Innovations in Insulin

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Outline...

- Setting the stage
- Insulin as pancreas replacement therapy
- Commonly used insulins
- New insulins
- Case Studies
- Dosing information
- Hypoglycemia
- 4 Essential skills for giving insulin
- Questions?

Setting the Stage

What is Diabetes &
What does insulin do?

Types of Diabetes

- **Type 2**
  - is at least a ‘dual’ diagnosis
  - diagnosed when insulin production is dwindling because of insulin resistance
  - accounts for 80-90% of all diabetes
  - is the main media and government funding focus
  - Management includes treating insulin resistance (ie Metformin) and treating insulin deficiency (ie Diamicron MR or insulin)
  - treated with lifestyle measures, oral &/or injectible medications
Types of Diabetes

> **Gestational**
- may happen during pregnancy where significant insulin resistance is present
- the woman and her baby will have increased risk of developing Type 2 Diabetes later in life
- treated with lifestyle measures, oral medications &/or insulin

Types of Diabetes

> **Type 1**
- The pancreas does not produce the insulin needed to give the body life sustaining energy.
- treated with insulin

Insulin is

Pancreas Replacement or *Augmentation* Therapy

What does a PANCREAS do anyway?

Current Best Practice

**Basal / Bolus Theory**

The healthy pancreas produces some insulin 24 hrs/day to support the energy for *basal* body functions – to make the heart beat and the brain think.

- It also produces insulin in response to blood glucose rises related to food intake, stress, illness, some medications, excitement, growth hormone etc. – more like *boluses* of insulin.
- Therefore, insulin therapy should ensure both of these needs for insulin are being met.

‘Nice & Simple !!’ eh?

*Insulin + Sugar = ENERGY*
Insulin categories

- **Long Acting ‘Basal’** insulins
- **Short or Rapid Acting** meal or ‘**Bolus**’ insulins
- **Premixed** - a mixture of basal and bolus insulins

### Basal Insulin

- Longer acting insulin is used for ‘basal’ coverage.
  - **Glargine** (Lantus)
  - **Detemir** (Levemir)
  - **NPH** (Humulin N or Novolin NPH)

### The healthy pancreas

- **Basal** Insulin

![Graph showing the healthy pancreas and time-action profile of NPH and Levemir®](image)

- **Bolus** Insulin

A short or most commonly ‘rapid’ acting insulin is used with meals and sometimes snacks as a ‘bolus’ insulin.
  - **Lispro** (Humalog)
  - **Aspart** (NovoRapid)
  - **Glulisine** (Apidra)
The healthy pancreas

Time-action profile of regular insulin

The healthy pancreas

Time-action profile of Rapid acting insulins (NovoRapid, Humalog, Apidra)

Basal-bolus analogue therapy

Premixed Insulin

A short or most commonly ‘rapid’ acting insulin is mixed with intermediate acting insulin and used 2 or sometimes 3 x’s daily with meals.

- Humalog Mix 25, Humalog Mix 50
- NovoMix 30

(The number represents the % of the mix that is rapid acting insulin. The remaining will be intermediate acting insulin.)
**Commonly Used Insulins**

<table>
<thead>
<tr>
<th>human insulins</th>
<th>analogue insulins</th>
</tr>
</thead>
<tbody>
<tr>
<td>basal</td>
<td></td>
</tr>
<tr>
<td>Novolin NPH</td>
<td>Glargine/Basaglar (Lantus)</td>
</tr>
<tr>
<td>Humulin N</td>
<td>Toujeo is U300 lantus</td>
</tr>
<tr>
<td>- Shake well</td>
<td>Detemir (Levemir)</td>
</tr>
<tr>
<td>bolus</td>
<td></td>
</tr>
<tr>
<td>Novolin Toronto</td>
<td>Aspart (NovoRapid)</td>
</tr>
<tr>
<td>Humulin R</td>
<td>Lispro (Humalog)</td>
</tr>
<tr>
<td>- best reserved for use in IV’s</td>
<td>Humalog U200 kwikpen</td>
</tr>
<tr>
<td></td>
<td>Glulisine (Apidra)</td>
</tr>
<tr>
<td></td>
<td><strong>must be taken WITH food</strong></td>
</tr>
<tr>
<td>premix</td>
<td></td>
</tr>
<tr>
<td>Novolin or Humulin</td>
<td>NovoMix 30</td>
</tr>
<tr>
<td>30/70</td>
<td>HumalogMix 25</td>
</tr>
<tr>
<td>30% bolus - regular; 70% basal - NPH</td>
<td>Humalog Mix 50</td>
</tr>
<tr>
<td></td>
<td>- Shake well</td>
</tr>
<tr>
<td></td>
<td><strong>must be taken WITH food</strong></td>
</tr>
</tbody>
</table>

