CASE REPORT

Should warm fresh whole blood be the first choice in acute massive hemorrhage in emergency conditions?

Pınar Kendigelen, M.D.,[1] Zeynep Kamalak, M.D.,[2] Deniz Abat, M.D.[3]

[1]Department of Anesthesiology and Reanimation, Afşin State Hospital, Kahramanmaraş-*Turkey*

[2]Department of Gynecology and Obstetrics, Afşin State Hospital, Kahramanmaraş-*Turkey*

[3]Department of Urology, Afşin State Hospital, Kahramanmaraş-*Turkey*

ABSTRACT

Early management of rapid massive hemorrhage requires early administration of blood products and rapid surgical control of bleeding. Professionals in peripheral hospitals with limited resources often work under conditions similar to those in the military. Described in the present report are 3 cases in which warm fresh whole blood (WFWB) was used in patients with massive bleeding who presented to a peripheral hospital that had no blood products suitable for emergency conditions. Described first is the case of a 16-year-old female patient who underwent emergency cesarean section. The patient had massive bleeding from the uterus due to atony. Her hemoglobin (Hb) dropped to 3.5 g/dL. Six units of WFWB were transfused during surgery. Hemodynamic parameters and complete blood count (CBC) stabilized. She was transferred from the intensive care unit (ICU) to obstetrics on day 2 and was discharged on day 7. Described second is the case of a 35-year-old female patient who also underwent emergency cesarean section, and for whom massive bleeding was due to uterine atony. Hb dropped to 2 g/dL and hematocrit (HCT) to 5.4%. Nine units of WFWB were transfused, after which hemodynamic and laboratory parameters stabilized. The patient was extubated the following day, transferred from the ICU to obstetrics on day 3, and was discharged on day 8. Described third is the case of a 36-year-old male patient with stab injuries and hemorrhagic shock who underwent emergency surgery. The patient had injuries to the right renal artery and kidney. Nine units of WFWB were transfused due to continued hemorrhage during surgery. Following surgical control of bleeding and transfusion, hemodynamic parameters improved. The patient was transferred from the ICU on day 5 and discharged on day 10. WFWB transfusion nearly disappeared from civilian medicine after blood was separated into components, and whole blood is not usually available at blood banks. In massive transfusions, WFWB effectively replaces red blood cells (RBCs), platelets, plasma volume, and coagulation factors, while preventing hypothermia and dilutional coagulopathy. Blood components go through biochemical, biomechanical, and immunological changes during long storage, the duration of which affects both transfusion efficacy and associated risks. In the future, with the use of fast donor tests, fast ABO compatibility tests, platelet-sparing leukocyte filters, and developments in pathogen-decreasing technology, fresh whole blood (FWB) may be the first choice for massive transfusion. Future studies will reveal new procedures.

Keywords: Massive hemorrhage; massive transfusion; warm fresh whole blood.

INTRODUCTION

Whole-blood transfusion was widely used in the first half of the 20th century, particularly in cases of massive hemorrhage due to trauma. Following World War II, the use of whole blood declined, and component therapy predominated. Present knowledge of whole-blood transfusion comes mainly from military studies, according to which, whole-blood transfusion may provide survival advantage, though safety concerns limit its widespread use.[1] However, in low-resource settings in which blood products are not always readily available, transfusion of fresh whole blood (FWB) can be life-saving.

As presently described, warm fresh whole blood (WFWB) was transfused in 3 patients with massive bleeding who presented to a peripheral hospital that did not have blood products suitable for emergency conditions. Full clinical recovery was observed in all cases.

