

Title: Guidelines for Emergency Management of Continuous Subcutaneous Insulin Infusion Pump Therapy (CSII - “insulin pump”) in Hospital

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Diabetes - Emergency - Insulin Infusion (CSII) Pumps

Emergency management of patients using Continuous Subcutaneous Insulin Infusion Pumps for children with Diabetes.

1. Introduction

This guideline is intended to support medical staff at Queens Hospital in the emergency management of children and young people with diabetes mellitus using a continuous subcutaneous insulin infusion pump

2. Aim and Purpose

The guideline applies to children and young people with diabetes mellitus cared for by the diabetes team based at Queens hospital Burton on trent

3. Definitions

Continuous subcutaneous insulin infusion (CSII) therapy is also known as 'pump' therapy.

4. Main body of Guidelines

The guideline should be used for the emergency management of children in Burton with Type 1 diabetes on an insulin pump.

Please inform the Diabetes team if any child on a pump attends the emergency department or is admitted to the wards

Section 1: Principles of 'pump' therapy

An insulin pump mimics the body by providing:

- Background insulin known as 'basal insulin'.
- A bolus of insulin when food containing carbohydrates are eaten.

Basal insulin

The pump is programmed to deliver basal insulin continuously. The rate delivered (units/hr) may vary at different times of day.

Bolus insulin

All patients using CSII are trained in carbohydrate counting and give a bolus of insulin when food containing carbohydrates is eaten

A bolus can be given in 2 ways:

- **Manual bolus**
The patient calculates the dose for the carbohydrate given based on the insulin: carbohydrate ratio and 'manually' programmes the insulin dose into the pump.
- **Using the 'bolus calculator'**
This is an advanced function of the pump. The pump is pre-programmed with the patient's insulin: carbohydrate ratio as well as blood glucose target. The patient will programme in the amount of carbohydrates to be eaten and the pump will calculate the required insulin bolus including insulin to cover for the food as well as a correction 'bolus' to correct for high glucose. The majority of pump patients will be using the bolus calculator. On the Medtronic pump this is called the 'bolus wizard'

Please note: medical equipment can interfere with the functions of a pump. Please disconnect the pump during X-rays/ CT or MR scans or if in theatre

Management of hyperglycaemia

Hyperglycaemia is generally a glucose level higher than 11mmol/l, but symptoms may not start to become noticeable until even higher levels eg 15-20mmol/l.

Typical symptoms

- Feeling irritable
- Thirsty and passing more urine
- Tired
- Loss of weight
- Nausea and vomiting (if this happens patient must be advised to attend the emergency department immediately)

When using an insulin pump, high sugars may be due to: Infusion set problem

- Dislodged or blocked infusion set

- Inflammation at site
- Insertion into a hardened area
- Left in too long (infusion set should be changed at least every 3 days)
- Blood or large air bubble in tubing
- Empty cartridge
- Leak
- Pump failure

Not enough insulin delivered by pump

- Forgot to give bolus
- A problem with carbohydrate counting (inaccurate or change in ratio needed)
- A problem with the basal rate (does it need increasing?)
- Rebound after hypo
- Over treatment of hypo
- Pump stopped or forgot to reconnect pump

Increased insulin requirements

- Illness
- Growth
- Stress
- Reduced exercise

Key points when managing high blood sugars on an insulin pump

- As there is no long acting insulin (eg glargine), blood ketones will develop in 4-5 hours if not enough insulin is delivered. A common reason for this is a problem with the infusion set.
- It is therefore important that patients check at least 6-8 glucose levels a day and take immediate action if the blood glucose and ketones start to rise.
- If the child is unwell with an intercurrent illness, it is essential to check for ketones if blood glucose levels rise
- If blood ketones are 0.6mmol/l or more, the first priority is to give fast acting insulin (novorapid) via a subcutaneous injection (insulin pen) and then check the pump is working and replace the infusion set.
- When blood ketones are present, higher doses of insulin may be needed in comparison to the usual correction dose. See attached chart for recommended doses.
- If blood ketones persist despite the pump functioning properly, consider increasing the basal rate in 20% steps eg set temporary basal rate of 120% and monitor sugars every 1-2 hrs and increase further as necessary. This may be particularly useful if the increased insulin

requirements and high blood glucose levels are due to illness.

