THINKGLUCOSE™
Inpatient care for people with diabetes

Ketone Monitoring and DKA in pregnancy

GIG CYMRU NHS WALES
Bwrdd Iechyd Prifysgol
Cwm Taf Morgannwg
University Health Board

What is diabetic ketoacidosis ?

Diabetic ketoacidosis (DKA) happens when there is a severe lack of insulin in the body.

Therefore the body is unable to use glucose for energy and uses fat instead.

As a result ketones are released- ketones build up and cause blood acidosis

Ketones are measured in blood and urine

What are ketones?

- Made up of 3 water soluble molecules:
    - acetoacetate
    - beta-hydroxybutyrate
    - acetone (breakdown product of the other two)

- Why are ketones present ?- produced in liver from fatty acids
    - during periods of low food intake,
    - low carbohydrate diet
    - starvation
    - prolonged intense exercise
    - untreated/inadequately treated diabetes

Ketones in pregnancy

Ketones can commonly be detected in women with diabetes during pregnancy

- If too few carbohydrates eaten
- If you have not eaten for a long time
- Eating too little in general
- If dehydrated

- Other causes of ketones in pregnancy
  - Hyperemesis Gravidarum
  - Morning sickness
  - Illness
  - Poor blood glucose management
- Capillary ketone level of 1.0mmol/L or more in pregnancy *always* requires treatment

Ketone measurement

If Capillary Blood Glucose is ≥11mmol/L or if woman unwell, check capillary blood for ketones, if >1.0mmol/L consider DKA and call Dr

Capillary -

- **0 - 0.6 mmol/L** - normal
- **0.7 to 1.5 mmol/L** - indicates increased ketone production
- **1.6 to 2.9 mmol/L** - high level of ketones, might indicate risk of DKA
- **3.0 mmol/L or higher** - potential DKA
- Any positive result for ketones report to doctor

Urinary –

- **Trace -** normal
- **1 +** - indicates increased ketone production
- **2 +** - potential DKA
- Any positive result for ketones report to doctor

Ketone Management

Any woman with pre existing diabetes – Type 1 or type 2 who is unwell, i.e vomiting and nausea, will require VRIII and basal (long acting) insulin to minimise risk of DKA developing

DKA in pregnancy

- DKA in pregnancy is a medical emergency which requires immediate recognition and prompt treatment. Any pregnant woman suspected of DKA should be managed in ITU/HDU with specific DKA Think Glucose chart located on medical wards
- Women in the third trimester of pregnancy are most at risk.
- Intercurrent illness or steroid administration can also trigger DKA
- In pregnancy DKA can occur at lower levels of hyperglycaemia (>11.0mmol/L)

Diagnostic criteria for DKA

Specific Medical DKA chart to treat DKA

1. Blood glucose - 11.0mmol/L or above- however DKA can occur with normal blood glucose in pregnancy AND
2. Capillary ketone - 3.0mmol/L or above AND
3. Acidosis-Venous pH ≤ 7.3 (adult range 7.35-7.45, babe range 7.25-7.35)

AND/OR bicarbonate – HCO3 ≤15.0mmol/L

Symptoms of DKA in pregnancy

Common pregnancy symptoms

- Nausea/vomiting
- Polyuria- frequent urination
- Polydipsia- thirst
- Leg cramps
- Weakness/fatigue

DKA should always be considered in a pregnant woman with diabetes who feels unwell….

Uncommon pregnancy symptoms

- Abdominal pain-think labour?
- Dehydration- dry skin
- Blurred vision- think PET?
- Tachypnoea- rapid breathing- Kussmauls resps
- Tachycardia- fast heart rate
- Drowsiness/coma/collapse
- Ketotis- peardrop aroma/acetone breath

Management

- Urgent referral to medical/endocrine specialist-HDU/ITU-joint care required- low threshold for critical care
- Follow local CTMUHB DKA guideline/chart – available on medical wards at PCH and POW
- Rehydrate – IV fluids- monitor fluid balance
- Venous blood analysis- blood gas, FBC, glucose, U+E, LFT, Urate, cogulation, group + save, venous ketones comes under beta-hydroxybutyrate on WCP request
- CTG monitoring
- Correct abnormalities of potassium
- Blood glucose monitoring hourly
- Treat hyperglycaemia – fixed rate intravenous insulin infusion (FRIII)- DKA Chart found on medical ward
- Treat co-existing illness or condition that precipitated DKA (pregnancy test for women of reproductive age if pregnancy not confirmed)

THINK !!! PREVENTION!!!!

