Diabetes Control in Pregnancy - Part II

Expires Tuesday, April 30, 2019 Nursing Tamerou Asrat , M.D. F.A.C.O.G.

Objectives

1. Calculate the conversion of intravenous insulin infusion therapy to subcutaneous insulin doses.
2. Discuss the outpatient control of the pregnant diabetic and which insulin dose and blood sugar value is associated to a given meal.
3. Describe the effect that corticosteroid drugs or beta-sympathomimetic agents have on blood sugar control.
4. Discuss hypoglycemic reactions and the various methods by which this problem can be managed if and when it occurs.

Article

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Introduction

Part I of this series reviewed diabetes in pregnancy and the potential ramifications of poor glucose control. In addition, it discussed how to monitor diabetic patients and manage them by insulin infusion when they are admitted to the hospital. This section will discuss subcutaneous therapy, how to detect and manage hypoglycemic reactions, and will cover special circumstances that may arise when these patients receive other drugs that can affect glucose control.

Conversion of Insulin Infusion to Subcutaneous Doses

Patients who are admitted to the hospital and placed on an insulin infusion will eventually be converted to a subcutaneous dosing schedule. This is accomplished by calculating the total amount of insulin that was infused over a 24-hour period. In addition, the total number of calories consumed in the same 24-hour time span should also be tabulated. When these numbers are obtained, divide the total number of calories by the total amount of insulin to determine the C/I ratio (calorie to insulin ratio). Then take the total calories in the prescribed ADA diet and divide that by the C/I ratio. This will give you an approximate amount of insulin that will be administered subcutaneously. This value is considered as the "daily insulin requirement".

Once the daily insulin requirement is calculated, multiply that number by .67 (which is 67%). This will give you the total morning dose that will consist of NPH and regular insulin. The remaining 33% of the total daily insulin requirement is the evening dose that will also consist of NPH and regular insulin. Some groups may want to split the evening insulin dose into one injection of the regular insulin given just before dinner and the other injection (of NPH insulin) at bedtime. Others may wish to keep them as one shot of mixed insulin given at dinnertime.

The amount of insulin calculated for the morning dose is again multiplied by .67 (or 67%), which gives the amount of NPH insulin in the morning shot and the remaining .33 (or 33%) consists of the regular insulin. Half of the total evening dose is NPH insulin and the other half is regular insulin. The easiest way to explain this is by giving an example. Lets take a case where the total

amount of insulin infused over 24 hours was 84 units and the total amount of calories consumed in that time period was 2050. The C/I ratio would be 24.4 (which is 2050 divided by 84). The plan for the patient is to be placed on a 2400 calorie ADA diet. If you divide the 2400 calorie ADA diet by the C/I ratio of 24.4 the total daily insulin requirement would be about 98 units.

The morning dose is 67% of this total daily requirement. Thus you would multiply the 98 units by .67 and obtain a value of about 66 units. The morning shot would then consist of 66 units that is a mixture of NPH and regular insulin. Again, 67% of the morning shot is NPH, which would be 44 units (66 units multiplied by .67), and the remaining 22 units would be regular insulin. Therefore, the morning shot would be 44 units of NPH insulin mixed with 22 units of regular insulin (for a total injection of 66 units).

The evening dose or dosages are split between NPH and regular insulin. In our example, the total daily insulin requirement was 98 units and 66 of that was used for the morning injection. Therefore, the remaining amount of insulin is 32 units (98 minus 66). Half of this 32 unit amount (or 16 units) would consist of regular insulin and the other half (or 16 units) would be NPH insulin. As stated above, some groups would give the 16 units of regular at dinnertime and the 16 units of NPH at bedtime. Others might give one injection of 32 units (16 units of NPH mixed with 16 units of regular) at dinnertime.

This conversion from intravenous insulin infusion to subcutaneous injection should only be considered as a rough guidance. How insulin is absorbed from a subcutaneous injection can vary from person to person. In addition, you might have several individuals who prefer to eat larger or smaller meals at given times. This above approach presumes that the patient was seen by a diabetic nutritionist who calculated the patient's caloric requirements and broke down the number of calories per meal (which on average is around 25% for breakfast, 30% for lunch, 30% for dinner and 15% for a bedtime snack). However, the subcutaneous dosing amount and mixture (NPH versus regular) will need to be modified if the amount of calories consumed for a given meal changes. For example, the amount of regular and NPH insulin in the morning injection will be different if one person eats a large breakfast and a small lunch when compared to someone who eats a small breakfast with a large lunch. Therefore, each diabetic patient will need to be treated in a unique manner.

The best success comes when the patient has some control over what the management entails. Many cases that result in wide fluctuations in blood sugar and an unhappy patient are due to strict regiments that are enforced on a patient, such as a certain number of calories that have to be eaten at breakfast, etc. An approach that is usually accepted by most patients is to create a diet for the patient regarding the total number of calories per day with the percentage of carbohydrates, proteins, and fats, but let the patient participate in how much (of the total) they eat at each meal and whether they have 3 meals with 3 snacks or 3 meals with a bedtime snack. Once the diet has been worked out between herself and the physician and / or dietician, the total insulin dosage can be broken down accordingly. If the patient has some input in her diet, there is a higher likelihood that the "diet protocol" will be followed.