Address for correspondence: Pınar Kendigelen, M.D.
Afşin Devlet Hastanesi, Anesteziyoloji ve Reanimasyon Kliniği, Kahramanmaraş, Turkey
Tel: +90 344 - 511 53 05 E-mail: pinarken@gmail.com

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CASE REPORTS

Case 1– A 16-year-old female patient underwent emergency cesarean section due to fetal stress at 38 weeks of gestation. She had premature rupture of membranes and protracted descent of fetus in the first stage of labor, with late decelerations. Initial hemoglobin (Hb) was 11.4 g/dL, hematocrit (HCT) was 34.3%, and platelet count was 154000/µL. She delivered a male with a birth weight of 3550 g and an Apgar score of 7. No placental or uterine abnormality was observed. However, proper uterine contraction could not be achieved, despite uterine massage and administration of oxytocin and ergot alkaloids, causing massive uterine bleeding. A central venous catheter was inserted in the right internal jugular vein. Boluses of crystalloid and colloid fluids was administered. Systolic arterial pressure (SAP) was 80–90 mmHg, diastolic arterial pressure (DAP) was 50–60 mmHg, and heart rate (HR) was 100–130 bpm. Despite maintenance of normovolemia, hemoglobin count was 3.5 g/dL due to hemodilution, and bleeding persisted. Treatment of transfusion with FWB was decided upon, as fractionated blood products were not readily available. Six units of FWB were transfused, after which SAP rose to 100–110 mmHg, DAP to 60–70 mmHg, HR decreased to 100–110 bpm, and diuresis was 1 mL/kg/h. Emergency hysterectomy was performed due to persistent bleeding of atonic uterus. On postoperative complete blood count (CBC), Hb was 9.7 g/dL, HCT was 28%, and platelet count was 168000/µL. The patient was transferred to the intensive care unit (ICU) of a tertiary center, where she was extubated the same day. Hemodynamic parameters and CBC stabilized, and the patient was transferred from the ICU to obstetrics on day 2. She was discharged on day 7.

Case 2– A 35-year-old woman with placental abruption underwent emergency cesarean section. On preoperative CBC, Hb was 9.9 g/dL, HCT was 25.5%, and platelet count was 224000/µL. She delivered a 2500 g male with an Apgar score of 8. The patient bled en route to surgery, and bleeding continued following delivery. SAP was 70 mmHg, DAP was 50 mmHg, and HR was 130–140 bpm. A central venous catheter was inserted, and crystalloid and colloid bolus infusions were initiated. In spite of all efforts to maintain normovolemia, CBC showed Hb of 2 g/dL, HCT of 5.4%, and platelet count of 65000/µL. Nine units of FWB were transfused, after which SAP was 60–110 mmHg, DAP was 40–70 mmHg, HR was 80–130 bpm, and diuresis was 0.5–1 mL/kg/h. Emergency hysterectomy was performed due to persistent bleeding of atonic uterus. Postoperative CBC showed Hb of 9.7 g/dL, HCT of 29%, and platelet count of 110000/µL. The patient was transferred to the ICU of a tertiary center and was extubated the following day, transferred to obstetrics on day 3, and discharged on day 8.

Case 3– A 36-year-old male patient with stab injuries and hemorrhagic shock underwent emergency surgery. At first monitoring, SAP was 60 mmHg, DAP was 30 mmHg, and HR was 120–130 bpm. Following intubation, central and peripheral venous catheters were inserted. Crystalloid and colloid bolus infusion was initiated, and 2 units of red blood cells (RBCs) that had been prepared for a planned surgery were transfused. Following the transfusion, control CBC showed Hb of 6 g/dL, HCT of 20%, and platelet count of 135000/µL. Having sustained injuries to the right renal artery and right kidney, the patient bled throughout the surgery, and 9 units of WFWB were transfused. Hemodynamic parameters improved following surgical control of bleeding, nephrectomy, and binding of the artery. Postoperative CBC showed Hb of 10 g/dL, HCT of 29%, and platelet count of 146000/µL. Still intubated, the patient was transferred to the ICU of a tertiary center. He was transferred out of the ICU on day 5 and was discharged on day 10.

