

Guidelines for Management of Diabetes Mellitus during Surgery

Latest version: see www.diabetes-scotland.org/ggc

Preparation of Diabetes Patients admitted for Surgical Procedures

- Consult surgeon or anaesthetist whether planned procedure minor or major.
- Child may be admitted day of procedure, or the afternoon before to allow for stabilisation.
- Ensure all relevant ward staff know child concerned has diabetes.
- Check ward has a supply of:
 - Blood glucose (BG) meter testing strips.
 - Lucozade.
 - Rapid-acting analogue (RAA) insulin (Novorapid, Humalog).
 - Slow-acting analogue (SAA) insulin (Levemir, Lantus).
 - Soluble human insulin (Actrapid, Humulin S).

Routine Diabetes Management

Surgery is a physical stress characterised by catabolism, increased metabolic rate, increased protein and fat breakdown, negative nitrogen balance, starvation and glucose intolerance. The degree of stress will be related to factors such as operation length, type of procedure and the presence of complications such as infection. All of these metabolic effects are exaggerated with diabetes, particularly where there is a virtual absence of endogenous insulin. Marked catabolism results in fatty acid production, ketogenesis, hyperglycaemia and eventually leads to ketosis and ketoacidosis.

The aim of routine diabetes care during admission for surgical procedures is therefore to:

- prevent hypoglycaemia
- moderate hyperglycaemia
- prevent ketosis and ketoacidosis
- avoid delay to surgical procedures

Blood glucose management BG target 4-8 mmol/l (may aim for 6-12 mmol/l to help prevent low BG).

- **CBG < 4 mmol/l: Hypoglycaemia** Requires immediate treatment as follows:
 - *Taking orally:* Immediately: 60 ml Lucozade OR 1 tube Glucogel.
Repeat: Every 10 mins till CBG \geq 4 mmol/l.
Once CBG \geq 4: Long-acting carbohydrate (e.g. digestive biscuit) to prevent CBG again falling < 4 mmol/l.
 - *Nil by mouth:* Immediately: Increase infused dextrose (glucose) concentration e.g. if on Dext 5% (+NaCl) increase to Dext 10% (+NaCl)
Temporarily Increase IVF rate while preparing higher Dextrose conc. fluid
Must resume maintenance rate once higher concentration fluids start or CBG \geq 4 mmol/l.
- **CBG > 14 mmol/l: Hyperglycaemia** Requires *immediate* ketonuria or ketonaemia testing.
 - *Ketonuria:* Neg, trace, small: No further action required except continued monitoring
Moderate/large: Seek further advice (requires additional insulin).
 - *Ketonaemia:* < 1 mmol/l: No further action required except continued monitoring.
 \geq 1 mmol/l: Seek further advice (requires additional insulin).

Insulins available for administration

The following insulins are available within the UK. Please note that some insulins with similar names actually have *very different* durations of action, and are very different preparations.

- Novorapid Insulin Aspart
- Levemir Insulin Detemir
- Lantus Insulin Glargine
- Humalog Insulin Lispro
- Actrapid Soluble insulin
- Humulin S Soluble insulin
- Humulin I Isophane insulin
- Humulin M3 Soluble Insulin + Isophane insulin
- Novomix 30 Insulin Aspart + Isophane insulin *NB: This is not "Novorapid"*
- Humalog Mix 25 Insulin Lispro + Isophane insulin *NB: This is not "Humalog"*

While Novorapid & Levemir are available from Pharmacy, Humalog may substitute for Novorapid and Lantus for Levemir if routinely used by patient concerned. Change may be made due to allergy, and this should be checked if insulin to be prescribed differs from patient's usual insulin type.

Minor Procedures

Summary

- Anaesthetic usually under 20 mins duration (up to 1 hour), with low impact on glycaemic control.
- Child usually discharged same day as procedure.
- Examples include endoscopy, jejunal biopsy, adeno-tonsillectomy, grommet insertion, dental extraction, & repeated short procedures (such as for haematology/oncology or burns patients).
- Routine Diabetic Team review not essential, but call Team and/or anaesthetist if any concerns.
- Calculate Insulin Total Daily Dose (TDD) by adding ALL insulin taken in a typical 24 hour period.

