Case 009: A 22 year-old woman overdosed herself in a suicide attempt.

Authors: Thomas YK Chan MD, PhD, FRCP
         David C Chung MD, FRCPC
Affiliation: The Chinese University of Hong Kong

A 22-year-old woman was brought to the Emergency Department after she has overdosed herself with one of the pills taken from her grandfather who lived across the harbor. This patient had a history of eating disorder being followed up regularly.

On arrival in the hospital, her vital signs were: BP 128/74 mmHg, PR 120/min & regular, RR 16/min, SpO2 98% on room air. She was mentally lucid but she refused to name the drug or the amount she has swallowed. Her grandfather was unreachable by phone but it was known that he was under treatment for hypertension, heart failure, and type 2 diabetes. Venous blood was sampled from the patient for complete blood count, clotting profile, electrolytes, renal and liver function tests, glucose level, and drug screen. An electrocardiogram (ECG) was obtained and the tracing appears below:

Fifteen minutes later, when her condition was being reviewed by the duty medical resident, he found her drowsy but easily rousable. Her BP has fallen to 102/64 mmHg, PR 96/min & regular, RR 20/min, and SpO2 100% on O2 supplement by nasal cannula. A repeat ECG was obtained and it appears on the next page:
She was resuscitated and admitted to Intensive Care Unit (ICU) for further management.

1. What is the drug that this patient has overdosed herself with?

According to the medical history of her grandfather, the drug this patient has overdosed herself with could have been a drug from one of the following classes: diuretics, β and calcium channel blockers, angiotensin converting enzyme inhibitors or angiotensin receptor antagonists, some other antihypertensive drugs no longer in common use (e.g. methyldopa, hydralazine), and oral hypoglycemic agents.

The patient did not have physical signs of overdose from any one of the above drugs but her first ECG showed peaking of T wave in V2 and V3. This ECG sign is suggestive of hyperkalemia. Her second ECG obtained 15 minutes later showed marked widening of the QRS complex and tall T wave in both limb leads and chest leads suggestive of worsening hyperkalemia. These ECG signs suggest that the drug she overdosed herself with was a potassium containing compound. Although potassium is not prescribed to treat hypertension and heart failure per se, this patient’s grandfather was most like prescribed potassium as a supplement because he was on a diuretic. In fact, the patient admitted to having swallowed a handful of sustained release potassium (Slow K) tablets when she was well enough to be discharged from the ICU. Drug screen results were negative.
2. What are the ECG signs of hyperkalemia?

- As plasma potassium level rises above normal, the T wave becomes tall and peaked in some (need not be all) of the leads. Peaking of T wave is defined as > 6 mm in limb leads and > 10 mm in chest leads.
- As plasma potassium level rises further, there is more widespread peaking of T wave; the PR interval lengthens and the QRS complex widens.
- At even higher potassium level the QRS complexes are so wide and merge with the T waves that the ECG tracing looks like a series of sine waves (see tracing below).

![ECG tracing](http://www.medicine-on-line.com)

- If the rise in potassium level remains unabated, the heart arrests in asystole.

3. What is the treatment of hyperkalemia?

Hyperkalemia is a medical emergency, particularly when it occurs acutely and the level is high enough to cause more than just peaking of the T wave. Heart block, widening QRS, and arrhythmias are sinister signs. Several classes of drugs, with different modes of action, are available to treat this condition.

Calcium does not lower plasma potassium level but it antagonizes the electromechanical effect of potassium on the heart. Its effect is immediate but lasts no more than 30 minutes. It is most useful when the situation is urgent.

- **Calcium gluconate** or **chloride** 1 G (10 ml of a 10% solution) can be given intravenously over 5 minutes under ECG monitoring. The effect is immediate and the ECG changes will normalize rapidly. The dose may be repeated if indicated.

The following measures lower plasma potassium level by promoting the movement of extracellular potassium into the intracellular compartment. Effect is seen within 30 minutes.

- **Sodium bicarbonate** 44 – 88 mmol IV. Effect lasts for about 2 hours. The sodium load is considerable and may precipitate heart failure in the susceptible patient.
- **Dextrose** 25 G and **regular insulin** 10 units diluted to 50 ml given IV over 10 minutes. Effect lasts for about 2 hours. Have extra glucose on hand in case the patient develops hypoglycemia.
- **Albuterol** (a \( \beta_2 \) agonist), 10 – 20 mg by nebulization will lower potassium concentration by approximately 0.6 mmol/L for at least 2 hours.

A cation exchange resin given orally or rectally will bind potassium and release sodium in exchange. Subsequently potassium bound by the resin is eliminated from the body in
bowel movements. Since the released sodium is absorbed into the circulation, sodium induced fluid retention can precipitate congestive heart failure in susceptible patients.

- **Sodium polystyrene sulphonate** 15 G in water orally 3 – 4 times a day.
- **Sodium polystyrene sulphonate** 30 G in 2% methylcellulose and water as enema daily.

Other measures of removing potassium from the body include:

- **Diuretics** (e.g. furosemide) to promote renal excretion of potassium.
- **Renal dialysis** to remove excess potassium.

4. Are there reliable ways to remove ingested sustained release potassium tablets from the gastrointestinal tract?

Nasogastric suction or gastric lavage can remove some but not all of the ingested tablets and whole bowel irrigation (WBI) using a polyethylene glycol electrolyte solution (PEG-ES) has been described in 2 patients. There is no conclusive evidence that either method contributes to favorable outcomes. The mainstay of treating potassium overdose remains with monitoring the patient’s ECG and plasma potassium level and aggressive treatment of hyperkalemia.

Further Readings

