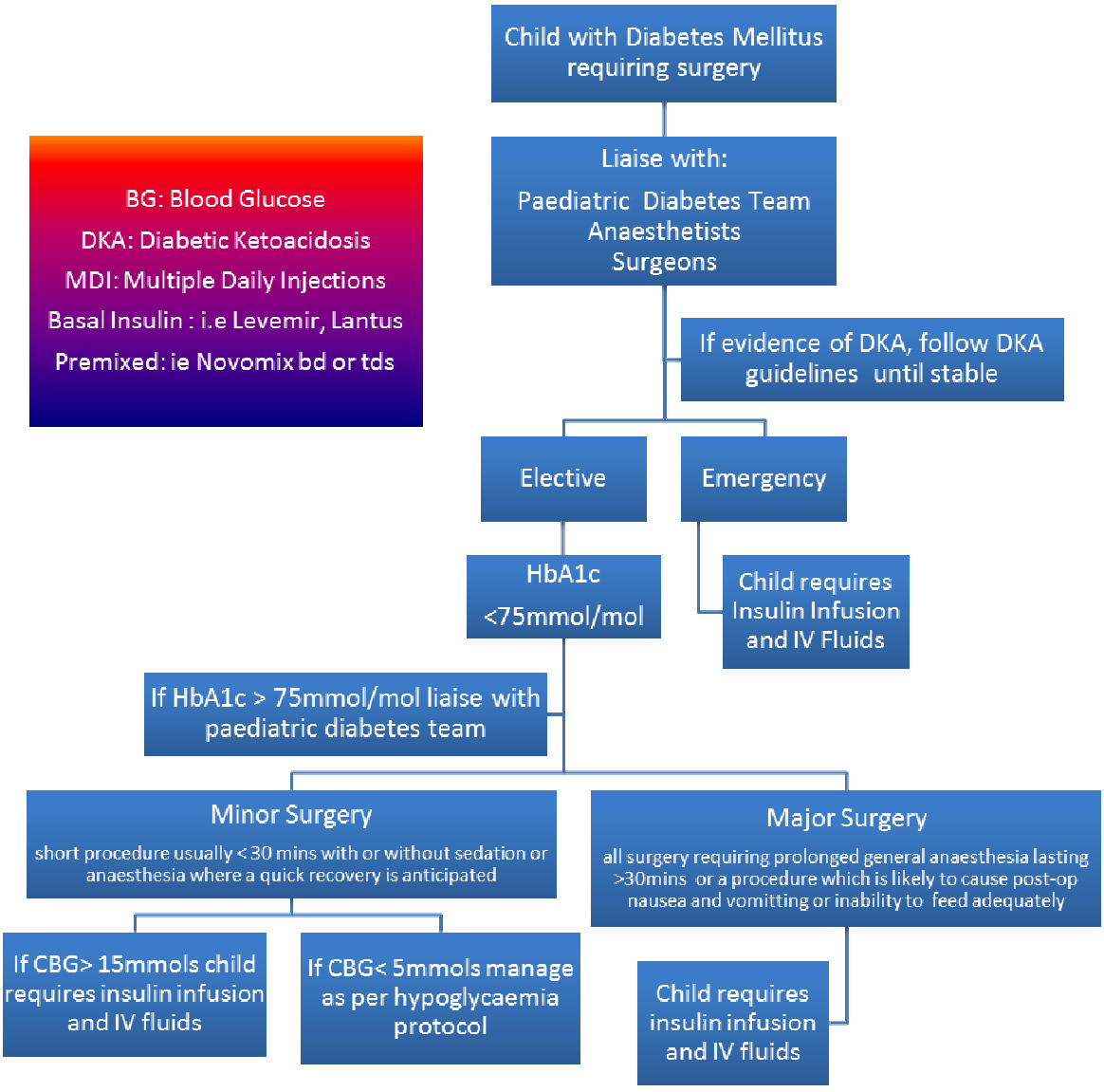
Ashford and St. Peter's Hospitals NHS
NHS Foundation Trust

Guidelines for the care of Children with Diabetes Mellitus undergoing Surgery

Background

Surgery places physical and emotional stress on the body. This, alongside new surroundings, parental anxiety and surgical pain can lead to alterations in glucose control and insulin requirements. Optimising glucose control will improve outcomes and reduce complications such as hypoglycaemia, hyperglycaemia, medication errors and inappropriate use of insulin infusions.

