The Basics of Insulin

UCSF Mini Medical School: Diabetes
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No disclosures
Insulin helps capture the energy that we get from carbohydrates
What happens to the carbohydrates we eat?

- Carbohydrates are digested by the intestines into sugars (e.g., glucose)

- Glucose is transported from intestines into circulation

- The pancreas senses a rise in blood glucose and **insulin** is released
What is Insulin?

• Insulin is a **hormone** that is made by the pancreas
• A hormone is a chemical messenger

Images from https://www.niddk.nih.gov
Insulin tells other organs to take in glucose from bloodstream.
Insulin release from the pancreas

Insulin production by the pancreas

Mealtime Insulin

Background Insulin

Insulin release dynamically changes throughout the day to keep blood glucose levels in a narrow range.
Diabetes results from insulin insufficiency

**Type 1 Diabetes**
- Total or near total lack of insulin due to autoimmune attack of beta cells

**Type 2 Diabetes**
- Insulin resistance
- Varying degrees of insulin deficiency due to lack of enough functioning beta cells
We can take “exogenous” insulin if we don’t make enough

Insulin is injected into the fatty space under the skin

Insulin molecules disassociate and enter the bloodstream
Different Ways of Injecting Insulin

Images from Getty Images, Wikipedia, Cleveland Clinic
The difference between different types of manufactured insulin is **timing**.

**Long-Acting Insulins**
- One injection delivers insulin over many hours (12-36 hours)
- Mimics background insulin needs

**Short-Acting Insulins**
- One injection delivers insulin for a short time (2-6 hours)
- Mimics mealtime insulin needs
<table>
<thead>
<tr>
<th>Long Acting “Basal” Insulins</th>
<th>Time to Onset</th>
<th>Duration of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glargine</td>
<td>1 hour</td>
<td>24 hours Peakless</td>
</tr>
<tr>
<td>Detemir</td>
<td>1 hour</td>
<td>12-24 hours Small peak</td>
</tr>
<tr>
<td>NPH (Neutral Protamine Hagedorn)</td>
<td>1-2 hours</td>
<td>12-18 hours peaks ~6 hours</td>
</tr>
<tr>
<td>Degludec</td>
<td>1 hour</td>
<td>36 hours Peakless</td>
</tr>
<tr>
<td>Rapid or Short Acting Insulins</td>
<td>Time to Onset</td>
<td>Peak Action</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>“Regular”</td>
<td>30 minutes</td>
<td>2-3 hours</td>
</tr>
<tr>
<td>Aspart</td>
<td>15 minutes</td>
<td>1 hour</td>
</tr>
<tr>
<td>Lispro</td>
<td>15 minutes</td>
<td>1 hour</td>
</tr>
<tr>
<td>Glulisine</td>
<td>15 minutes</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
Insulin release from the pancreas

- Insulin production by the body

- Rapid/Short Acting Insulin

- Long Acting "Basal" Insulin

- The timing and dose of insulin are important for good glucose control
Timing and Dose of Long Acting (basal) Insulin

• Best to be given the same time each day

• The dose of basal insulin depends on:
  • Your weight
  • Amount of insulin resistance in your body
  • How much/how little insulin your pancreas makes
Timing and Dose of Mealtime Insulin

• Best to be given right before you start your meal

• The dose of mealtime insulin depends on:
  • The amount of carbohydrates you are about to eat
  • Amount of insulin resistance in your body
  • How much/how little insulin your pancreas makes
## Sliding Scale Insulin

<table>
<thead>
<tr>
<th>Blood Sugar</th>
<th>Insulin Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150</td>
<td>0</td>
</tr>
<tr>
<td>151-200</td>
<td>1 unit</td>
</tr>
<tr>
<td>201-250</td>
<td>2 units</td>
</tr>
<tr>
<td>251-300</td>
<td>3 units</td>
</tr>
</tbody>
</table>

- Insulin given in reaction to a high sugar
- Not able to prevent a high blood sugar from happening
- Best used in conjunction with mealtime insulin
Take Home Points

• Insulin is necessary to utilize the energy we obtain from carbohydrates
• Insulin tells the cells of the body to store glucose
• Diabetes is characterized by a relative or absolute lack of insulin production
• There are long acting and short acting synthetic insulins
• Taking insulin in a way that mimics natural insulin production is best for keeping glucoses in a healthy range