

I Herd it through the Bovine....

A Case of Lactation (Bovine) Ketoacidosis

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The Case

- ❖ 31F, from rural Queensland
- ❖ G5P5 (twins)
- ❖ 7 months post partum
 - ❖ GDM, diet
 - ❖ Exclusively breastfeeding until 2 weeks ago, now 1x solid feed in addition
- ❖ Presents with:
 - ❖ 2/7 general malaise, nausea
 - ❖ 1/7 headache, photophobia, emesis x3
 - ❖ “clouding of consciousness”
 - ❖ No infective symptoms, rash, sick contacts

The Case

- ❖ Failed to respond to “Hydration at Home” (3L Hartmans, 1L 0.9% Normal Saline, ondansetron)



Initial investigations

❖ Blood gas

iSTAT	Result
pH	7.065
pCO ₂	23.6
BE	-23
Bicarb	6.8
Lactate	1.04
Glucose	5.9

❖ Serum ketones **7.1**

❖ Anion gap **25**

High anion gap acidosis

❖ Drugs:

❖ Metabolites of ethanol, methanol or ethylene glycol

❖ Aspirin

❖ Cyanide, iron

❖ Decreased acid metabolism or excretion:

❖ Renal failure

❖ Hepatic failure

❖ Increased acid production:

❖ Lactic acidosis

❖ Ketoacidosis

Mechanism of acidosis	Increased AG	Normal AG
Increased acid production	Lactic acidosis	
	Ketoacidosis	
	Diabetes mellitus	
	Starvation	
	Alcohol associated	
	Ingestions	
	Methanol	
	Ethylene glycol	
	Aspirin	
	Toluene (if early or if kidney function is impaired)	Toluene ingestion (if late and if renal function is preserved - due to excretion of sodium and potassium hippurate in the urine)
Diethylene glycol		
Propylene glycol		
D-lactic acidosis	A component of non-AG metabolic acidosis may coexist due to urinary excretion of D-lactate as Na and K salts (which represents potential HCO ₃)	
Pyroglutamic acid (5-oxoproline)		
Loss of bicarbonate or bicarbonate precursors		Diarrhea or other intestinal losses (eg, tube drainage)
		Type 2 (proximal) RTA
		Posttreatment of ketoacidosis
		Carbonic anhydrase inhibitors Ureteral diversion (eg, ileal loop)
Decreased renal acid excretion	Chronic kidney disease	Chronic kidney disease and tubular dysfunction (but relatively preserved glomerular filtration rate)
		Type 1 (distal) RTA
		Type 4 RTA (hypoaldosteronism)

Further history

- ❖ Dietary history:
 - ❖ “very healthy”: low carbohydrate, high fat diet
 - ❖ Breakfast: bacon, spinach
 - ❖ Snack: peanut butter balls
 - ❖ Lunch: meat and salad, occasionally in a wrap
 - ❖ Dinner: protein and salad