If woman unwell and if blood Ketones ≥1mmol/L are present – still requires treatment with fluid hydration and VRIII
even if blood glucose levels are normal range

Resolution Criteria

- Venous pH > 7.3
- Capillary ketone < 0.6mmol/L for 2 consecutive hours
- Do not use bicarbonate level or absence of urinary ketones as markers of resolution

Fetal considerations

“ DKA can result in intrauterine death, with mortality rates estimated at 9-35% (Jovanovic 2016). Ketoacidosis readily crosses the placenta and may contribute directly to fetal demise, although it is likely that other maternal influences such as volume depletion or electrolyte imbalance are important”

Starvation ketoacidosis in pregnancy, Frise C et al (2013).

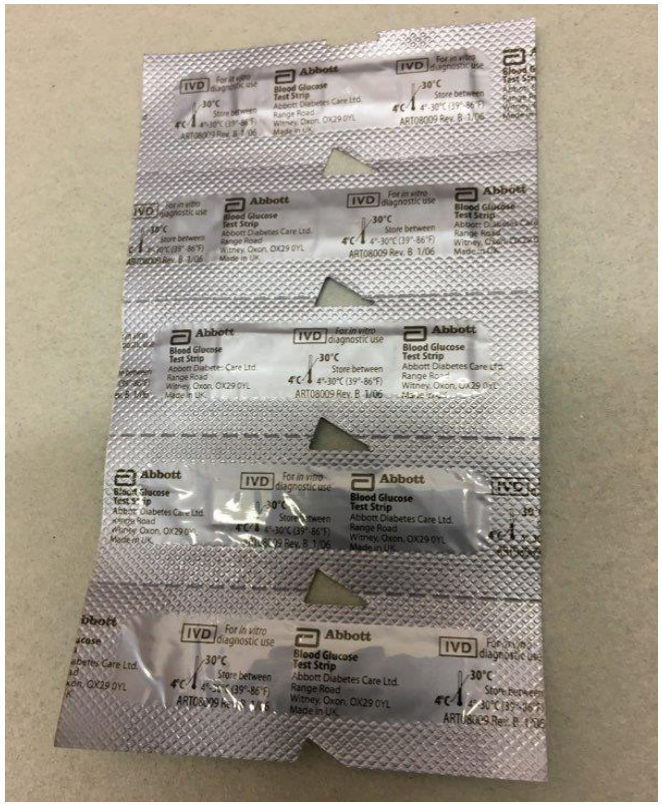
Mechanisms affecting fetus

- Decrease in utero placental blood flow due to osmotic diuresis leading to volume depletion and maternal acidosis causing fetal hypoxic insult
- Maternal acidosis could lead to fetal acidosis and electrolyte imbalance
- Maternal hypokalaemia (low potassium) and fetal hyperinsulinaemia (high insulin level) if severe could cause fetal hypokalaemia leading to myocardial suppression and fatal arrhythmia
- Fetal hyperinsulinaemia resulting from maternal hyperglycaemia increases fetal oxygen requirement by stimulating oxidative metabolic pathway

