Diabetes Management at Time of Childbirth

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About the Author

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Introduction

Dynamic changes occur in glucose handling as well as insulin sensitivity and pharmacokinetics at the time of childbirth in pregnancies complicated by diabetes. The unpredictable timing and nature of labour and childbirth contribute to intrapartum glycemic challenges. Furthermore, there is a lack of high-quality evidence in the literature to guide glycemic targets and management in the intrapartum period.[1] This lack of high-quality evidence contributes to the controversies about optimum intrapartum glycaemic targets, and results in wide variations between hospital protocols for intrapartum glucose monitoring and management. Despite these controversies, women with diabetes, particularly those with type 1 diabetes, are vulnerable for the development of hypoglycemia and/or diabetic ketoacidosis if their intrapartum glycemia is not appropriately managed.

An in-depth discussion of the timing of delivery in women with diabetes in pregnancy is beyond the scope of this article. Briefly, communication between diabetes and obstetrical care providers is encouraged to develop an individualized plan for the optimum timing of childbirth for women experiencing diabetes in pregnancy. This plan should be based on the glycemia achieved in pregnancy, the type of diabetes, and other risk factors for stillbirth such as maternal age, smoking status, the presence of retinopathy and fetal monitoring findings.[2-4]

What Intrapartum Glycemic Target Should We Strive For?

In theory, avoidance of hyperglycemia at time of labour and childbirth reduces the risk of neonatal hypoglycemia by reducing maternal glucose transferred to the fetus, and resultant glucose induced fetal hyperinsulinemia, which contributes to fetal overgrowth and neonatal hypoglycemia. However, the existing evidence to support this theory is conflicting.[1] There is increasing recognition of the contribution of maternal hyperglycemia in the second and third trimester of pregnancy to the risk for neonatal hypoglycemia. This has led groups to debate the relative contribution of intrapartum

hyperglycemia to the development of neonatal hypoglycemia and to question the risk/benefit ratio of striving for tight glycemic targets of 4.0 to 7.0 mmol/L, as recommended by guidelines. Tight glycemia at the time of childbirth has been challenging to achieve with our traditional modalities of insulin delivery. Glycemic management challenges during childbirth are generally more pronounced among women living with type 1 diabetes in pregnancy compared to those with type 2 or gestational diabetes. One large retrospective study found that over one third of women with type 1 diabetes experienced intrapartum hypoglycemia, defined as a least one recorded capillary or venous glucose level of <3.5 mmol/L.[5] The proportion of women with type 2 or gestational diabetes with intrapartum hypoglycemia in this study was 14% and 2.4%, respectively.[5] This study did not find a significant association between in-target intrapartum glycemia and neonatal hypoglycemia after adjustment for neonatal factors such as prematurity. A higher intrapartum glycemic target range of 5.0 to 8.0 mmol/L has been proposed by some experts to reduce intrapartum maternal hypoglycemia.[6]

Preparation for Glycemic Management Prior to Childbirth

Peripartum considerations should be discussed with women with diabetes in pregnancy well before childbirth. Women should receive instruction about which diabetes supplies they should bring to the hospital. It is particularly important for women who use insulin pump therapy to bring extra insulin pump supplies with them for their hospitalization, which should include batteries or a charging cord, insulin pump cartridges, and infusions sets.

The day prior to induction/cervical ripening, the usual diabetes management including glucose testing, insulin, and metformin should continue as usual, with an exception for those using degludec insulin. Postpartum hypoglycemia is a risk for women using long duration insulin (degludec) in pregnancy. In order to prevent challenges with postpartum hypoglycemia, consideration should be given to switching from degludec insulin to a basal insulin that is shorter acting well in advance of anticipated childbirth. Alternatively, a reduction in the degludec insulin dose to be 30% to 50% less than the preconception degludec insulin dose starting two to three days in advance of a scheduled caesarean birth could be considered, which acknowledges that hyperglycemia requiring correction with rapid-acting insulin boluses may occur prior to childbirth.

