

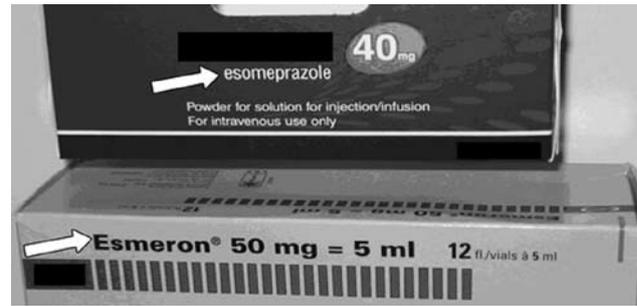
### Sudden death of a young ICU doctor by injection with the muscle relaxant, rocuronium bromide. Committed suicide or sound alike medication error?

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Thousands of medication name pairs have been confused based on similar appearances or sounds, when written or spoken. Medication errors remain an important cause of patient morbidity and mortality. In the Intensive Care Unit (ICU), a neuromuscular blocking agent (NMBA) is used with sedatives and/or analgesics, for the management of mechanically-ventilated critically ill patients. The trade name of the 2 drugs; rocuronium bromide (Esmeron), and esomeprazole (proton pump inhibitor) may cause sound alike medication error.

A 33-year-old female ICU resident of Hera General Hospital, Makkah, Kingdom of Saudi Arabia was found dead in the doctor's room. She was previously quite well, and had carried out a round with the staff nurse just a few minutes before her death. She went to the doctor's room to take some food at 8:30 PM. After an hour when she was called by the nursing staff to attend a patient, she did not respond; neither did she come out of the room, nor answered the cell phone. Then a staff nurse entered the room, and was surprised to see the situation. The doctor was unresponsive lying on the floor. Two empty ampoules of the muscle relaxant rocuronium bromide (Esmeron), and a plastic disposable syringe stained with blood were found near the body. The ICU consultant and specialist on duty were urgently called to examine the doctor. They noticed that the doctor was severely cyanosed, flaccid, with fixed dilated pupils. There was absent radial and carotid pulse. She was immediately intubated. The cardiopulmonary resuscitation (CPR) was started right from the doctor's room, and continued until she was transferred to a patient room. She was put on a mechanical ventilator, and the cardiac monitor showed asystole. There was no positive outcome of the CPR, and death was declared at 10:00 PM.

The cause of death was may be due to severe hemodynamic instability, bronchospasm, and respiratory paralysis resulting from rocuronium. There was no sign of erythema, or any marks of strangulation on her body. A day prior to the incident she asked for the medicine esomeprazole from her colleagues for herself, as she was a known case of gastric and duodenal ulcer. Both medications Esomeprazole and Esmeron are included in the hospital formulary medication with available strengths for use. There is no similarity



**Figure 1** - Sound alike fatal medication error between esomeprazole (upper), and Esmeron (lower).

between the Esmeron vial and Esomeprazole vial, and both these medications do not belong to the same company. Esmeron in the ICU refrigerator is segregated and labeled. A postmortem blood sample and gastric aspirate were taken for forensic examination. No urine sample was taken, as the urinary bladder was empty. Toxicology report showed that all her samples (blood and gastric aspirate) were free from the following substances; paracetamol, salicylic acid, mephenamic acid, benzodiazepine compounds, narcotics, amphetamine, phenothiazine, barbiturates, tricyclic antidepressants, phosphorus compound, alcohol, and rocuronium bromide.