Summary



Key Points

- Close liaison with all team members
  - Paediatric Diabetes Team - Anaesthetists - Surgeons
- Surgery to be delayed if DKA present until electrolyte and fluid imbalance stabilised
- Try to have patient first on the list – ideally morning list
- All patients require insulin in some form even if fasting to prevent DKA
- Continue with Long acting Insulin
- If BG < 5 mmols at any stage, follow addendum B
- If BG > 15 mmols at any stage follow addendum C
- If insulin pump stopped for 30minutes or more follow addendum A
- Use Addendum E + F for IV fluid and insulin infusions protocol
- Use Addendum G for restarting subcutaneous insulin after being on intravenous insulin infusion

Paediatric Diabetes Team

NAME	GRADE	BLEEP	EXTENSION
Dr Bahl	Consultant	8137	
Dr Baksh	Consultant	8418	
Dr D'Cruz	Consultant	8954	
Jocelyn Hall	PDNS		3314
Cathy Bryant	PDNS		3314

Elective Surgery

		Minor Surgery Short procedure, usually <30mins with or without sedation or anaesthesia where a quick recovery is expected.			Major Surgery All surgery requiring prolonged general anaesthesia lasting >30mins, or a procedure which is likely to cause post-op nausea and vomiting or inability to feed adequately.		
		Basal Insulin + MDI	**Insulin Pump**	**Pre-mixed**	**Basal Insulin + MDI**	**Insulin Pump**	**Premixed**
Morning List	**Day Before**	• Advise normal insulin and diet			• Admit: Weight, U&Es, FBC, Urinary or Blood Ketones • Pre Meal and Pre bed BG • Usual insulin on evening/night before surgery • **Insulin pumps**: continue as usual with parental management until surgery		
	Pre-Op	• Admit on morning of surgery • Child should ideally be first on list • IV cannula placed on admission to ward • No IV fluids or insulin infusion need • Measure and record BG hourly pre-op[B+C]			• Nothing to eat 6 hours before surgery • Starved from 0300 • Clear fluids until 2 hours before surgery • Omit rapid acting insulin • Start IV maintenance fluids and Insulin infusion • Maintain BG between 5-12mmols • **Insulin Pumps**: Parents may be able to continue with their usual management until time of surgery when the pump should be stopped and IV fluids and insulin started		
		If CBG 5-12mmol[B+C] - Omit rapid acting insulin - If basal insulin is given in the morning, give as usual	- Run pump at usual basal rate - Check BG hrly and adjust to maintain BG between 5-12mmol[B+C]	Delay morning dose till after the procedure when they can have it with a late breakfast			
	Intra-Op	Measure BG ½ hourly	- Run pump at normal basal rate - Check BG hourly[A]	Measure BG ½ hourly	Measure BG ½ hourly		
	Post-Op	Once eating give usual dose of rapid acting insulin generally taken with that meal	Allow parents to re-start the pump at the usual basal rate once the child has recovered	Delayed morning dose to have with a late breakfast	• Check BG and Ketones hourly • Continue IV fluids and insulin infusion until ready to start eating • See Addendum on how to convert to s/c insulin		