Additional points of discussion to help prepare women with diabetes for childbirth are provided in **Table 1**.

✔	Discuss and develop a plan well in advance of anticipated childbirth
✔	Adjust very long-acting insulin prior to childbirth if it is being used
✔	Retinal assessment, when indicated, since this may influence the mode or method of childbirth
✔	Who/what supports are available during labour and the postpartum period
✔	Food intake during labour
✔	Personal desire to self-manage the insulin pump at the time of childbirth: Is there is a birth partner that is skilled in providing assistance with the insulin pump?
✔	Resources for hospital staff regarding insulin pump therapy in hospital to ensure they understand that if the insulin pump stops, basal insulin must be replaced within 2 hours to prevent the onset of diabetic ketoacidosis (example: To learn more, click here.
✔	Need to bring home diabetes supplies to hospital
✔	Review glucose monitoring type and frequency
✔	Provide recommendations for postpartum insulin dosing based on pre-pregnancy insulin dosing or diabetes agents: Reduce the insulin dose to be 20%-30% less than used in pre-pregnancy or to 50% of that used in late pregnancy if the former is unknown
✔	Postpartum diabetes follow-up plan: who, when, and how
✔	Avoidance of glucocorticoids for postpartum nausea prevention

Table 1: Planning checklist for childbirth in women with diabetes in pregnancy; courtesy of Lois E. Donovan, MD, FRCPC

Intrapartum Glucose Monitoring: Frequency and Type

The frequency of intrapartum glucose monitoring should be based on the type of diabetes, how it has been managed during pregnancy, and how it is being managed in the intrapartum period. When intravenous (IV) insulin therapy is used, hourly capillary glucose testing is required. Women who present for delivery with in-target glycemia using lifestyle measures alone require much less frequent monitoring. The experience of the author is that no further glucose monitoring is required for such women once in-target glycemia is documented at presentation for childbirth. Further glucose monitoring can be safely discontinued without negative consequences[5] provided no new concerns arise such as the need for glucocorticoid therapy.

Women using continuous glucose monitoring (CGM) should be informed that since CGM glucose levels lag behind capillary glucose monitoring by as much as 20 minutes, hospital policies usually require CGM to be supplemented with capillary glucose monitoring, and that capillary glucose monitoring is a requirement when IV insulin therapy is used. CGM sensors should be situated away from a potential operative site or unipolar diathermy pads because of the potential for electrical conduction.

When is Intravenous Insulin Required?

Once in active labour, if the glucose level is above 7–8 mmol/L for two consecutive hours in the absence of carbohydrate ingestion, insulin is traditionally initiated or continued depending on the clinical situation. Women with type 1 diabetes who are on a regimen of multiple daily insulin injections are generally switched to IV insulin at the onset of active labour. Many women with type 2 or gestational diabetes, even if they are using multiple daily doses of insulin during pregnancy, maintain in-target glycemia levels without the need for insulin during labour.

Close communication with the obstetrical team is required since the optimum glycemic management strategy will depend on the timing and mode of delivery, and if or when oral intake is permitted or tolerated. Nausea and vomiting are common occurrences during labour. Especially in the setting of type 1 diabetes, or when antenatal glucocorticoids have been recently administered, there should be a low threshold for assessing additional signs or symptoms of diabetic ketoacidosis (DKA), and to send lab work to screen for the possibility of DKA even in the setting of euglycemia, since 50% of DKA in pregnancy is euglycemic.[7]

The night prior to an elective caesarean birth, women taking intermediate acting insulin can take their usual evening intermediate-acting insulin dose or decrease their dose by 20%, depending on the clinical scenario and type of intermediate acting insulin. Those using degludec insulin should have insulin adjustments as outlined above in the days-to-months prior to delivery. An IV insulin infusion can be started the morning of a caesarean section if the glycemic level is above target or if there will be a delay in the timing of caesarian birth or anticipated return to subcutaneous insulin, owing to postoperative nausea and vomiting. Although the use of glucocorticoid therapy to prevent postoperative nausea and vomiting is gaining popularity amongst anesthesiologists, this practice should be avoided in women with diabetes in pregnancy because of the potential for this therapy to cause DKA.

