

# Severe hypercalcaemia after years on the ketogenic diet: A novel case report

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### What is known?

- An association between the ketogenic diet (KD) and hypercalcaemia has been seen in a case series of three children
- In these cases, the children experienced hypercalcaemia within 12 months of starting KD

### What this poster adds?

- Severe hypercalcaemia may occur four years after commencement of the KD
- This may be refractory to standard management and require cessation of the KD

### Case:

5.5 year old male referred for new onset severe hypercalcaemia

### Background:

- Infantile epileptic encephalopathy (Dynamin-1 gene mutation)
- Developmental delay
- Ketogenic diet started 4 years ago due to drug-resistant seizures
- Deep Brain Stimulator (DBS) inserted 18 months ago due to hyperkinetic movements
- Recurrent non-systemic DBS infections requiring intermittent long term intravenous antibiotics
- No recent changes to medications (anti-epileptic drugs and antibiotics)

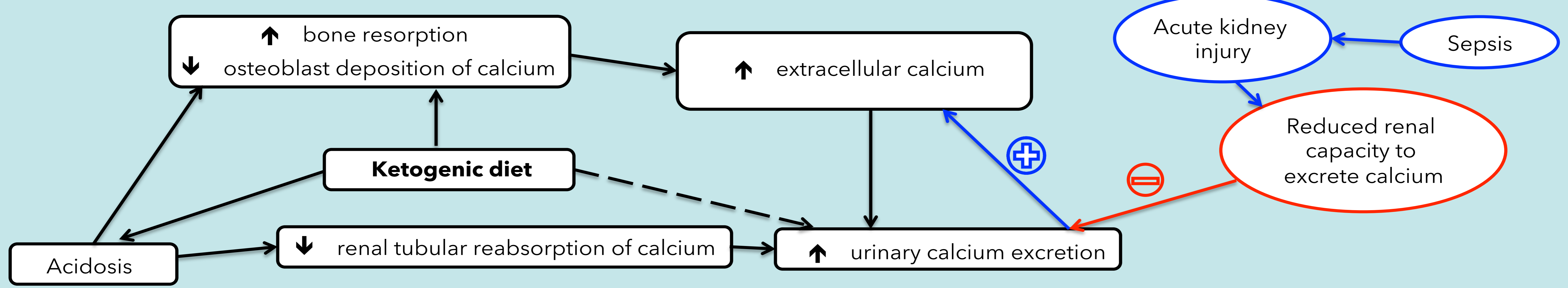
### Presentation:

- New hypercalcaemia (4.07mmol/L) noted on bloods done due to non-specific symptoms
- Subsequent admission revealed sepsis due to DBS infection and associated acute kidney injury
- Calcium had been normal 6 months prior to presentation
- Intermittent hypercalcaemia evident for past 12 months (max 2.83mmol/L)
- Hypercalcaemia initially resistant to hyperhydration and two pamidronate infusions but eventually improved
- Unable to cease hyperhydration and introduce normal dietary calcium until KD stopped, despite resolution of sepsis and kidney injury
- PTH and calcium normalised once KD weaned
- Subsequent symptomatic subacute fracture of L5 vertebrae confirmed on MRI and managed with zoledronic acid infusion

Investigation at presentation	Result	Normal Range
<b>Calcium Corrected</b>	<b>4.07 ↑</b>	<b>2.19-2.69mmol/L</b>
Phosphate	1.7	1.0-1.9mmol/L
Magnesium	0.9	0.65-1.05mmol/L
<b>Alkaline Phosphatase</b>	<b>99 ↓</b>	<b>139-347IU/L</b>
<b>Parathyroid Hormone</b>	<b>6 ↓</b>	<b>10-65ng/L</b>
Vitamin D	84	>50nmol/L
PTH-related protein	<1.4	<1.4pmol/L
<b>Urine Calcium:Creatinine Ratio</b>	<b>1.3 ↑</b>	<b>0.05-0.60</b>
Vitamin B6	70.1	35.2-110.1nmol/L
<b>1,25 Vitamin D</b>	<b>24 ↓</b>	<b>48-192pmol/L</b>
<b>Creatinine</b>	<b>73 ↑</b>	<b>24-45umol/L</b>
ACE	40	<91 U/L
T spot	Negative	
<b>DEXA scan</b>	<b>Low bone mineral density</b> Lumbar spine Z score -2.7 Whole body less head Z score -0.8	
<b>Chest/hand/wrist X-rays</b>	<b>Low bone mineral density</b>	
<b>Renal Ultrasound</b>	<b>Bilateral nephrocalcinosis</b>	
Full Blood Count	Normal	
Thyroid Function Tests		
Electrolytes		

### Discussion and proposed mechanism

- The **ketogenic diet** has been shown to **increase urinary calcium:creatinine ratio** and **reduce bone mineral density**, potentially leading to complications such as **fractures** and **renal calculi**
- Proposed mechanisms for the chronic reduction of bone mineral density include **impairment of osteoblastic deposition of bone** with relative **preservation of bone resorption**
- Intermittent acidosis**, which can occur with the ketogenic diet, may **increase urinary calcium excretion** due to **increased bone mineral resorption**. This results in compensatory **increased urinary calcium excretion**
- Hypercalcaemia may occur when there is a **reduction in renal capacity to excrete excess calcium**, such as in **acute kidney injury**



### Conclusions:

- There is a risk of **severe hypercalcaemia** when on the **ketogenic diet**, even after several years
- This can be very difficult to manage and may not resolve until the **ketogenic diet is ceased**
- Hypercalcaemia** may lead to complications such as **nephrocalcinosis**, and long term use of ketogenic diet can contribute to risk of fractures
- The risk of hypercalcaemia is greater when patients have a **reduced renal capacity to excrete calcium**

Reference: Hawkes CP, Levine MA. Ketotic hypercalcemia: a case series and description of a novel entity. *J Clin Endocrinol Metab.* 2014;99(5):1531-1536. doi:10.1210/jc.2013-4275