Perioperative management of diabetes mellitus

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WHO defines diabetes

Metabolic disorder of multiple aetiology characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both.
Diagnosis of Diabetes

*A1C* ≥6.5%

*OR*

Fasting plasma glucose (FPG) ≥126 mg/dl (7.0 mmol/l)

*OR*

Two-hour plasma glucose ≥200 mg/dl (11.1 mmol/l) during an OGTT

*OR*

A random plasma glucose ≥200 mg/dl (11.1 mmol/l)
Classification of Diabetes

- **Type 1 diabetes**
  - β-cell destruction

- **Type 2 diabetes**
  - Progressive insulin secretory defect

- **Other specific types of diabetes**
  - Genetic defects in β-cell function, insulin action
  - Diseases of the exocrine pancreas
  - Drug- or chemical-induced

- **Gestational diabetes mellitus**

ADA. I, Classification and Diagnosis. Diabetes Care 2011;34(suppl 1):S12.
Type 1 Diabetes

- Absolute Insulin Deficiency
- Autoimmune destruction of pancreatic $\beta$ cells
- Signs of diabetes develop when 80% of $\beta$ cells are destroyed

**TREATMENT**

- Insulin therapy - long and short acting
- Newer developments - aerosols continuous pumps
Insulin Therapy

- **Short Acting** - Regular, Lispro/Aspart
- **Intermediate Acting** - NPH, Lente
- **Long Acting** - Lantus, Ultralente

**Regimens**

- 2Regular + 2NPH
- 3Regular + 1NPH
- 3Regular + 1 Lantus
- **Subcutaneous Infusion of Insulin (Insulin Pump)**
Type 2 Diabetes

- Insulin resistance and relative insulin deficiency or increased hepatic glucose production
- **Obesity** – risk factor

**TREATMENT** - multimodal therapy

- Diet
- Exercise
- Oral hypoglycemic Agents
- OHA + Basal Insulin
- Insulin therapy
### Spectrum of Oral Hypoglycemic Agents

<table>
<thead>
<tr>
<th>Category</th>
<th>Example Drugs</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secretagogues/Sulphonylureas</td>
<td>Glibenclamide, Gliclazide</td>
<td>Increase Glucose availability</td>
</tr>
<tr>
<td>Biguanides</td>
<td>Metformin</td>
<td>Suppress excessive hepatic glucose release</td>
</tr>
<tr>
<td>Thiazolidinediones/Glitazones</td>
<td>Rosiglitazone, Pioglitazone</td>
<td>Improve glucose sensitivity</td>
</tr>
<tr>
<td>α-Glucosidase inhibitors</td>
<td>Acarbose, miglitol</td>
<td>Delay GIT glucose absorption</td>
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Clinical Situations

1. A 50 year old man, DM, taking medication OHA, for nail extraction surgery.

2. A 45 year old female, Diabetic, well controlled on OHA for cholecystectomy.
Contd.....

1. A 22 year old male, diabetic on regular insulin therapy for removal of ganglion wrist

2. A 30 year old lady on insulin therapy for brain tumor
Why? Complications

**Macrovascular**
- Stroke
- Heart disease and hypertension (2-4 X increased risk)
- Peripheral vascular disease
- Foot problems

**Microvascular**
- Diabetic eye disease (retinopathy and cataracts)
- Renal disease
- Erectile Dysfunction
- Peripheral Neuropathy
WHAT are the issues?

- **Cardiac Involvement** - Silent Myocardial Ischemia
  - ECG: may not show anomaly
  - Autonomic neuropathy blunts angina
  - Empirical Beta-adrenergic blockade preoperatively-mask

- **Renal Involvement**
  - Intravenous fluid sensitivity high leads to volume overload
  - Increase half-life of insulin and risk of hypoglycemia
  - GFR & Creatinine Clearance affected- Drug kinetics altered
Diabetic Neuropathy

Sensorimotor neuropathy (acute/chronic)
Autonomic neuropathy
Mononeuropathy
  *Spontaneous*
  *Entrapment*
  *External pressure palsies*
Proximal motor neuropathy
**Autonomic Neuropathy**

**Symptomatic**
- Postural hypotension
- Gastroparesis
- Diabetic diarrhea
- Neuropathic bladder
- Erectile dysfunction
- Neuropathic edema
- Charcot arthropathy
- Gustatatory sweating

