

## Labor Glucose Management for Diabetes in Pregnancy

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### Abstract

Several adverse outcomes have been associated with diabetes during pregnancy and these complications diverge according to the type of diabetes and the severity of the disease. Controlling blood glucose during pregnancy will minimize the risk of complications. Furthermore, intrapartum glycemic control is very important because the occurrence of fetus academia and hypoglycemia is highly related to maternal hyperglycemia during labor. There is no clear recommendation regarding blood glucose target during labor or the best way to control it with different types of diabetes. The National Maternity Hospital (NMH) is a tertiary level unit in Dublin, Ireland with more than 9000 births per year. A weekly multidisciplinary clinic is provided by endocrinologists, obstetricians, midwife diabetes specialists and dietitians with support. We are sharing our experience in management of blood glucose during labor for pregnant patients attending NMH, with 4 different cases of diabetes; Fixed labor protocols were used for each of the above patients with excellent outcome and glycemic control.

**Keywords:** Pregnancy; Diabetes; Gestational Diabetes

### Introduction

Several adverse outcomes have been associated with diabetes during pregnancy and these complications diverge according to the type of diabetes and the severity of the disease.

### Cases

#### Case 1

33-year-old female para 1+0 with history of gestational diabetes at first pregnancy controlled with diet only with no complications. GDM was diagnosed at 21 weeks of gestation treated with diet initially and at 22 weeks of gestation required metformin 500mg twice daily and under regular follow up in maternity multidisciplinary diabetes clinic. Our patient showed excellent blood glucose control till the end of pregnancy with fructosamine level of 183 - 185  $\mu\text{mol/L}$ . Her fetal scan at 36 weeks showed polyhydramnios and baby abdominal circumference > 95<sup>th</sup> centile. At 39 weeks of gestation she went into labor and was started on protocol 1 for blood glucose control. She was prescribed 2 unit of Aspart (SC) if blood sugar  $\geq 6$  mmol/L and 3 units of novorapid if  $\geq 8$  mmol/L. She underwent normal vaginal delivery and her labor last 4 hours and 34 minutes. Her blood glucose during labor were 5.3, 4.4 and 5.6 mmol/l respectively. She had a healthy 3.8 kg boy with no neonatal hypoglycemia. Post labor her blood glucose was checked only before meals for 48 hours.

### Case 2

29-year-old female para 0 diagnosed with gestational diabetes at 23 weeks of gestation. Initially on diet control for two weeks with suboptimal control. She was commenced on insulin; Aspart and insulatard with regular follow up in multidisciplinary diabetes in pregnancy clinic. The patient showed excellent blood glucose control mostly in targets with HbA1c of 35 - 37 mmol/mol and fructosamine level of 187 - 189  $\mu\text{mol/L}$ . Our patient fetal scan at 36 weeks of gestation was normal. At 37 weeks of gestation our patient went into labor and was started on protocol 2 for blood sugar control. She was prescribed one liter of sodium chloride 18% infusion rate 125 ml/h with additives of 20 mmol potassium chloride in each liter and 5 unit of actrapid. Supplementary SC sliding scale was also prescribed with 3 units of novorapid if blood glucose  $\geq 6$  mmol/L and 4 units of Aspart if  $\geq 8$  mmol/L. She underwent normal vaginal delivery and her labor last 5 hours and 27 minutes. Her blood sugars during labor were 4.9, 5.5 and 4.4 mmol/l respectively. She had a healthy 2.6 kg girl with no neonatal hypoglycemia. Insulin held post labor; blood glucose was monitored for 48 hours before meals.

### Case 3

35-year-old female with history of type 1 diabetes for 13 years duration. She was para 2 with two previous cesarean sections. She had uncontrolled diabetes pre pregnancy with booking HbA1c of 67 mmol/L and fructosamine level of 348  $\mu\text{mol/L}$  on treatment with Detemir 16 units daily and Aspart 20 units daily. She was evaluated by our team at maternity diabetes clinic at 5 weeks of pregnancy. She showed significant improvement in diabetes control with fructosamine level of 241  $\mu\text{mol/L}$ . Her fetal scan at 37 weeks of gestation was normal. At 38 weeks of gestation she went into labor and was started on protocol 2 for blood glucose control same as in case 2. She was delivered by caesarian section which last one hour with a blood glucose of 6.9 mmol/l prior to surgery, 6.2 and 6.9 mmol/l during and 7.2 mmol/l post-delivery. She had a healthy 3.9 kg boy with no neonatal hypoglycemia. Her insulin was reduced post labor to detemir 15 units and aspart 5 units with each meal.