IV delivery of insulin has traditionally been endorsed for women with diabetes during active labour because of the unpredictability of the timing of childbirth and the quick "on/off" duration of action when insulin is administered intravenously compared to subcutaneous delivery of insulin. Protocols used to guide the administration of IV insulin vary from centre to centre and are based on site-dependent hospital formularies and policies. Most centres initiate and vary the IV insulin dose based on total daily insulin requirements late in pregnancy and adjust infusion rates based on capillary blood glucose results. An infusion containing a 5% to 10% dextrose is administered with the insulin infusion to avoid hypoglycemia and ketosis. After delivery of the placenta, the IV insulin infusion should usually be decreased by 50% for women with type 1 diabetes and usually stopped for those with gestational or type 2 diabetes.

Insulin Pump Use for Intrapartum Insulin Delivery

Women living with diabetes that predates pregnancy are often very interested in maintaining control of their glucose management during the intrapartum period. Studies have shown the safety of continued nonautomated and automated ("closed-loop") insulin pump therapy in the intrapartum period.[8-11] This is provided that pain medications or exhaustion do not impair the ability of her or her birth partner, who is familiar with the operation of the insulin pump, to manage her pump effectively. Qualitative studies have highlighted women's

confidence and desire to continue automated insulin delivery at the time of childbirth to make their childbirth experience more enjoyable.[9-11] Furthermore, automated insulin delivery appears to be a promising option to reduce maternal hypoglycemia at the time of childbirth and in the postpartum period.[9-12] Regardless of whether women choose continued use of their insulin pump during labour and childbirth, postpartum insulin doses should be programmed into the pump beforehand for subsequent activation. Drever and Feig have previously outlined recommendations for nonautomated pump adjustments during labour and delivery,[8] which are summarized in **Table 2**, along with additional recommendations for insulin pump setting adjustments for automated insulin pump use.[10,11]

Postpartum

There is a dramatic decrease in insulin resistance immediately following the delivery of the placenta that results in a reduction of approximately 50–60% in postpartum insulin dosing in the setting of type 1 diabetes and may completely eliminate the need for insulin among women with type 2 diabetes in pregnancy. Because predicting postpartum insulin doses for women with type 1 diabetes can be challenging, there are risks postpartum of severe hypoglycemia and DKA. Postpartum insulin doses should be discussed by women and their primary diabetes team prior to delivery. A copy of this plan should be entered into the health record and be provided to the woman in advance of childbirth. Women using IV insulin should continue using it until it is safe to transition to either multiple daily injections or their insulin pump. Hourly capillary glucose testing should be maintained until after the woman is transitioned off of IV insulin and back to subcutaneous insulin. This should be clearly indicated in the hospital orders. Women using degludec insulin may need to skip the first postpartum day dose depending on how the degludec insulin was adjusted prior to childbirth as discussed above. Prior to hospital discharge, postpartum insulin dosing should be reviewed daily with the diabetes team with the goal of reducing the risk of hypoglycemia. Women with type 1 diabetes have indicated their need for ongoing close follow up in the early postpartum weeks.[13] As a result, the author recommends outpatient phone follow up for women with type 1 diabetes within a week of childbirth to support their need for insulin titration during this challenging period.

If intrapartum IV insulin was used for women with type 2 or gestational diabetes it should be stopped once the placenta is delivered. The frequency of capillary glucose monitoring for women with gestational diabetes prior to hospital discharge should be guided by how great the concerns are for persistent diabetes immediately postpartum as well as the potential obstacles to follow up for oral glucose tolerance testing postpartum. The plan for postpartum glucose testing for women with gestational diabetes, and diabetes management for women with type 2 diabetes, and with whom follow up is being provided (i.e. primary care or diabetes care providers) should be clearly communicated with the woman and her primary care provider. Postnatal prevention strategies to mitigate the risk of future development of diabetes and cardiometabolic disease should be discussed.

