

**Episode 12 - Diabetes and Perioperative Glycaemic Control***Blood glucose measurement*

|                         |                                                                  |
|-------------------------|------------------------------------------------------------------|
| Normal (fasting)        | 4-7 mmol/L (70-130 mg/dL)<br><br>Average: 5.5 mmol/L = 100 mg/dL |
| Target (intraoperative) | 6-10 mmol/L (110-180 mg/dL)                                      |

*Hypoglycaemia*

Note that the perioperative target is higher than the normal blood glucose targets. Bedside tests have a margin of error of about 20% which means that a reading of 5.5 mmol/L (average normal fasting glucose) could be anywhere from about three-and-a-half to four-and-a-half mmol/L.

Glucose is the obligatory metabolic fuel for the brain and the brain starts to malfunction at concentrations less than 3 mmol/L. If the target range for blood glucose was 4-7 mmol/L there is a risk that the patient may frequently become hypoglycaemic; either because the capillary glucose reading is not perfectly accurate or because by the time it has been recorded as low, the glucose concentration may have dipped even lower.

*Hyperglycaemia*

Hyperglycaemia is not so much a problem. Given the stress response associated with illness and surgery, blood glucose concentrations even above 10 mmol/L are probably acceptable. Very high blood glucose concentrations can expose the patient to the risk of infection but it is really their long term control that is relevant to how well they will do.

*Monitoring*

- Glucose, Ketones, Potassium, Fluids and electrolytes

|                                                               | Blood glucose measurement frequency |
|---------------------------------------------------------------|-------------------------------------|
| Perioperative                                                 | 2-4 hourly                          |
| Intraoperative                                                | 1 hourly                            |
| Changes to medication or treatment of hypo- or hyperglycaemia | 15 minute intervals                 |

*Fasting*

The best way to improve glycaemic control is to minimise fasting times and get the patient eating and drinking, and back on their normal medications, as soon as possible following surgery.

Any more than one missed meal means that the patient ought to be put on a variable rate intravenous insulin infusion. This will mean pretty much all emergency patients and some elective patients. Insulin regulates blood glucose but just as importantly, it inhibits lipolysis and the production of keto-acids (acetoacetone, acetate, beta-hydroxybutyrate).

Type 1 diabetics should never be off insulin. They should either take their long acting insulin, be on a closed-loop insulin pump, or be on a variable rate insulin infusion.

*Anti-diabetic medication*

| Mechanism                  | Drugs                                   | Notes                    |
|----------------------------|-----------------------------------------|--------------------------|
| Reduce glucose absorption  | Alpha-glucosidase inhibitors (Acarbose) |                          |
| Promote glucose excretion  | SGLT-2 inhibitors                       |                          |
|                            |                                         |                          |
| Increase insulin secretion | Sulphonylureas                          | Hypoglycaemia            |
|                            | Meglitinides                            | Hypoglycaemia            |
|                            | GLP-1 receptor agonists                 | Delayed gastric emptying |
|                            | DPP4 inhibitors                         |                          |
|                            |                                         |                          |
| Sensitise cells to insulin | Biguanides (Metformin)                  |                          |
|                            | Thiozolidinediones (Pioglitazone)       |                          |

In general, anything that leads to the secretion of insulin should be omitted on the day of surgery (risk of hypoglycaemia). DPP4 inhibitors are the only exception to this since they only stimulate insulin secretion when blood glucose levels are high.

### *Metformin*

Metformin sensitises the tissues to the effects of insulin. It has been associated with an increased risk of lactic acidosis especially in the context of impaired renal function, or dehydration or exposure to other risk factors for acute kidney injury, i.e. major surgery, contrast media or nephrotoxic medicines. It is not a lactic acidosis caused by hypoxia. It is due to the fact that Metformin interferes with the way cells and mitochondria utilise glucose. Excreting the extra lactate is normally not a problem but it becomes a problem under conditions of physiological stress.

### *Insulin*

No patient should go without insulin (type 2 diabetics - endogenous insulin; type 1 diabetics - exogenous insulin). As a rough and ready guide, never stop long acting insulins, even if the patient goes onto a variable rate insulin infusion (VRII).

| Long acting insulin regimen          | Perioperative guidance                                                                                                                                                        |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Once daily                           | Reduce dose by 20%                                                                                                                                                            |
| Twice daily                          | Reduce total dose by 50%                                                                                                                                                      |
|                                      |                                                                                                                                                                               |
| Fixed rate subcutaneous insulin pump | Basal rate reduced by 20%                                                                                                                                                     |
|                                      |                                                                                                                                                                               |
| Closed-loop system                   | a) Set target Glucose of 6-10 mmol/L or<br>b) Set basal fixed rate insulin infusion at 80%<br><br>Check capillary blood glucose every 30 minutes (do not rely on the device). |

### *Closed-loop systems*

Closed-loop systems measure glucose in interstitial fluid. This can differ from blood glucose measurements by more than 1 mmol/L (roughly 20 mg/dL) in either direction. There is a lag of up to 20 minutes before a change in blood glucose is reflected in the interstitial fluid. Reliance on these readings risks missing intraoperative hypoglycaemia. Surgery will also affect the accuracy of the device due to changes in fluid distribution and skin blood flow, and compression due to lying on the device.