Original Article

Management of gestational diabetes in a resource-limited setting in India

Debmalya Sanyal[1], Moutusi Raychaudhuri[2]

India has a huge burden of gestational diabetes mellitus (GDM) involving huge financial burden of monitoring and management, according to established guidelines.

We evaluated the effectiveness of a simple, safe and cost effective strategy of GDM management which can be easily implemented in resource-limited and remote areas. Medical nutrition therapy (MNT) was advised for two weeks after diagnosis of GDM. Patients were provided with free glucometers and were asked to self monitor blood glucose (SMBG) levels at fasting (FBG) and two hours post prandial (breakfast, lunch and dinner) once every week. Patients were asked to report every two weeks or at least once a month either in person or over phone/online with SMBG records. Treatment targets were a fasting glucose <95mg/dl and 2 hour postprandial glucose <120mg/dl. Regular or NPH human insulin was started according to prevailing SMBG reports if diet alone did not achieve control. 70 uncomplicated GDM patients were followed up till delivery and pregnancy outcomes were compared with 35 healthy pregnant controls.

In 98.6% of GDM patients adhered to our protocol. 20% were controlled on diet only. 90% of GDM patients on insulin required only regular insulin for glycaemic control with most requiring two doses of regular insulin-before breakfast and dinner. No case of macrosomia, perinatal death, birth injury, congenital malformations and shoulder dystocia were reported.

A simple, safe and cost-effective modification of established guidelines can be easily implemented in resource-limited and remote setting with excellent maternal and neonatal outcomes. Compliance with a simple strategy based on insulin and once weekly SMBG is effective in majority of uncomplicated GDM patients.

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Key words **: GDM, resource-limited and remote setting, insulin, SMBG, maternal and neonatal outcomes.**

Six million births in India is associated with prediabetes and diabetes, majority (90%) being are due to GDM[1]. In HAPO study even mild GDM was associated with adverse fetal, neonatal and pregnancy outcomes while ACHOIS and MFMUN trials showed that treating even mild GDM reduces perinatal morbidity[2-4]. Cornerstone of GDM management is glycemic control through lifestyle modification and proper monitoring; insulin is considered as the gold standard for glycemic control during pregnancy. Insulin is included in the national list of essential medicines in India, it is affordable and accessible. Effective self-management improves glycemic control and promotes better pregnancy outcomes in GDM[3,4]. The management of GDM is still challenging in remote and resource-limited areas in India due to the huge financial cost involved in monitoring and management of GDM according to established guidelines. Hence we evaluated the effectiveness of a simple, safe, cost effective and easily implementable approach for resource-constrained and remote settings.

[1]DM (Endocrinology), Professor, Department of Endocrinology, KPC Medical College, Kolkata 700032

[2]DM (Endocrinology), Professor, Endocrinology Unit, Institute of Child Health, Kolkata 700017 and Corresponding Author

Materials and Methods

The study was conducted in the Endocrine OPD of a medical college in Kolkata, India with patients referred from primary health centres (PHCs) from remote rural areas. 70 uncomplicated GDM patients were followed up till delivery & pregnancy outcomes were compared with 35 healthy pregnant controls. International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria were used to diagnose GDM with fasting glucose ≥92 mg/dl, 1-hr glucose ≥180 mg/dl, 2-hr glucose ≥153mg/dl. Those with diagnosed pregestational diabetes were excluded.

Treatment targets of capillary SMBG were based on IADPSG guidelines with fasting glucose ≤95 mg/dl and 2 hour post meal glucose ≤120mg/dl. MNT was advised for two weeks after diagnosis of GDM. Regular or NPH human insulin was started according to prevailing SMBG reports if diet alone did not achieve targets.

Monitoring : Patients were provided with free glucometers and were asked to do four SMBGs once every week - fasting and two hour post prandial (breakfast, lunch

and dinner). Patients/family members were asked to report every two weeks or at least once a month either in person or over phone/online with SMBG records.

Pregnancy outcomes were compared between GDM and non-GDM groups using unpaired Student's t-test and Chi-square tests.

Results : Adherence to our protocol was 98.6% (69 patients). 20% (14 patients) were controlled on diet alone. 78.6% (55 patients) required insulin. 90.9% (50 patients) of those on insulin achieved target FBG without NPH insulin (only 5 required NPH insulin). 25.45% (14 patients) required regular insulin only once before breakfast, 50.9% (28 patients) required two doses before breakfast and dinner and 14.5% (8 patients) required three doses before each meal. No case of macrosomia , perinatal death, birth injury, congenital malformations and shoulder dystocia were recorded. Only 3 episodes of hypoglycemia GDM occurred in the GDM patients, none were severe. GDM pregnancy had significantly ($p < 0.05$) higher incidence of planned Caesarean Section (CS) delivery at term in 71% (49 patients) compared to 40% (14 patients) in non-GDM pregnancy. 20 patients (41%) of GDM pregnancy had planned CS on patient request compared to only 2 patients (14.3%) in non-GDM pregnancy (Table 1).

