Dakota Diabetes Coalition is proud to offer this column on diabetes and related concerns every other Friday.

Dr. Johnson is a family practice doctor in Grand Forks with a special interest in diabetes -- and a special knack for writing. As a member of the Dakota Diabetes Coalition, he has generously made himself available to answer questions through our listserv. If you have comments, or questions for Dr. Johnson to address in future columns, please contact gailhand@q.com

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Practical Pointers on Multiple Daily Injection Therapy for type 2 Diabetes

It's well established that most, if not all, type 2 patients will require insulin therapy at some point. This is because as people age, beta cell function declines. As a result, the pancreas produces less insulin over time.

Oral agents and non-injectable insulin therapies work well -- if the body is still producing adequate amounts of insulin. Certain oral agents, such as metformin or TZD's, can be used with exogenous (injected) insulin. At 7 to 8 years after diagnosis, a good majority of type 2 patients should be on insulin.

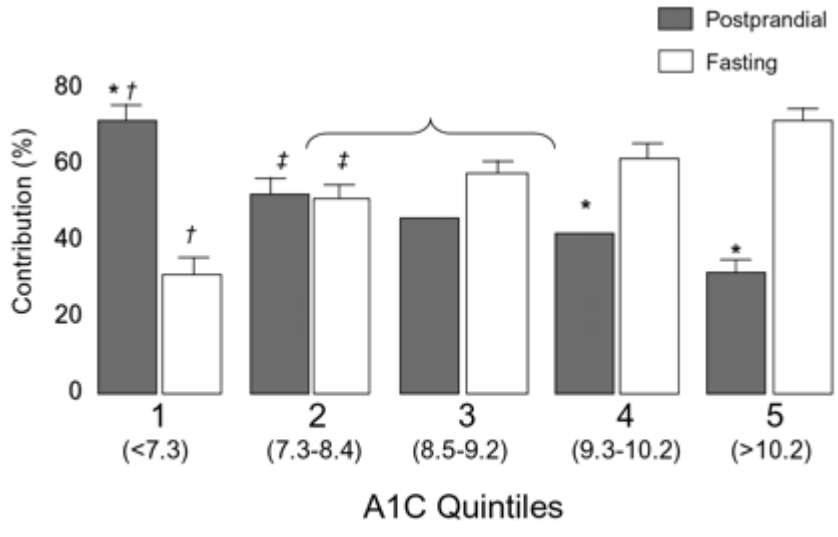
Most patients with type 2 diabetes will be kept on at least some of their oral medications when a basal insulin is started. A common strategy is to continue metformin and add a single injection of a basal insulin at bedtime. Glargine (Lantus) and detemir (Levemir) are insulins introduced in the last

10 years that are used this way. These are generally taken once daily, morning or evening, and both come in very user-friendly pen devices. Most often, a patient starts on 10 units a day, with a titration schedule that targets fasting blood glucose values to below 10. For some patients, keeping the value to less than 140 may be acceptable.

Usually, insulin is then increased by 3 units every three to five days. Patients need to understand that they likely will be on larger doses of these insulin products and that it doesn't reflect badly on them or their prospects. Type 2 patients will typically require anywhere from 40 to 80 units or more daily.

Adding basal insulin, when titrated appropriately, will almost always improve A1C and blood glucose levels. However, the closer one gets to an A1C of 7%, the role of post-prandial glucose becomes more important. It's interesting to note that at an A1C of 10%, fasting and post-prandial blood glucose values each contribute about 50% to the overall A1C. A person whose A1C is 7.5%, however, is getting 70% of that value based on post-prandial blood glucose values. (See chart.)

Basal insulins usually target fasting blood glucose values very effectively, but are not as effective with post-prandial values. Most of these patients will need an additional meal time rapid-acting insulin to achieve or sustain an A1C of <7%, as these insulins target post-prandial glucose values. Rapid-acting insulins include aspart (Novolog), lispro (Humalog), and glulisine (Apidra). All of these insulins come in pen devices as well.