DISCUSSION

Acute hemorrhage leading to acute hypovolemic shock is a medical emergency, and initial resuscitation requires rapid intravenous boluses of crystalloid and colloid solution in order to achieve volume replacement. Early management of rapid massive hemorrhage requires early administration of blood products and rapid surgical control of bleeding. Massive blood transfusion is commonly defined as transfusion of 10 or more units of blood within 24 hours.[2]

FWB transfusion almost disappeared from civilian medicine after blood was fractionated into RBCs, fresh frozen plasma (FFP), platelet concentrations (PLT), and cryoprecipitate. Following World War II, blood banks fractionated, stored, and transported blood. Blood products are used as targeted replacement to treat conditions such as anemia, thrombocytopenia, and coagulation factor deficiency. While donated blood is used more economically, unnecessary reactions to transfusion have also decreased. Component therapy is a valuable modality, particularly in the preservation of resources. Due to this advancement, however, whole blood is not typically available at blood banks, and the use of whole blood has become increasingly less frequent in civilian medicine.[3] Meanwhile, transfusion of RBCs, which have extended shelf life, has renewed the study of changes that occur during storage. Multiple studies have identified these biochemical, biomechanical, and immunologic changes, termed "RBC storage lesion." Intracellular pH, 2,3-diphosphoglycerate, and adenosine triphosphate levels fall within a few weeks of refrigerated storage. In addition, extracellular pH drops, and potassium, free Hb, histamine, interleukin-1, and tumor-necrosis-factor levels rise.[3] Duration of storage affects both transfusion efficacy and associated risks.

Selection of treatment method for massive hemorrhage poses an important question, even when blood components are available. Whether FWB is less harmful than blood components that have been stored for prolonged periods is similarly unclear.[3] Red Cell Storage Duration Study (RECESS)

trials have long been ongoing. Their results will demonstrate whether long RBC storage time is harmful.[4]

FWB is more concentrated than blood products prepared with a 1:1:1 ratio of RBCs, frozen plasma, and platelets, and is the only functional alternative that includes all fractions. Nessen et al.[5] evaluated the therapeutic role of additional FWB treatment in patients who required platelet replacement after having received RBCs and FFP. It was concluded that administration of FWB increased survival. Spinella et al.[6] compared WFWB and stored blood products in trauma patients with shock and observed that use of long-storage-duration RBCs was associated with increased risk of multiple organ insufficiency and mortality. Patients transfused with WFWB had better chance of 30-day survival, compared to those transfused with stored blood products.[6] Massive transfusion may increase risk of hemorrhage due to presence of anticoagulants and high levels of preservative solutions, which may lead to dilutional coagulopathy within the first 24 hours.[7]

WFWB has the several advantages. Risk of hypothermia is reduced, oxygen delivery capacity is maintained in RBCs, and platelets and coagulation factors can be preserved for up to 72 hours. The use of anemic, thrombocytopenic, coagulopathic, and cold blood products with prolonged storage times may increase mortality due to hypothermia, acidosis, anemia, coagulopathy, citrate toxicity, hypocalcemia, and hyperkalemia following massive transfusion.[6] Repine et al.[7] suggested that FWB supported resuscitation and corrected acidosis, hypothermia, and coagulopathy. Perkins et al.[8] compared trauma patients who had received massive transfusions of FWB or PLT and found survival in both groups to be equivalent. According to the authors, although it is too early to suggest that whole blood be used in routine management of civilian trauma, it is an appropriate option when blood components are not accessible.

While circumstances in military and civilian life vary, conditions at peripheral hospitals with limited resources can resemble those of the military. WFWB was used out of necessity in the cases described in the present report. FWB is not currently indicated for routine practice. However, it can be a life-saving treatment option when all blood components are needed simultaneously, particularly in low-resource settings. The main risks associated with FWB transfusion are transfusion-transmitted infectious diseases, leukocyte-associated acute pulmonary injury, microchimerism, and graft-versus-host disease.[9] The risk of transmitted infectious diseases can be decreased with quick tests for HIV, and hepatitis B and C.

In conclusion, full clinical recovery was achieved in all 3 patients who received massive transfusions of WFWB. FWB transfusion as an emergency treatment is supported by the literature. In the future, FWB may even be the first choice for massive transfusions, aided by the implementation of fast donor tests, ABO compatibility tests, thrombocyte-sparing leukocyte filters, and developments in pathogen-decreasing technology. New procedures will be revealed in upcoming studies.