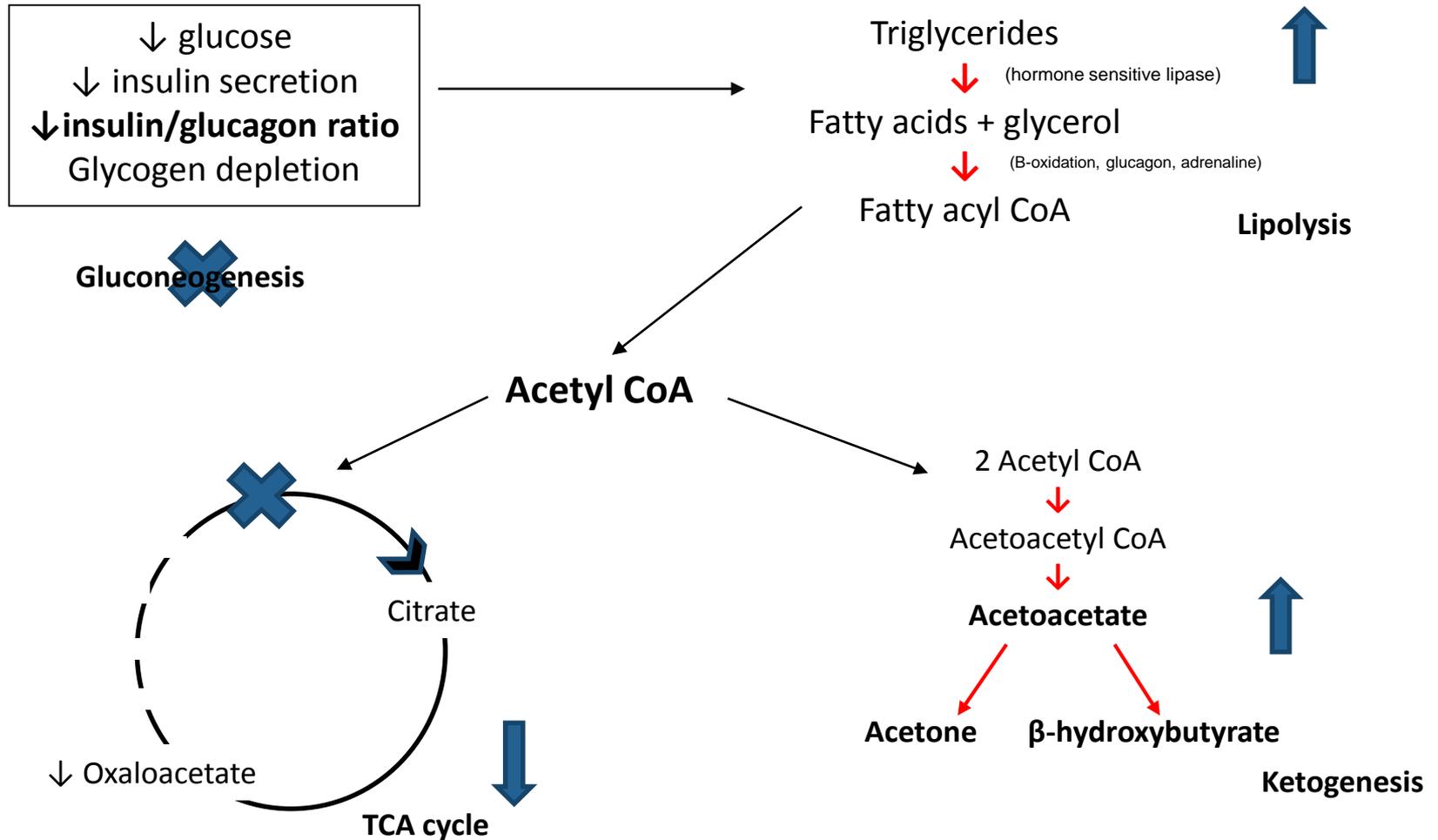
- ❖ Approx 1000 calories daily; 32g CHO

Further history

- ❖ Low carbohydrate, high fat diet
- ❖ Approx 1000 calories daily; 32g CHO

Primary metabolic acidosis
Likely secondary to starvation
ketoacidosis of lactation

Formation of Ketone Bodies



Lactation Ketoacidosis

- ❖ Rare in humans as it is uncommon for the mother to be unable to meet her own metabolic demands through diet
- ❖ May occur in:
 - ❖ Low caloric intake (carbohydrate restriction)
 - ❖ Prolonged fasting
 - ❖ Intercurrent illness
 - ❖ Residual insulin resistance of pregnancy

Lactation Ketoacidosis

- ❖ Energy cost of breastfeeding:
 - ❖ Birth to 6 months: additional 500kcal/day
 - ❖ 7 months to 1 year: additional 400kcal/day
 - ❖ Higher than those required during the pregnancy

