NHS
Sussex Community
NHS Foundation Trust

Ketone Monitoring and Sick Day Rules for Type 1 Diabetes

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Excellent care at the heart of the community

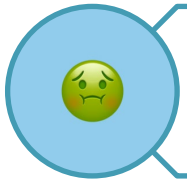
Aims of Session

- The physiology of illness in type 1 diabetes
- Hyperglycaemia and ketonaemia
- Insulin management during inter-current illness
- Carbohydrate replacement
- When to admit to hospital
- Costings and resources for practices and out of hours services

Factors leading to hyperglycaemia

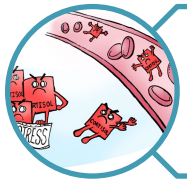
- Colds
- Influenza
- Infections
- Pain
- Injury
- MI/CVA
- Stress
- Menstruation
- Medication- steroids, antipsychotics
- Omission of medication
- New presentation of diabetes

Physiological response to illness



Illness= stress response

Higher cellular energy requirement

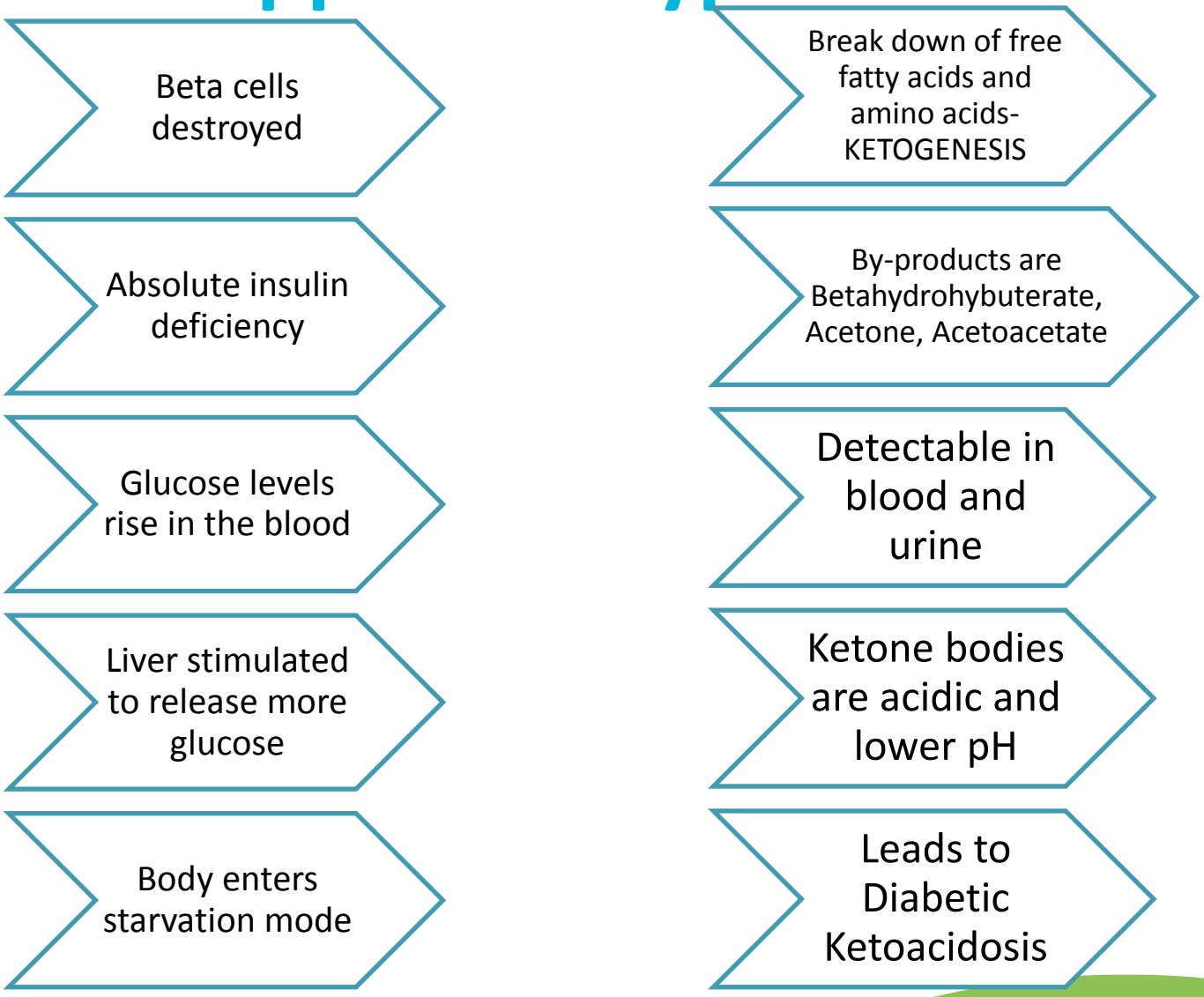


Increase in counter regulatory hormones:
Glucagon, cortisol, adrenaline, growth hormone

Stimulate glucose release from the liver: GLUCONEOGENESIS

Beta cells release more insulin to transport glucose into the cells.

What happens in Type 1 diabetes?



