Case Report

Hyperkalemia caused by rapid red cell transfusion and the potassium absorption filter

ABSTRACT

We report a case of transient hyperkalemia during hysterectomy after cesarean section, due to preoperatively undiagnosed placenta accreta that caused unforeseen massive hemorrhage and required rapid red cell transfusion. Hyperkalemia-induced by rapid red cell transfusion is a well-known severe complication of transfusion; however, in patients with sudden massive hemorrhage, rapid red cell transfusion is necessary to save their life. In such cases, it is extremely important to monitor serum potassium levels. For an emergency situation, a system should be developed to ensure sufficient preparation for immediate transfusion and laboratory tests. Furthermore, sufficient stock of preparations to treat hyperkalemia, such as calcium preparations, diuretics, glucose, and insulin is required. Moreover, a transfusion filter that absorbs potassium has been developed and is now available for clinical use in Japan. The filter is easy to use and beneficial, and should be prepared when it is available.

Key words: Hyperkalemia; massive hemorrhage; potassium absorption filter; rapid red cell transfusion

Introduction

Hyperkalemia-induced by rapid red cell transfusion is a well-known severe complication of transfusion; however, in patients with sudden massive hemorrhage, rapid red cell transfusion is necessary to save their life. In such cases, it is extremely important to monitor serum potassium levels as rapid transfusion of red cell preparations to patients with a state of metabolic acidosis due to massive blood loss may cause fatal hyperkalemia. A transfusion filter that absorbs potassium has been developed and is available for clinical use in Japan. We describe a case of transient hyperkalemia and the filter to adsorb the potassium in the red cell bags was useful.

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Case Report

A 36-year-old female was scheduled for elective cesarean section with spinal anesthesia due to her history of cesarean section. Preoperative examinations did not show notable health problems. The infant had an Apgar score of eight points at 1 min and nine points at 5 min. Surgery was completed in about 60 min; however, persistent bleeding was observed from the vagina. Uterine hemorrhage was observed by transvaginal examination, and an attempt of hemostasis did not succeed. After blood loss exceeded 1500 ml, laparotomy was performed for hemostasis. Anesthesia was changed to general anesthesia, which was induced by 5 mg of midazolam, and

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tracheal intubation was performed after the administration of 50 mg of rocuronium. While preparing the transfusion, plasma expander was rapidly administered; however, systolic blood pressure dropped to approximately 50–60 mmHg, hemoglobin to 4.2 g/dL, and hematocrit to 13.4%. The blood loss exceeded 4000 ml; therefore; treatment was changed to total hysterectomy. On rapid transfusion of 1120 ml of packed red blood cell in approximately 15 min by syringe, systolic blood pressure increased to approximately 80–90 mmHg. Arterial blood gas analysis performed on the completion of the rapid red cell transfusion revealed that serum potassium level had increased to 8.3 mEq/L. We immediately performed the intravenous administration of calcium gluconate 2250 mg, insulin 10 units, glucose 40 g, and furosemide 40 mg. Her cardiac rhythm remained stable. The hemorrhage continued, and therefore, subsequent administration of packed red blood cells was performed using a potassium absorption filter (KPF-4 Kawasumi Laboratories, Tokyo, Japan). Thereafter the hyperkalemia gradually improved. Ultimately, there was 11497 ml of blood loss, with the administration of 2520 ml of packed red blood cell transfusion, 1920 ml of fresh frozen plasma, and 200 ml of platelet concentrate. Even though the administration of packed red blood cells was continued with the KPF, serum potassium levels were not increased again, and final potassium level was 4.3 mEq/L. Systemic management was continued in the Intensive Care Unit following the surgery, and on the day 15 postoperatively, the patient was able to walk independently and discharged without complications. Her uterus was diagnosed with placenta increta pathologically at a later date.