- ❖ Our patient's energy **deficit**, breastfeeding twins
1800kcal/day

Lactation Ketoacidosis

Patient	Symptoms	Laboratory results	Diet	Treatment	Breastfeeding	Reference
36, 5 weeks post partum Breastfeeding singleton	Nausea, vomiting, dyspnoea for 2 days	pH 6.9 Bicarb <5mmol/L Lactate 2.1mmol/L AG 35mmol/L Urine ketones +++	High protein, carbohydrate free	IV 5% dextrose, IV bicarbonate, commenced 1800kcal/day diet	Ceased	Sandhu, Michelis, DeVita (2009)
36, 9 weeks post partum Breastfeeding singleton	Nausea, vomiting, malaise for 24 hours	pH 6.88 Bicarb 5.8mmol/L Lactate 1mmol/L AG 29mmol/L Serum ketone 5.8mmol/L	High protein, low carbohydrate diet Frequently skipped meals to lose weight	IV 20% dextrose, IV Ringers lactate Regular dietician advice, frequent CHO intake	Continued	Greaney and Benson (2016)
19, 7 weeks post partum Breastfeeding singleton	Dehydration, nausea, vomiting, abdominal pain	pH 7.25 Bicarb 10mmol/L Urine ketones +	Hypocaloric weight reduction program	IV normal saline resuscitation, insulin, commenced 2500kcal/day diet	Ceased	Chernow, Finton, Rainey and O'Brien (1982)
32, 10 months post partum Breastfeeding singleton	Nausea, vomiting, palpitations for 10 days	pH 7.2 Lactate 1.0mmol/L Ketones 7.1mmol/L	Low carbohydrate, high fat diet for 10 days	IV 10% glucose, IV Insulin	Not discussed	Von Geijer & Ekelund (2015)
27, 8 weeks post partum Breastfeeding singleton	Nausea, vomiting and malaise for 4 days, decreased oral intake	pH 7.02 Bicarb 5.1mmol/L AG 37mmol/L Serum ketones 5.4mmol/L	Strict low carbohydrate, high fat diet, minimal intake as unwell for preceding 4 days	IV normal saline, 10% dextrose, bicarbonate, increased carbohydrate diet	Ceased	Sloan, Ali and Webster (2017)

Mrs JH

❖ Management:

- ❖ IVF
- ❖ Bicarbonate infusion (controversial)
- ❖ Regular oral intake
- ❖ Dietician review
- ❖ Lactation advice

- ❖ Complete resolution of biochemical imbalance over 48 hours
- ❖ Discharged home

In summary

- ❖ During lactation, caloric requirements are usually met through a combination of diet, body fat and energy-sparing metabolic adaptations
- ❖ Breastfeeding requires adequate caloric intake of approximately 2500kcal/day
- ❖ With the increasing popularity of low carbohydrate/high fat, and “ketosis” diets, education regarding the unique nutrition requirements during breastfeeding is essential
- ❖ Cessation of breastfeeding is NOT required as part of the management of Lactation ketoacidosis.

References

1. Sandhu HS, Michelis MF, DeVita MV. 2009. A case of bovine ketoacidosis in a lactating woman. *NDT Plus* 2:278-9
2. Greaney DJ, Benson P. 2016. Life-threatening lactation or “bovine” ketoacidosis: A case report. *A&A Case Reports* 7:81-4
3. Chernow B, Finton C, Rainey T and O’Brien J. 1982. “Bovine ketosis” in a non-diabetic postpartum woman. *Diabetes Care*5(1):47-9
4. Von Geijer L and Ekelund M. 2015. Ketoacidosis associated with low-carbohydrate diet in a non-diabetic lactating woman: a case report. *Journal of Medical Case Reports*9:224-6
5. Sloan G, Ali A and Webster J. 2017. A rare cause of metabolic acidosis: ketoacidosis in a non-diabetic lactating woman. *Endocrinology, Diabetes and Metabolism Case Reports* DOI: 10.1530/EDM-17-0073.
6. Low carbohydrate diets and breastfeeding, 2017 Australian Breastfeeding Association <https://www.breastfeeding.asn.au>



Bovine Ketoacidosis

- ❖ Well described in veterinary literature, in high yield cows
- ❖ The animal is unable to maintain sufficient energy intake and hepatic gluconeogenesis to match the increased demand for glucose during lactation
- ❖ Stimulates adipose tissue breakdown, increasing ketone production
- ❖ Ketonemia, ketonuria, low levels of hepatic glycogen, and hypoglycemia in postpartum cows