Pre-op *See information below if patient using an insulin pump (CSII).*

MORNING LIST Patient must be first on theatre list. Ensure no allergy to Levemir.

- Normal insulin on DAY BEFORE surgery (e.g. usual Before Tea or Bed insulin).
- Fast from solids from 12 midnight, and from fluids from 0400 on day of surgery.
- Monitor capillary blood sugars HOURLY from time insulin given.
- IV fluids (NaCl 0.45% with Dextrose 5%) at maintenance rate, starting at 0800.
- 20% of insulin Total Daily Dose (TDD) as slow-acting analogue insulin (Levemir or Lantus) by SC injection when IV fluids start.

AFTERNOON LIST Patient must be first on theatre list. Ensure no allergy to Levemir.

- Normal insulin DAY BEFORE surgery (e.g. usual Before Tea or Before Bed insulin).
- Light breakfast on morning of surgery (approximately 0730-0800), then FAST.
- 20% of insulin TDD as slow-acting analogue (Levemir or Lantus) by SC injection immed. Before Breakfast.
- 10% of insulin TDD as rapid-acting analogue (Novorapid or Humalog immediately Before Breakfast.
- IV fluids (NaCl 0.45% & Dextrose 5%) at maintenance rate from time insulin given.
- Monitor capillary blood sugars HOURLY from time insulin given.

Post-op *See information below if patient using an insulin pump (CSII).*

IF EATING LUNCH

- Give 10% of insulin TDD as rapid-acting insulin analogue (Novorapid or Humalog (NOT Humalog Mix 25)) AFTER lunch (to ensure oral intake established).
- Once eating/drinking satisfactorily stop IV fluids.
- Monitor blood glucose 2-4 hourly.

IF EATING EVENING MEAL

- Resume usual insulin regimen but give dose AFTER child has eaten in case of refusal/vomiting.
- Once eating/drinking well stop IV fluids.
- Monitor capillary blood glucose as necessary until stable (e.g. 4 hourly), but increase frequency if patient clinically unwell or develops hypoglycaemia.
- If patient not eating within 4 hrs of usual evening meal time call for advice and/or commence insulin VRI infusion (see over).

IF NOT YET EATING AND DRINKING

- Levemir (or Lantus) should prevent ketosis and maintain blood glucose control for several hours post-op.
- Resume oral intake as soon as patient no longer Nil By Mouth.
- If post-op fasting is prolonged (e.g. beyond 6-8 hours)
 - continue intravenous fluids and
 - commence an Insulin Variable Rate Infusion (VRI dose increases as pre-op Levemir effect wanes).
- If *not* fasted but on a VRI, child may resume oral intake while continuing IVF and VRI until reasonable intake established.

See Over Page for more details on prescribing IV Fluids and IV Insulin Variable Rate Infusion.

Patient Using Insulin Pump* Undergoing Minor Procedure:

- If the anaesthetist and surgeon consider it appropriate, a continuous subcutaneous insulin infusion (CSII) pump *may* be used by patients before, during and after a surgical procedure.
- All insulin should then be given via pump, replacing any above recommended Levemir SC injection with usual *pump-delivered basal insulin rates*, and any SC Novorapid injections with *pump-delivered boluses*, (calculated according to usual pump settings for carbohydrate intake or raised Blood Glucose).
- Ward parental supervision of insulin pump use is mandatory. If continuous parental supervision of an insulin pump is not possible, for whatever reason, the pump should be stopped and all insulin prescribed as SC injections or IV infusion.

- Start and cease IV Fluids as indicated above.
- See Insulin Pump Guidelines for further details (www.diabetes-scotland.org/ggc).

