Metformin therapy may be used if preferred by the patient since it may enhance treatment adherence, as it is more convenient, less expensive, and requires less monitoring after discussing its benefits and risks with the woman
- Metformin is initiated as 500 mg OD for a week, then 500 mg twice a day to a maximum of 2 gm daily. Common side effects are abdominal pain and diarrhea, which may be reduced by sustained release preparations.
- Metformin is useful for obese women or for women who are already on the high doses of insulin as it improves insulin sensitivity and causes less weight gain during pregnancy**.**
- Metformin also reduces the chances of neonatal hypoglycemia **(II)**.
- About 26–50% of women on metformin may eventually need insulin.
- Metformin therapy is associated with an increased incidence of preterm labor **(II)**.
- Metformin should not be prescribed for women with GDM if there is any significant organ dysfunction, if accompanied with the hypertensive disorders of pregnancy, fetal growth is restricted, or the woman has a high-risk factor, which predisposes her to preterm birth **(II)**.

Insulin

- Insulin is the drug of choice and is recommended for use in pregnancy as it does not cross the placenta **(I)**.
- There is no evidence that any one type of insulin or regimen of insulin is better than the other. Thus, insulin type and regimens should be individualized based on resource setting and feasibility. It is beneficial to pair rapid-acting with intermediate or long-acting insulin, in order to simulate the physiologic insulin secretion **(II)**.
- Early insulin therapy without waiting for the trial of MNT for euglycemia may be considered in cases where a woman is already having GDM-related complications such as hypertensive disorders of pregnancy, FGR, macrosomia, or polyhydramnios and in women with high glucose levels such as fasting plasma glucose (FPG) >126 mg/dL or 2-hour postprandial glucose (PPG) >200 mg/dL **(L1)**.

- Insulin analogs, such as aspart and lispro, which are rapidly-acting insulin, have advantage over regular insulin as they can be injected at the start of a meal with their pharmacokinetics mimicking physiological insulin thereby reducing the chances of hyper- and hypoglycemia **(L1)**.
- Profile of insulin, which are approved for use in pregnancy currently, is mentioned in **Table 2**.

Table 2 Profile of insulin safe for use in pregnancy

Insulin name	*Type*	*Onset*	*Peak effect*	*Duration*	*Dosing interval*
Aspart	Rapid acting	15 min	60 min	3–5 hr	At start of each meal
Lispro	Rapid acting	15 min	60 min	3–5 hr	At start of each meal
Regular	Short acting	60 min	2–4 hr	6–8 hr	60–90 minutes before meal
Neutral Protamine Hagedorn (NPH)	Intermediate acting	2 hr	4–6 hr	12–20 hr	Every 8–12 hr
Insulin Detemir	Long acting	2 hr	–	24 hr	Every 24 hr
Insulin Degludac	Long acting	–	–	>24 hr	>24 hr

How to Titrate Insulin?

- Insulin dosage should be adjusted according to glycemic trends every 2–3 days as assessed by glucose profile.
- Insulin needs are highly variable during pregnancy. Requirements increase throughout pregnancy and average 0.8 units/kg/day in the first trimester, 1.0 unit/kg/day in the second trimester, and 1.2 units/kg/day in the third trimester **(L1)**.
- In GDM, insulin is generally given as pre-meal short or rapid acting human insulin along with intermediate insulin at bedtime if there is fasting hyperglycemia. Thereafter, after attaining euglycemia, the total requirement may be adjusted with a combination of intermediate and rapid insulin in the ratio of 2:1 in the morning and 1:1 at night such that two-thirds of total requirement is administered in the morning and one-third at night **(L1)**.
- If the control is unsatisfactory, the potential sources of the problem, such as faulty diet, concurrent medication, intercurrent illness or infections, stress, lack of exercise, and faulty lifestyle, need to be explored and rectified.
- Self-monitoring of blood glucose (SMBG) is recommended for all pregnant women with diabetes, 3–4 times a day:
  - *Fasting:* Once daily, following at least 8 hours of overnight fasting.
  - *Postprandial:* 2–3 times daily, 2 hours after the onset of meals, rotating meals on the different days of the week.

