Diabetes - Emergency - Insulin Infusion (CSII) Pumps Full Clinical Guideline UHDB

Reference no.: CH CLIN D14

Emergency management (including sick day rules) of patients using Continuous Subcutaneous Insulin Infusion Pumps (NOT insulin injection therapy)

Introduction

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

1. **Aim and Purpose**

   The guideline applies to children and young people with diabetes mellitus cared for by the diabetes team based at RDH and QHB.

2. **Definitions**

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

3. **Main body of Guidelines**

   The guideline should be used for the emergency management of children with Type 1 diabetes on an insulin pump under care of University Hospitals of Derby and Burton Paediatric Diabetes Service.

   Should Diabetic Ketoacidosis be suspected or identified please refer to the DKA guideline CH CLIN 03 and stop CSII once intravenous insulin infusion started.

   If the child requires surgery, please see guideline CH CLIN D06.

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

   On weekdays 8 am-6pm, call the Paediatric diabetes specialist nurse-on-call on 01332 786963, selecting option 1 for emergency advice. The call on this number will be redirected to switchboard during out of hours, who will then direct the call to on-call Paediatric Registrar.

Email address **dhft.diabetesdietitians.nhs.net (RDH)** or **bhftpaed.diabetesteam@nhs.net (QHB)**

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Section 1: Principles of 'Insulin 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 and is programmed into the pump in time blocks throughout the 24 hour period or the basal rate is adjusted automatically in accordance with real-time Continuous Glucose monitoring (Hybrid-closed loop). Some patients may only have 4 different time blocks, for others it may vary hour by hour. We would expect all parents to keep a record of their most recent basal rate settings. They are not recorded on clinic letters as they are altered very frequently and often in between clinic appointments as well, by remote review of blood glucose profiles, carried out by the diabetes nursing team. However, there should be an indication of the total daily dose of insulin (TDD) on the clinic letter, and the percentage of this that is basal insulin. The detail of how this is divided throughout the 24 hour period is not in the clinic letter, though it may be in the clinic notes.

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 using the 'bolus calculator'. 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, with allowances given for any active insulin on board from a previous bolus.

Please note: medical equipment can interfere with the functions of a pump. Please plan to disconnect the pump during X-rays/ CT or MR scans or if in the theatre. This may need additional insulin to be given by injection if a prolonged procedure is planned.

Section 2: Management of hypoglycaemia – Refer to guideline CH CLIN D05/Sept 2022/v009

Section 3: 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 blood glucose may be due to:

a) 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

b) 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 hypoglycaemia
- Over treatment of hypoglycaemia
- Pump stopped or forgot to reconnect pump

c) 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, Degludec), 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 blood or sensor glucose levels a day and take immediate action if the blood or sensor glucose and ketones start to rise.
- Check sensor or blood glucose (BG) levels more frequently eg every 2 hours including through the night [1] if they are unwell
- If sensor or blood glucose 11 mmol/l or above check ketones
- Check blood ketones whenever the child is ill, regardless of blood glucose levels [1]
- Target blood glucose: 4 - 6.9mmol/l pre meal, and 5-8mmol/l before bed.
- **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 glucose levels every 2 hours 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 guideline CH CLIN 03) 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 raised ketones ***(Insulin injection refers to Novorapid Insulin subcutaneous injection)

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

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 (when the blood glucose is 11mmol/l or more or feeling unwell) every 2-4 hours and ring switchboard to contact the Paediatric Diabetes Nurses or the Paediatric Registrar 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:

a. **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 increments of 0.025units/hr (Medtronic pump) or 0.05 units/hr (Omnipod pump) or 0.01 units/hr (Tandem pump). Those on the minimal basal rate of 0.025units/hr (Medtronic) or 0.05 units/hr (Omnipod) or 0.01 unit/hr (Tandem) 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

b. **Reduction in bolus for carbohydrates eaten**

Decrease each bolus by 50% while symptoms are present. This is best achieved by using the bolus calculator 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.

In Closed - loop insulin pumps, setting the temporary target glucose levels will automatically adjust the basal rates.

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.

