CASE REPORT

Uncommon Case of Gross Haemolysis in a Blood Donor Unit: A Case Report

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ABSTRACT

Red blood cell (RBC) transfusion is an essential component of medical care, and has long been found to be beneficial for patients worldwide. However, RBC haemolysis has been reported in units meant for transfusion, which may be disastrous for the recipient if missed. Haemolysis in individual RBC units can be attributed to several factors, the most common in-vitro causes are inappropriate handling during component preparation or inappropriate storage conditions. Other uncommon causes include bacterial haemolysins, RBC membrane defects or in-vivo haemolysis in the blood donors themselves. It is important to identify haemolysed units prior to transfusion, and one must not forget the uncommon in-vivo causes of RBC haemolysis, to ensure the well-being of the donor. This report highlights one of the rare causes of haemolysis in an individual unit, leading to the donor's incidental finding of mild haemolysis secondary to hereditary spherocytosis.

Keywords: Red blood cell, Haemolysis, Blood donor, Component preparation

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INTRODUCTION

Red blood cells (RBC) have been established as one of the important therapeutic products of human origin, making it the most frequently transfused blood product with approximately 85-million RBC units transfused worldwide annually (1). The foremost responsibility of blood banks is to maintain a safe and adequate blood supply. This continuous supply is sustained by a complex, standardised process for blood collection, component preparation, storage and administration (2). The rigorous process starts from choosing suitable donors to safeguard both the recipients' and blood donors health (2). Donated blood is then processed into components by centrifugation and stored accordingly. Depending on the storage solution, RBC units are stored for up to 35 or 42 days (2).

Biochemical and morphological changes can occur in RBCs as they undergo the whole process from collection to transfusion, as these conditions diverge strongly from their natural environment (1). RBC haemolysis is one of the changes that can occur, and it is an important parameter to assess the quality of stored RBCs (1). Haemolysed RBCs release free haemoglobin into the surrounding fluid, causing serious deleterious effects for the transfused patients (1). Free haemoglobin in circulation can cause vascular dysfunction and injury in the kidneys and liver (1).

There are many factors associated with haemolysis of a donated RBC unit. These include inappropriate storage environment, inappropriate personnel techniques during collection and component preparation, bacterial haemolysins, the materials used, or blood-donor related parameters (2,3). It is therefore important to identify haemolysed units before issuing to avoid any inadvertent serious transfusion effects. Here, we investigated the causes of gross haemolysis in a donated RBC unit, leading to a diagnosis of hereditary spherocytosis (HS) in the donor.

CASE REPORT

In this case, a whole blood unit received from a collection centre was found to be haemolysed during component preparation.

The unit was from a blood drive that yielded 92 units of blood at an air-conditioned venue. The drive was held between 10am to 4pm, and this unit was collected at 10:45am. The donor, a 23-year-old Chinese gentleman, was a first-time donor. He works as a foreman, and has no known medical illnesses. He met all the pre-donation

screening criteria, with a haemoglobin of 14.6g/dL and donated 450mls uneventfully in a double CPDA-1 bag. Once completed, the blood units were kept in storage boxes at the site. The temperature recorded by monitoring logger was between 20-24°C at all times. After the event ended, the units arrived at the National Blood Centre (NBC) at 7:44pm. Temperature during the journey was monitored and maintained between 20-24°C.

Once the units were registered into the system in the NBC, they were kept in the processing laboratory between 20-24°C. Sample tubes were sent to the respective laboratories. Component preparation for this batch started at 08:30am the next day, well within the quality requirements of 24hours from time of collection. It was noted that the unit showed reddish coloured plasma immediately after hard spin centrifugation at 2-6°C. The plasma was separated manually into the satellite bag for better view of the haemolysis (Figure 1A). Upon visual detection of haemolysis, the unit was sent to the Quality Department for further investigations. The percentage of haemolysis was found to be 3.25% (Normal <1%).

In view of the high percentage of haemolysis, an investigation was conducted to identify the cause of haemolysis. The donor was called back immediately, in order to rule out ongoing haemolysis. The collection venue conditions, storage, personnel and component preparations were all examined to identify the cause of haemolysis. The blood collection team was interviewed, confirming the temperature of the units were 20-24°C and monitored via a temperature logger at all times. The blood bags had no direct contact with ice during storage and transportation, and no kinking of blood bag tubes were identified.

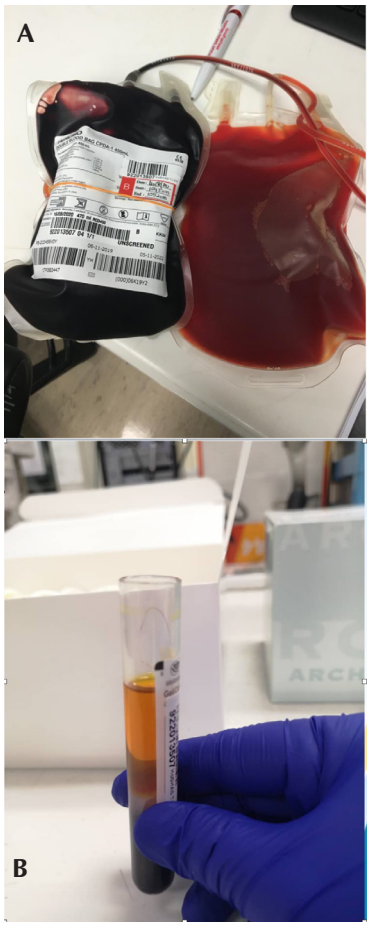

Figure 1: Visual detection of RBC haemolysis. (A)Red discolouration of plasma in the satellite bag. (B)Pinkish discolouration of the serum in ABO sample tube.

