Management of Children and Adolescents with Diabetes during Illness

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June 2017
Management Goals during Illness

> Prevent ketoacidosis
> Prevent hypoglycaemia
> Prevent dehydration
Effects of illness on T1Diabetes

> Illness may cause high or low blood glucose levels

- **High blood glucose levels**
  - More common
    > e.g. in viral or bacterial infections with fever
  - Due to high levels of stress hormones
    > causing gluconeogenesis and insulin resistance

- **Low blood glucose levels**
  - Less common, but can occur in illness associated with vomiting and diarrhoea (gastroenteritis)
    > due to reduced intake, poor absorption and slower gastric emptying
Effects of illness on T1Diabetes

> Illness may lead to increased ketone levels if inadequate insulin is given

> Inadequate insulin during illness may be due to:
  • Failure to increase insulin doses as required
  • Reducing or stopping insulin due to reduced appetite/ oral intake – even when not eating, regular insulin doses are usually required during illness (gastroenteritis is the exception)
Ketones

> Ketones are produced by the liver as an alternative energy source in the following circumstances:

- **During starvation / fasting**
  - Glucose levels will be normal or low
  - Ketone levels are usually <1.5mmol/L

- **When there is inadequate insulin**
  - Glucose levels will be high
  - Ketone levels will vary according to the severity and duration of inadequate insulin,
  - In DKA blood ketones are usually >3.0mmol/L

> Blood ketones are a wonderful triage tool!
- Guide insulin dosing and the need for hospitalisation
Symptoms of Ketosis / DKA

- Nausea, vomiting, abdominal pain
  - Very common if ketosis present
  - Often misdiagnosed as gastroenteritis
  - BG may be only mildly elevated (10-20mmol/L) in DKA if vomiting

- Dehydration

- Ketones on the breath

- Kussmaul breathing

- Reduced consciousness
Sick Day Management

> Treat underlying illness

> Monitor BGL and ketones 2- 4 hourly
  • Closer parental involvement

> Maintain hydration
  • If BGL >10mmol/L – give water or sugar free fluids
  • If BGL < 10mmol/L – give sugar containing fluids

> Insulin adjustment
  • If hyperglycaemic – May need extra insulin
    ▪ Give 5%, 10%, 20% of TDD as rapid acting insulin depending on BGL and ketone levels
  • If hypoglycaemic – May need insulin dose reduction
    ▪ Rapid acting insulin can be reduced significantly or stopped
    ▪ Long acting insulin may also need to be reduced by 20-50%
  • Never stop insulin completely!

> Call Diabetes Team for help if unsure what to do
  • 24 hour consultant on-call service for families / GPs: Call WCH Switchboard 08- 8161 7000
## Calculating extra insulin (rapid acting) for sick days

<table>
<thead>
<tr>
<th>Blood ketones (mmol/L)</th>
<th>Under 0.5 (urine ketones –)</th>
<th>0.5-1.5 (urine ketones +)</th>
<th>Over 1.5 (urine ketones ++++/++++)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Over 15</strong></td>
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<tr>
<td>Consider rapid acting insulin (5% TDD). Check BGL and ketones in 2 hours.</td>
<td>Give rapid acting insulin (5-10% TDD). Check BGL and ketones in 2 hours.</td>
<td>Give rapid acting insulin (10-20% TDD). Check BGL and ketones in 1 hour.</td>
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<tr>
<td><strong>8-15</strong></td>
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<tr>
<td>Recheck BGL in 2 hours. If persistently elevated, consider 5% TDD.</td>
<td>Recheck BGL and ketones in 2 hours. If persistently elevated, give 5-10% TDD.</td>
<td>Give rapid acting insulin (10% TDD). Check BGL and ketones in 2 hours.</td>
<td></td>
</tr>
<tr>
<td><strong>4-8</strong></td>
<td></td>
<td>BGL (mmol/L)</td>
<td>Ketones indicate carbohydrate and insulin deficiency. Give extra glucose / carbohydrate to maintain or increase BGL. Consider extra insulin (5% TDD) if ketones not clearing. Check BGL hourly and ketones 2 hourly.</td>
</tr>
<tr>
<td><strong>Under 4</strong></td>
<td>Treat hypo by giving sweet fluids/food and ongoing carbohydrate to maintain BGL. Ketones indicate carbohydrate and insulin deficiency. Do not stop usual insulin doses, but doses may need to be lowered especially if not eating or if vomiting and diarrhoea present. Consider mini-dose Glucagon if BGL cannot be maintained. Hospital admission for IV fluids may be needed if BGL cannot be maintained.</td>
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</table>
Total daily insulin dose (TDD)

- TDD = all long acting insulin + all rapid acting insulin given per 24 hours

- TDD before puberty  0.5 - 1.0 units/kg/day
- TDD during puberty  1.0 - 1.5 units/kg/day
- TDD in adulthood  0.5 - 1.0 units/kg/day

- TDD in remission phase < 0.5 units/kg/day
  - Onset 2-3 weeks post diagnosis
  - Duration usually <12 months

- Use current weight and lower end of expected TDD range if insulin doses uncertain
Gastroenteritis

- Often associated with hypoglycaemia
- Frequent monitoring essential
- Frequent sips of glucose containing fluids
- Insulin doses may need to be reduced, but never stop insulin completely
  - Rapid-acting insulin can be reduced significantly or stopped
  - Long-acting insulin may also need to be reduced by 20-50%