**Insulin Overview – Action Profile**

*Time-action profile of Novolin® ge 30/70 (older premix, leaves risk of hypoglycemia)*

**Humalog Mix 25** (Lilly) Newer ‘ANALOGUE’

Premixed
New insulins

U200 & U300 are new, more concentrated formulations of insulin

New insulin actions – one faster, one longer

New insulin formulations

- Until recently all insulins were ‘U100’
- Which is a concentration of 100 units/mL
- Toujeo U300 and Humalog U200 are more concentrated forms of insulin.
- What does this mean to the patient?

Lantus vs Toujeo

No conversion needed
One unit of Toujeo has the same amount of insulin as one unit of Lantus (insulin glargine injection) 100 U/mL.

Never draw into a syringe!

Lantus vs Toujeo

More insulin in every mL vs. Lantus
Each unit of Toujeo has 3/4 the fluid volume of Lantus.

Humalog family of insulins

New Insulin actions
(NovoNordisk)

- Fiasp = Faster acting insulin aspart
- & coming soon
- Degludec (Tresbia) = Ultra Long acting basal insulin
**Fiasp**
- a more ideal bolus/meal insulin

- Faster initial absorption
- Aiming for improved glycemic control after a meal
- For tx of people with type 1 and type 2
- Distribution in Canada as of Jan.2017

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**What is a more ideal basal insulin?**

- Has a physiological, *flat* time–action profile
- Has a low risk of hypoglycaemia
- Has a *long duration* of action (more than 24 hours)
- Controls fasting glucose with *one daily injection*
- Has a *predictable* metabolic effect

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**Degludec (Tresbia)**

- provides uniform "peakless" action
- extends over more than 24 hours
  - ½ life of ~ 24 hrs; duration of action ~42 hrs
- highly consistent from dose to dose
- Will be available in 2 concentrations:
  - 200 Units/mL in a FlexTouch prefilled pen – likely used for most people with type 2 diabetes
  - 100 Units/mL cartridges to be used in a NovoPen by patients requiring small basal insulin doses, including most patients with type 1 diabetes

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**Degludec**

- Not yet available in Canada; on the world market since ~2013

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**Case Study # 1**
- Insulin adjustment

- 90 yr. old female with Type 2 Diabetes residing in a nursing home
- Rx Lantus – start at 10 units hs and increase 2 units/day until fasting BG is 5-7mmol/L
Case Study # 1 – Insulin adjustment
- Now on 14 units qhs - FBS 4.5mmol/L
- You are the nurse; do you...
  a) Hold the insulin?
  b) Reduce the dose?
  c) Call the community pharmacist or the doctor?
  d) Cross your fingers?
  e) Do an extra blood sugar check in the night?
  f) Give the patient an extra snack?
  g) Give the insulin as ordered?

Case Study # 1 - Solved
- You can reduce a dose for the safety of avoiding low blood sugar and then get order the next day. (Document the rationale.)
- Holding the dose can cause more harm than reducing the dose
- Give the dose, give the patient an extra snack and do an extra blood sugar check in the night? (Document the rationale.)

