Brighton and Sussex University Hospitals NHS Trust

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GUIDLELINES FOR THE MANAGEMENT OF CHILDREN WITH DIABETES UNDERGOING SURGERY.

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Approved by the Children and Young Person's South East Coast and London Diabetes Network

This Guideline is based on ISPAD Clinical Practice Consensus Guidelines 2014 Compendium – Chapter 15

The following recommendations are for guidance only. Each child must be assessed individually and their management based on normal insulin requirements, diabetic control and the operative procedure itself. To ensure the highest levels of safety, careful liaison is needed between surgical, anaesthetic and children's diabetes teams before, during and after admission for elective surgery and as soon as possible after admission for emergency surgery.

Minor surgery / procedures are those that require a brief GA usually of less than 2 hours duration, and that do not have a major impact on glycaemic control (e.g. jejunal biopsy, endoscopies, adenotonsillectomy, grommet insertion etc.). The child will usually be discharged from hospital on the day of the procedure.

Major surgery requires more prolonged GA, is associated with greater risks of metabolic decompensation, and the child is unlikely to be discharged from the hospital on the day of the procedure. These surgeries are typically expected to last for at least 2 hours.

If glycaemic control is poor, admission to Hospital the day prior to surgery may be necessary. Ketosis or severe hyperglycaemia will necessitate correction, preferably by overnight IV insulin infusion, and **might cause a delay or cancellation in surgery**.

(ISPAD 2014)

PLEASE NOTE

1. For elective surgery please notify the Diabetes team and the Paediatric Diabetes Nurse Specialist (PDSN) (Ext 3140) and Paediatric Registrar when date of surgery is known. PDSN will liaise with parents to help optimise diabetes care prior to admission.

2. The Paediatric Registrar on call for the wards is responsible for in-patient diabetes care. The Surgical Team is responsible for surgical management. The Anaesthetists manage the blood sugar from induction until return to the ward.

3. At surgical pre-admission clinic, the PDSN will assess diabetes control and liaise with the diabetes team consultants if required.

4. On admission to the ward, the Surgical SHO should liaise with the appropriate medical Registrar and also inform the Anaesthetic Team when there is a diabetes patient on the list.

5. The Surgical Day Case Unit and Surgical Ward Nursing Staff to liaise with Medical Nursing staff and Diabetes Nurse Specialist for advice and guidance as necessary.

GENERAL PRINCIPLES:

- **THE PATIENT SHOULD BE FIRST ON THE LIST.** The best time would be first on morning list and if not possible, then this should be FIRST on the afternoon list. This will give more time for the patient to recover and to be discharged home the same day if possible.

- IV access, infusion of 5% dextrose (10% if there is a risk of hypoglycaemia) with 0.9% saline with IV insulin sliding scale and 1hrly blood glucose monitoring is essential in most situations where GA is given.

- Aim for Blood glucose levels between 5 – 10 mmol/L during and after surgical procedures (ISPAD 2014)

- The usual recommendation is no solid food for at least 6 h before surgery. Clear fluids (and breast milk) may be allowed up to 4 h before surgery (check with anesthetist).

- **Patients need insulin, even if fasting, to avoid ketoacidosis.**

- The stress of surgery leads to a complex neuroendocrine stress response characterized by hyperglycemia and a catabolic state. To achieve optimal glycemic control, insulin dosage may need to be increased on the day of major surgery and for approximately 2 d after surgery. Hyperglycemia has been associated with an increased risk of postoperative infection.

FLUID AND INSULIN TABLES

Table 1: IV Fluids for surgical procedures

1. Maintenance Fluid Guide

- Generally use 5% dextrose, NaCl 0.9% with KCL 20 mmol in 500 ml.
- If BG >14mmol/l, use just 0.9% NaCl with KCL 20 mmol in 500ml.
- If BG <14mmol/l, change to 5% dextrose, NaCl 0.9% with KCL 20 mmol in 500 ml.
- If BG persistently < 6.0mmol/l, change to 10% dextrose, NaCl 0.9% with KCL 20 mmol in 500 ml.

	Body Weight	Fluid requirements/24 hours
	3-9 kg	100ml/kg
	10-20kg	Add 50ml/kg
	Above 20kg	Add 20ml/kg (max 2500ml)

Table 2: IV INSULIN SLIDING SCALE FOR SURGICAL PROCEDURES

2. **Insulin sliding scale**

- Start IV fast acting insulin sliding scale to control blood glucose accurately changing the rate of insulin infusion according to blood glucose level as per below
- *Method:* Make up the insulin infusion as follows
- Withdraw 2.4 units/kg of fast acting Insulin Actrapid
- Inject into a 50ml syringe
- Dilute insulin with 48mls of normal saline
- Rotate and mix
- **1ml per hour = 0.05 units/kg/hour**

Blood glucose in mmols/l	Infusion rate
4 or < 4	0.25 ml per hour (0.0125 units/kg/hour)
4.1 – 7	0.5 ml per hour (0.025 units/kg/hour)
7.1 – 11	1 ml per hour (0.05 units/kg/hour)
11.1 – 17	1.5 ml per hour (0.075 units/kg/hour)
17.1 – 24	2 ml per hour (0.1 units/kg/hour)
24.1 or above	2.5 ml per hour (0.125 units/kg/hour)

REMEMBER – NEVER STOP INSULIN* AIM FOR BLOOD GLUCOSE 5 – 10 mmol/L

If BG <4mmol/l do not stop insulin infusion as this causes rebound hyperglycaemia. Re-check BG, halve insulin infusion rate further. *** The insulin infusion may be stopped if BG < 3mmol/l, BUT ONLY FOR 15 MINUTES**