**Subclinical abnormalities**
- Abnormal pupillary reflexes
- Esophageal dysfunction
- Abnormal cardiovascular reflexes
- Blunted counter-regulatory responses to hypoglycemia
- Increased peripheral blood flow
Autonomic imbalance implications

- Intra-operative hypotension/hypertension
- Perioperative cardiac arrhythmias
- Gastroparesis: aspiration
- Unawareness - Hypoglycaemia
- Increased decubitus ulceration
- Increased vascular damage and poor post-op healing
HOW? - Pre-operative Checkup

- Complete physical and clinical assessment
- Biochemical assessment
- Drug therapies - optimization
History and Examination

- Duration of DM
- Blood Pressure
- Palm Print Sign
- Prayer Sign - difficult intubation
- Fundoscopy
- Thyroid palpation
# Tests for AUTONOMIC NEUROPATHY

<table>
<thead>
<tr>
<th>System</th>
<th>Measure</th>
<th>Normal</th>
<th>Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sympathetic system</td>
<td>Measure systolic blood pressure lying down then standing.</td>
<td>Decrease $&lt;10$ mmHg</td>
<td>Decrease $&gt;10$ mm Hg</td>
</tr>
<tr>
<td>Parasympathetic system</td>
<td>Measure heart rate response to deep breathing</td>
<td>Increase rate $&gt;15$ beats /min</td>
<td>Increase rate $&lt; 10$ beats /min</td>
</tr>
</tbody>
</table>
Preoperative Investigations

- Complete blood count
- Blood sugar and serum electrolytes
- Renal function tests
- Coagulation profile
- Liver function tests
- Chest X-ray
- ECG, Echocardiogram, stress testing
- Urine for sugar and ketones
- Fasting lipid profile
Drug Therapy Optimization

- Well controlled blood sugar levels – 48 hrs
- Uncontrolled DM – prior hospitalization
- Major Surgery – shift OHA to Insulin
Stop OHA before Surgery

- **Sulphonylureas** - stopped 3 days prior to surgery, convert to shorter acting drugs or insulin if major surgery
- **Metformin** - continued upto 24 hrs before surgery
  - Risk of lactic acidosis extremely rare
- **Acarbose** - Avoid due to GI side effects
- **DPP4 inhibitors**: delays gastric emptying

OMIT MORNING OHA DOSE
Perioperative mortality increases with increasing glucose levels.

Intraoperative Glycemic Control

Cardiac Surgery

- Lazar et al Circulation 2004; 109
  - Prospective randomized trial
  - Tight glycemic control with GIK infusion during perioperative period improved survival and decreased perioperative complications

- Ouattara et al Anesthesiology 2005; 103
  - Poor intraoperative short-term glucose control during cardiac surgery is associated with worse postoperative outcomes
Other Consequences

- Marked hyperglycemia
- Dehydration
- Electrolyte abnormality
- Impaired wound healing
- Predispose to infections
AIMS of Management

1. Hypoglycaemia
   Dangerous in anaesthetised or neuropathic patient – warning signs absent

2. Hyperglycaemia
   Osmotic diuresis, delayed wound healing, exacerbation of brain, spinal cord and renal damage by ischaemia

3. Ketoacidosis
   Precipitated by the stress response, infection, MI, failure to continue insulin

4. Electrolyte abnormalities
   Potassium, magnesium, phosphate
Preoperative Orders

- NPO 6-8 hrs prior to surgery
- Informed consent
- FBS on morning of day of surgery
- Urine – sugar, ketones and S. electrolytes if patient is on insulin
- Adequate anxiolysis- reduces stress of surgery
- Anti aspiration prophylaxis
- Prefer to keep first on OT list
- Avoid lactate containing fluids
Minor surgery in type 2 DM (diet/OHA)

- Omit OHA on the day of operation and avoid glucose infusions
- Check FBS. Kept 1st on list.
- For afternoon cases, can have clear fluids only
- Oral medication should be restarted as normally prescribed with the first meal. The only exception to this is for patients taking Metformin
Minor surgery in type 2 DM (OHA+ basal insulin)

- Hold oral agents (on combination therapy) on the day of surgery
- Check FBS
- Fair metabolic control (FBS <180 mg/dl)
  * Give half of intermediate-acting insulin (NPH) morning of surgery
  * if on Lantus - should receive usual basal insulin dose night before
  * infuse dextrose 5% saline plus KCl (10-20 mEq/L) at 100 mL/hr + regular or rapid-acting insulin - as guided by FBS
Patients with “poor” metabolic control (FBS>180 mg/dL)