### Case 4

39-year-old female with type 1 diabetes for 24 years. Her diabetes was complicated with proliferative diabetic retinopathy and nephropathy. Our patient was commenced on continuous subcutaneous insulin infusion (insulin pump) with aspart insulin three years ago due to frequent hypoglycemic episodes. This was her first pregnancy, and she was seen in our maternity diabetes clinic at 4 weeks of gestation. She had three basal rates per day with carbohydrate correction ratio with all meals and insulin sensitivity factor of 1:2. The patient required an average of 30 units of insulin per day. Her initial HbA1c of 79 mmol/L and fructosamine level of 325  $\mu\text{mol/L}$ . Her fetal scan at 34 weeks of gestation showed abdominal circumference  $>95\text{th}\%$ . At 38 weeks of gestation she went into labor and was started on protocol 3 for blood glucose control. She was prescribed one liter of solution 18% infusion rate 125 ml/h with additives of 20 mmol potassium chloride in each liter and insulin pump one rate of 0.5 units/hour. Supplementary sliding scale was also prescribed with 3 units aspart if blood sugar  $\geq 6$  mmol/L and 4 units of aspart if  $\geq 8$  mmol/L. She delivered by caesarian section which takes 40 minutes with blood glucose of 4.4 mmol/l prior to surgery, 6.2 mmol/l during and 7.8 mmol/l post-delivery. She had a healthy 3.8 kg girl with no neonatal hypoglycemia. Her insulin was reduced post labor with regular follow up in diabetic clinic.

## Discussion

DM in pregnancy can be categorized into either preexisting diabetes or GDM [1], GDM defined as glucose intolerance with onset or first recognition during pregnancy [2]. In both categories there is higher risk of complication to the mother and the fetus. Preeclampsia, macrosomia, maternal and infant birth trauma, fetal hepatomegaly or cardiomegaly, operative delivery, perinatal mortality and others all are complication of hyperglycemia during pregnancy [3]. Management of diabetes during pregnancy depends on the type and severity of diabetes. Pregnant women with preexisting type 1 DM either be treated with subcutaneous insulin or continues subcutaneous insulin in-

fusion (CSII). Type 2 DM can either be managed with Insulin, OHA or diet. GDM can also be managed with diet alone, OHA or/and insulin. The main goal with either management plan is achieve normoglycemia and preventing maternal and fetal complication.

Achieving normoglycemia during pregnancy is very important for maternal and fetal outcome, on the other hand good glycemic control during labor as same important because the occurrence of fetus academia and hypoglycemia is highly related to maternal hyperglycemia during labor due to fetal hyperinsulinemia [4]. Reduced calories intake and cessation of oral intake during latent phase of labor and higher energy requirement during active phase of labor both implicated in lower insulin requirement and even the needs of glucose (dextrose) is important for optimal myometrial function [5,6].

The metabolic changes during labor required close glucose level monitoring, and this is depends on the phase of labor, diet, insulin administration and glucose level. However, the ideal glucose level target during labor to prevent fetal complications is still unclear. Monitoring of blood sugars during intrapartum period depends in the phase of labor. It is recommended to monitor capillary blood glucose 2 - 4 hourly during the latent phase of labor and 1 - 2 hourly during the active phase to achieve good glycemic control [4]. There is no proven target blood glucose during intrapartum period. It was found that a blood glucose between 4 - 7 mmol/L consider a safe target during labor. Table 1 summarized different guidelines and recommendation for target blood glucose. It's important to know that a maternal blood glucose value of more than 10 mmol/L (180 mg/dl) during labor has been conclusively proven to be associated with high risk of neonatal hypoglycemia [7].

The American College of Obstetricians and Gynecologists [8]	> 3.9 and < 7 mmol/L (> 70 and < 126 mg/dL)
The Endocrine Society Clinical Practice Guidelines [9]	> 3.9 and < 7 mmol/L (> 70 and < 126 mg/dL)
NICE guidelines [10]	4 - 7 mmol/L
Canadian Diabetes Association (CDA)	4 - 7 mmol/L
International Federation of Gynecology and Obstetrics (FIGO) [11]	4 - 7 mmol/L

**Table 1:** Recommendation of Blood glucose target during labor with different guidelines.

The insulin management during labor should be individualized for each pregnant woman due to the differences in the type and severity of diabetes, beta cells reserve and the severity of insulin resistance. Unfortunately, a recommendation of optimal approach to achieve normoglycemia intrapartum does not exist due to the lacking of well-designed, sufficiently powered, randomized trials.