Outpatient Control by Subcutaneous Treatment

The diabetic patient that has been managing herself as an outpatient with subcutaneous insulin and then learns that she is pregnant will probably discover that her blood sugars are more elevated. This is because insulin requirements increase during pregnancy. This phenomenon does not occur because the diabetes has suddenly become worse. This is because the placenta metabolizes insulin and, in addition, the metabolic needs of the mother have increased. Therefore, the total daily insulin requirement will increase as the gestational age increases. In fact, if a patient is well controlled prior to becoming pregnant, it is not uncommon for her total daily insulin requirement to double by the time she is in the third trimester.

Modifying the amount of insulin that is administered subcutaneously will depend on the blood sugar value that is connected to a particular part of the insulin scheme. To clarify this point, if a patient is utilizing a three-dose regiment, in essence there are 4 parts of the insulin dosage scheme. The regular insulin in the morning injection primarily covers the calories consumed at breakfast. The NPH insulin in the morning injection covers the calories covered at lunch. The regular insulin administered at dinner covers those calories and the NPH at bedtime covers the evening snack. However, the blood sugar that is used to monitor one of the 4 parts of the insulin scheme is the blood sugar that is obtained after the meal. Thus, the blood sugar obtained after breakfast will tell you if the amount of insulin was adequate for the calories that were consumed at breakfast. If the blood sugar value was elevated, then this would be adjusted the following morning. Table I depicts the 4 parts of the insulin scheme and which meal they are utilized for and the blood sugar value that should be used to determine if a change is necessary.

Table I: This table describes the three-injection method

Insulin Injection	Meal that is Covered	Blood Sugar to Follow
Morning regular insulin	Breakfast	Postprandial value after breakfast or Pre-lunch blood sugar
Morning NPH insulin	Lunch	Postprandial value after lunch or Pre-dinner blood sugar
Dinner regular insulin	Dinner	Postprandial value after dinner or Pre-bedtime snack blood sugar
Bedtime NPH insulin	Bedtime Snack	First blood sugar in the morning before breakfast

In the two-injection method, the bedtime NPH insulin is mixed with the dinner regular insulin and is administered just before dinner.

As seen in the table, some patients will be checking their blood sugar 1 to 2 hours after a meal (the postprandial value), whereas others will check their blood sugar right before each meal. If the blood sugar values are not significantly off, it is easier to follow short trends when adjusting the insulin regiment. This means obtaining 3 to 4 days of values and then analyzing any continued patterns. To better explain this, lets take a patient who is currently on an insulin regiment and is obtaining blood sugars 4 times a day and her values are listed in Table II below. The blood glucose goal range for a glucometer (remember that a glucometer is checking whole blood which is a value that is 10% to 15% lower than a laboratory plasma value) is as follows:

Fasting or Pre-Breakfast = 60 to 90 mg/dl (should be obtained in all patients)

2-hour Postprandial Values = $\leq$ 120 mg/dl

Pre-meal Values = 60 to 105 mg/dl (if used instead of postprandial values)

Table II: Blood sugar values obtained over 4 days by a pregnant diabetic

Fasting or Pre-Breakfast	2-hour Postprandial Breakfast	2-hour Postprandial Lunch	2-hour Postprandial Dinner
86	127	138	98
91	108	119	102
79	115	141	110
83	99	136	89

As seen in Table II, all of the fasting blood sugars and the postprandial dinner values are in the expected range. All of the postprandial breakfast values are also as expected except for one, thus no change is indicated. However, nearly all of the

postprandial lunch values are slightly elevated. Therefore the patient's morning NPH insulin could be increased by 1 to 2 units, because the morning NPH is primarily responsible for the postprandial lunch value.

To summarize, use the following guide:

Fasting blood sugar values are too high or too low change the dinner/bedtime NPH

Postprandial breakfast or (pre-lunch) values are too high or too low alter the morning regular

Postprandial lunch or (pre-dinner) values are too high or too low alter the morning NPH

Postprandial dinner or (pre-bedtime snack) values are too high or too low alter the dinner regular

Factors That Can Affect the Diabetes Control

Corticosteroids:

Some pregnant women with diabetes may develop preterm labor or some other problem that may suggest the use of corticosteroids (usually betamethasone or dexamethasone) to improve fetal lung maturity in case of preterm delivery. This therapy (in the case of betamethasone is usually a 12 mg intramuscular injection administered twice – 12 to 24 hours apart) will usually result in transient higher blood glucose concentrations as a result of gluconeogenesis and decreased tissue sensitivity to insulin. Ketoacidosis may occur if inadequate insulin is administered. The onset of hyperglycemia is usually about 24 hours after the first injection and may persist for 24 to 48 hours after the last injection. Marked increased amounts of insulin may be required in some cases. The majority of these patients will be hospitalized when receiving this therapy because of the potential for preterm birth. It may also be necessary to obtain more frequent blood sugar values following corticosteroid therapy. If the patient is being managed on a subcutaneous regiment, it may be necessary to temporarily place them on IV insulin infusion therapy.