TIMING AND MODE OF DELIVERY

Timing of Delivery

- Due to delayed fetal lung maturity associated with DM in pregnancy, delivery prior to 39 weeks is not recommended in well-controlled GDM without any fetomaternal complications.
- In the case of poorly controlled GDM/pregestational DM, timing needs to be individualized. Delivery between 37w0d and 38w6d may be recommended.
- In the presence of comorbidities, abnormal fetal tests or the failure of in-hospital glycemic control, delivery between 34w0d and 36w6d may be is advocated.

Mode of Delivery

- Vaginal delivery is preferred with cesarean reserved for only obstetric indications or fetal macrosomia after proper counseling.
- Based on the degree of suspected macrosomia, the risks and benefits of vaginal and cesarean delivery need to be individualized and the counseling is provided accordingly.
- Elective cesarean section is suggested beneficial if estimated fetal weight is ≥4,500 gm in a diabetic mother.
- In the Indian setting, estimated fetal weight ≥3,500 gm in diabetic mother is an indication for elective cesarean section at 39 weeks in case fetopelvic disproportion is suspected (**2+**).
- In a woman with suspected macrosomia, elective cesarean section is recommended if she had a previous delivery of macrosomic baby with poor obstetrical outcome.

- Suspected macrosomia is not a contraindication to labor after cesarean after considering the birth weight of previous and current pregnancy.

INTRAPARTUM CONSIDERATIONS

Introduction

- Maternal hyperglycemia during labor and delivery is associated with neonatal hypoglycemia, in both GDM and T2DM.

Management During Labor

- The glycemic target during labor is to maintain a plasma glucose (PG) level of 70–120 mg/dL and PG should be checked with glucometer every 1–2 hourly in active labor and urinary ketones should be checked 4 hourly.
- The induction of labor can be done by prostaglandin E2 (PGE2) gel, misoprostol, or Foley's catheter.
- It is important to administer the dose of intermediate acting insulin on the night prior to the induction of labor. The morning dose of insulin is withheld on the day of induction/labor and sugars monitored 2 hourly.
- Woman should be allowed to take oral fluids during induction and early labor.
- Insulin requirement is significantly reduced in labor since labor is exercise intense with an increased utilization of glucose. Most GDM women will not require insulin **(L1)**.
- Insulin is titrated according to plasma glucose level **(Table 3)**.

Table 3 Insulin therapy during intrapartum period

Blood sugar level	*Amount of insulin added in 500 mL NS*	*Rate of NS infusion*
90–120 mg/dL	0	100 mL/hr
120–140 mg/dL	4 U	100 mL/hr
140–180 mg/dL	6 U	100 mL/hr
>180 mg/dL	8 U	100 mL/hr

Abbreviation: NS, normal saline

- An infusion of 5% dextrose is started @ 125 mL/hr if plasma glucose is <100 mg/dL, no insulin is required.
- Other methods of insulin delivery in labor includes neutralizing drip, intermittent subcutaneous boluses of insulin, or continuous subcutaneous insulin infusion (CSII).
- Fetal monitoring during intrapartum period should be done as per high-risk protocol.
- Labor progress is observed with a partogram and cesarean section considered when labor is protracted.

Management During Cesarean Delivery

- Elective cesarean section should be scheduled as the first case on the morning list.
- The usual dose of intermediate insulin is given on the night before surgery. The patient is kept fasting after midnight, her usual morning dose of insulin is withheld.
- On the morning of the surgery, FPG and serum electrolytes are done.
- Regional anesthesia is desired because an awake patient permits an earlier detection of hypoglycemia.
- Target sugars during surgery are 70–100 mg/dL.
- Post-surgery, early resumption of oral intake, pneumatic compression stockings, and early mobilization should be encouraged to avoid the risk of thromboembolism.

MANAGEMENT OF THE NEWBORN

Introduction

- The goal of neonatal management is to anticipate the complications and morbidities associated with maternal diabetes and maternal hyperglycemia.
- The risk of complications varies depending on gestational age, birth weight, and degree and severity of hyperglycemia.