There is an increasing trends in case reports on anaphylactic and anaphylactoid reactions to rocuronium bromide as stated by Baillard et al 2002.<sup>1</sup> In this case, the sudden death can be explained due to the intake of the nondepolarizing muscle relaxant, rocuronium bromide, which caused severe bronchospasm.<sup>2</sup> Its parenteral administration of any dose may be sufficient to cause respiratory paralysis, hypoxia, and death if respiratory assistance is not available. The incident was so sudden that the mechanical ventilation was impossible to save her life; a similar case has already been reported by Kubitz et al in 2006.<sup>3</sup> Both anaphylaxis and bronchospasm associated with the use of rocuronium have been reported.<sup>4</sup> In our patient, the bronchospasm was the sole sign of a serious drug reaction, and there were no signs of allergic reaction. The possible cause was paralysis and carbon dioxide (CO<sub>2</sub>) retention, confirmed on blood investigation that showed partial pressure CO<sub>2</sub> of 18.49 kPa (normal range 4.26-5.99). Further, it has also been reported that females are more sensitive than males to a single bolus dose of rocuronium. The incident may be a first experience of rocuronium intake by our patient leading to her sudden death, as female gender sensitivity to rocuronium bromide has also been supported in many other studies.

The first consideration while evaluating the case was that the doctor committed suicide by injecting herself

with the muscle relaxant drug, rocuronium bromide. This drug is easily available in the ICU, and within reach of doctors and nurses. We excluded the possibility of suicide for many reasons; 1) her social, personal, and behavioral history from her close contacts, 2) Esmeron had not been in use for the previous 6 months in the ICU, and had been placed far behind, so it is not easily accessible, while another muscle relaxant like pancuronium (pancuronium bromide) was in-use, and placed very prominently in the refrigerator; 3) just before this incident, she was performing her duty very well without any sign of depression. She was not emotional, or disoriented. Her attitude and behavior towards other doctors, nurses, and the patients were quite normal 4) there was no proven motive of suicide 5) there was no suicidal note, and 6) her blood, and gastric aspirate from toxicology laboratory were free from any poisonous or toxic substances.

Although suicides by intravenous injection of an overdose of rocuronium are uncommon, recently a case of suicide has been reported by Nikolic et al 2005.<sup>5</sup> To inject herself by the intravenous route is a difficult task and many questions arise like; why she selected such a difficult procedure, and why she did not seek help from any staff nurse for intravenous medication?

The second possibility was that she inadvertently administered Esmeron for relief of gastric pain instead of Esomeprazole, reflecting a sound alike medication error as shown in Figure 1. The only strong and valid point in this favor was that she asked for Esomeprazole for relief of gastric pain from her colleagues in the ICU a day before the incident. The entire fatal drug adverse reaction is considered in terms of 3 categories: accidental, self-inflicted, and undetermined (whether accidental, or with intent to harm) deaths. The presumed cause of death is likely secondary to respiratory muscle paralysis as the patient had evidence of severe hypercapnia. The negative postmortem blood sample for rocuronium can be explained as the terminal half-life of the drug existed in plasma, but was not observed, because it occurred at concentrations below the limit of quantification. No recovery of rocuronium from the gastric aspirate was due to several reasons. First, its main excretion is through the biliary tract, but unfortunately its concentration in a bile sample from the common bile duct was not assessed. Second, a stool sample was also not available for the recovery of rocuronium. Third, as this drug is excreted from the urine, and we could not collect the urine sample at the time of examination.

In conclusion, a young female ICU doctor died due to intravenous injection of an overdose of rocuronium-bromide. The indication of drug intake was undetermined, either she committed suicide, or underwent a sound-alike medication error. The investigation team declared that it was a medication error, rather than a suicide on the bases of indirect circumstantial evidence. Therefore, all our recommendations should prevent harm associated with look-alike or sound-alike drug names, and look-alike product packaging.

The Joint Commission for Accreditation and the Institute for Safe Medication Practices (ISMP) should assess the magnitude of medication errors, for example, look-alike trade names like Esomeprazole (proton pump inhibitor) and Esmeron. Furthermore, the ISMP should formulate policies for the prevention of such incidents.

Clinicians should use the generic name of drugs while prescribing any medication, and the pharmacy department should not dispense any drug prescribed with the trade name. The hospitals should develop a list of look-alike, sound-alike medications, and develop a system of differentiation at the level of storages, labeling of intravenous preparations, and dispensing.

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