Beta-sympathomimetic Drugs:

Beta-sympathomimetic medications (such as terbutaline or ritodrine) may also be administered to a pregnant diabetic who has developed premature labor. These medications are used for their tocolytic effect (ability to decrease uterine contractions). However, these agents can also result in an increase in the blood sugar value because they have a glycogenolysis (breakdown of glycogen) effect, as well as, a gluconeogenesis effect. The development of ketoacidosis is also a possibility. The increase in blood sugar is seen more quickly (usually within 4 hours) than the rise associated with corticosteroid drugs. If the patient receives these drugs for an extended period of time, this blood sugar elevation effect may diminish over time. Like corticosteroid medications, if the patient is being managed on a subcutaneous regiment, it may be necessary to place them on IV insulin infusion therapy.

Combination Corticosteroid and Beta-sympathomimetic Therapy:

A patient receiving both corticosteroid treatment and beta-sympathomimetic drugs for preterm labor represents a challenge in the management of the diabetes. Large increases in the blood sugar value may be seen that require large increases in the insulin dosage. Typically, the easiest way to manage this complicated patient is to place them on IV insulin infusion therapy until 24 to 48 hours after the last corticosteroid dose (when the effect of that drug has passed). By that time, the overall effects of the beta-sympathomimetic drug will also have diminished, even if the tocolytic therapy continues.

Managing Hypoglycemia

By definition, hypoglycemia is a blood glucose value that (by glucometer) is less than 50 mg/dl, a level at which most patients will exhibit symptoms. (Though the goal of therapy is blood sugars by glucometer in the range of 60 to 110 mg/dl, the 50 mg/dl to 60-mg/dl level is the gray zone.) The early warning signs of hypoglycemia vary from patient to patient, but usually include one or more of the following: generalized sweating, a cold feeling, palpitation, blurred vision, tremor, hunger, sweaty palms, headache, or tingling of the lips and tongue. The central nervous system effects of hypoglycemia may include lethargy, confusion,

agitation, nervousness, and ultimately convulsion. Though not absolute, most convulsions / seizures do not occur unless the blood sugar value by glucometer is less than 25 mg/dl.

It is important to re-review that if a patient is being treated by insulin infusion therapy, the infusion rate should temporarily be turned off if the blood sugar value falls below 60 mg/dl. If a patient on IV infusion therapy displays or complains of symptoms that are consistent with hypoglycemia, the insulin infusion should again be temporarily turned off and a blood sugar obtained immediately. If the value is less than 60 mg/dl the dextrose IV fluid rate can be increased until the blood glucose level increases back into the normal range. It should also be noted that if a patient starts out with a very high blood sugar value and this level is reduced too rapidly, patients might also experience symptoms consistent with hypoglycemia (even though they are not hypoglycemic by criteria). Under these circumstances, it is best to slow the infusion rate and allow the blood sugar to drop more slowly. This should help to minimize any symptoms the patient is experiencing.

There are several ways of correcting hypoglycemia. If the blood sugar value is < 60 mg/dl, the best method is to temporarily increase the IV dextrose infusion rate because the number of calories dispensed can be calculated. Another option is to administer D50 (50% dextrose) by IV push. A 25 cc push of D50 is roughly equal to 50 calories and a 50 cc push of D50 is roughly equal to 100 calories. A third option is to give 4 ounces of juice (especially if an IV is not present or is not infusing well). Orange juice has about 40 calories in 4 ounces, whereas grape juice has about 80 calories in 4 ounces. A fourth option is to administer 40% glucose gel of which a few products are commercially available and they give about 35 to 45 calories per dose. Juices and glucose gel products, however, have to be swallowed and may not be the best treatment for a patient with central nervous system symptoms (who may have difficulty swallowing). It should be noted that D50, juices, and glucose gels are bolus sugar treatments that will often result in an over-swing in the blood sugar value (where the blood sugar level goes from the hypoglycemic range to a range above normal). Thus, the insulin infusion rate, when restarted, will need to be adjusted.

A final treatment option (usually given for severe reactions, seizures, or coma) is glucagon at 1 mg administered IV, IM, or subcutaneously. A response is usually seen within 5 to 20 minutes. In many cases, glucagon is given when IV access is not available. Thus once it is administered, an IV should be started so that IV glucose can also be infused as the glucagon is taking affect.

In summary, management of the pregnant diabetic is challenging, however, the best outcomes occur in patients who are well controlled. The information supplied in Part I and Part II of this series **should be considered as rough guidelines, not as strict protocols**. In addition, the best approach is the team approach where the physician, pharmacist, nurse, and dietician work together. In this system, different parameters from those listed in this series may be adopted based on personal experience and or preference.

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