Two Patients Receiving Massive Transfusion

YÜKSEK MİKTARDA KAN TRANFÜZYONU ALAN İKİ HASTA

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Summary

Objective: Here we report two cases of coagulapathy who receive massive transfusions and management of patients

Case Report: The first presented case describes a patient who develops coagulapathy during TURP. In the second case, patient had a major vascular injury developing DIC because of dilution and consumption of coagulation factors with a blood loss of 25 liter and replacement exceeding three times her total blood volume.

Conclusion: Dilutional thrombocytopenia is regarded as the most common cause of transfusion-related coagulopathy. Shock, hypoxia, acidosis, hypothermia and persistent hemorrhage are other risk factors for coagulation failure. Massive transfusion exceeding three times total blood volume might be deleterious on organ systems causing coagulopathy, electrolyte and acid-base disorders. It should be diagnosed and treated promptly not to jeopordize patient's health.

Key Words: Massive transfusion, Hypothermia, Coagulopathy

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Özet

Amaç: Yüksek miktarda kan transfüzyonu uygulanan ve koagulasyon bozukluğu gelişen iki olguda, transfüzyonun istenmeyen etkilerini tartışmayı amaçladık.

Olgu Sunumu: İlk olgu TURP sırasında gelişen koagulopati tablosunu, ikinci olgu ise vasküler yaralanma sonrası yaklaşık 25 L kan kaybı ile birlikte koagulasyon faktörlerinin dilüsyon ve kullanımı sonucunda gelişen DIC tablosunu anlatmaktadır.

Sonuç: Dilüsyonel trombositopeni transfüzyon ilintili koagülopatinin en önemli nedenlerinden biridir. Şok, hipoksi, asidoz, hipotermi ve israr eden kanama koagülasyon bozukluğuna neden olan diğer risk faktörleridir. Total kan volümünün üç katını geçen yüksek miktardaki kan transfüzyonu koagülopati, elektrolit ve asit-baz bozukluklarına neden olarak çeşitli organ sistemlerine zarar verebilir. Bu tip olgularda erken teşhis ve tedavi hastanın sağaltımı açısından çok önemlidir.

Anahtar Kelimeler: Yüksek miktar kan transfüzyonu, Hipotermi, Koagulopati

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Patients who receive massive transfusion (MT) are frequently a challenge. Not only voluminous exchange transfusion present problems in itself, but these patients have usually been subjected to shock and vigorous resuscitation. Transfusion reactions due to clerical errors and transfusion related acute lung injury are of equally importance. Clinical and laboratory monitoring of anticipated ongoing transfusion should be started early and involve serial assessment of hematocrit, prothrombin time (PT), partial thromboplastin time (PTT), fibrinogen, and platelets. In patients requiring massive transfusions, the assessment of electrolytes, including ionized calcium, and the close monitoring of temperature and the degree of acidosis (by arterial pH) are also important in identifying correctable factors that may affect coagulation. We report two patients receiving MT averaging three times their total blood volume.

