

Life Threatening Hyperkalemia during Cardiopulmonary Bypass: An Avoidable Drug Error

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Abstract

Cardiopulmonary bypass (CPB) is a routine part of open heart surgery. Sodium bicarbonate is an essential component of prime solution to neutralize the prime and maintain physiological pH. Potassium chloride and sodium bicarbonate were supplied at our institute one year before were in identical ampoules. They were same in shape, size, color and lettering. Such ampoules introduce potential sources of error including life threatening situation in the operating room.

A medication error related to administration of excessive potassium caused ventricular fibrillation and cardiac arrest immediately at the initiation of cardiopulmonary bypass (CPB). The purpose of this report is to improve perfusionist training in intravenous drug management, the use of drug ampoules with distinct labels, and the development of a standardized color code system for labels on all the drugs used by the perfusionist. Furthermore, it is recommended that all drug errors (drugs used in the operating room) be reported to the Agencies responsible for drug packaging in order to identify patterns in perfusionist drug errors, and to facilitate implementation of effective drug identification systems.

Case Report

A 38 year old female had sudden ventricular fibrillation (VF) followed by cardiac arrest immediately at the onset of CPB. She had a perfusion pressure of 68mmHg at the time of VF and normal arterial blood gas values 10 minutes before. Aortic cross clamp was applied and root cardioplegia was delivered. Blood sample was taken from CPB circuit after 10 minutes thereafter as a routine protocol which did not show the values of sodium(Na⁺), potassium(K⁺), bicarbonate, base excess(BE⁻) and hematocrit. However the pH was 7.6. The analysis was repeated in another blood gas machine to rule out any equipment related error and a similar finding was obtained. The second sample was taken 5 minutes later, and near similar values was observed. There was a delay of 15 minutes to get the second sample report as both the arterial blood gas (ABG) machines were in calibration. Both the blood gas machines were checked with blood samples from other patients which revealed normal values for the corresponding patients.

In our operating room we use transparent plastic jars for disposal of used drug ampoules/vials which we keep nearby to the drug tray. One of the resident doctors noticed plenty of potassium chloride ampoules in the jar and raised an alarm. All the broken ampoules were taken out which showed anesthesia drugs and 10 ampoules of potassium chloride. The perfusion team was enquired regarding its use and the junior perfusionist confessed that she had broken these ampoules thinking of H₂CO₃ ampoules as both the ampoules were nearly of similar color, size and shape. Conventional ultra-filtration as well as forced diuresis with 100 mg of furosemide was started immediately. The

blood gas was repeated 15 minutes after these steps and the K⁺ was still nor recordable (our ABG machine has the upper limit of 9 meq/L for that of K⁺). The aortic cross clamp was released at 47 minutes of its application as the mitral valve was already replaced. The patient had continuous VF and this time the K⁺ was 8.8 meq/L. 20 ml of 10% calcium gluconate and 10 units of soluble insulin was given with 40 gm of glucose in the pump as a bolus. The ultrafiltration was continued and the heart started beating at a K⁺ value of 6.3 meq/L. The total urine output was 4.5 L and ultrafiltrate was 5 L at this point of time. The patient was weaned off from CPB once the K⁺ value was came down to 4.5 meq/L. This patient needed multiple inotropes at a higher dose which was unusual for a patient with normal ventricular function undergoing mitral valve replacement surgery. She had recurrent episodes of hyperglycemia and hypokalemia during her intensive care unit (ICU) stay which was without any adverse sequel. His ICU stay was 74 hrs and hospital stay was 9 days.

Discussion

Medication error is not uncommon in the operating room [1,2]. Although majority of these errors are without any serious adverse outcome but some of them are associated with increased morbidity and mortality leading to prolonged hospital stay, high cost of treatment and potential for litigation. Most of the errors till reported are related to the anesthesiologist. However this is the first reported case of drug administration that is related to perfusionist. Syringe swaps, drug ampoule swaps, overdose and incorrect choices are the most frequent problem [3,4].

This case of accidental and life threatening acute 100 ml of potassium chloride infusion during CPB underlines a hitherto unrecorded risk during cardiac surgery. It was not laudable that the sodium bicarbonate ampoules from a different manufacturer which was introduced just a day before this incidence was not communicated to all the users in the operating room. My personal conclusion is that we have to do much more in this respect. Certainly every staff who used to handle the drugs require every bit of information and education regarding the drugs nearly as much as the physician if not in detail at least regarding the uses and side effects.

Following this incidence we insisted the manufacturer to supply potassium chloride (KCl) ampoules with red color label (this indicates a warning for a danger). Secondly; since this mishap we keep KCl ampoules separately from sodium bicarbonate and calcium gluconate ampoules to avoid mix up. As all these three drugs are routinely used in the cardiac surgical operating room, while breaking these ampoules a second staff member used to cross check the same.

In real life it will never be possible to achieve 100% safety. But the above considerations show that much can be done to improve safety and to reduce hazards to a minimum during cardiopulmonary bypass.

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