- Mini dose glucagon rescue
Mini-dose Glucagon

> Useful if child has **mild** hypoglycaemia but cannot or won’t eat or drink

- Make up Glucagen® solution as usual (stable 24hrs)
- Use insulin syringe to draw up 1 “insulin unit” of the Glucagen® solution per year of child’s age
  - (if child <2yrs use 2 units, if >15yrs use 15units)
- Give as you would give an insulin injection
- Recheck BGL in 30 mins, repeat with double dose if no response
- If no response to 2nd injection – go to hospital

- Remember new script for Glucagen®
Severe Hypoglycaemia

Severe Hypoglycaemia = coma / seizure

- Management
  - Coma position
  - Nil by mouth
  - Call Ambulance
  - **Glucagon injection 0.5-1.0 units IM**
    > 0.5 units for children <25kg or 8yrs
    > 1.0 unit for children >25kg
  (All families should have Glucagon kit at home)
- BGL often 3-4mmol/L following a hypoglycaemic seizure
- Headache & vomiting very common following severe hypoglycaemia

Subsequent management

- Why did it occur?
- Is insulin dose adjustment required?
- Discuss subsequent management and the need for any investigations with the Diabetes Team
Insulin Pump Therapy

> Now standard therapy in paediatrics
  • >40% of all children and adolescents in Australia are on insulin pumps

> Continuous glucose monitoring (CGM) has also increased in uptake following government funding support in 2017

> Insulin pumps and CGM generally make the management of diabetes during illness easier - but parents need to take over or closely supervise management
Increased risk of ketosis on insulin pump

- High BGLs require more urgent attention on a pump as they may indicate an insulin delivery problem.

- Blood ketone testing will determine the appropriate action:
  - If no ketones present, correct with pump and monitor.
  - If ketones present, do not correct with the pump, give an injection of rapid acting insulin and change the delivery set.

- DKA should not occur if monitoring regularly and following sick day protocols:
  - Insulin pen must be available at all times.
Pump Delivery Failure Sticker
(injection doses provided at each clinic visit)

> Vomiting + high BGL = **pump delivery failure** until proven otherwise
> Give injection of rapid acting insulin and change pump set

> Injection Doses:

<table>
<thead>
<tr>
<th>BGL (mmol/L)</th>
<th>Ketones (mmol/L)</th>
<th>Novorapid/Humalog</th>
</tr>
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<tr>
<td>&gt; 15</td>
<td>0.5-1.5</td>
<td>= 10% of TDD</td>
</tr>
<tr>
<td>&gt;1.5</td>
<td></td>
<td>= 20% of TDD</td>
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If off the pump >24 hrs, give Lantus (= total basal insulin) once daily and Novorapid/Humalog with meals (according to bolus ratios used on the pump)
Insulin Pumps in illness

> Managing high BGLs

- If ketones present or vomiting
  - A blocked insulin delivery set is the most common cause of high BGLs and vomiting if on a pump
  - If ketones are present give an injection of rapid acting insulin and change the delivery set
- If no ketones present
  - Give frequent correction boluses
  - Consider increasing basal insulin using a temporary basal rate – start with a temp basal of 120% for 4 hours

> Managing low BGLs

- Only need to bolus if eating and bolus dose can be reduced
- Consider reducing basal insulin using a temporary basal rate - start with a temp basal of 80% for 4 hours
Insulin Omission

> Recurrent vomiting / DKA is almost always due to insulin omission

> HbA1c usually a clue

> Don’t confront when unwell
  • Treatment the same
  • Discuss afterwards when learning can occur
  • Often major family / psychological dysfunction
Approach to Recurrent DKA

> Try to get to know them and understand their circumstances
  - Threats and scare tactics don’t help – increase sense of despair
  - Mental health support for patient/family
  - Understand this will take time

> Simplify insulin regimen and increase support
The Burden of Care

> Inherent burden of care and diligence required to maintain optimal glycaemic control has not changed (? increased)
  - T1D unique in the level of patient input required
  - Not surprising most don’t meet targets
  - Not everyone willing or capable of using intensive therapy
  - Burnout common

> Psychological morbidity increased in T1D
  - Higher rates of adjustment disorders, depression, anxiety and eating disorders
WCH Diabetes Service

- Provides multidisciplinary diabetes care for 700 children/adolescents with T1Diabetes
- Diabetes Team: 5 paediatric endocrinologists, 4 diabetes educators, 2 dietitians and trainees
- 24 hour consultant on-call service for families / GPs: Call WCH Switchboard 08-8161 7000
- Outreach services
  - Pt Lincoln, Whyalla, Pt Augusta, Mt Gambier
- SA centre for new pump trials, vascular complications and type 1 diabetes prevention trials & national register
- NHMRC Centre of Research Excellence
  www.endia.org.au
Resources

> NHMRC Guidelines  Updated (2011): National Evidence-Based Clinical Care Guidelines for Type 1 Diabetes for Children, Adolescents and Adults  

> ISPAD Guidelines  www.ispad.org

> WCH Intranet:  

  - DKA Protocol
  - Mini-dose Glucagon protocol
  - Management of diabetes during surgery
  - Sick day management