

Management of children and young people with diabetes during surgery

Authors: Paediatric Diabetic Team (Shaun Gorman)

Approved by: Paediatric Diabetic Team – 13.3.19 (no change)

Review date: 5.5.20

Version: 3

NB - This replaces `Emergency Surgery in the Child with
Diabetes Mellitus

This guideline is intended for those children with diabetes mellitus undergoing surgery. It is important to avoid the immediate complications of diabetes peri-operatively, particularly hypoglycaemia and ketoacidosis.

General points:

- A child with diabetes fasting before surgery, still needs insulin, even though they are not eating.
- A child with diabetes cannot fast without the risk of hypoglycaemia.
- Surgery is a stress and will alter the action of insulin and insulin requirements.
- Children with diabetes should be scheduled first on the operating list (am or pm) to avoid unnecessarily long starvation periods.

Need to consider:

- whether elective or emergency surgery
- minor or major procedure
- will surgery delay normal oral intake post-op, eg gastrointestinal surgery
- the usual insulin regimen of the child

Admission checklist:

- inform Paediatric Diabetes team of child's arrival
- alert anaesthetist and ward staff
- check that child has own diabetic equipment including, pens, insulin, blood glucose strips
- check child's current insulin regimen
- ensure that IV infusion equipment and syringe pumps are available
- clear management plan to be written in notes for the types of procedure using the outlines below, but with individualised doses clearly stated and entered on the drug chart
- state clearly who is responsible for the adjustments to the insulin regimen and how to contact

Standard starvation times

- Food - six hours pre-op.
- Free clear fluids - up until two hours pre-op irrespective of timing of the surgery. This should avoid requirement for pre-op IV fluids at least for minor surgery.

Management for minor procedures

Definition: general anaesthetic lasting less than 30 minutes with low risk of nausea, vomiting or inability to eat, e.g. dental extraction, short ENT procedures, longline insertion.

(i) Children on multiple dose insulin regimen (MDI)

These children will usually have short or rapid acting insulin three times daily with main meals.

Long acting insulin is usually given as once daily (usually at bedtime) glargine (Lantus) or detemir (Levemir)

- admit as day case
- consult checklist

Preparation

- Consider a reduction in the evening insulin dose the night before as advised by the diabetes team.
- Check blood glucose levels on admission. Inform the diabetes team or on call paediatric registrar if glucose levels high >14 mmols/l or low <4 mmols/l

Morning operations

Prior to surgery:

- Standard starvation times as above.
- Omit usual morning bolus insulin.
- Measure capillary blood glucose hourly until operation and notify the diabetes team or on call paediatric registrar and anaesthetist if <4 mmols/l or >14 mmol/L pre-op.

During surgery:

- If blood glucose stable, measure capillary blood glucose every half hour during procedure.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively.
- On return and if child well, give usual morning insulin and breakfast.
- Return to normal regimen, adjusting insulin doses if necessary. Aim to maintain blood glucose between 5-11 mmol/l.
- If unable to tolerate oral intake, set up IV infusions of insulin and 5% dextrose + 0.45% saline solution, until child is taking and tolerating adequate oral fluids and snacks.
- After minor surgery and if the child has recovered, discharge should be possible provided blood glucose is between 5-11 mmol/L and urine is free of ketones and the surgical team are happy.
- The child can return to normal insulin regimen with normal dose of Lantus or Levemir that evening.

Afternoon operations

Prior to surgery:

- Usual bolus insulin with breakfast before 7.30am and omit usual lunchtime bolus insulin.
- Clear fluids may be allowed up to two hours pre-operatively and then nil by mouth.
- Measure capillary blood glucose hourly until operation and notify the paediatric diabetes team or on call paediatric registrar and the anaesthetist if <4 mmols/l or >14 mmol/L pre-op.