Case Reports

Case 1

A 83-yr-old man (165 cm, 55 kg) was scheduled for transurethral prostatectomy (TURP) for prostatic hyperplasia. Spinal anesthesia was performed at the L4-5 lumbar vertebral interspace. During the second hour of transurethral resection, patient was recorded as having a bleeding which was diffuse in nature and could not be controlled with standard procedures. Following induction of general anesthesia and laryngeal mask airway insertion, suprapubic approach was performed to identify the site of bleeding. After no surgically correctable bleeding site could be identified packs were left in prostatic fossa to control diffuse oozing. Intraoperative laboraotory values from arterial blood were as follows: pH, 7.08; $PaCO_2$, 53; PaO_2, 106; HCO_3, 15.6; base deficit,-14.5; ionized calcium, 0.45 mmol/l; sodium, 127 mmol/l; potassium, 3.7 mmol/l; hemoglobin, 9.2/dl; platelet count, 103,000/mm^3, PT; 25, and PTT; 55.2 (preoperative PT 15, PTT 32.8). Ca gluconate (0.9%) 2000 mg and Na bicarbonate (8.4%) 8400 mg were added in the maintenance intravenous solutions. At the end of surgery the estimated blood loss was 20 L and urinary output was 1 L. Totally 17 units of whole blood, 1200 ml of FFP, 2000 ml of normal saline, 3000 ml of lactated ringer, 4000 ml of gelatin were administered during the course of surgery. Fluid warmers were used during administration of intravenous solutions and blood products to prevent hypothermia. Body core temperature was maintained at 35.8-36.3^{O}C. In spite of vigorous resuscitation efforts and vasopressors (noradrenalin infusion) systolic blood pressure continued to decline to 50 mmHg (remained at 50-60 mmHg for 2.5 h). He couldn't extubated at the end of surgery and he was transferred to intensive care unit (ICU) where his lungs were mechanically ventilated. Results of blood tests and blood gas analysis at the time of arrival in ICU showed a hemoglobin concentration of 5.7 g/dl, platelet count of 38,000/mm^3, PT 27.5, PTT 53.2, INR 2.1, ionized Ca^{+2} 0.87 mmol/l (normal range 1.16-1.32), sodium 145 mmol/l, potassium 3.9 mmol/l, Cl 107 mmol/l, fibrin degradation products (FDP) 30µg/ml (normal range < 10), D-dimer 3.2µg/ml (normal range< 0.5). pH, 7.15; $PaCO_2$, 48.2; PaO_2, 207; and base deficit of–12.2 mmol/l. Five units of whole blood, 600 mL of FFP and 6 platelets concentrates were administered in the early postoperative period. Sodium bicarbonate were added in the maintenance intravenous solutions. At the third postoperative day administration of vasopressor was stopped as the patient's cardiovascular condition was stabilized. Trachea was extubated on the sixth postoperative day. During his stay in the ICU, he had no organ failure except coagulopthy which was treated with blood and blood products. The patient was transferred out from the ICU on the thirteenth day. His stay in the ward was uneventful, and he was discharged on the nineteenth day.

Case 2

A 35-yr-old woman (160 cm, 55 kg) was scheduled for revision of infected total hip prosthesis. Her past medical history was significant for congenital hip dislocation and she had total hip arthroplasty in 1993. Sudden changes were noted in blood pressure (from 110/60 to 80/50 mmHg) and heart rate (from 70 to 110 bpm) during fixation of the transacetabular screw. The site of bleeding was determined as the injured iliac artery and vein. General and vascular surgeons were informed and emergency laparotomy was performed. After ligating the left common iliac vein, external iliac artery and vein ligated above the inguinal ligament. Iliofemoral by-pass was performed with PTFE (polytetrafloraethylene) graft. After a blood loss of 15 L, laboratory values were as follows: pH, 7.23; $PaCO_2$, 36; PaO_2, 179; base deficit,-11.4; hemoglobin, 6.4 g/dl; platelet, 56,000/mm^3; PT, 22; PTT,48 (preoperative PT, 12; PTT, 32.1); sodium, 149; potassium, 2.8 mmol/l; ionized calcium, 0.44 mmol/l and magnesium, 0.8 mg/dl. Ca gluconate (%0.9) 1500 mg, K chloride (7.5%) 2250 mg and Mg sulphate (15%) 3000 mg were added in the

