

Personal practice

Children with diabetes who need surgery

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A surgical operation needing a general anaesthetic carries a greater risk to the child with diabetes than to the child without diabetes. I do not think it necessary nowadays to try and avoid general anaesthesia in the child with diabetes, but I do think that every such surgical procedure and anaesthetic should be taken seriously and a meticulous team approach adopted if perioperative hypoglycaemia, hyperglycaemia, or electrolyte disturbance are to be prevented. This means that every anaesthetic, however short, in a child with diabetes should be given in hospital, using an insulin infusion regime such as that to be described. Diabetes is a practical subject and diabetologists tend to be possessive about their patients and their own regimens. There are different ways to the same end, and the important point in surgery and diabetes, as in diabetic ketoacidosis, is to have a simple, rational regimen and to stick to it. Again as in diabetic ketoacidosis the clearest writer has been Alberti,¹ who states that 'many different regimens have been proposed . . . for the treatment of diabetes during surgery of the diabetic patient, most of which are based on dogma and idiosyncrasy rather than logic and reason'.² Our regimen is an adaptation of the Alberti method for children with diabetes.

The Royal Aberdeen Children's Hospital diabetic clinic, covering a total population of 500 000 in the Grampian Region, Orkney, and Shetland, is attended by 130 children with diabetes under the age of 13 years, all maintained on twice daily rapid acting and isophane insulin (either highly purified pork or human). In the past six years an average of seven of our children with diabetes have required elective surgery each year, perhaps regrettably about half of these for dental procedures and the rest mostly for ear, nose, and throat operations. There has been an average of one emergency operation a year over the same period, all for appendicectomy or trauma.

Preoperative (Fig. 1)

We prefer to admit all children with diabetes for

Fig. 1 Preoperative regimen for elective surgery in school age diabetic children with diabetes.

- 1 Admit morning before operation after usual insulin before breakfast.
- 2 Schedule operation for next morning (first on list if possible).
- 3 Assess control, checking for intercurrent infection and ketosis.
- 4 Check blood urea and electrolytes concentrations.
- 5 Rapid acting insulin only before tea.
- 6 Start infusion at bedtime (or 4-5 hours after tea):
 - 500 ml 10% Dextrose
 - +N/5 saline
 - +10 mEq potassium chlorideat 50 ml/kg/24 hours
+0.05 U/kg/hour insulin by digital syringe pump;
or by adding rapid acting insulin to each bottle (see text):
 - if 2-3 hourly blood sugar by BM Stix or Visidex;
 - > 10 mmol/l increase insulin to 0.07 U/kg/hour;
 - if <5 mmol/l decrease insulin to 0.03 U/kg/hour.

When using a digital syringe pump it is important to record the strength of insulin solution (for example, 30 units in 60 ml of saline) and the setting of the pump in ml per hour and units of insulin per hour and units/kg/hour.

elective surgery to the one medical ward that routinely admits patients with diabetes, and our anaesthetic and surgical colleagues are usually happy to agree to this. Admission the morning before surgery after usual morning insulin allows routine clerking, assessment of recent control, and checking for intercurrent infection. We used to use a regimen of rapid acting insulin only on the day before surgery with a preoperative check on fasting blood sugar concentrations. We have recently found it simpler and less trying for the child if we give rapid acting insulin only before tea after normal insulin in the morning of the day before operation and then begin the insulin infusion at bedtime. This need not deny the child a good night's sleep, for capillary blood glucose estimations by BM Stix (Boehringer) or Visidex (Ames) read either visually or with a meter can be taken using an Autolet (Owen Mumford) or Autoclix (Boehringer) device on the

sleeping child. Providing the control of diabetes was previously good enough to allow surgery to proceed, this method ensures stable control and fewer problems on the morning of surgery.

Alberti strongly advocates adding the insulin to the infusion bottle (for which we use 10% dextrose and fifth isotonic saline ready made by our local pharmaceutical service with potassium chloride added on the ward). Since we obtained a Vickers Treonic TP5 digital syringe pump, which is highly accurate and variable to 0.1 ml an hour, we find a separate insulin infusion preferable, starting at a fixed insulin to glucose ratio of 0.24 U/g dextrose, when the insulin can be varied independently without changing the infusion bottle. Above all, we can use the same equipment, the same record charts, and a similar system for control of diabetes during surgery, for insulin infusion in the child with diabetes without serious acidosis who is vomiting, and for diabetic ketoacidosis. In the latter case we merely begin with normal saline as the infusion with or without added potassium and 0.1 U/kg/hour insulin, changing to 4% dextrose and fifth isotonic saline with added potassium chloride and 0.05 U/kg/hour of insulin when the capillary blood glucose concentration falls to 10 mmol/l and to the standard maintenance regimen as for surgery after 12 hours or until the child is fully recovered and ready to eat normal meals. An equivalent amount of insulin to add direct to the bottle rather than given through a digital syringe pump is 12 U/500 ml.

Per- and postoperative (Fig. 2)

The infusion is continued during and after surgery and as long as necessary until the child is ready to eat normal meals, usually by teatime after operation for short elective cases. The infusion rate has been

Fig. 2 *Per- and postoperative*

- 1 Check serum potassium concentration and that pre-operative blood glucose concentration is 5–10 mmol/l.
- 2 Continue infusion as above.
- 3 After operation check serum potassium concentration and continue checking the blood glucose concentration every two hours, adjusting potassium and insulin infusion as necessary.
- 4 If child is able to eat stop insulin just before tea after normal insulin half an hour before.
- 5 If child is not able to eat continue to give infusion and check the blood glucose concentrations every two to four hours and serum potassium concentrations twice daily.

quoted for older children. Infants with diabetes need a larger amount of fluid.

Emergency surgery

Where emergency surgery is indicated it is important to check blood glucose, electrolytes, and ketones concentrations and acid-base state. Ketoacidosis should, if possible, be corrected before surgery, especially as an apparent acute abdomen may be due to the abdominal pain of diabetic ketoacidosis.

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References

- ¹ Alberti KGMM, Thomas DJB. The management of diabetes during surgery. *Br J Anaesth* 1979;51:693–709.
- ² Alberti KGMM, Gill GV, Elliott MJ. Insulin delivery during surgery in the diabetic patient. *Diabetes Care* 1982;5: (suppl 1):65–77.

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