All women with diabetes in pregnancy should be informed of the benefits of breastfeeding, effective contraception, and the importance of planning for the next pregnancy should they desire another pregnancy.[14] Although it has become common to recommend a snack with breastfeeding to prevent hypoglycemia with breastfeeding in women on insulin, this is generally not required, especially among women skilled in carbohydrate counting and insulin adjustment who have appropriately reduced postpartum insulin dosing.[15]

Conclusions

Labour and childbirth present unique challenges in the management of diabetes. While protocols should be available to guide healthcare providers, clinical scenarios, personal preference, and experiences are unique; therefore, care must be individualized. Women who are able and willing can safely continue using the insulin pump during labour and vaginal or caesarean childbirth, however, IV insulin therapy should be discussed and used if necessary. Postpartum insulin dosing requirements must be considered prior to the onset of labour since there is a steep reduction in insulin resistance postpartum that drastically reduces the insulin dose requirements postpartum.

Well before childbirth
Enter and save, but do not activate, a profile for postpartum insulin pump settings that results in an insulin dose of approximately 20–30% less than the dose required preconception or approximately 50% less than the dose required in late pregnancy.[10] Note: certain insulin pumps will allow for multiple basal rate settings only (Medtronic™, Omnipod™) while other insulin pumps will allow entry of multiple profiles that include basal rates, insulin to carbohydrate ratios, and insulin sensitivity factors (Tandem™).
Educate women and their birth partners on the available resources and responsibilities for safe insulin pump therapy use in hospital. To learn more, click here.
Reinforce the importance of bringing extra pump supplies to the hospital.
Prior to childbirth
The insulin pump, infusion set, and CGM should be situated away from a potential operative site.
A Teflon insulin infusion cannula is a potential option to address this hypothetical risk of electrical conduction when used close to unipolar diathermy.
During labour
If the patient is not able to manage her insulin pump because of confusion or illness, call in the hospital diabetes management team to start an IV insulin drip, and only stop the insulin pump once the IV insulin drip is running. If capillary blood glucose is greater than 8 mmol/L for 2 consecutive hours while the patient is in active labour, notify the doctor to discuss glucose management with the patient.
Nonautomated insulin pumps: • If the blood glucose level is <4.0 mmol/L, decrease the basal insulin rate by 30%–50%. • If the blood glucose level is ≤3.7 mmol/L or the patient is symptomatic, treat the low blood glucose level as per hypoglycemia orders. • If the blood glucose level is ≥6 mmol/L, administer a correction insulin bolus.
Automated ("closed-loop") insulin delivery pumps: • Increase the insulin pump target glucose level if glucose is below the target glucose range. • Decrease the insulin pump target glucose level if possible if glucose is above the target level for 2 consecutive hours.
Prior to delivery activate postpartum insulin pump settings: • Non-automated insulin pumps: 1 to 2 hours prior to caesarean section or at the start of pushing. • Automated insulin delivery: Just prior to caesarean section or at the start of pushing.
Postpartum
If IV insulin is started and the insulin pump is stopped during labour, continue IV insulin until 2 hours after the insulin pump is restarted.
Relax glycemic targets to 5–10 mmol/L postpartum.
Increase the insulin pump target glucose setting if the glucose level is running too low postpartum.
If using CGM, personalize but consider relaxing high glucose alarms.

Table 2: Recommendations for insulin pump use at the time of labour and childbirth; adapted from Drever et al.[8]

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Financial Disclosures:

Disclosures: In-kind donations, loan and reduced cost for study supplies for investigator-initiated trials from Medtronic, Dexcom, Tandem Diabetes Care and Inter-analytics

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