Survival of ingestion of a potentially lethal dose of caffeine

Introduction

Caffeine is the most widely used psychoactive substance in the world. At low doses it is thought to be relatively safe, but at high doses it is thought to be toxic and can be fatal. This article presents a case of a patient who ingested 30 g of caffeine and subsequently developed multiple complications including agitation, cardiovascular instability, severe lactic acidosis, rhabdomyolysis, electrolyte disturbances and acute kidney injury. Management included a combination of benzodiazepines, continuous veno-venous haemodiafiltration, electrolyte replacement and antihypertensive agents.

Discussion

Caffeine is the most widely used psychoactive substance in the world. At low doses it is relatively safe, but at high doses it can be toxic and fatal. Toxbase recommends that treatment should be considered if the quantity ingested exceeds 30 mg/kg in an adult or more than 15 mg/kg in a child.

The effects of caffeine occur via adenosine receptor antagonism, phosphodiesterase inhibition and direct effects on intracellular calcium release (Rang et al, 1999). It has very high bioavailability, is metabolized in the liver and is excreted in the urine. Peak plasma concentration is reached within about 1–1.5 hours of ingestion (Nawrot et al, 2003) and the elimination half life is between 3 and 7 hours in healthy adults (DrugBank, 2013).

Commonly documented symptoms of caffeine overdose include vomiting, altered mental status, diaphoresis, palpitations, myoclonic jerks and seizures (Bioh et al, 2013). Initial observations commonly reveal tachycardia and hypertension. Initial blood tests may show hypokalaemia, hyponatraemia and a metabolic acidosis (Bioh et al, 2013). This can lead to dysrhythmias, myocardial infarction, rhabdomyolysis and acute kidney injury (Bioh et al, 2013).

Initial management includes consideration of gastric lavage in adults within 1 hour of potentially life-threatening overdose, correction of electrolyte disturbances, administration of magnesium sulphate for rhythm disturbances, control of hypertension and volume replacement. A few case reports have advocated continuous renal replacement therapy to remove caffeine (Fausch et al, 2012).

In this case the patient developed rhabdomyolysis. Caffeine interferes with calcium transport resulting in calcium accumulating in the cells, potentiating muscle contraction and leading to rhabdomyolysis (Poels and Gabreels, 1993). Acute kidney injury associated with rhabdomyolysis results from a combination of ischaemia caused by renal vasoconstriction, direct tubular toxicity mediated by myoglobin-associated oxidative injury and distal tubular obstruction caused by precipitation of the Tamm–Horsfall protein–myoglobin complex (Bosch et al, 2009).

Traditionally in rhabdomyolysis-induced acute kidney injury continuous renal replacement therapy was only indicated when there was uncontrolled hyperkalaemia (potassium >6.0 mmol/litre), metabolic acidosis (pH <7.2), fluid overload and uraemic encephalopathy (Vanholder et al, 2000). Early continuous renal replacement therapy may help prevent rhabdomyolysis as well as treating it, since myoglobin can

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CASE REPORT

A previously fit and well 20-year-old white man presented to the emergency department 1 hour and 40 minutes after accidental ingestion of a potentially lethal dose of caffeine. He had inadvertently taken a 30 g dose of caffeine instead of 30 mg. Soon after ingestion he began to vomit and experience additional symptoms such as tremor, palpitations, blurred vision, diaphoresis, epigastric pain, diarrhoea and polyuria.

Upon arrival he had a sinus tachycardia with episodic non-sustained ventricular tachycardia. Magnesium sulphate was administered intravenously and subsequent electrocardiograms showed a sinus tachycardia with an incomplete right bundle–branch block and a prolonged QTc interval (536 ms). Initial biochemistry revealed hypokalaemia (2.4 mmol/litre), a raised creatine kinase level (1369 u/litre) and a compensated lactic acidosis (plasma lactate 4.91 mmol/litre). Fluid administration and potassium replacement were commenced.

When he arrived in the critical care department he had a persistent tachycardia with a heart rate of 130–140 bpm, was hypertensive with a blood pressure 163/74 mmHg and his QTc interval (562 ms) had worsened. His lactic acidosis (plasma lactate 8 mmol/litre) had deteriorated and it was now only partially compensated with a pH 7.32, HCO_3^- 15.9 mmol/litre and a base excess -11.1 mmol/litre. He had ongoing hypokalaemia (K+ 2.8 mmol/litre), stage 1 acute kidney injury according to the KDIGO classification and his creatine kinase level (5010 u/litre) was rising.