Immediate Management

- After thorough initial evaluation, routine neonatal care, immediate skin-to-skin care, and breastfeeding should be practiced.
- A comprehensive newborn examination is a must in the infant of diabetes mother (IDM).
- Laboratory screening of hypoglycemia (at birth, 6 hours of life, 12 hours of life, 24 hours of life, and 48 hours of life) and polycythemia (clinically indicated) at prescribed intervals should be done. Target plasma glucose in the first 24 hours of life is 40 mg/dL and 50–60 mg/dL after 24–48 hours of life.
- Vigilant watch and timely intervention for the detection of hyperbilirubinemia, hypocalcemia, and hypomagnesemia should be done since the incidence of these adverse events is increased in the IDM.

Follow-up and Long-term Outcomes

- There is increased risk (2%) of developing T1DM in neonates born to mothers with DM. The incidence of T2DM is same as that predisposed genetically. The lifetime risk if a first degree relative is affected with T2DM is 5–10 times higher.
- The risk of obesity and deranged glucose metabolism is also increased in the IDM.
- Lower cognitive testing scores as compared to controls have been seen, after adjusting
- for confounding factors.

Care of Macrosomic Neonate

In a macrosomic neonate, one should:

- Rule out congenital anomaly or any trauma by thorough physical examination.
- Prevent hypoglycemia by initiating early breastfeeding or intravenous glucose infusion if breastfeeding is delayed.
- Detect any neonatal complication at the earliest by keeping neonate under intensive observation.
- Surveillance for long-term complications and the promotion of healthy lifestyle practices.

ROLE OF POSTPARTUM AND INTERCONCEPTIONAL COUNSELING IN PREVENTING FUTURE NON-COMMUNICABLE DISEASES

Introduction

- Women with GDM are at risk of developing late-onset complications - abnormal OGTT (30%), recurrence of GDM (two-thirds cases), T2DM (10-fold increased risk), dyslipidemia, hypertension, and cardiovascular diseases (CVDs); thereby warranting follow-up for postpartum screening.
- The children are at risk of developing childhood obesity, metabolic syndrome, and impaired glucose tolerance (IGT), adult onset T2DM, and CVDs secondary to intrauterine programming.
- Postpartum care provides the opportunity to detect high-risk cases and initiate early preventive health interventions for both the mother and the child, which is best done by linking the postpartum care and immunization program of mother-child dyad.

Management of Glycemic Status in Immediate Postpartum Period

- Pregestational diabetic women, previously on oral hypoglycemic, should resume the same therapy; women who were on insulin need reduced insulin dose titrated with blood glucose levels.
- Women with GDM usually do not need any medical therapy in view of normalized blood sugar values in immediate postpartum period.
- Women with GDM are advised to continue with healthy lifestyle to reduce the risk of T2DM in future.

Postpartum Screening in Women with Gestational Diabetes Mellitus

- Postpartum screening at 6–12 weeks is recommended for all women who had GDM with the aim to identify women with DM, or IGT.

- Interpretation of the results of 75 gm 2-hour OGTT at 6 weeks are interpreted as euglycemic (<100 mg/dL), prediabetic/IGT (140–199 mg/dL), or overt diabetic (≥200 gm/dL).
- Women diagnosed with DM should be referred to diabetic clinic for medical therapy.
- Women diagnosed with IGT are managed with diet and exercise or metformin. They are advised to undergo OGTT yearly.
- Euglycemic and prediabetic patients are advised to continue with regular follow-up, lifestyle modifications, and contraceptive advice.
- All women with normal OGTT are advised to repeat testing every year.