Discussion

In general, the potassium concentration in packed red blood cell increases during the storage period. Furthermore, radiation exposure promotes the increase in potassium. Therefore, it is recommended to transfuse packed red blood cell as slowly as possible. Smith *et al*. conducted a detailed analysis of cardiac arrests caused by hyperkalemia brought about by intraoperative transfusion in 16 patients.[1] According to their results, potassium levels increased to a mean of 7.2 ± 1.4 mEq/L. When cardiac arrest occurred, the patients were in a state of acidosis, hyperglycemia, hypocalcemia, and hypothermia. Furthermore, the majority of the patients were administered transfusion via central venous catheter. They also reported that in adult cardiac arrest patients red blood cell transfusion was performed rapidly using a rapid administration device, a pressure bag, and a syringe. Hyperkalemia caused by rapid red blood cell transfusion is a well-known severe complication of transfusion.[2] Therefore, in cases where massive hemorrhage is anticipated in advance, it is important to expect transfusion-hyperkalemia and take measures accordingly, while preparing the blood product. The transfusion should be timed to prevent rapid administration and as pointed out by Smith *et al*., systemic management should be performed to avoid acidosis, hyperglycemia, hypocalcemia, and hypothermia. In recent years, a transfusion filter that absorbs potassium has been developed and is now available for clinical use in Japan[3-6] [Figure 1]. This KPF absorbs and removes potassium through the substitution of sodium and potassium by cation exchange resin. Although in our patient, we gave a various medical treatment, so the validity only of the filter was unclear, the filter is easy to use, and should be prepared when it is available.

On the other hand, some cases develop sudden massive hemorrhage, including our patient in whom a diagnosis of placenta accreta was not established before surgery. In general, preoperative diagnosis of normally implanted placenta increta is not likely to be achieved, including our case. In such instances, the patient experiences shock state, requiring massive rapid transfusion of red blood cells for resuscitation. In addition to the systemic management of patients in an unexpected state of emergency, various preparations must be managed quickly. In such instances, potassium concentration test should not be delayed as hyperkalemia can immediately aggravate the patient into critical condition. In our patient, only one venous line was placed for the spinal anesthesia in the same manner as other normal cesarean sections. Therefore, various procedures such as venous route establishment, blood tests, ordering the transfusion, changing to general anesthesia, rapid infusion, and transfusion had to be performed immediately. For an emergency situation, a system should be developed to ensure sufficient preparation for immediate transfusion and laboratory tests. Furthermore, sufficient stock of preparations

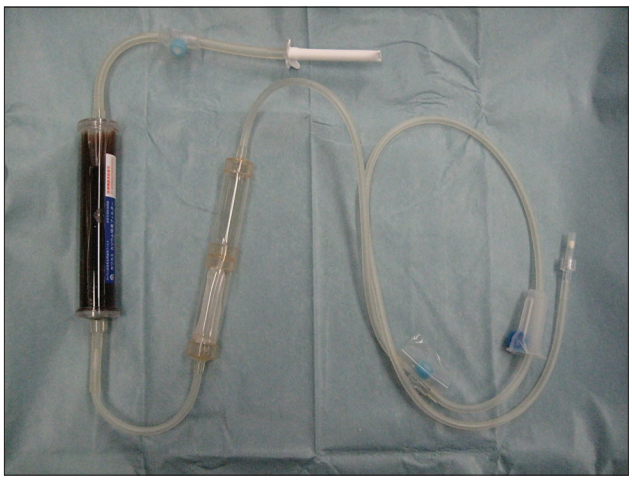

Figure 1: Potassium absorption filter

to treat hyperkalemia, such as calcium preparations, diuretics, glucose, insulin, and KPF (if available) is required.

Conclusion

Rapid administration of packed red blood cell can cause hyperkalemia. In cases, in which unexpected massive hemorrhage occurs, and rapid red cell transfusion is needed, we should take into account the possibility of hyperkalemia. Moreover, the use of a KPF will be also useful.

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Conflicts of interest

There are no conflicts of interest.

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