During surgery:

- If blood glucose stable measure capillary blood glucose every half hour during procedure.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively.
- On return and if child is well, give usual insulin bolus with next meal (either a late lunch or early evening meal).
- Return to normal regimen, adjusting insulin doses if necessary. Aim to maintain blood glucose between 5-11 mmol/L.
- If unable to tolerate oral intake, set up IV infusions of insulin and five per cent dextrose 0.45 per cent saline solution, until child is taking and tolerating adequate oral fluids and snacks.
- After minor surgery and if the child has recovered, discharge should be possible after the evening meal, provided blood glucose is between 5-11 mmol/L and urine is free of ketones and the surgical team are happy.
- The child can return to normal insulin regimen with normal dose of Lantus or Levemir that evening.

(ii) Children on continuous subcutaneous insulin infusion (CSII)

As these systems deliver basal insulin separate from any bolus insulin, all that is required is to run the pump on the normal basal setting for the duration of the procedure.

Blood glucose should be checked on hourly basis and carer/patient asked to alter infusion rate accordingly. Basal rate can be suspended or reduced temporarily to correct any episodes of mild hypoglycaemia.

- admit as day case
- consult checklist

Preparation

- Check blood glucose levels on admission. Inform the diabetes team or on call paediatric registrar if glucose levels high >14 mmols/l or low <4 mmols/l

- Discourage family from doing a routine change of cannula site immediately prior to theatre.

Morning operations

Prior to surgery:

- Standard starvation times as above.
- Run on normal basal rates for the time of day.
- Measure capillary blood glucose hourly until operation and notify the paediatric diabetes team or the on call paediatric registrar and the anaesthetist if <4 mmols/l or >14 mmol/L pre-op.

During surgery:

- If blood glucose stable, measure capillary blood glucose every half hour during procedure.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively. Continue to run on normal basal insulin infusion rate.
- On return and if child is well, give usual bolus insulin with breakfast.
- Aim to maintain blood glucose between 5-11mmol/L.
- Return to normal CSII regimen, a correction bolus may be necessary if glucose levels are high and should be discussed with the paediatric diabetes team.
- If unable to tolerate oral intake, continue basal insulin infusion and set up IV infusion of 5% dextrose + 0.45% saline solution, until the child is taking and tolerating adequate oral fluids. Adjustments to the basal rate may be required and should be discussed with the paediatric diabetes team.
- After minor surgery and if the child has recovered, discharge should be possible provided blood glucose is between 5-11 mmol/L and urine is free of ketones and the surgical team are happy. Return to normal CSII regimen.

Afternoon operations

Prior to surgery:

- Normal CSII programme with breakfast at 7.30am.
- Clear fluids may be allowed up to two hours pre-operatively and then nil by mouth. Continue on basal insulin infusion rate.
- Measure capillary blood glucose hourly until operation and notify the paediatric diabetes team or on call paediatric registrar and the anaesthetist if <4 mmols/l or >10 mmol/L pre-op.

During surgery:

- If blood glucose stable, measure capillary blood glucose every half hour during procedure.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively. Continue to run on normal basal insulin infusion rate.
- On return and if child is well, give usual bolus insulin with late lunch.
- Aim to maintain blood glucose between 5-11mmol/L.
- If unable to tolerate oral intake, continue basal insulin infusion and set up IV infusion of 5% dextrose + 0.45% saline solution, until the child is taking and tolerating adequate oral fluids. Adjustments to the basal rate may be required and should be discussed with the paediatric diabetes team.
- Return to normal CSII regimen, a correction bolus may be necessary if glucose levels are high and should be discussed with the paediatric diabetes team.
- After minor surgery and if the child has recovered, discharge should be possible after the evening meal provided blood glucose is between 5-11 mmol/L and urine is free of ketones and the surgical team are happy. Return to normal CSII regimen.

(iii) Twice daily insulin mixtures

For example, children on Novomix 30.

Morning operations**Prior to surgery:**

- Standard starvation times as above.
- Omit usual morning insulin.
- Measure capillary blood glucose hourly until operation and notify the paediatric diabetes team or on call paediatric registrar and the anaesthetist if <4 mmols/l or >10 mmol/L pre-op.