Counseling

- Counseling at the time of discharge is most important to ensure the continuation of diet, exercise, breastfeeding, contraception, and the need for follow-up at 6–12 weeks postpartum.
- Postpartum women should also be explained regarding the significantly higher risk of progression to T2DM and other non-communicable disease (NCD) within 5–10 years and the importance of adhering to the healthy diet, exercise, stress management, and close medical supervision.
- Women in the postpartum period should be encouraged to lose weight as weight retention is a significant risk factor for future obstetrics and cardiometabolic complications.
- Children of women with GDM should also be marked as high risk in the neonatal discharge card and need close surveillance to delay or prevent the development of obesity, IGT, DM, hypertension, and metabolic syndrome later in their lives.
- All women with GDM are advised to visit the clinic for a preconceptional evaluation, when they plan a subsequent pregnancy.

Breastfeeding

- Breastfeeding is strongly recommended after delivery for all women with DM, pregestational or gestational.
- Initiating early breastfeeding within 30 minutes of delivery and then 2–3 hourly on demand is essential to avoid neonatal hypoglycemia. Breastfeeding is advised after meals to avoid maternal hypoglycemia.
- Breastfeeding assists in postpartum weight loss, improves glycemic and metabolic parameters, and reduces the risk of T2DM and metabolic syndrome.

Contraception

- Copper intrauterine device (IUD), lactation amenorrhea method (LAM), and barrier contraceptives are category 1 contraceptives for all types of diabetes in pregnancy.
- In GDM and overt DM without vascular complications, any contraceptive method may be prescribed (category 1/2); while in women with diabetes >20 years or with vascular complications, combined hormonal contraceptives and injectable progestin-only contraceptives are category 3 or 4.
- In the case of the prolonged use of hormonal contraceptives, one needs to be vigilant due to an increased risk of associated weight gain, depression [combined oral contraceptive (COC)], osteoporosis [depot medroxyprogesterone acetate (DMPA)/progestin-only pills (POPs), and progression to DM.

Lifestyle Modifications

- Lifestyle interventions reduce postpartum weight, and BMI; and, hence, reduce insulin resistance in women with previous GDM.
- The diet is modified based on daily calorie requirement, which is 27–30 kcal/kg/day for breastfeeding women; and 25 kcal/kg/day in non-breastfeeding women.
- Moderate exercise of 30 minutes per day for 5 days a week is recommended.
- Overweight and obese women should join structured programs to achieve a weight loss of ≥5% of initial body weight over the first year. Even modest weight loss improves blood pressure (BP), low-density lipoprotein cholesterol (LDL-C), triglyceride, and glucose levels and delays progression from GDM to T2DM.

Use of Metformin

- Metformin is the first-line drug for the prevention and treatment of T2DM among prediabetics and diabetic women respectively.

DIABETIC COMPLICATIONS

- Diabetes affect multiple organs and may result in end-organ involvement - retinopathy, nephropathy, neuropathy, and CVD. The end-organ involvement needs assessment at regular intervals and referral to relevant specialists if present **(Annexure 1)**.

SUGGESTED READING

1. Balaji V, Balaji M, Anjalakshi C, et al. Diagnosis of gestational diabetes mellitus in Asian-Indian women. Indian J Endocrinol Metab. 2011;15(3):187-90.
2. Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin No. 190: Gestational Diabetes Mellitus. Obstet Gynecol. 2018;131(2):e49–64.
3. Diagnosis & Management of Gestational Diabetes Mellitus (2021) by Diabetes in Pregnancy Study Group India. 2021. Available from: https://icogonline.org/wp-content/uploads/pdf/gcpr/gdm-dipsi-guidline.pdf.
4. Diagnosis and Management of Gestational Diabetes Mellitus: Technical and Operational Guidelines. Maternal Health Division, Ministry of Health and Family Welfare, Government of India. 2018. Available from: https://nhm.gov.in/New_Updates_2018/NHM_Components/RMNCH_MH_Guidelines/Gestational-Diabetes-Mellitus.pdf.
5. Diabetes in pregnancy: management from preconception to the postnatal period. NICE guideline [NG3]. 2015, Updated Dec 2020. Available from: https://www.nice.org.uk/guidance/ng3.
6. Kapur K, Kapur A, Hod M. Nutrition management of gestational diabetes mellitus. Ann Nutr Metab. 2021;1-13.
7. Macrosomia. ACOG Practice Bulletin No. 216. Obstet Gynecol. 2020;135(1):e18–35.
8. Pai HD, Pandey A, Patel M, et al. FOGSI FOCUS on Birthing: Current Concepts. 1st Edition. New Delhi: Evangel Publishers. 2023.
9. Reddy UM, Deshmukh U, Dude A, et al. Society for Maternal-Fetal Medicine (SMFM) Consult Series #58: Use of antenatal corticosteroids for individuals at risk for late preterm delivery: Replaces SMFM Statement #4, Implementation of the use of antenatal corticosteroids in the late preterm birth period in women at risk for preterm delivery, August 2016. Am J Obstet Gynecol. 2021;225(5):B36-42.
10. Saxena P, Pandey A, Prakash A. Clinical Guidelines for Management of Diabetes in Pregnancy. 1st Edition. New Delhi: FOGSI Publication, Jaypee Brothers Medical Publishers. 2017.
11. SOGC Clinical Practice Guideline. Guideline No. 393-Diabetes in Pregnancy. J Obstet Gynaecol Can. 2019;41(12):1814–25.e1.
12. WHO Medical Eligibility Criteria for Contraceptive Use. 5th Edition. Geneva: World Health Organization. 2015. Available from: https://www.who.int/publications/i/item/9789241549158.

