G31 Homicide in a Surgical Intensive Care Unit

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The goals of this presentation will be to increase the forensic community's awareness of the potential for potassium overdose to be intentionally administered to patients in health care facilities; to explore the problems and difficulties encountered in the medicolegal investigation of such cases; and, to devise means of preventing hyperkalemic deaths as a result of intentional overdose.

With the increasing number of frail, elderly patients with multiple medical complications, it may be tempting for health care workers who are taking care of these patients to put them "out of their misery." However logical it may sound, it is unethical and contrary to law. The criminal use of intravenous potassium salts on these victims usually will not leave any evidence to identify the cause of death or the perpetrator. Investigating these cases is very difficult because the victims have multiple problems and police departments, medical examiners, and forensic pathologists are reluctant to conduct a homicide investigation in a hospital, especially the intensive care unit. Publicizing these cases will keep the forensic community alert. This presentation will impact the forensic community and/or humanity by discussing the various means of investigating such cases.

Case Background: On January 3, 2002 at 09:30 hours, E.J.M., an 83-year old woman who lived alone, was found by police in a semi- conscious state in her home. She was taken to the emergency department of a tertiary care hospital in Winnipeg, Manitoba. She was diagnosed with a fractured left hip, renal failure, myoglobinuria, and pneumonia. She was admitted at 17:47 hours and transferred to the Surgical Intensive Care Unit (SICU). The plan was to stabilize her condition before she underwent corrective hip surgery.

The following day, at 15:45 hours, her serum electrolytes revealed a potassium level of 3.3 mmol/L. As her serum chloride level was elevated, the physician prescribed potassium acetate – to be infused at a rate of 5 mmol/hour for four hours for a total of 20 mmol. A 50 cc vial of potassium acetate (with a concentration of 4 mmol/ml) was sent to the SICU by the pharmacy. Apparently 5 ml of the potassium acetate was drawn into a 10 cc syringe and injected into a 100 ml buretrol and topped with 95 ml of normal saline and 5% dextrose. The pump was set to run at 25 ml/hour beginning at 17:00 hours.

E.J.M. was also started on 4 ml of magnesium sulfate (2000 mmol/L) intravenously to run over two hours. At 18:40 hours, as the primary nurse was otherwise occupied, the nurse responsible for the patient in the next bed added 4 ml of magnesium sulfate to the same buretrol. This nurse noted that the buretrol contained 60 ml of fluid and the pump was running at 25 ml/hour.

At 19:30 hours a shift change occurred and a third nurse became involved with E.J.M. On taking over the patient's care, the nurse "eyeballed" the buretrol and noted it contained about 75 ml of fluid and that the fluid was infusing at a rate of 50 ml/hour. Although the patient's chart contained instructions for the pump to run at 25 ml/hour, based on the volume remaining in the buretrol (75 ml) and that it would take two hours to complete the infusion, the nurse apparently, at 20:00 hours, overwrote the order to read 50 ml/hour. Around this time it also became apparent that E.J.M.'s condition was becoming unstable. Blood was drawn at 20:30 hours and sent to the hospital laboratory for electrolyte and hemoglobin levels. At 20:38 hours, E.J.M. went into cardiac arrest. An emergency code was called and she was pronounced dead after 15 minutes of resuscitation.

At 21:13 hours, the SICU was notified by the laboratory of a critical potassium level of 7.6 mmol/L. The physician was informed of these results and immediately suspected a medication error. The buretrol was seized and sent to the hospital laboratory for analysis. A search for the used 50 cc vial of potassium acetate, however, was not successful.

The death of E.J.M. was reported to the medical examiner's office on January 4, 2002 at 22:35 hours by the physician due to the possible medication error. The medical examiner commenced an investigation that included the results of the medicolegal autopsy (concluded that hyperkalemia was the cause of death), as well as the findings from the internal investigation done concurrently by the hospital. Following extensive meetings between the medical examiner's office, the hospital and the police; hours of interviewing physicians, nursing staff and other health care workers; numerous searches for the missing potassium acetate vial; and repeated testing on the buretrol contents, the medical examiner's office and the hospital jointly concurred that E.J.M.'s death was not an accident, but the result of an intentional act. Consequently, detectives from the Winnipeg Police Service officially took over the investigation on February

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12, 2002.

Results: Repeated laboratory analyses of the buretrol contents revealed a potassium concentration ten times higher than what had been prescribed for the patient, an increased amount of chloride, and a trace amount of diphenhydramine, which had never been prescribed. It was also evident from the investigation that the pump speed had been doubled and additional fluids had been injected into the buretrol. Lastly, the used 50 cc vial of potassium acetate had never been recovered. Thus, it was reasonable to conclude that someone, probably a member of staff at the hospital, had doubled the pump speed and added potassium acetate, potassium chloride and diphenhydramine to the buretrol to intentionally cause E.J.M.'s death. Therefore, the manner of death was homicide. Despite a thorough police investigation, which included an extensive report by a Major Crimes analyst, there was insufficient evidence to lay charges against any individual or individuals involved.

Conclusion: This death clearly illustrates that administering excessive amounts of potassium can kill patients in health care facilities. However, hyperkalemia as a result of intentional overdose is next to impossible to diagnose by autopsy alone. Other, thorough investigations, including a review of the medical chart, analyses of any remaining fluids, and examination of the pump's memory system, are vital to the investigator in reaching a conclusion of intentional overdose. Following the death of E.J.M., it is now the practice in intensive care units in Manitoba hospitals not to store potassium acetate or potassium chloride on the wards.

In February 2003, in the absence of criminal charges, the Chief Medical Examiner directed that an inquest be held into the death of E.J.M. The findings of the inquest judge were released in September 2005. The report can be accessed by visiting website: http://www.manitoba courts.mb.ca/inquest_reports.html (Report No. 6 - E.J.M. – September 12, 2005).

Hyperkalemia, Intensive Care Unit Death, Homicide

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