<table>
<tr><th>Afternoon List</th><th>Day Before</th><th>Basal Insulin + MDI</th><th>Insulin Pump</th><th>Pre-mixed</th><th>Basal Insulin + MDI</th><th>Insulin Pump</th><th>Pre-mixed</th></tr>
<tr><td rowspan="6"></td><td></td><td colspan="3">• Advise normal insulin and diet</td><td colspan="3">• Admit: Weight, U&Es, FBC, Urinary or Blood Ketones
• Pre Meal and Pre bed BG
• Usual insulin on evening/night before surgery
• Insulin pumps: continue as usual with parental management until surgery</td></tr>
<tr><td>Pre-Op</td><td colspan="3">• Advise child to have normal breakfast no later than 7.00am
• Patient to have breakfast insulin dose dependent on regimen
• Measure and record BG on arrival, Insert IV cannula
• Child should be first on the list
• Measure and record BG hourly once nil by mouth</td><td colspan="3">• Light Breakfast at 0700 on morning of procedure
• Starve after breakfast
• Clear fluids till 2 hours pre surgery
• Liaise with anaesthetist re: exact timings</td></tr>
<tr><td></td><td>Full dose of rapid acting insulin
Full dose of basal insulin if given in the morning</td><td>Run pump at normal basal setting
BG should be checked hrly[A+B+C]</td><td>Give ½ rapid-acting component of morning insulin as rapid acting insulin[E].</td><td>Full dose of rapid acting insulin
Full dose of basal insulin if given in the morning</td><td>Run pump at normal basal setting
BG should be checked hrly[A+B+C]</td><td>Give half the morning insulin dose</td></tr>
<tr><td>Peri-Op</td><td colspan="3">• Measure BG half hourly during the operation
• No IV fluids or insulin infusion needed routinely[A+B+C]</td><td colspan="3" rowspan="2">• Insulin infusion and IV fluids from 12 noon
• Ideally, first on afternoon list
• Measure BG half hourly during the operation</td></tr>
<tr><td></td><td>- Run pump at usual basal rate
- Check BG hrly and adjust to maintain BG between 5-12mmol[A+B+C]</td><td></td></tr>
<tr><td>Post-Op</td><td>Once eating give usual dose of rapid acting insulin generally taken with that meal</td><td>Allow parents to re-start the pump at the usual basal rate once the child has recovered</td><td></td><td colspan="3" rowspan="2">• Check BG and Ketones hourly
• Continue IV fluids and Insulin infusion until ready to start eating
• See Addendum on how to convert back to s/c insulin</td></tr>
<tr><td></td><td colspan="3">Home when eating and drinking, regardless of BG level; parent</td></tr>
</table>

		will control better at home	

Emergency Surgery

Pre-Op	• On arrival: Weight, U&Es, FBC, Creatinine, Plasma and Capillary BG, Venous blood gases, Urinary or Blood Ketones • Inform paediatric diabetes team of admission • If **Ketoacidotic** - Follow guidelines on DKA - Operate when rehydrated, BP stable, Blood gas is normal, Na+ and K+ in normal range - This may not be possible for some life-saving operations • If not **Ketoacidotic** - Start IV fluid and insulin infusion - Nothing to eat 6 hours before surgery - Clear fluids until 2 hours before surgery - For those on **insulin pumps**: the pump should be stopped once the Insulin infusion is started • Always give **basal insulin** analogue at usual time, even if still on IV fluids and sliding scale insulin
Intra-Op	Measure blood glucose ½ hourly
Post-OP	• Check BG and Ketones hourly • Continue IV fluids and insulin infusion until ready to eat • See Addendum on how to convert back to s/c insulin

Addendum

A: For **insulin pumps**, basal rate can be suspended for 30minutes to correct any episodes of mild hypoglycaemia.

If the pump is stopped for more than 1 hour, child must be started on IV insulin and IV fluids as they have no basal insulin in their body.

B: If **BG < 5mmols** give 2ml/kg bolus of 10% glucose, re-check BG in 15 minutes

- If procedure is delayed for > 2hours or child has repeatedly low BGs start on maintainance IV fluids.