Other blood bags from the same collection were not affected. Centrifugation was performed according to the guidelines, and the machine used was last calibrated on 28/7/2020. Calibration is performed every 6 months.

The donor was examined by a doctor to exclude donor-related factors associated with haemolysis. He was comfortable and was not jaundiced. His vital signs were all normal, and he had no hepato-splenomegaly. A panel of investigations was performed that included full blood count as well as peripheral blood film (PBF). He was found to be mildly anaemic with a haemoglobin of 12.3g/dL, however no bleeding tendencies or evidence of blood loss were discovered. Numerous spherocytes were present on PBF, suggesting acute haemolysis secondary to HS. Osmotic fragility test confirmed the diagnosis of HS. Identification of the defective gene or its products was not performed, as it was beyond the scope of a routine haematology laboratory. Total bilirubin level and lactate dehydrogenase were raised suggesting RBC haemolysis. Glucose-6-phosphate dehydrogenase (G6PD) level was normal, and the Direct Antiglobulin Test was negative. A family screening was done, and his father was also diagnosed with HS. On further questioning, it was found that the donor had a history of admission for prolonged neonatal jaundice, but was not transfused. Both father and son had been otherwise asymptomatic until now.

The donor was counselled regarding his condition, and to be aware of the signs and symptoms of haemolysis. He was permanently deferred from donating blood.

DISCUSSION

The degree of haemolysis is the percentage of free haemoglobin in relation to the total haemoglobin with appropriate correction for the haematocrit (3). The acceptable level of haemolysis at the end of storage should be <1% in the United States or <0.8% in the European Union (2).

In this case, plasma haemoglobin in the ABO sample tube (Figure 1B) was measured using the Plasma/Low Hb System, HemoCue®, Sweden. Percentage of haemolysis was calculated using this formula :

$$\% \text{ Haemolysis} = \frac{(100 - \text{Haematocrit}) \times \text{Plasma Haemoglobin (g/dL)}}{\text{Total Haemoglobin (g/dL)}}$$

The haematocrit, plasma haemoglobin and total haemoglobin was 45.9%, 0.83g/dL and 13.8g/dL respectively, giving a percentage of haemolysis of 3.25%, much higher than the accepted value.

The causes of haemolysis in a donated RBC unit can be attributed to either in-vivo or in-vitro haemolysis. In-vitro haemolysis contributes to 98% of RBC haemolysis (4). That is why more emphasis is put on the preventable in-vitro causes of haemolysis, as these are more common. In-vivo haemolysis is associated with conditions that cause RBC membrane defect and decrease its deformability, such as HS, G6PD deficiency, sickle cell anaemia, or other forms of haemoglobinopathies (3). These conditions play a significant role in spontaneous or storage-induced haemolysis.

HS is a rare inherited disorder of RBC membrane that is uncommon in Malaysia. The defect in the RBC membrane proteins causes it to form micro-spherocytes in the bloodstream, predisposing the patient to haemolysis (5). It is dominantly inherited with a wide spectrum of severity. Patients with mild HS are asymptomatic and are incidentally diagnosed, much like our case here (5). Drugs, such as penicillin, alpha methyldopa, and quinidine may also cause in-vivo haemolysis if taken in high enough doses (2,3).

In-vitro haemolysis also occurs due to decreased RBC membrane deformability and stability secondary to thermal injury (3,4). Generally, blood should be kept at a temperature of 20-24°C during the pre-processing and processing period. Once separated, RBC units should be maintained at a temperature of 2-4°C. Other causes of in-vitro haemolysis include traumatic phlebotomy procedures, or turbulent shear stress on RBCs due to stripping techniques against kinked tube segments or partially opened entry ports in blood collection bags (3). Di-(2-ethylhexyl) phthalate (DEHP) has been shown to decrease RBC haemolysis. Blood storage containers that do not contain DEHP can contribute to further haemolysis of RBCs that may have been damaged during preparative procedures (2). Large variation in centrifugal speed during RBC concentrate preparation can also cause haemolysis (3). Other causes include bacterial contamination, rapid suspension of blood with anticoagulant or high anticoagulant ratio to blood, such as cases of underweight units (3).

CONCLUSION

It is important to be vigilant on the colour of the plasma at every step of the process to avoid any inadvertent serious transfusion effects of a haemolysed blood unit. Even though the causes of RBC haemolysis are largely due to in-vitro causes, emphasis should be given to the in-vivo causes as well.

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