Conflict of interest: None declared.

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OLGU SUNUMU - *ÖZET*

Sıcak taze tam kan masif kanamalı acil durumlarda ilk seçenek olmalı mıdır?

Dr. Pınar Kendigelen,[1] Dr. Zeynep Kamalak,[2] Dr. Deniz Abat[3]

[1]Afşin Devlet Hastanesi, Anesteziyoloji ve Reanimasyon Kliniği, Kahramanmaraş
[2]Afşin Devlet Hastanesi, Kadın Hastalıkları ve Doğum Kliniği, Kahramanmaraş
[3]Afşin Devlet Hastanesi, Üroloji Kliniği, Kahramanmaraş

Hızlı masif kanamanın erken yönetimi, kan ürünlerinin erken verilmesi ve hızlı cerrahi kontrolün sağlanmasını gerektirir. Periferik hastaneler kaynak kısıtlılığı nedeniyle askeri koşullara benzer. Kan ürünleri bulunmayan periferik bir hastanede masif kanamayla nedeniyle sıcak taze tam kan (TTK) verdiğimiz üç olgu sunuldu. Olgu1: On altı yaşında kadın hasta acil sezaryana alındı. Uterus atonisi nedeniyle masif kanaması olan hastanın Hb değeri 3.5g/dl'ye kadar düştü. Cerrahi süresince altı ünite sıcak TTK transfüzyonu yapıldıktan sonra, hemodinamik parametreleri ve tam kan sayımı normal düzeye geldi. İki gün yoğun bakımda takibi yapılan hasta, yedinci gün taburcu edildi. Olgu 2: Otuz beş yaşında kadın hasta acil sezaryana alındı. Uterus atonisi nedeniyle masif kanayan hastanın Hb'i 2g/dl, Htc'i %5.4'e kadar düştü. Dokuz ünite sıcak taze tam kan verilen hastanın hemodinamik ve laboratuvar değerleri normal düzeye geldi. Ertesi gün ekstübe edilip üçüncü gün yoğun bakımdan servise çıkarılan hasta sekizinci günde taburcu edildi. Olgu 3: Otuz altı yaşında erkek hasta bıçak yaralanması sonrası hemorajik şokta acil cerrahiye alındı. Hastada sağ renal arter ve böbrek yaralanması vardı. Cerrahi süresince kanamaya devam eden hastaya dokuz ünite sıcak TTK verildi. Cerrahi kontrol sağlanan ve kan transfüzyonu yapılan hastanın hemodinamik parametreleri düzeldi. Beşinci gününde yoğun bakımdan çıkarılan hasta 10. günde taburcu edildi. Kan bileşenlerine ayrılabildiğinden beri sivil tıpta TTK kullanımı neredeyse yoktur. Ayrıca, kan bankalarında tam kan rutin mevcut değildir. Bu nedenle tam kan kullanımı sivil tıpta azalmıştır. Sıcak TTK masif transfüzyonda, kırmızı kan hücrelerini, trombositleri, plazma volümünü, koagülasyon faktörlerini etkili bir şekilde yerine koyarken aynı zamanda hipotermiyi ve dilüsyonel koagülopatiyi önler. Kan ürünleri, uzun depolanma süresince biyokimyasal, biyomekanik ve immünolojik değişikliklere uğrar. Depolama süresi transfüzyon etkinliğini ve transfüzyonla ilişkili riskleri etkiler. Gelecekte hızlı ABO uyumluluğu testleri, trombosit koruyucu lökosit filtreleri ve patojenleri azaltan yeni teknolojilerin kullanımı ile TTK massif transfüzyonda ilk seçim olabilir. Yeni çalışmalar gelecekte yeni prosedürler ortaya çıkaracaktır.

Anahtar sözcükler: Masif kanama; masif transfüzyon; sıcak taze tam kan.

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