Table 1 — *Comparison of GDM and non-GDM pregnancies*

Outcome	GDM (n=69)	Non-GDM(n=35)	p-Value
Age of mothers (years)	26 ± 3.6	24 ± 4.8	Not significant
Pregestational BMI	23.5 ± 4.5	22.1 ± 3.2	Not significant
Birth Weight (g)	2814 ± 325	2695 ± 291	Not significant
Neonatal Hypoglycemia	2 (2.9%)	1 (2.85%)	Not significant
APGAR – 5min	10	10	Not significant
Preterm delivery	8(11.6%)	4(11.4%)	Not significant
Planned CS	49 (71%)	14(40%)	p <0.05
CS on patient request	20 (41%)	2 (14.3%)	p <0.05

Discussion

Successful outcome in GDM depends on the glycemic control maintained with meal plan or pharmacological intervention. Self Monitoring of Blood Glucose (SMBG) is an integral part of gestational diabetes mellitus (GDM) management. It improves glycemic control of GDM and feedback on self-management[5]. There is a consensus that measuring postprandial glucose levels is more important than pre-prandial levels since the former correlates better with adverse fetal and neonatal adverse events[6]. However it has been debated as to whether glucose should be measured 1 or 2 hours after a meal. Continuous glucose monitoring system (CGMS) has recently shown that glucose peaks occur about 70 ± 13 min after meals in nondiabetic pregnant women and after about 90 min in diabetic women[7]. Studies suggest different time intervals like 1, 1.5 and 2-hour post-meal for monitoring glycemic control[8]. FPG less than 95mg/dl, 1 hour PPG less than 140mg/dl or 2 hour PPG less than 120mg/dl is the IADPSG criteria for glycemic control is adequate to prevent macrosomia and adverse fetal outcome. In our study we went for a fasting of less than 95mg/dl and 2-hour postmeal values because of familiarity of clinicians with 2 hour postmeal value for diagnosis and monitoring of both diabetes and GDM. This approach was also in accordance with the Indian Diabetes In Pregnancy Study Group India (DIPSI) guidelines[9].

Daily SMBG has been the standard for women with GDM, however, new research has shown that SMBG testing every other day or every third day would not delay therapy modification in mild GDM[10]. We improvised further and went for SMBG once a week only, as cost, whether out of pocket or limited government resources, is the most important barrier to successful GDM management. Once weekly monitoring cuts down the cost of glucose strips in resource-limited setting. Moreover, simpler protocol is easier to follow decreases dropout rate and improves adherence, which was 98.6% in our study.

If after two weeks of MNT, SMBG criteria of glycemic control were not achieved we started our patient on insulin as recommended by most guidelines[11]. Studies suggest that 70% of GDM patients are controlled with MNT, however, in our study it was only 20%[12]. Cultural habits and myths in India such as, exercise is not good for pregnancy outcome and mother should eat for two have a profound negative impact on GDM patients. Sedentary habits and consumption of high calorie diet inspite of advice to the contrary could have led to failure of MNT in 80% of patients in present study.

We used only insulin and did not use metformin as it was not approved at the time of our study Moreover metformin is a category B medication in pregnancy with very high maternal-to-fetal transfer rate[13]. Neonatal hypoglycemia is not increased but premature delivery is slightly increased with metformin, moreover follow-up of 4-year-old offspring demonstrated higher BMI and increased obesity in offspring exposed to Metformin[14,15]. Further study of long term outcomes in the offspring is needed[16].

Insulin is the treatment of choice in GDM as it does not cross the placenta and at the same time achieves good glycemic control without any teratogenic effects. The glycemic control achieved with Regular and NPH insulins is comparable with analogue insulins, though analogues have slightly lower hypoglycaemia[17]. In our study, we used Regular and NPH insulins with very good outcome with only 3 episodes of mild to moderate hypoglycemia, reaffirming its cost-effectiveness in resource limited settings.

True to the fact that GDM is largely a post-prandial

hyperglycemia, 89.9% of our patients required only prandial insulins for glycaemic control with only 9.1% needing additional NPH insulin for fasting hyperglycemia. 25.48% required only once daily prandial insulin at breakfast, majority 50.9% needed twice daily insulin before breakfast and dinner and only 14.5% needed thrice daily prandial insulin to reach the targets. There was no statistically significant difference outcome measures, like birth weight, macrosomia, neonatal hypoglycemia pre-term delivery, perinatal death, birth injury or shoulder dystocia, between babies of healthy pregnant controls and GDM mothers.

The maternal outcome in GDM pregnancy was again similar to that in non-GDM pregnancy except that the elective caesarean section (CS) rate was significantly higher (71%) in GDM compared to 40% in non GDM group. There is background fear and anxiety among treating obstetrician and GDM patient regarding adverse outcomes and perinatal mortality with normal delivery in GDM pregnancy. In GDM group, 41% of planned Caesar were on patient request as opposed to 14.3% in non GDM group. Absence of hypertension and obesity coupled with lifestyle modification and a good level of glycemic control with adherence to our simple SMBG protocol are the probable reasons for these good outcome measures.

Our study had several limitations. It was neither blinded nor adequately powered. Moreover, our protocol was only intended for those patients with uncomplicated GDM. RCTs and adequately powered studies are needed to validate our approach.

Conclusion :

It is difficult to implement standard GDM guidelines in resource-constrained areas in developing country like ours. A simple and cost-effective easily implementable protocol is very important for good compliance and success of any GDM management protocol. Compliance with a simple strategy based on insulin and once weekly SMBG is effective in the majority of uncomplicated GDM patients in remote settings and resource-limited settings and ensures excellent maternal and neonatal outcomes .

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