- While NPO, infuse dextrose 5% plus KCl (10-20 mEq/L) at 100 mL/hr + continuous insulin infusion (50 units regular insulin in 50 ml saline piggy-backed)
- Check blood glucose every 4 to 6 hours – supplement short-acting insulin
Minor surgery in type 1 DM

- “first on list”
- on a multiple injection regimen - usual basal (long acting) insulin prior evening
- on twice daily insulin – usual prior evening insulin
- NPO
- omit the morning insulin
- Check blood glucose before and after the procedure
Resume the usual insulin where expected to be eating within 2 hours of the procedure

If on BD insulin regimen half of the normal ‘breakfast’ insulin dose should be prescribed with lunch after procedure

If the patient is unable to tolerate diet or the blood glucose is >14 mmol/L, then a GKI infusion or alternative (see below) will be required
Major surgery in Type 1 and 2 DM treated with insulin

- Hold oral agents the day of surgery
- Start continuous insulin infusion (GIK) prior to surgery and continue during perioperative period (sliding Scale)
- Postoperatively: Start S/C insulin 2 hrs prior to discontinuation of insulin infusion

Perioperative Glucose Control in the Diabetic or Nondiabetic Patient:
Dawn D. Smiley, MD, and Guillermo E. Umpierrez, MD, FACP, FACE
Southern Medical Journal • Volume 99, Number 6, June 2006
“NON–TIGHT CONTROL” REGIMEN

- Aim: To prevent hypoglycemia, ketoacidosis and hyperosmolar states
- NPO after midnight
- Intravenous fluids containing 5% dextrose @ 125 mL/hr
- Give half the usual morning insulin dose s/c
- In recovery room, monitor blood glucose and treat on a sliding scale.

“TIGHT CONTROL” REGIMEN

- Aim: plasma glucose levels 79 to 120 mg/dL
- Intravenous infusion of 5% dextrose in water at a rate of 50 mL/hr
- “Piggyback” an infusion of regular insulin (50 units in 50 mL of NS to the dextrose infusion with an infusion pump.
- Repeat RBS every hour and adjust insulin accordingly
Improves wound healing and prevents infections

Improves neurological outcome after global or focal CNS ischaemic insults

Advantages of Tight Control Regimen

Improve weaning from cardiopulmonary bypass

Retards all harmful affects associated with glucotoxicity
Insulin Dose

Initial insulin rate - blood sugar (mg/dl) / 100

Insulin infusion

- Normal adult patient: 0.02u/kg/hour
- Severe infection: 0.04u/kg/hour
- Steroid-Dependent State: 0.04u/kg/hour
- CABG or on Vasopressors: 0.06u/kg/hour

Hourly RBS - insulin dose adjustment

NO ROOM FOR URINE SUGAR MONITORING
Postoperative Management

- Continue GKI solution infusion as determined by blood glucose and potassium every 4-6 hrs
- Start regular insulin sc overlapping with the infusion for 1-2 hrs before stopping the infusion
- Additional 20% insulin may be required - presence of infection
- Start preoperative regimen - when patient resumes normal diet
DM and Emergency Surgery

- Increased risk of developing **DKA** and **HHS**
- If possible delay surgery for 4 to 6 hours to optimize patient’s metabolic status
- Precipitating factors:
  1. Infection
  2. Gastrointestinal obstruction
  3. Acute stress - trauma, emotional
  4. Hypovolemic
  5. Failure to take insulin
Case Scenario

- A 45 year man for foot debridement, Ketones +, Blood sugar -432mg/dl, Urine Sugar ++++
Replace fluids: 2–3 L of 0.9% saline over first 1–3 h (10–15 mL/kg per hour)

0.45% saline at 150–300 mL/h

change to 5% glucose and 0.45% saline at 100–200 mL/h when plasma glucose reaches 250 mg/dL
- **Short-acting insulin**: IV (0.1 units/kg) or IM (0.3 units/kg), then 0.1 units/kg per hour by continuous IV infusion; increase 2- to 3-fold if no response by 2–4 h
- Potassium <3.3 meq/L, do not administer insulin
- Potassium, magnesium and phosphate deficiencies replaced when adequate urine output documented
- Check **RBS** every 1–2 h, **ABG** every 4 hrly
- Ph < 7.10, give **sodium bicarbonate**
Superiority of any method remains controversial

Individualized decision making for each patient

Clinical judgement remains key component in good perioperative treatment
Islets of Humor

One year my resolutions will be more realistic!

THANK YOU