During surgery:

- If blood glucose stable, measure capillary blood glucose every half hour during procedure.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively.
- On return and if child is well, give normal morning insulin dose. Aim to maintain blood glucose between 5-11mmols/L.
- Return to normal insulin regimen in the evening.
- If unable to tolerate oral intake, set up IV infusions of insulin and 5% dextrose + 0.45% saline solution until the child is taking and tolerating adequate oral fluids and snacks.
- After minor surgery and if the child has recovered, discharge should be possible provided blood glucose is between 5-11 mmol/L and urine is free of ketones and the surgical team are happy.

Afternoon operations

Prior to surgery:

- Give short acting insulin (one third of total morning insulin dose) only and light breakfast before 7.30am.
- Clear fluids up to two hours pre-operatively and then nil by mouth.
- Measure capillary blood glucose hourly until operation and notify the paediatric diabetes team or on call paediatric registrar and the anaesthetist if <4 mmols/l or >10 mmol/L pre-op.

During surgery:

- If blood glucose stable, measure capillary blood glucose every half hour during procedure.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively.
- On return and child is well give NovoRapid (one third of total morning dose) and lunch.
- Aim to maintain blood glucose between 5-11mmols/L.
- Return to normal insulin regimen prior to the evening meal.
- If unable to tolerate oral intake, set up IV infusions of insulin and 5% dextrose + 0.45% saline solution until the child is taking and tolerating adequate oral fluids and snacks.
- After minor surgery and if the child has recovered, discharge should be possible provided blood glucose is between 5-11 mmol/L and urine is free of ketones and the surgical team are happy.

Management for Major Elective Procedures

Definition: general anaesthetic lasting more than 30 minutes, likely to cause post-operative nausea, vomiting or inability to feed adequately.

Pre-op preparation

- Liaise and notify the Paediatric Diabetes team to ensure the best blood glucose control preoperatively.
- The child should be first on the list, preferably in the morning.
- Weigh the child.
- Inform the anaesthetist that the child has diabetes.
- Admit the afternoon prior to surgery for morning operations, or early morning after 8.00am for operations later in the day.

Evening prior to surgery

- Check urine for ketones and glucose and repeat morning of surgery. Treat ketoacidosis if present.
- Measure full blood count, U&E, blood glucose and bicarbonate.

- Do pre-mealtime and pre-bedtime capillary blood glucose measurements.
- Give usual evening time insulin, if on twice daily regimen, and adequate carbohydrate for supper and bedtime snack.
- Consider a reduction in the Lantus or Levemir dose if on MDI regimen.

Morning operations

Prior to surgery:

- Standard starvation times as above.
- Omit morning insulin.
- Check electrolytes and glucose pre-op and inform anaesthetist of results.
- Start IV fluid. Give 5% dextrose + 0.45% saline with potassium using the maintenance regimen.
- Commence at the same time insulin infusion.
- Measure capillary blood glucose hourly until operation.

Afternoon operations

Prior to surgery:

- For patients on MDI, give usual bolus with breakfast at 7.30am.
- For CSII, give normal bolus with breakfast and normal basal until theatre.
- For twice daily regimens, give 20 per cent of the usual morning insulin dose as soluble insulin eg NovoRapid. Do not give any long acting insulin, so no insulin mixture.
- Fast after breakfast and admit to hospital.
- Clear fluids up to two hours pre-operatively.
- Start intravenous fluids and insulin by 11am at the latest.
- Then follow guidance as for morning operations.
- Afternoon operation will require a continuation of the IV infusion regimen until the next morning, when a decision can be made about breakfast and normal insulin regimen if clinically appropriate.