ANNEXURE 1

Calculating Energy Requirement

- Equations proposed by the Indian Council of Medical Research (ICMR) expert group:
  Energy requirement (kcal/d) = BMR × PAL
  *BMR = Basal metabolic rate and *PAL = Physical activity level
- BMR (kcal/d) for adult females (18–30 years) = 14 × BW (kg) + 471
  BMR (kcal/d) for adult females (30–60 yrs) = 8.3 × BW (kg) + 788
  *BW = body weight
- Pre-pregnancy body weight to be taken into consideration when calculating the requirement.
- For the ease at field level, the experts recommend the addition of 350 kcal can be made for pregnant women after calculating the energy requirement for adults as per the level of activity (**Table 4**).

Table 4 Energy requirement as per the level of activity in pregnancy

S.No.	*Level of activity*	*Energy requirement during pregnancy*	*Total energy requirement (kcal/day)*
1.	Sedentary work	1,900 + 350	2,250
2.	Moderate work	2,230 + 350	2,580
3.	Heavy work	2,850 + 350	3,200

- Further, the addition or deduction of 500 calories per day is recommended as per the body mass index (BMI) (**Table 5**).

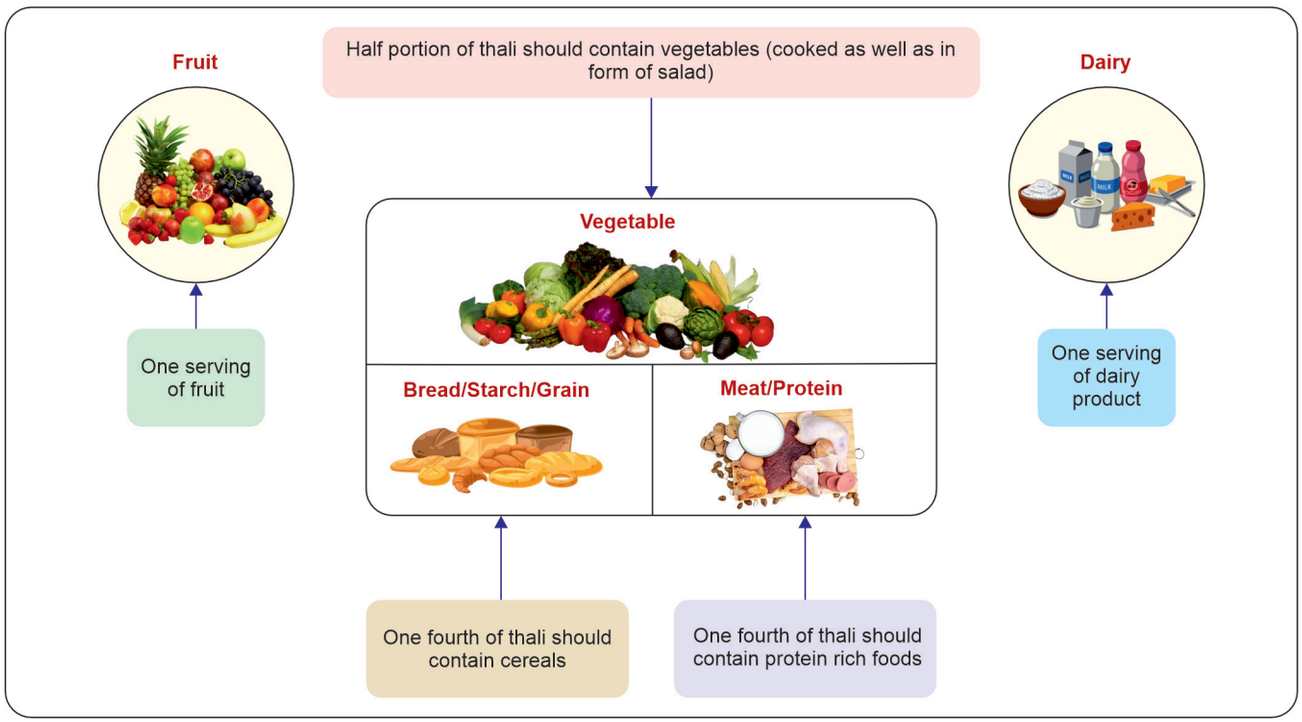
Table 5 Calculation of energy requirement as per body mass index (BMI)