Symptoms

Hyperglycaemia

- Polyurea
- Polydypsia
- Dry mouth
- Fatigue
- Blurred Vision
- Weight loss
- Confusion
- Drowsiness

Ketoacidosis

- Nausea
- Vomiting
- Stomach cramps
- Leg pain
- Laboured (Kussmaul) breathing
- Acetone breath
- Confusion
- Loss of consciousness

Advice for insulin users:

- NEVER omit basal insulin (Lantus, Levemir, Tresiba, Abasaglar, Toujeo)
- MONITOR blood glucose level at least every 4 hours
- KEEP DRINKING- ensure regular intake of sugar free fluids-aim for hourly drinks and for a minimum of 100ml per hour.
- Aim to eat as normally as you can. If unable, eat small amounts of food containing carbohydrate every 1-2 hours. E.g. soup & bread, toast, cereal, yoghurt, rice pudding, ice cream.
- If you can only manage fluids you will need to ensure that you have carbohydrate fluids in addition to your free fluids e.g. fruit juice, Lucozade, milk, non-diet coke/lemonade, Complan.
- T1DM/ previous DKA in T2DM, MODY, Type 3c DM- Check for ketones if 2 consecutive levels >14mmols.

Carbohydrate Replacement

	Fruit juice 100 ml
	Milk 200 ml
	Plain vanilla ice-cream 1 large scoop
	Tomato soup 200 gram (half a large tin)
	Low fat yoghurt 150 gram (1 small pot)
	2 Rich tea or malted milk biscuits

Basal bolus insulin adjustment

Ketone result	Action	Additional rapid insulin required
Less than 0.6mmol/l OR (urine ketones = negative 0)	This level is normal. Continue to monitor blood glucose and ketone levels 4 hours during illness.	None
0.6—1.5 mmol/l OR (urine ketones=trace)	Continue with regular insulin and take additional dose of rapid acting insulin recheck your blood glucose and ketone level after 2-4 hours.	10% of Total daily dose of insulin = units rapid every 4 hours until ketones reduced and CBG in target.
1.5—3.0 mmol/l OR (urine ketones Moderate - +/ ++)	Continue with regular basal insulin and take additional dose of rapid acting insulin. Retest blood glucose and ketones in 1-2 hours	20% of Total daily dose of insulin = units rapid every 4 hours until ketones reduced and CBG in target
More than 3.0 mmol/l OR (urine ketones large -+++/ +++)	Contact GP/ NHS 111 or Specialist team immediately If symptoms below ring 999. Ensure that you are drinking sugar free fluids every hour.	20% of Total daily insulin dose = units rapid and call for expert medical advice

People on twice a day mixed insulin (TREND)

1.5 to 3 mmol/L on blood ketone meter (+ to ++ urine ketones)		More than 3 mmol/L on blood ketone meter (+++ to ++++ urine ketones)
Give an additional 10% of your TDD as rapid-acting or mixed insulin every 2 hours	**Total daily insulin dose: TDD**	**Give an additional 20% of your TDD as rapid-acting or mixed insulin every 2 hours**
1 unit	Up to 14 units	2 units
2 units	15 to 24 units	4 units
3 units	25 to 34 units	6 units
4 units	35 to 44 units	8 units
5 units	45 to 54 units	10 units
If you take more than 54 units or if you are unsure how to alter your dose, contact your specialist team or GP		

When to admit to hospital

- When any of the following happen, urgent hospital admission is required:
  - Unable to swallow or keep down fluids
  - Persistent vomiting
  - Persistent high blood glucose levels despite corrective dosing
  - Persistent increasing levels of ketones despite corrective dosing
  - Abdominal pain, breathlessness, change in conscious level

Diabetic Ketoacidosis DKA
The biochemical triad

Hyperglycaemia (glucose above 11mmmols/L OR known diabetes with normal blood glucose levels)

Ketonaemia: Urine ketones >++, blood ketones >3.0mmols/L

Acidosis: pH <7.3 and/or HC03 <15mmols/L

Treatment of DKA

- Requires admission to hospital
- Intensive fluid replacement- restore circulatory volume and correct electrolyte imbalances
- Insulin infusion- to reverse ketones
- Underlying precipitants to be identified and treated
- Specialist Diabetes assessment
  - Management and education

Complications and mortality

- Mortality rates have fallen significantly in the last 20 years from 7.96% to 0.67%- early diagnosis and implementation of treatment, although rates still higher in developing countries
- Cerebral oedema remains the most common cause of mortality, particularly in young children and adolescents.
- Mortality in the adult population include severe hypokalaemia, adult respiratory distress syndrome, and co-morbid states such as pneumonia, acute myocardial infarction and sepsis
- Complications of treatment include hypoglycaemia, hypo/hyperkalaemia

Ketones Strips pending formulary agreement

Ketone Strips and compatible Blood Glucose Strips that can be used with the one meter available on FP10 / Drug Tariff (September 2018)	Ketone Strips (10)	Blood Glucose Strips (50)
GlucoMen areo Ketone Sensors Strips (Glucomen Areo 2K meter)	£9.95	£9.95
KetoSens ketone strips (Caresens Dual Meter)	£9.95	£9.95
FreeStyle Optium B-Ketone Reagent Strips	£21.53	£16.12

Resources for practices

- https://trend-uk.org/wp-content/uploads/2019/01/A5_T1Illness_TREND_FINAL.pdf
- https://trend-uk.org/wp-content/uploads/2018/12/A5_T2Illness_TREND.pdf
- http://www.diabetologists-abcd.org.uk/JBDS_DKA_Management.pdf

Thank you for listening.
Any questions?