OVERVIEW

• Introduction
• Medications
• Complications of diabetes
• Challenge of surgery
• Approach to anesthesia
• Intraoperative management
INTRODUCTION

Hyperglycaemia

Morbidity & Mortality
W.H.O. RECOMMENDATIONS

Insulin dependent

Type 1 diabetes
pancreatic B-cell destruction

Non-insulin dependent

Type 2 diabetes
• defective insulin secretion
• insulin resistance
## INSULIN PREPARATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Subcutaneous</th>
<th>Intravenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>30min – 8hr</td>
<td>5 min</td>
</tr>
<tr>
<td>Long</td>
<td>24 – 36hr</td>
<td><strong>Not suitable</strong></td>
</tr>
</tbody>
</table>
# Oral Hypoglycaemic Agents

<table>
<thead>
<tr>
<th>Types</th>
<th>Examples</th>
<th>Mechanism</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphonylureas</td>
<td>chlorpropamide</td>
<td>• ↑ insulin secretion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>glyburide</td>
<td>• ↑ sensitivity</td>
<td></td>
</tr>
<tr>
<td>Biguanides</td>
<td>metformin</td>
<td>• ↑ glucose utilization</td>
<td><strong>Lactic acidosis:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ↓ hepatic glucose production</td>
<td>• elderly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• renal failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• hepatic failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• postoperative</td>
</tr>
<tr>
<td>Absorption modifiers</td>
<td>acarbose</td>
<td>• ↓ carbohydrate absorption in gut</td>
<td></td>
</tr>
</tbody>
</table>
ACUTE COMPLICATIONS
KETOACIDOSIS

- Type 1 diabetes
- Causes:
  - poor medical compliance
  - illness (pneumonia / UTI)
- Medical emergency - **mortality** = 15%
- Treatment:
  - Rehydration (usually 5-8 l deficit)
  - Insulin infusion
- Frequent measurements:
  - serum electrolytes
  - acid-base status
HYPOGLYCAEMIA

- Tighter control → more likely hypoglycaemia
- More **common** than ketoacidosis
- Potentially as dangerous
- Glucose is **only energy source** for:
  - CNS
  - Erythrocytes
  - renal medulla
- Symptoms **masked** with:
  - stress / exercise
  - Alcohol
  - sleep / anaesthesia
HYPEROSMOLAR NON-KETOTIC HYPERGLYCAEMIC COMA

- Type 2 diabetes
- Causes:
  - sepsis
  - corticosteroids

Elderly population + co-existing disease = Mortality > 15%
CHRONIC COMPLICATIONS
MICROVASCULAR DISEASE

- Retinopathy
- Nephropathy
  - complication associated with highest mortality
  - confers increased risk of CAD
MACROVASCULAR DISEASE

- Coronary artery disease
  - 4-5 x more likely than in non-diabetics
- Cerebral vascular disease
- Peripheral vascular disease
AUTONOMIC NEUROPATHY

20-40 %

- Orthostatic hypotension (*insulin makes worse*)
- Dysrhythmias:
  - resting tachycardia
  - loss of heart rate variability (*including with drugs*)
  - prolonged QT interval
  - sudden death syndrome
- Gastroparesis
  - vomiting / diarrhoea
  - abdominal distention
- Asymptomatic hypoglycæmia
- Silent ischæmia
SENSORY NEUROPATHY

Distal symmetrical sensory / sensorimotor:

• unnoticed injury → infection → amputation
• positioning !!!
STIFF JOINT SYNDROME

30 - 40%

difficult laryngoscopy & intubation

(atlanto-axial joint involvement)
PREGNANCY WITH DIABETES

5 x incidence of stillbirth

10 x incidence congenital malformations
CHALLENGE OF SURGERY

1. Stress response:
   • catecholamines
   • cortisol
   • growth hormone
   • glucagon

2. NPO

3. Altered consciousness

4. Circulatory disturbances
CHALLENGE OF SURGERY

1. Coronary artery disease
   - silent ischemia

2. Diabetic nephropathy
   - no agent reno-protective
   - ensure adequate renal perfusion

3. Autonomic neuropathy
Better wound healing

BETTER GLYCAEMIC CONTROL
APPROACH TO ANÆSTHESIA
NEURAXIAL / REGIONAL BLOCKADE

✓ Attenuate stress response
✓ Faster resumption oral intake

But:

• **no** benefit in terms of morbidity / mortality

and...

• risks with autonomic neuropathy
• profound hypotension with CAD / PVD
• increased risk infection / vascular damage
• confuse DM neuropathy / block complication
GENERAL ANÆSTHESIA

Glycæmic response decreased by:

- Etomidate
- Benzodiazepines (*minimal at sedative dose*)
- Opiates (*particularly high-dose*)

Inhaled agents inhibit insulin response

- reversible
- dose-dependent
PREOPERATIVE

Surgery in the morning

Correct:

- hyperglycæmia
- ketoacidosis
- electrolyte disturbances

Premedicate:

- metoclopramide
- bicitra.
PREOPERATIVE

Non-insulin dependent

• Sulfonylureas withheld 12-24 hrs
• Other agents given until patient NPO
• Glucose checked pre- & postop
PREOPERATIVE

Insulin dependent

For major surgery:

• none of regular insulin
• half of long-acting insulin
BUT…

- **Intravenous** administration better
- Infusions - effective / physiologic / safer
- GA masks hypoglycæmic symptoms
- Hypokalæmia !!!
INTRAOPERATIVE MANAGEMENT
SIMPLE INSULIN INFUSION STRATEGY

Infusion Rate (u/hr) = \( \frac{\text{Blood Glucose (mmol/l)}}{7} \)
# PORTLAND PROTOCOL

<table>
<thead>
<tr>
<th>Blood Glucose</th>
<th>Bolus</th>
<th>Non-diabetic Type 2 not on insulin</th>
<th>Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – 6</td>
<td>0</td>
<td>0.5 u/hr</td>
<td>1 u/hr</td>
</tr>
<tr>
<td>7 – 10</td>
<td>0</td>
<td>1 u/hr</td>
<td>2 u/hr</td>
</tr>
<tr>
<td>11 – 13</td>
<td>4 u</td>
<td>2 u/hr</td>
<td>3.5 u/hr</td>
</tr>
<tr>
<td>14 – 16</td>
<td>8 u</td>
<td>3.5 u/hr</td>
<td>5 u/hr</td>
</tr>
<tr>
<td>17 – 20</td>
<td>12 u</td>
<td>5 u/hr</td>
<td>6.5 u/hr</td>
</tr>
<tr>
<td>&gt;21</td>
<td>16 u</td>
<td>6.5 u/hr</td>
<td>8 u/hr</td>
</tr>
</tbody>
</table>
REMEMBER

Dextrose infusion (100 ml/hr)

Hypokalæmia !!!
COMMENTS

- 10g dextrose will $\uparrow$ blood sugar $\approx$1-2 mmol/l
- 1u insulin (iv) will $\downarrow$ blood sugar $\approx$1-2 mmol/l
- Metoclopramide !!
- Insulin requirements may drop after delivery
- Lactate $\Rightarrow$ glucose in liver
  Lactated Ringers may $\uparrow$ blood glucose
REVIEW

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