- **Vomiting, abdominal pain and reduced conscious level are all signs of diabetic ketoacidosis (DKA). If these symptoms develop the child must go to hospital immediately to be assessed and treated for DKA if present (see DKA guideline using intravenous insulin and fluids as per DKA guideline. The insulin pump treatment must be discontinued until DKA is resolved.**

Guide to managing blood glucose levels above 11mmol/l with ketones

<p>Blood ketones: 0.6mmol/l or less</p>	<p>Blood ketones: 0.6-1.5mmol/l</p> <p>If symptoms of DKA develop must attend hospital for assessment</p>	<p>Blood ketones: 1.6 mmol/l or more</p> <p>If symptoms of DKA develop must attend hospital for assessment</p>
<p>Check infusion set site and pump</p> <p>Give a correction dose to correct high blood glucose by pump. Use 'bolus calculator' eg 'wizard'</p> <p>Give normal bolus for carbohydrate eaten</p>	<p>Give a correction dose by injection immediately:</p> <p>10% of the total daily dose (TDD) of insulin</p> <p>eg TDD 50 units , 10% = 5 units</p> <p>If eating, work out bolus for carbohydrate and give insulin by injection</p>	<p>Give a correction dose by injection immediately:</p> <p>20% of the total daily dose (TDD) of insulin</p> <p>eg TDD 50 units , 20% = 10 units</p> <p>If eating, work out bolus for carbohydrate and give insulin by injection</p>
<p>Then</p> <p>Re-check blood glucose and ketones in 2 hours</p>	<p>Then</p> <p>Change the reservoir, infusion set and site and trouble shoot the pump and insulin</p> <p>Drink sugar free fluids</p> <p>Re-check blood glucose and ketones in 2 hours</p>	<p>Then</p> <p>Change the reservoir, infusion set and site and trouble shoot the pump and insulin</p> <p>Drink sugar free fluids</p> <p>Re-check blood glucose and ketones in 2 hours</p>
<p>If blood glucose is going down, monitor closely throughout the day or night</p> <p>If blood glucose is increasing but ketones 0.5mmol/l or less:</p> <p>Give another correction dose by injection</p> <p>Change reservoir, infusion set and site</p> <p>Check blood glucose and ketones in 2 hours</p> <p>If blood ketones 0.6-1.5mmol/l, follow orange column</p> <p>If ketones 1.6mmol/l or more, follow red column</p>	<p>If blood ketones 0.5mmol/l or less, follow green column advice</p> <p>If blood ketones 0.6-1.5mmol/l, continue to give 10% of TDD as a manual bolus via the pump every 2hrs</p> <p>Re-check blood glucose and ketone levels every 2 hours, even through the night</p> <p>If blood ketones increase to 1.6mmol/l or more, follow the red column advice</p>	<p>If blood ketones 0.5mmol/l or less, follow green column advice</p> <p>If blood ketones reduce to 0.6-1.5mmol/l , follow orange column advice</p> <p>If blood ketones are still 1.6mmol/l or more, give another 20% TDD via injection</p> <p>Give bolus for food via injection</p> <p>Re-check blood glucose in 2 hours</p> <p>If after 2nd 20% TDD injection, blood ketones are still above 1.6mmol /l or more, advise to attend hospital immediately. On arrival please assess for DKA.</p>

Section 4: Management of gastroenteritis

Diarrhoea and vomiting can prevent absorption of food and drink, causing a fall in blood glucose levels (hypoglycaemia).

In this situation, parents are advised to check blood glucose and blood ketones every 2-4 hours and ring the paediatric diabetes nurses for advice.

The following interventions may be necessary:

1) Insulin dose adjustment (Insulin must never be stopped)

If the symptoms of gastroenteritis are associated with hypoglycaemia (glucose <4mmol/l) then a reduction in insulin dose may be required whilst symptoms persist.

There are 2 ways to reduce the insulin dose and both these options can be considered:

Reduction in basal rate

eg set a reduced 'temporary' basal rate. 70% of the usual basal rate would be a good starting point but you need to take in to account the usual basal rates. Basal rates can be altered by 0.025units/hr. Those on the minimal basal rate of 0.025units/hr will not be able to reduce basal rate further. In this situation then it may be more useful to have a reduction in bolus for carbohydrates eaten

Reduction in bolus for carbohydrates eaten

Decrease each bolus by 50% while symptoms are present. This is best achieved by using the bolus calculator (Wizard function on Medtronic pump) and programming in only half of the actual carbohydrates eaten.