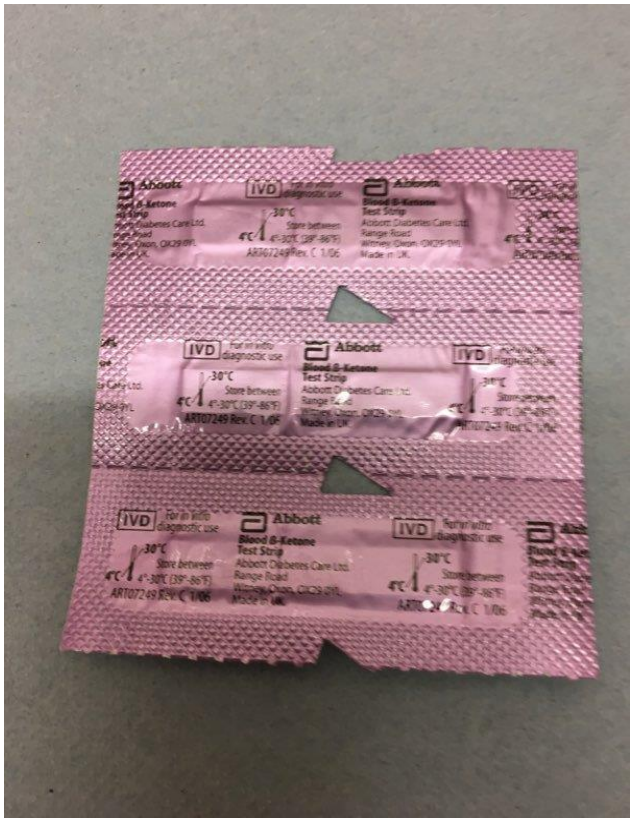
(Kamalakannan et al 2003)

Testing strips

Blood glucose strips-blue



Ketone test strips-purple



Variable rate Programme settings on pump

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CONFIRMING DKA DIAGNOSIS

1. CAPILLARY GLOOD GLUCOSE ≥ 11mmol/L
Consider that DKA can occur with normal blood glucose

AND

2. CAPILLARY BLOOD KETONES -≥3.0mmol/L

AND

3. ACIDOSIS-
VENOUS PH ≤7.3 AND/OR
BICARBONATE (HCO3) ≤15.0mmol/L

- **If CAPILLARY BLOOD GLUCOSE is <11mmol/L OR ≥11mmol/L AND CAPILLARY BLOOD KETONES ≥1.0mmol – treatment will be required with fluid hydration and VRIII (remember DKA can occur with normal blood glucose)**

- **HYPERGLYCAEMIA may require stabilisation with VRIII- please refer to DIP guideline**

DKA CONFIRMED

URGENT REFERRAL to OBSTETRIC AND MEDICAL TEAM- NEEDS ITU/HDU ADMISSION
DKA CHART- FIXED RATE INSULIN INFUSION
REHYDRATE AND STRICT FLUID BALANCE
VENOUS BLOODS- BLOOD GAS,GLUCOSE<FBC,U+E, LFT,URATE, COAG, G+S
request on WCP- BETAHYDROXYBUTURATE (KETONES)
CTG monitoring
Hourly BLOOD GLUCOSE MONITORING
TREAT CO-EXISTING ILLNESS
TREAT POTASSIUM ABNORMALITIES

DKA NOT CONFIRMED BUT TREATMENT STILL INDICATED

REFERRAL to OBSTETRIC AND MEDICAL TEAM
VRIII MATERNITY THINK GLUCOSE CHART
REHYDRATE and fluid balance
VENOUS BLOODS- BLOOD GAS, GLUCOSE<FBC,U+E, LFT,URATE, COAG, G+S
request on WCP- BETAHYDROXYBUTURATE (KETONES)
CTG monitoring
Hourly BLOOD GLUCOSE MONITORING
TREAT CO-EXISTING ILLNESS
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Abbott Freestyle Precision Pro Meter for both glucose and ketone blood testing

Please complete further training

E-learning module on ESR-
Abbot Diabetes Freestyle Precision Pro- Ketone meter

Takes around 20 minutes to complete with 15 questions on completion of module with certificate of competency

Ketone testing facts

- QC check only when blood ketone is tested not daily like glucose QC
- Will last 90 days from opening
- Strips more expensive
- Use only when clinically indicated
- Check result as blood glucose and ketone parameters very different

QUIZ

- What women are at risk of DKA ?
- Why does DKA occur ?
- When would a blood ketone test be considered?
- Do I need to call Dr if blood ketone >1.mmol/L ?
- Is DKA a medical emergency? If so, why ?
- Do I feel more informed about ketone testing- why ?

Scenario

- Alice is admitted @32+4 gestation with type 1 diabetes
- She has had reduced fetal movements for past 24 hours
- She has been vomiting for past 24 hours, has not eaten or taken her usual insulin
- She tested her capillary ketones prior to admission- capillary blood ketones=2.6mmol/L, capillary blood glucose =10.5mmol/L

How would you care for Alice?