**Conclusion**

We are sharing here our experience to control blood glucose level during labor using fixed protocols. These protocols are individualized according to the type of diabetes during pregnancy, required management and blood sugar control.

<b>Protocol 1: Labor regime for women with diabetes treated with metformin during pregnancy</b>	
<ol style="list-style-type: none"> <li>1. Stop metformin At delivery ward</li> <li>2. Use dextrose free fluids at 125mls/h</li> <li>3. Sliding scale of insulin: check capillary blood glucose every 2 hours or more if needed</li> </ol>	
If capillary blood glucose is	Give Novorapid S.C extra
_____ mmol/L	Novorapid _____ IU
_____ mmol/L	Novorapid _____ IU
Postnatal ward plan <ul style="list-style-type: none"> <li>• If GDM stop metformin</li> <li>• Check blood sugars pre-meals and bedtimes for 48 hours (normal ≤ 6 mmol/L)</li> </ul>	
<ol style="list-style-type: none"> <li>4. Follow up appointment to be made                             <ol style="list-style-type: none"> <li>A. OGGT <input type="checkbox"/></li> <li>B. Follow up with _____ in _____</li> </ol> </li> </ol>	

**Protocol 2: Labor regime for women with diabetes treated with insulin**

1. Standard diluent: One liter of sodium chloride 0.18%
2. Additives:
  - A. 20 mmol of KCL (potassium chloride)
  - B. \_\_\_\_\_ units of Actrapid \*(see calculation)
  - C. Infusion is to run over 8 hours (i.e. 125 mls per hour)
  - D. After 8 hours makeup a fresh infusion and continue as prescribed
3. Action for hypoglycemia in labor
 

If capillary blood glucose is	Action
< 3.5 mmol/L	<ol style="list-style-type: none"> <li>1. 50 mls dextrose 10% IV stat</li> <li>2. Re- check glucose level after 10 minutes</li> </ol>

N.B. don't stop labor regime  
Sliding scale of insulin: check capillary blood glucose every 2 hours or more if needed

If capillary blood glucose is	Give Novorapid S.C extra
mmol/L	Novorapid IU
mmol/L	Novorapid IU

N.B. Stop sliding scale after delivery  
Postnatal insulin instruction

\* Calculation of insulin dose

- Calculate 2/9 (two ninths of total daily insulin)
- Subtract 20%
- Result is the insulin dose to be added to one liter of sodium chloride 0.18% for use in labor
- Round to nearest full digit
- Example:
  - Total daily dose of insulin = 54 units
  - $2/9 = 54/9 \times 2 = 6 \times 2 + 12$
  - Subtract 20% =  $12/5 = 2.4 \rightarrow 12 - 2.4 = 9.6$  units
  - Add 10 units of Actrapid to infusion

<b>Protocol 3: Labor regime for women with diabetes treated with subcutaneous insulin infusion pump (CSII)</b>	
1. Standard diluent: One liter of sodium chloride 0.18%	
2. Additives: 20 mmol of KCL (potassium chloride)	
<ul style="list-style-type: none"> <li>• Infusion is to run over 8 hours (i.e. 125 mls per hour)</li> <li>• After 8 hours makeup a fresh infusion and continue as prescribed</li> <li>• If Cesarean section required, continue insulin infusion</li> </ul>	
3. Insulin rate via patients CSII pump run at _____ units per hour	
4. Action for hypoglycemia in labor	
If capillary blood glucose is	Action
< 3.5 mmol/L	3. 50 mls dextrose 10% IV stat 4. Re- check glucose level after 10 minutes
Sliding scale of insulin: check capillary blood glucose every 2 hours or more if needed	
If capillary blood glucose is	Give Novorapid extra via pump
mmol/L	Novorapid IU
mmol/L	Novorapid IU
N.B. Stop sliding scale after delivery	
Postnatal insulin instruction	
CSII Basal rates	
Bolus ratio	
Pre breakfast	
Pre lunch	
Pre-dinner	
Check blood glucose x 7 daily or as required (target ≤ 6mmol/L pre meals, ≤ 8 mmol/L two hours post meals)	
5. Postnatal diabetes clinic review in OPD ☐ in _____	

**Table 2:** Suggested protocols to manage diabetes during labor.

## Declaration of Interest

The author declares no conflict of interest with respect to the paper content.

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