Weight Category	*BMI (kg/m^2)*	*Energy requirement (kcal/day)*
Underweight	<18.5	Energy requirement as per level of activity + 500 kcal/day
Normal weight	18.5–22.9	Energy requirement as per level of activity
Overweight	23–24.9	Energy requirement as per level of activity
Obese	>25	Energy requirement as per level of activity - 500 kcal/day

ANNEXURE 2

Thali Concept

National guidelines recommend that in a busy outpatient department (OPD) without a registered dietician, it is important to do the counseling of patients by explaining to them the thali concept. Half of the plate should comprise of cooked and uncooked vegetables or salad, 1/4th with high-quality proteins, and 1/4th with complex carbohydrates along with one portion of fruit and one portion of dairy product like buttermilk.



- Complex carbohydrates, such as whole grains, e.g. oats, *jowar, ragi*, whole pulses, vegetables, and fruits with skins should be preferred over simple carbohydrates like food with lots of added sugar or honey, or foods that are made from refined white flour. Some examples of simple carbohydrates, such as sweets, cakes, biscuits, pastry, juice, and soft drinks, should be avoided.

- Counting the number of carbohydrate serves that a mother eats during the day will help her to eat the right amount of carbohydrate. As a guide, aim should be for 2–3 carbohydrate serves at each major meal and 1–2 carbohydrate serves at each snack.
  One serve = approximately 15 grams of carbohydrate
- Food sources of carbohydrate include cereals (wheat, *bajra*, *ragi*, corn rice, etc.) and its products (*suji*, refined flour, breads, pasta, noodles, etc.), pulses (green gram, bengal gram, black gram, etc.), starchy vegetables (potato, sweet potato, corn, tapioca, etc.), and fruits, sweets, juices, etc.

Disclaimer - These recommendations for “Hyperglycemia in Pregnancy: Optimizing Pregnancy Outcome” have been developed, to be of assistance to obstetricians, gynecologists, consulting physicians and general practitioners by providing guidance and recommendations for managing women with anemia and suffering from hemorrhagic conditions. The recommendations included here shouldn't be viewed as being exclusive of other concepts or as covering all legitimate strategies. The suggestions made here are not meant to dictate how a particular patient should be treated because they neither set a standard of care nor do they guarantee a particular result. To diagnose patients, choose dosages, and provide the best care possible while also taking the necessary safety precautions, clinicians must rely on their own experience and knowledge. The writers or contributors disclaim all responsibility for any harm and/or damage to people or property resulting from the use or operation of any techniques, goods, guidelines, or ideas presented in this content.