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

2) **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. See below

- **IV Maintenance fluid guide:**

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

Body weight	**Fluid requirement**
First 10kg	100mls/kg/day
Second 10kg	50mls/kg/day
Subsequent kg	20mls/kg/day
e.g. for a 30kg child:	10 x 100 = 1000mls
	10 x 50 = 500mls
	10 x 20 = 200mls
	= 1700mls for a 24 hour period

Therefore, run fluids at 70 mls/hour

Additional fluid may be required to correct for dehydration, if present.

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 1 unit/ml should be used.**

Please refer to Insulin infusion guide 7g on Insulin management during Surgery guideline as below:

7g. Insulin Infusion Guide (Insulin infusion sliding scale Ref CH CLIN D06/May 21/v008.1)

- Derby: Use 30 units soluble insulin (Actrapid) in 30 ml of 0.9% sodium chloride, giving 1 unit per ml.
- Burton: Add 50 units soluble insulin (Actrapid) to 49.5mls of 0.9% sodium chloride, giving 1 unit per ml.
- Start infusion at
    - 0.01 ml/kg/hour if BG is between 5–6mmol/l,
    - 0.025 ml/kg/hour (i.e., 0.025 U/kg/hour) if BG is between 6–8mmol/l,
    - 0.05 ml/kg/hour if 8–12mmol/l,
    - 0.075 ml/kg/hour between 12–15mmol/l
    - 0.1 ml/kg/hour if > 15mmol/l.
- If BG <5mmol/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.

Section 5: Temporary removal of the Pump

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

If the insulin pump fails, even out of hours, ask the family to 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 and for all the carbohydrate eaten.

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

If you do not have access to the exact basal rate settings, look at the last clinic letter for the total daily dose (TDD) of insulin, and the percentage basal.

For eg Jonny has a TDD of 65 units, with 35% basal = 22.75 units of basal

This approximates to 0.95 units per hour, which would be the equivalent of a novorapid bolus of 3.8 units every 4 hours (likely round up to 4 units). In addition to this amount, he should also be given insulin for the carbohydrate eaten during this time.

Blood glucose levels should be monitored every 2 hours with blood ketones every 2 hours if feeling unwell or if blood glucose is >11mmol/l. Continue intensive monitoring until four hours after pump therapy has resumed, and if blood glucose and ketones have normalised.

Temporary removal for more than 1 day

If the pump is removed for over 24hrs, a long-acting insulin (eg glargine or Degludec) 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 mealtimes ie every 4 hrs. This is until the basal insulin can be initiated on the evening.

Commence glargine/ Degludec insulin in the evening.

The dose of Glargine / Degludec = total daily basal rate when on pump.

Section 6: -informing the diabetes team

RDH - Discuss any concerns with the Consultant on call. If the consultant on call is still concerned, he/she may contact Dr Smith, Dr Tinklin or Dr Kumar at RDH via switchboard.

QHB - Discuss any concerns with the Consultant on call. If the consultant on call is still concerned, he/she may contact Dr Vasista or Dr Lloyd-Nash via switchboard.

If they are unavailable, use the Paediatric Endocrine rota (copy available in CED or via switchboard, QMC Nottingham).

If you give advice to a patient please let the diabetes team know.

On weekdays 8 am-6pm, call the Paediatric diabetes specialist nurse-on-call on 01332 786963, selecting option 1 for emergency advice. The call on this number will be redirected to switchboard during out of hours, who will then direct the call to on-call Paediatric Registrar.

Email address **dhft.diabetesdietitians.nhs.net (RDH)** or **bhftpaed.diabetesteam@nhs.net (QHB)**

Section 7: Documenting advice given

It is essential that medical advice given is documented. This should be done in an email (as above) with the subject “OUT OF HOURS ADVICE GIVEN”. Please give as much detail as possible, as your email will be copied and pasted into V6 / Twinkle (diabetes nursing notes database) as a permanent record.

Section 8: References

1 Management of Type 1 Diabetes Mellitus during illness in children and young people under 18 years (Sick Day Rules): BSPED / ACDC Endorsed Diabetes guidelines Version 5, March 2021

2 Patient Advice for Management of Type 1 Diabetes Mellitus during illness in children and young people under 18 years (Sick Day Rules) : ACDC Endorsed Diabetes Guidelines

3 ISPAD Clinical Practice Consensus Guidelines 2018: Sick day management in children and adolescents with diabetes

4 Diabetes (type 1 and type 2) in children and young people: diagnosis and management NG18, last updated 9th June 2022

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