Case Study # 2 – How much is too much?
- 57 yr. old male, 10 yr hx T2D, 115 kg
- Rx Lantus – start at 20 units hs and increase 2 units/day until fasting BG is 5-7 mmol/L
- In 3 months, the patient is on 100 units with FBG of 8-10 mmol/L

Case Study # 2 – Solved
- He is very close to 1 Unit/Kg of basal insulin alone – we will discuss the implications of this shortly
- We haven’t given A1c information
- When teaching self-adjustment of insulin, I try to give people an educated, but arbitrary ‘limit’ before consulting & reviewing total therapy

Case Study # 2
- Things to consider...
  - Consider low BG’s – night eating
  - How often is he monitoring?
  - What is night snack? Is it different?
  - What does he drink for thirst?
  - Was ‘control’ established in hosp.?
- Food, activity & well-being may have changed
- Review all medication change/adherence

Dosing Information
What is a ‘Typical’ Dose of Insulin?
**What is a ‘Typical’ Dose of Insulin?**

- Have you ever been concerned that an ordered insulin dose was too high or too low?
- Important notes on the differences between Type 1 and Type 2 diabetes

**People with Type 2 diabetes**

- Usually have *some endogenous* insulin
- Often do not become metabolically unstable if medications are stopped in the short term; this may impede healing/recovery
- Often have significant *insulin resistance* and therefore take *larger doses* of insulin

**People with Type 1 diabetes**

- Do **not** have endogenous insulin
- Insulin omission will promptly result in *metabolic decompensation*
- Are usually quite *insulin sensitive* and therefore *smaller doses* of insulin will have more of an effect than you might expect

**Insulin sensitivity affects insulin dosing**

and accounts for the dramatic difference in insulin doses for patients with Type 1 vs Type 2 diabetes.

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**Some examples of reasonable insulin dosing**

<table>
<thead>
<tr>
<th></th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 patients</td>
<td>65 Kg female</td>
<td>90 Kg female</td>
</tr>
<tr>
<td>Usual range of insulin/Kg body weight</td>
<td>0.5–0.7 U/Kg</td>
<td>1 – 2 U/Kg</td>
</tr>
<tr>
<td>Basal insulin</td>
<td>16 – 22 U daily</td>
<td>45 – 90 U daily</td>
</tr>
<tr>
<td>Bolus insulin</td>
<td>5 – 8 U TID ac</td>
<td>15–30 U TID ac</td>
</tr>
</tbody>
</table>

**Type 1**

<table>
<thead>
<tr>
<th></th>
<th>110 Kg male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usual range of insulin/Kg body weight</td>
<td>0.5–0.7 U/Kg</td>
</tr>
<tr>
<td>Basal insulin</td>
<td>28– 40 U daily</td>
</tr>
<tr>
<td>Bolus insulin</td>
<td>9 – 13 U TID ac</td>
</tr>
</tbody>
</table>
Insulin Using Type 1 vs Type 2

- **Type 1**
  - No endogenous insulin
  - Very *insulin sensitive*

- **Type 2**
  - Often has some endogenous insulin
  - May be very *resistant to insulin*

*Body weight can be a deceiving indicator of Type 1 vs Type 2 diabetes.*

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**Hypoglycemia**

**Low Blood Sugar**

**HYPOGLYCEMIA = Low Blood Sugar**

- People are in crisis
- Stay with them until treatment and recovery are complete
- S & sx -- Sweaty, shaky, trembling, nervous restless, irritable, spacey, pale, inappropriate confusion

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**3 tsp. or 15 gms of SUGAR 1st**

- 4 candies or
- 3/4 cup juice or
- 3/4 cup regular pop

- Wait 15 min. with the person
- !!!!!!!!!! Retreat with SUGAR as necessary !!!!!!!!

- When feeling better or
- Blood sugar is rising and above 4
- Then and **ONLY THEN**, follow with a snack of ~ 15 gms of carbohydrate
  - 2-3 plain cookies
  - granola bar

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**4 Essential skills for giving insulin**

Supporting Clients on Insulin - the *ESSENTIALS*

- To give insulin the client needs to know...
  1. How to give insulin
  2. How to monitor blood sugars
  3. How to treat low blood sugar
  4. Basic information about food

- To support clients on insulin, you may want to be familiar with their
  - meter
  - usual symptoms and treatments for low blood sugars
NEVER UNDERESTIMATE THE EFFECT OF INJECTION SITE ROTATION

Questions?

Refer to the ‘Clinical Practice Guidelines for the Management of Diabetes in Canada’ current version.

found online @ http://www.diabetes.ca/