Morning and afternoon operations

During surgery:

- Measure capillary blood glucose every half hour.
- Adjust insulin infusion according to blood glucose concentrations.
- Suggested insulin infusion rates (blood glucose, insulin infusion rate)
 - >12 mmol/l - 0.05 units/kg/hr
 - 9 to 12mmol/l - 0.04 units/kg/hr
 - 7 to 8.9mmol/l - 0.03 units/kg/hr
 - 4 to 6.9mmol/l - 0.02 units/kg/hr
 - <4mmol/l - 0.01units/kg/hr with 2ml/kg of 10 per cent glucose
- These doses may need to be revised in severely ill patients and children who were on high doses of insulin or receiving steroids.

- Do not stop the insulin infusion if the blood glucose is lower than four, as this will cause hyperglycaemia. Reduce the rate of the insulin infusion further. Continue with glucose infusion and increase the rate if required or increase the dextrose concentration.

After surgery:

- Hourly capillary blood glucose measurements for four hours post-operatively.
- Six hourly U&E measurements until stable, daily U&E measurements and accurate fluid balance thereafter.
- If no change in insulin infusion rate is required, do two hourly capillary blood glucose measurements until the usual insulin is restarted.
- Aim to maintain blood glucose between 5-11mmols/L.
- Continue IV infusions of insulin and five per cent dextrose 0.45 per cent saline, until the child is taking adequate oral fluids and snacks.
- Once the child is drinking and eating, the return to standard insulin regimen can be contemplated.
- If on MDI, then stop infusions and give the normal Novorapid insulin dose subcutaneously, immediately. Then follow with normal regimen.
- If on CSII, start on normal basal rate and switch off IV insulin infusion after 15 mins.
- For those patients on a twice daily insulin regimen, the normal insulin dose can be given with breakfast or the evening meal.

Emergency surgery

- Remember that diabetic ketoacidosis may present as an acute abdomen.
- Acute illness may precipitate diabetic ketoacidosis.
- Do not overlook established diabetes
- Stress, trauma or surgery may unmask impending diabetes.
- It is always wise to check blood glucose and ketonuria in all emergencies.
- Inform diabetes team.
- Keep nil by mouth.
- Check weight, electrolytes, glucose, venous pH/bicarbonate and urine for ketones pre-operatively.
- If ketoacidosis is present, follow guidance for diabetic ketoacidosis and delay surgery until circulating volume and electrolyte deficit are corrected. Operate only when rehydrated and blood pressure stable.
- If there is no ketoacidosis, start insulin and maintenance fluid regimen as for elective surgery.

Contact Numbers

Dr Gorman #6542
Dr Mathai #6533
Paediatric Registrar Bleep 488
Diabetes Nurse Specialists 5219 or #6443

Appendix 1- Maintenance Fluid Guide

5% dextrose and 0.45% saline with 10mmol added potassium chloride per 500ml bag.

Maintenance fluid guide

Body weight (kg)	Maintenance fluid (ml/kg/day)
For first 10kg body weight	100
For each kg between 10-20kg	50
For each kg above 20kg	25

Appendix 2- Insulin Infusion Regimen for patients with diabetes undergoing surgery

1. Draw up 50mls 0.9 per cent saline into 50ml syringe.
2. Draw up actrapid 50 units into insulin syringe.
3. Add actrapid insulin to the 50mls of saline in the syringe and attach to syringe pump (1ml solution = 1 unit soluble insulin).
4. Label syringe clearly.
5. Give the insulin along with the IV dextrose infusion at a rate of 0.05 unit/kg/hour (0.05ml/kg/hour) via the same cannula with non-return valve.
6. Monitor blood glucose hourly and adjust insulin infusion rate to maintain blood glucose between 5-11 mmol/L.

If blood glucose levels are not returned to target range after one adjustment of insulin infusion rate:

- check cannulae patency
- check infusion equipment
- make up fresh insulin infusion solution
- discuss with Diabetic team

References

Reference 1:

Edge JA, Swift PG, Anderson W, Turner B, Youth and Family Advisory Committee of Diabetes UK (2005) [Diabetes services in the UK: fourth national survey; are we meeting NSF standards and NICE guidelines?](#) Arch Dis Child 90 (10): 1005-9.
