Anesthetic Management of Patients with Diabetes Mellitus
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The prevalence of diabetes mellitus in both adults and children has been steadily rising throughout the world for the past 20-30 yrs. Inevitably, diabetic patients presenting for incidental surgery, or surgery related to their disease will place an increasing burden on anaesthetic services.

Preoperative assessment

**Cardiovascular** - Diabetics are more prone to hypertension, ischaemic heart disease, cerebrovascular disease, myocardial infarction which may be silent and cardiomyopathy.

**Renal** - kidney damage may already be present, often indicated by the presence of protein (albumin) in the urine. The diabetic is at risk of acute renal failure and retention postoperatively. Blood electrolyte measurement (if possible) may reveal a raised urea and creatinine

**Respiratory** - diabetics, especially if obese and smokers, are particularly prone to chest infections

**Airway** - thickening of soft tissues occurs eg ligaments around joints. If the neck is affected there may be difficulty extending the neck, making intubation difficult.

**Gastrointestinal** - the nerves to the gut wall and sphincters can be damaged. Delayed gastric emptying and increased reflux of acid make them more prone to regurgitation and at risk of aspiration on induction of anaesthesia. Prescribe an H₂ antagonist and metoclopramide as a premedication.

**Infection** - diabetics are prone to getting infections that can upset their sugar control. If possible, delay surgery until these are treated. Wound infections are common. Great care should be paid to aseptic techniques when any procedure is undertaken.

**Miscellaneous** - diabetes may be caused or worsened by treatment with corticosteroids, thiazide diuretics and the contraceptive pill. Thyroid disease, obesity, pregnancy and even stress can affect diabetic control.

**The aim is to keep the blood glucose level within the range 6 -10 mmol/l at all times.**

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**Figure 1:- Which Regime for my Patient?**

1. Decide on the type of surgery
   - Minor- patients expected to eat and drink within 4 hours of operation
   - Major- all other patients
2. Then, is the patient **Insulin** or **Non-insulin dependent**?
3. Finally, are they:-
   - poorly controlled: delay surgery and change to soluble insulin three times daily **but** if surgery urgent, use **Major surgery regime**
   - well controlled: use the appropriate regime from the **Major** or **Minor**
General Measures for all diabetics:

Measure random sugar preoperatively

- 4 hourly for IDDM
- 8 hourly for NIDDM

Test urine 8 hourly for ketones and sugar

Place first on operating list

Aim for a blood glucose of 6 - 10mmol/l

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**Figure 2: - Minor Surgery**

Non insulin Dependent Diabetics

<table>
<thead>
<tr>
<th>Preoperatively - random blood sugar on admission</th>
<th>&lt; 10 mmol/l Normal medication until day of op</th>
<th>&gt; 10 mmol/l Follow as for MAJOR SURGERY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day of operation</td>
<td>Omit oral hypoglycaemics</td>
<td>Blood glucose- 1 hour preop and at least once during op (hourly if op &gt; 1 hour long) postop - 2 hourly until eating</td>
</tr>
<tr>
<td>Postoperatively</td>
<td>Restart oral hypoglycaemics with first meal</td>
<td></td>
</tr>
</tbody>
</table>

Insulin dependent Diabetics

This regime only suitable for patients whose random sugar is < 10 mmol/l on admission, will only miss one meal preop & are first on the list for very minor surgery eg cystoscopy

<table>
<thead>
<tr>
<th>Preoperatively</th>
<th>Normal medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day of operation</td>
<td>No breakfast, no insulin, place first on list. Blood glucose- 1 hour preop and at least once during op (hourly if op &gt; 1 hour long) postop - 2 hourly until eating then 4 hourly</td>
</tr>
<tr>
<td>Postoperatively</td>
<td>Restart normal S/C insulin regime with first meal.</td>
</tr>
</tbody>
</table>

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**Figure 3: - Major surgery**
- All insulin dependent and non-insulin dependent who are poorly controlled (blood glucose >10mmol/l) (many NIDDM become insulin dependent during major surgery and will need managing as such. Regular glucose measurements will detect this).
- Normal medication until day of operation

**Day of operation**

Omit oral hypoglycaemics and normal subcutaneous (S/C) insulin

Blood glucose - check blood sugar(and potassium) 1 hour preop then 2 hourly from start of infusion at least once during operation (hourly if op > 1 hour long) at least once in recovery area 2 hourly post operatively

**Regime 1 - no infusion pump available.**

Start intravenous infusion of 5 or10 % dextrose (500 ml bags) over 4 - 6 hours and add Insulin and Potassium Chloride (KCl) to each 500 ml bag as below. Change bag according to blood sugar level readings:-