Continuous veno-venous haemodiafiltration was started to correct his biochemical disturbances and also because it can directly clear caffeine. He required continuous potassium replacement (10 mmol/hr) for the first 12 hours. He was initially commenced on a glyceryl trinitrate infusion for blood pressure control, but this was not well tolerated so was changed to a labetalol infusion. He also required repeated doses of diazepam (0.1 mg/kg) for extreme anxiety with a tremor. The patient was fit for discharge to a medical ward 72 hours after ingestion of the caffeine. There was no evidence of ongoing renal impairment.

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be removed by dialysis (Sorrentino et al, 2011). Zeng et al (2008) showed that continuous renal replacement therapy for rhabdomyolysis can significantly shorten length of hospital stay compared to conventional therapy. However, a Cochrane review found continuous renal replacement therapy did not reduce mortality or rates of adverse events (Zeng et al, 2014). There is insufficient evidence to mandate the early use of continuous renal replacement therapy for prevention of rhabdomyolysis. In this case continuous renal replacement therapy was used for removal of both myoglobin and of the underlying cause – the caffeine.

Conclusions

Caffeine ingestion can be fatal. Its complications are predictable and manageable in most critical care units. Although theoretically attractive, continuous renal replacement therapy is not necessary for the management of caffeine overdose unless other indications exist. **BJHM**

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LEARNING POINTS

- Caffeine is the most widely used psychoactive drug in the world but its ingestion can be fatal.
- Management of overdose includes correction of electrolyte disturbances, administration of magnesium sulphate for rhythm disturbances, control of hypertension and volume replacement.
- Although not mandatory, continuous renal replacement therapy should be considered in patients who develop rhabdomyolysis following caffeine overdose.

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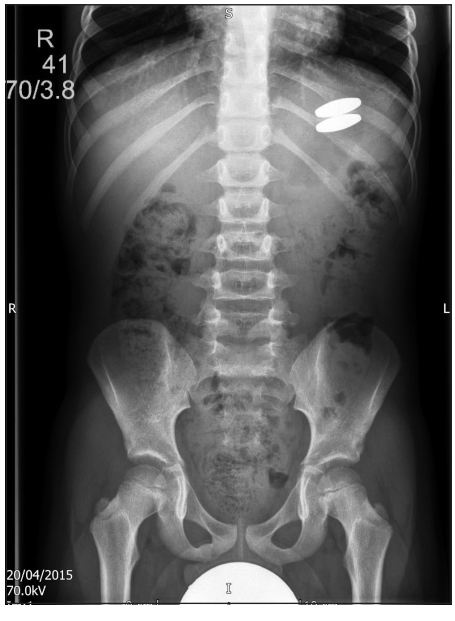
Accidental ingestion of two magnets: should we intervene?

An increase in the number of cases of magnet ingestions in children leading to serious complications including death has been reported (North American Society for Pediatric Gastroenterology, Hepatology and Nutrition, 2013; Shalaby, 2015). A retrospective multicentre French study with 40 children reported that 88% of multiple magnet ingestions needed interventional management by endoscopy or surgery *vs* only 12.5% of cases of ingestion of a single magnet (Talvard et al, 2015).

A 7-year-old boy accidentally swallowed two 0.5x2 cm magnets. At presentation 4 hours post-ingestion, he was asymptomatic. Abdominal X-ray (*Figure 1*) confirmed foreign body with normal bowel gas pattern. At endoscopy both magnets were at the gastric fundus with gastric mucosa trapped between them, so endoscopic retrieval was unsuccessful. The magnets were retrieved through an open small anterior gastrotomy under fluoroscopic guidance. The postoperative period was uncomplicated.

Figure 1. Abdominal X-ray showing two ellipsoid metallic opacities projected over the left upper abdomen consistent with foreign bodies within the stomach.



Simultaneous ingestion of two magnets may falsely reassure the physician that they are stuck together so can be treated as a single magnet. Suspicion of magnet ingestion should be included in the differential diagnosis of acute abdomen in children. **BJHM**

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