C: If **BG >12mmol** start IV insulin and IV fluids as per Sliding Scale protocol

- However, if child has required IV insulin go to fluid section to see how to convert back to s/c insulin

D: **Pre-mixed Insulin**. Example, 10 units of Novomix 30 then the usual rapid acting component is 30% of 10 units i.e 3 units

E: **Maintenance Fluids**

Fluid of choice: 0/9% Sodium Chloride + 5% Glucose

If BG < 5mmols or >15mmols – use guidance above

Potassium: Monitor electrolytes but always use 500ml bags that include 20mmol Potassium Chloride (KCL) in intravenous fluids

Maintenance Fluid calculations

Body Weight in KG	Fluid requirements for 24hours
Each kg between: 3-9kg	100mls/kg
10-20kg	Add an additional 50ml/kg
Over20kg	Add an additional 20ml/kg

(Maximum fluid volume per day: 2000 mL for females and 2500 mL for males)

F: Insulin Infusion

Dilute 50 units of Soluble Insulin in 50ml 0.9% Sodium Chloride (1 unit = 1 ml)

Start Infusion at:

- 0.025 ml/kg/h (i.e., 0.025 U/kg/hour) if BG is between 6–8 mmol/l,
- 0.05 ml/kg/h if 8–12 mmol/l,
- 0.075 ml/kg/h between 12–15 mmol/l
- 0.1 U/kg/h if > 15 mmol/l.

Monitor BG hourly before surgery and every 30-60 minutes during the operation and until the child recovers from anaesthesia.

- Adjust IV insulin accordingly.

If BG <5 mmol/l, stop the IV insulin infusion but only for 10–15 min.

- Give bolus of IV 10% glucose 2ml/kg
- recheck BG 15 minutes later.

G: Restarting subcutaneous insulin after being on intravenous insulin

If ready to eat at **Lunch** give the following insulin:

- Patients on **Long acting basal insulin** analogues
  - Give rapid acting insulin with lunch.
  - Check that Long-acting insulin has been carried on throughout stay. If they have missed a dose, delay re-starting subcutaneous insulin until they have had the long-acting insulin

- Patients on **insulin pump :**
  - Parents can re-start the insulin pump at the usual basal rate once the child is feeling better and BG levels are stable with no ketones.
  - Parents should be allowed to manage according to their usual practice

- Patients on **Pre-mixed twice or three times a day injection regimen NOT** using long acting basal insulin analogue.
  - allow to eat but continue IV insulin sliding scale until evening meal (then see below)

If ready to eat by **Evening meal** give the following insulin:

- Patients on **long acting basal** insulin analogue
  - give rapid acting insulin with evening meal and long-acting insulin analogue at usual time.
  - Always give dose of long acting basal insulin analogue at usual time even if still on intravenous fluids and intravenous insulin overnight to prevent rebound hyperglycaemia
  - Stop IV insulin 60 minutes after subcutaneous insulin has started if the child is first given long acting basal insulin analogue dose.

- Stop IV insulin 10 minutes after sc insulin has started if the child is given a rapid acting insulin dose

- For patients on **insulin pump –**
  - The parents can re-start the insulin pump at the usual basal rate once the child is feeling better and capillary BG levels are stable with no ketones.
  - Stop IV insulin 10 minutes after insulin pump has started
  - Parents should be allowed to manage according to their usual practice

- Patients on **Pre-mixed twice or three times a day injection regimen NOT** using long acting basal insulin analogue
  - Give usual dose of insulin with evening meal.
  - Stop IV insulin 60 minutes after subcutaneous insulin has started if the child is given a pre mixed insulin.

H: Guideline for Children on Oral Medications

Metformin

- Discontinue at least 24 hours before procedure for elective surgery.
- In emergency surgery and when metformin is stopped < 24 hours, ensure optimal hydration to prevent risk of lactic acidosis.
- The main concern regarding metformin therapy during surgery relates to the rare complication of lactic acidosis. Metformin has a long biological half-life (17-31 hours) hence the need to stop it at least 24 hours prior to surgery.

Other oral medications e.g. sulphonylureas or thiazolidinediones: stop on day of surgery

Adapted from :

Chizo Agwu A et al. Association of Childrens Diabetes clinicians. Clinical guidelines: Care of children under 18 years with Diabetes Mellitus undergoing Surgery. 1 October 2013

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