Once a light diet is tolerated and blood glucose levels are normal, advise patient to return to the usual doses of insulin.

2) Carbohydrate substitutes

Once insulin has been given, it is important to have some form of carbohydrate in order to reduce the risk of hypoglycaemia.

If the child is unable to tolerate a normal diet then small, frequent amounts of carbohydrate fluids are advised, as large quantities can lead to nausea or vomiting.

Please see **appendix** for suitable substitutes which will depend on the age of the child and should be given hourly.

We recommend drinking water as well, as the child may lose large quantities of water through diarrhoea or vomiting.

3) Hospital admission

If the child vomits within 10 minutes after drinking, medical review is advised, as they are at high risk of becoming dehydrated and hypoglycaemic

If on assessment, child is unable to tolerate oral fluids and becomes hypoglycaemic then admission will be needed for intravenous (IV) fluids. It may be possible to avoid IV insulin.

In the first instance:

Continue basal insulin using the insulin pump Commence IV fluids.

IV Maintenance fluid guide:

Start with 5% glucose 0.9% saline with 10mmol added potassium chloride per 500ml bag.

Monitoring: Blood glucose 2 hourly, electrolytes 12 hourly

If hypoglycaemia persists then treat and change fluid to 10% glucose 0.9% saline with 10mmol added potassium chloride per 500ml bag.

If the symptoms of gastroenteritis are ongoing and it is difficult to stabilise blood glucose levels using a combination of insulin pump basal insulin and iv fluids then stop the insulin pump and commence iv insulin infusion in addition to the iv fluids

Insulin infusion:

A solution of insulin in 0.9% saline at a concentration of 1unit/ml should be used Start infusion via a syringe pump at 0.05mls/kg/hour (i.e. 0.05units/kg/hour)

Insulin sliding scale

Aim to maintain blood glucose levels between 5 and 11mmol/l

Blood sugar (mmol/l)	Infusion rate
<4	0.01mls/kg/hour (0.01units/kg/hour)
4.1 – 7	0.02mls/kg/hour (0.02units/kg/hour)
7.1 – 11	0.03mls/kg/hour (0.03units/kg/hour)
11.1 – 17	0.05mls/kg/hour (0.05units/kg/hour)
17.1 – 28	0.07mls/kg/hour (0.07units/kg/hour)
>28.1	0.1mls/kg/hour (0.1units/kg/hour)

N.B. this is a different 'scale' than the one for children with DKA.

If the blood glucose is lower than 4, it is preferable to reduce the rate of the insulin infusion rather than stopping it altogether as this will cause rebound

- Monitoring:
 - Blood glucose levels hourly
 - Electrolytes 4 hourly

Section 5: Temporary removal of the Pump

Whether the pump is being removed for personal or mechanical failure reasons, close monitoring of blood glucose levels and ketones are essential (see above for management of hyperglycaemia).

If the insulin pump fails, notify the pump company as soon as possible to ensure a prompt replacement.

The child/young person will require subcutaneous insulin injections as directed below.

Temporary removal (<24 hours)

Short acting subcutaneous insulin required (eg novorapid) via a pen device or syringe every 4 hours, including throughout the night.

Amount required= the basal rate for the hours missed plus the insulin required for the carbohydrate eaten.

Blood glucose levels should be monitored every hour, with blood ketones every 2 hours.

Temporary removal for more than 1 day

If the pump is removed for over 24hrs, a long-acting insulin (eg glargine) will need to be used in addition to regular novorapid with meals.

Give an injection of short acting insulin equal to the basal rate missed and the carbohydrate eaten at regular meal times ie every 4 hrs. This is until the basal insulin can be initiated on the evening.

Commence glargine insulin in the evening. The dose = total daily basal rate when on pump.

Section 6: Management of CSII during surgery

Please refer to guideline –Management of Diabetes during Surgery.

5.References (including any links to NICE Guidance etc.)

- Continuous subcutaneous insulin infusion for the treatment of diabetes. National Institute for Health and Care Excellence. Technology Appraisal Guidance – TA151. July 2008.
- Diabetes (type 1 and type 2) in children and young people: diagnosis and management. National Institute for Health and Care Excellence. NG18 August 2015