* significant difference between fasting and postprandial (paired *t* test)
† significantly different from all other quintiles (ANOVA);
‡ significantly different from quintile 5 (ANOVA).

Monnier L, Lapinski H, Colette C: *Diabetes Care* 26:881-885, 2003

There are two ways to approach the patient with type 2 diabetes when adding rapid-acting insulin to a basal insulin. Ideally, these patients will use rapid-acting insulin to cover many of their snacks and all of their meals. However, some patients feel overwhelmed when asked to go from one shot to four injections a day. Converting from one to two shots a day is easy.

A good starting point for these patients is the “90/10” rule. If a patient is on a basal insulin, and needs to add a rapid-acting mealtime insulin, the basal insulin would be decreased by 10%. Then the dose of rapid-acting insulin takes the place of that subtracted 10% basal insulin. It’s used with the largest meal of the day, usually the evening meal. Thus, 90% of the daily insulin is basal and 10% is rapid acting.

Let’s look at this typical patient: A 56 year old white female is on 50 units of basal insulin at bedtime along with metformin 1000 mg twice a day. Her most recent A1C is 7.6%. You’d like to add a rapid-acting mealtime insulin to lower her A1C to below 7%. An easy way to start this transition is to cut the basal insulin to 45 units (that’s the 10% cut). The “missing” 10% is then given as rapid-acting insulin with the largest meal. So, in this case, that is 5 units. That means that the patient is taking 45 units of basal insulin (90%) and 5 units of rapid-acting insulin (10%) daily. Those insulins can be titrated according to fasting and 2-hour post-prandial blood glucose values respectively. Typically, fasting blood glucose values of less than 110 and 2 hour-post-prandial blood glucose values of less than 180 would be recommended for most non-pregnant adults.

Many type 2 patients who go on to more sophisticated regimens of multiple daily injections will do well with carbohydrate counting. Often, type 2 patients who are obese will need 2 to 3 units -- or more -- of rapid-acting insulin for every 15 grams of carbohydrate. In a multiple daily injection program, a general rule would be to take approximately 50% of the total daily insulin dose in basal insulin. The other 50% is rapid-acting insulin which is injected at mealtimes in amounts appropriate to cover the size of the meal. Frequently, this would mean decreasing the basal insulin dose initially as more rapid-acting insulin injections are added daily.

For patients who cannot or will not do carbohydrate counting, a formula proposed by Bergenstal (Diabetes Care, 2008) and associates can work well. When converting to a multiple daily injection program, 50% of the total daily insulin dose is basal insulin; 50% is rapid-acting. Of the 50% given as rapid-acting, it is broken down for each meal: 50% of the rapid-acting is used with the largest meal of the day, 33% with next largest meal, and 17% with the

smallest meal of the day. These doses can be adjusted based on fasting blood glucose values (basal insulin) and 2-hour post-prandial blood glucose values (rapid-acting).

Let's look at an example: Our patient noted above is now on 60 units of basal insulin and takes 10 units of rapid-acting for just the evening meal. As the total daily dose is 70 units, to convert to a multiple daily injection regimen, the basal insulin would be reduced to 34 or 36 units daily (50%).

The 50% to be given as rapid-acting mealtime insulin (34 or 36 units) would be broken down as follows:

18 units with the largest meal of the day (~50% of rapid-acting total),

12 units with next largest meal (~33% of rapid-acting total) and

6 units with the smallest meal of the day (~17% of the rapid-acting total). Doses can be adjusted based on blood glucose values, and eventually other injections for snacks can be worked in as well.

By using these relatively simple steps, and introducing pen devices to patients where it's appropriate, chances are the patient will settle into the new routine easily. And that matters because initiating and titrating insulin in type 2 patients can improve both blood glucose values and A1C. That in turn helps the patient avoid or reduce complications from diabetes.

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