More Complex Surgery (“Major”) and Emergency Procedures

Call Diabetes Service (T: 80331 M-F: 0900-1700) &/or Anaesthetist if using Complex/Emergency Surgery Protocol

- Best managed with:
 - IV Variable Rate Insulin Infusion] commence immediately if an emergency case, or once fasting
 - Appropriate Intravenous Fluids] for complex elective procedures (if good glycaemic control) *
- If glycaemic control *poor* commence IVF & VRI at least 12 hrs before procedure, to help normalise glucose and treat ketosis pre-op.
- Commence IV Fluids and Insulin VRI from time of fasting, using current BG value to establish initial insulin infusion rate.
 - Add: - 50 Units soluble insulin (Actrapid) via insulin syringe to
 - 49.5 ml NaCl 0.9% in 50 ml Luer lock syringe to give
 - 1 Unit/ml solution.

Suggested initial Variable Rate Infusion of Insulin prescription via IV Syringe Pump*

| BLOOD GLUCOSE (mmol/l) | INFUSE SOLUTION AT (ml/hr) | EQUIVALENT TO (Units/kg/hr) |
|------------------------|---------------------------------------------------|-----------------------------|
| > 22 mmol/l | Weight (kg) x 0.1 ml/hr (= Units/hr) | 0.10 |
| 14 - 22 | Weight x 0.07 | 0.07 |
| 8 - 13.9 | Weight x 0.04 | 0.04 |
| 4 - 7.9 | Weight x 0.02 | 0.02 |
| < 4 | Weight x 0.01 and INCREASE INFUSED DEXTROSE CONC. | 0.01 |

- N.B.: VRI may need re-prescription in light of clinical response (e.g. if persistent low or high BG’s).
- Use anti-reflux valve if both IV fluid infusion and Insulin VRI given via single cannula.
- Cap BG testing 1 hrly before, during, and after procedure (more often if concerns; e.g. hypoglycaemia).
- Ketosis will develop following insulin omission. Do *not* stop insulin infusion unless problems with persisting hypoglycaemia, and then only briefly pending restart with increased Dextrose concentration.
- Discuss with Diabetes Team, Anaesthetist or Medical Registrar if any concerns, esp. if patient ketotic.

Suggested initial Intravenous Fluid Infusion

- NaCl 0.45% and Dextrose 5% (may add 10 mmol KCl / 500ml IV fluid unless contraindicated) OR
- NaCl 0.9% and Dextrose 5% (may add 10 mmol KCl / 500ml IV fluid unless contraindicated).
- Increasing the Dextrose concentration of infused IV Fluids may be required to maintain adequate BG.

HOW TO MAKE UP NaCl 0.45% and DEXTROSE 10% + KCl

- Dextrose 10% 500 ml bag
- NaCl 30% 7.5 ml
- KCl 10 mmol/l

HOW TO MAKE UP NaCl 0.9% and DEXTROSE 10% + KCl

- Dextrose 10% 500 ml bag
- NaCl 30% 15.0 ml
- KCl 10 mmol/l

Insulin Prescribing Tips

- Calculate Insulin Total Daily Dose (TDD) by adding ALL insulin taken in a typical 24 hour period
- NEVER abbreviate the term “UNITS” by writing “U”, “IU”, etc.
- Humalog Mix 25 is a TYPE, not a DOSE, and different from Humalog!
- Write out fractional doses fully: e.g. “2.5 (TWO POINT FIVE) UNITS”.
- Always download the latest version of this Guideline from the following web-site URL:

<http://www.diabetes-scotland.org/ggc/documents/pdf%20files/20090512%20Surgical%20Protocol.pdf>

Diabetes Service Contact Numbers

- | | |
|---------------------------------------------------|------------------------------|
| • Diabetes Service Office (T: 80331) | • Dr. Craigie (Page: 8213) |
| • Diabetes Nurse Specialist (Page: 8054) | • Dr. Gallacher (Page: 8253) |
| • Diabetes & Endocrinology Registrar (Page: 8031) | • Dr. Robertson (Page: 8066) |

Flow Chart outlining Management of Diabetes Patients during Surgery

