Why Basal-Bolus Insulin Therapy May Be The Best Choice for Type 2 Diabetes

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Many medications, both oral and injectable, exist to manage blood glucose in type 2 diabetes. Even insulin has many different formulations, including fast-acting and long-acting analogs as well as various pre-mixed combinations of faster and slower acting insulins in the same vial.

This large selection of treatments is necessary because type 2 diabetes generally progresses over time from insulin resistance to outright beta cell failure. As a result, treatments must frequently be changed or added to one another in order to maintain good control. As the disease progresses, insulin might be combined with one or more oral agents, or different types of insulin might be used together to control glucose. Basal-bolus insulin therapy is one method of using different insulins together to treat diabetes.

In order to understand basal-bolus insulin therapy, it is important to understand how the body uses the insulin it produces naturally. Insulin released from the pancreas helps move glucose from the bloodstream into the cells of the body, which then use the sugar for energy. Because the cells need energy all the time, the body must have not only a constant supply of glucose, but also enough insulin to deliver this sugar to the cells.
Two important sources of glucose are carbohydrates from foods and glucose made in the liver. The liver supplies the body with glucose primarily during times when a person does not eat, both by breaking down complex sugars stored in the form of glycogen and by creating new sugar from proteins and fats in a process called gluconeogenesis. The combination of glucose from eating and glucose made by the liver provides a supply of sugar 24 hours a day. To move this sugar into the cells that need it for energy, insulin must be present 24 hours a day as well.

Although the body produces glucose continuously, the amount of blood sugar varies throughout the day. More glucose is present after eating meals, particularly meals containing sugar and other carbohydrates. Smaller, relatively constant amounts are present during the times when only the liver is producing sugar. The pancreas typically produces insulin in a similar pattern. In other words, a relatively small amount of insulin is present all day long to deal with the sugar that the liver is producing. Increased amounts are produced in response to eating, and even more is produced after a meal laden with carbohydrates and sugars.

Thus, the insulin produced by the body has essentially two roles: basal and bolus. The insulin produced for the "basal role" addresses the glucose that the liver is making throughout the entire day and night. This is a fairly constant background/baseline amount and is present whether or not a person eats. The "bolus role" is the quick burst of insulin that the pancreas makes to address the sudden appearance of extra glucose caused, for example, by eating. Bolus insulin may therefore be thought of as mealtime insulin and basal insulin as all-day background insulin.

In type 2 diabetes, there is not enough insulin available to perform these tasks, allowing blood sugar to run high. It may be that insulin is actually elevated, but that, due to insulin resistance, it is not able to do its job. Insulin therapy provides extra insulin to augment that which the body is failing to produce or properly use. For patients with type 2 diabetes, insulin dosing needs to "make up the difference" between what the body needs and the inadequate amount it has available.

Insulin dosing may be categorized in terms of whether it fills the basal role or the bolus role. Specific insulins generally fit one role better than the other, as listed in the following table. (Although NPH is listed as a basal insulin, it does have a pronounced peak approximately six hours after injection, which means that food might be needed around that time to avoid hypoglycemia.)

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**Different insulins listed according to whether they serve primarily as a bolus or a basal insulin.**

**Bolus Insulin**

- Aspart (Novolog®)
- Glulisine (Apidra®)
- Lispro (Humalog®)
- Regular

**Basal Insulin**

- Detemir (Levemir®)
- Glargine (Lantus®)
- NPH*
*NPH does have a pronounced peak approximately six hours after injection.

Basal-bolus insulin therapy is one of the most advanced and complicated insulin replacement therapies. It is also among the most flexible, however, giving doctors the most choice in matching the treatment to the needs of the patient. Often, people with type 2 diabetes can be treated with the addition of a single injection of basal insulin to their oral agents. If more insulin is needed with a certain meal, one of the bolus insulins may be added to that meal. If more insulin is needed with each meal, then a dose of bolus insulin may be added to each meal.

Although it may seem complicated to inject insulin with each meal and then inject more insulin for basal needs (four injections a day), there are great advantages to this approach to diabetes care. Because many people do not eat at the same time every day, conventional insulin approaches do not work efficiently for them. A person may be eating when the insulin is not acting, leading to high blood sugar.

Alternatively, he may not eat when the insulin is peaking, leading to low blood sugar. By taking bolus insulin just before eating, a person can eat at any time of the day. Using bolus insulin also permits the person to vary the amount of food eaten with any meal. More insulin can be taken when necessary and less taken with smaller meals.

Several studies have compared basal-bolus insulin to other forms of therapy in type 2 diabetes. While most have shown that basal-bolus dosing is associated with less hypoglycemia, few have shown that it leads to significantly lower A1c's. However, the studies have not focused on quality of life, which is enhanced by the fact that patients on basal-bolus insulin therapy can eat meals just like anyone who does not have diabetes (after a little training in how to adjust the insulin doses).

Basal-bolus insulin is one of the most advanced approaches to diabetes care, offering a way to closely simulate natural insulin delivery. The basal insulins address the glucose the liver makes, while the bolus insulins address the sugar in the foods that are eaten. Because some people need more basal insulin and others need more bolus insulin, this regimen can be custom fit to the needs of each individual.

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