Table 3: SC use of fast acting insulin Novorapid

When switching to sc Novorapid insulin. Give this 5 - 10 minutes before the meal and stop the intravenous insulin infusion 30 minutes after s/c injection. Consult diabetes team prior to giving if necessary. Keep IV cannula in situ in case diet & fluids are not tolerated.	
Blood glucose levels (mmol/L)	Units/kg (rounded to the nearest 0.5 unit)
>24.1	0.1 unit/kg + additional correction of 0.06 units/kg
17.1 – 24	0.1 unit/kg + additional correction of 0.04 units/kg
10.1 – 17	0.1 unit/kg + additional correction of 0.02 units/kg
<10	0.1 unit/kg + no additional correction
STOP INSULIN INFUSION 30 MINUTES AFTER A S/C DOSE HAS BEEN GIVEN	

Major surgery (as defined above)

- On the evening before the surgery give the usual evening and/or bedtime insulin and meals.
- Monitor blood glucose 1hrly and measure blood ß-hydroxybutyrate (BOHB) if BG >14mmol/l
- Omit the usual morning insulin dose.
- At least 2 h before surgery, start an IV insulin infusion (see Table 3)
- Provide IV maintenance fluids consisting of 5% dextrose and normal saline (0.9% NaCl) with KCl (see Table 1).
- Monitor blood glucose levels hourly before surgery and continue as long as the patient is receiving IV insulin.
- Aim to maintain blood glucose between 5 and10 mmol/L by adjusting the IV insulin sliding scale (or the rate of dextrose infusion during surgery).
- When oral intake is not possible, the IV dextrose infusion and insulin sliding scale should continue for as long as necessary post-surgery.

MINOR SURGERY (As defined above)

CHILDREN TREATED WITH BASAL- BOLUS REGIMENS

MORNING OPERATIONS

Pre-operative care:

- Consider the need for a 20-30% reduction of the preceding evening long-acting insulin (eg Levemir or Glargine/ Lantus) if there is a pattern of low blood glucose levels in the mornings

- If the GA is less than 1 hour, at 07.00h give 75 -100% of the long acting insulin dose if this is usually taken in the morning
- If the procedure is likely to take more than 1 hour, at 07.00 give 75-100% of the long acting insulin dose if this is usually taken in the morning and commence IV fluids – Table 1
- Do not give any rapid acting insulin in the morning unless necessary to correct hyperglycaemia
- Perform at least hourly blood glucose measurements before, during and after GA.
- If blood glucose is persistently low commence IV dextrose 10% as detailed in Table 1

AFTERNOON OPERATIONS

Pre-operative care:

- Allow child to eat breakfast and drink clear fluids until 4 hours pre operatively. Check with anaesthetist.
- Give usual dose of rapid acting insulin at breakfast and usual dose of basal long acting insulin (if usually given at this time)

Post-Operative care (morning and afternoon operations):

- Aim to keep BG between 5-10 mmol/L. HOSPITAL meter to be used.
- Supplemental mid-morning rapid acting insulin can be given s/c if necessary (10 – 25% of total daily dose) and, when tolerated, a light diet.
- Then resume normal meals and pre-meal insulin doses at the appropriate times.

CHILDREN ON INSULIN PUMPS

- If theatre and ward staff are not confident or competent in the use of continuous subcutaneous insulin infusion (CSII) pumps **discontinue the pump and commence continuous IV fluids and IV insulin sliding scale** as detailed above as appropriate until child able to tolerate normal fluids and food.
- If staff are competent in the use of CSII for diabetic children the following guidelines can be followed:
  - Secure the SC infusion site to prevent dislodgement and interruption of the insulin supply during the procedure
  - If the procedure is short (less than 1 hour), continue the pump's basal insulin rate, keeping IV 5% dextrose infusion at the maintenance rate (Table 1).

- Omit morning/meal bolus dose unless necessary to correct hyperglycaemia.
- Monitor blood glucose levels using HOSPITAL meter hourly pre-operatively and at least half - hourly during GA.
- Give correction doses via the pump as necessary pre and post operatively
- Give a pre-meal bolus of insulin when ready to eat.

SIMPLIFIED PROCEDURE for minor procedures requiring fasting

For short procedures (with or without sedation or anaesthesia) and when rapid recovery is anticipated, a simplified protocol may be organised by experienced diabetes/anaesthetic personnel and may include:

- Early morning procedure (08.00 – 09.00):
- Delay insulin and food until immediately after completion of procedure
  - For those on twice daily insulin: give 50% of usual insulin dose
  - For those on Basal/bolus or CSII: give usual basal insulin/basal rate in the morning. Add small doses of rapid acting insulin if needed. Give bolus dose and food when child able to eat.
- An IV cannula should always be sited in case IV fluids and or insulin is required.
- Frequent BG monitoring is always necessary.

EMERGENCY SURGERY

- DKA may present as an ‘acute abdomen’
- Acute illness may precipitate DKA (with severe abdominal pain)
- Nil by mouth
- Secure IV access
- Check weight, electrolytes, glucose, blood gases and blood ketones preoperatively
- If ketoacidosis is present, follow guidelines for DKA management and delay surgery until circulating volume, acid-base and electrolyte deficits are corrected.
- If there is no ketoacidosis, start IV fluid and insulin sliding scale as for elective surgery

Reference: ISPAD (2014) Clinical Practice and Consensus Guidelines: Management of children with diabetes requiring surgery