<table>
<thead>
<tr>
<th>Blood glucose (mmol/l)</th>
<th>Soluble insulin (units) to be added to bag</th>
<th>Blood potassium (mmol/l)</th>
<th>KCl (mmol) to be added to bag *</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4</td>
<td>No insulin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 - 6</td>
<td>5</td>
<td>&lt;3</td>
<td>20</td>
</tr>
<tr>
<td>6 - 10</td>
<td>10</td>
<td>3 - 5</td>
<td>10</td>
</tr>
<tr>
<td>10 - 20</td>
<td>15</td>
<td>&gt; 5</td>
<td>None</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* If blood potassium level not available, add 10 mmol KCl

**Postoperatively**

- **Non-insulin dependent**
  - stop infusion and restart oral hypoglycaemics when eating and drinking
- **Insulin dependent**
  - stop infusion when eating and drinking
  - calculate the total daily dose (units) of insulin the patient was taking preoperatively
  - give this as S/C Soluble insulin (Actrapid), divided into 3 - 4 doses in 24 hours
  - this may need to be adjusted up or down until blood sugar levels stable.

  - once stable restart normal regime

  **Remember**
  - the patient may need additional fluids depending on surgery, blood loss etc.
Figure 4:- Major surgery - alternative regime

Regime 2 - for use with infusion pumps

The insulin and dextrose infusions are given via separate infusion pumps. This allows better control than regime 1, but care is needed to ensure the separate lines do not become blocked, or that one infusion runs out leaving the other infusing alone.

**Insulin infusion** - 50 units insulin made up to 50 ml with saline (i.e. concentration is 1 unit per ml)

<table>
<thead>
<tr>
<th>Blood glucose (mmol / l)</th>
<th>Insulin infused at (units / hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5</td>
<td>0</td>
</tr>
<tr>
<td>5.1 - 10</td>
<td>1</td>
</tr>
<tr>
<td>10.1 - 15</td>
<td>2</td>
</tr>
<tr>
<td>15.1 - 20</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>6 &amp; review *</td>
</tr>
</tbody>
</table>

If it is proving difficult to reduce the blood sugar level, then consider increasing the rate of insulin for each glucose level or also giving a bolus of Actrapid of 3 - 5 units.

- Patients normally on higher doses of insulin will need higher rates of insulin infusion.
- Dextrose infusion - 5 or 10 % dextrose infused at 100 ml per hour. Add 10 mmol KCl to each 500 ml of solution.

- Post op - follow instructions as in figure 3

Figure 5:- Treatment of Diabetic Ketoacidosis

**Aims**-

- rehydration (water and salt)
- lower blood sugar
- correction of potassium depletion

**Start an intravenous infusion of 0.9 % saline as follows**-
<table>
<thead>
<tr>
<th>Time</th>
<th>Fluid Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 litre</td>
<td>over 30 minutes</td>
</tr>
<tr>
<td>then</td>
<td>1 litre over 1 hour</td>
</tr>
<tr>
<td>then</td>
<td>1 litre over 2 hours.</td>
</tr>
<tr>
<td></td>
<td>Continue 2 - 4 hourly until the blood glucose is below 15 mmol / l, then change to 5% glucose, 1 litre 2 - 4 hrly</td>
</tr>
<tr>
<td></td>
<td>Up to 6 -8 litres of fluid may be required or more. Use clinical signs BP, heart rate, CVP, conscious level to judge the amount.</td>
</tr>
</tbody>
</table>

**Give soluble insulin (Actrapid) intramuscularly (IM) as follows-**

- 20 units IM first dose then 6 units IM hourly
- measure the blood glucose hourly
- when the blood glucose is below 15 mmol/l, change to 6 units IM every 2 hours.

Once the patient has recovered and is eating/drinking, change to S/C insulin.

**Potassium (K⁺) supplementation will be required-**

There may be a high blood potassium initially, but this will fall as the sugar level comes down.

Measure the potassium hourly. Put 10 mmol K⁺ in the first litre of saline then 10 - 40 mmol in subsequent litres of fluid, depending on the plasma level (normal 3.5 - 5.0 mmol/l).

If potassium measurements are unavailable then put 10 mmol KCl in each litre of fluid.

Other measures- 100 % O₂. Blood gas estimation-if pH < 7.10, give 50 mmol of 8.4% bicarbonate. Usually acidosis will correct itself slowly as the sugar comes down. Emergency surgery can start once the rehydration and lowering of blood sugar is underway.

**Summary**

The diabetic patient presents the anaesthetist with many challenges. Careful attention to clinical signs and rapid action to prevent even suspected hypoglycaemia peroperatively should see them safely through their surgery. The goal is to keep things as normal as possible. Regional techniques are often safer than general anaesthesia, but require the same vigilance.