maintenance intravenous solutions. While the injuries were being repaired, transfusion of 14 units of packed red blood cell, 11 units of whole blood, 1000 ml of FFP, 8 platelet concentrates, 2000 ml of lactated ringer, 3000 ml of normal saline and 12000 ml of gelatin was managed with a rapid infusion system and adequately warmed with fluid warmers. An external heating device was used throughout the operation to maintain body core temperature at 36-36.5^{O}C. The lowest hemoglobin concentration was 2.8 g/dl, platelet count was 15,000/mm^3 and fibrinogen was 80 mg/dl. The estimated blood loss was 25 L. At transport to the ICU hemoglobin concentration had been restored to 9.4 g/dl, platelet count to 77,000/mm^3, PT 18.3, PTT 55.7, INR 1.62. Fibrinogen level was 100 mg/dl (normal range 200-400), FDP 20µg mL^{-1}, D-dimer 5.1 µg mL^{-1}. Result of blood gas analysis was pH, 7.27; $PaCO_2$, 35; PaO_2, 197; and base deficit –9. Four hundred mL of FFP and 2 units of cryoprecipitate were administered. She was transferred out from the ICU on the sixth postoperative day. Her stay on ward was uneventful and she was discharged on the 14th day of admission with anticoagulation therapy

Discussion

The first case report describes a patient who develops coagulapathy during TURP. TURP patients commonly bleed perioperatively. One possible cause is dilutional thrombocytopenia resulting from excessive absorption of irrigation solution. The irrigation fluid either gains direct intravascular access (through the prostatic venous plexus), or is more slowly absorbed from the retroperitoneal and perivesical spaces (1). TURP syndrome may occur as quickly as 15 minutes after resection starts (2), or up to 24 hours postoperatively (3). 10-30 ml of fluid is absorbed per minute of resection time. Absorption rates can reach 200 ml per minute (1). In our case, in the second hour of transurethral resection, patient developed respiratory distress and hypotension which was attributed to TURP syndrome. During the course of the operation he developed systemic coagulopathy. Another possible cause of bleeding is local release of fibrinolytic agents (plasminogen and urokinase) from the mucosa of the lower urinary tract (4). Systemic coagulopathy due to DIC can also occur during TURP. DIC is triggered during TURP by prostatic particles rich in thromboplastin that enter the blood stream during surgery.

Second case report describes a patient developing DIC because of dilution and consumption of coagulation factors with a blood loss of 25 liter and replacement exceeding three times her total blood volume. Vascular injuries as a result of total hip arthroplasty are rare (0.2- 0.3 %). Most vascular injuries have been reported to occur during revision surgery (5).

Coagulopathy occuring in association with massive transfusion continues to be one of the most serious problems after major injury. The precise relationship between coagulopathy and the transfusion of blood and blood products has not been determined. The most common cited cause of transfusion-related coagulopathy is dilutional thrombocytopenia. Severe hemodilution, created by the unbalanced administration of large volumes of crystalloid solutions, may also dilute coagulation factors as well as decrease blood viscosity and further exacerbate the effects of existing thrombocytopenia (6). Replacement of an entire volume leaves the patient with approximately one-third of the original concentration of coagulation factors (7). Previous studies report that clinical coagulopathy from dilution does not usually occur until replacement exceeds one blood volume or when the PT and PTT exceed 1.5-1.8 times control values (8-10).

Hypothermia and acidosis continue to be principal predictive factors in massively transfused patients of both mortality and severe coagulopathy and may directly and adversely affect coagulation (11). Hypothermia (core temperature< 35^{O}C) causes temperature-related inhibition of clotting factor enzymes, increases fibrinolysis, decreases

platelet counts and platelet function. Both temperature and blood gases should be carefully monitored and corrected to the extent possible. The patients presented here who received massive transfusion were monitored extremely closely with serial determinations of PT, hematocrit, platelet count and blood gases. Acid-base and electrolytes imbalances, hematologic profile and hypothermia corrected to the extent possible.

The transfusion of allogenic blood is associated with serious risks. In addition, the high cost of red cells, as well as difficulties with donor recruitment, necessitate the rational use of blood. The available guidelines on red cell transfusion are not clearly defined. The amount of blood loss, age of the patient and presence of intercurrent disease may be important in the decision to transfuse.

Synthetic colloids are used widely for replacement of blood loss during major surgical procedures. Defined blood components are transfused only when blood or plasma losses exceed the various limits set for replacement of blood components. The main reason for using colloidal volume replacement is to maintain the circulating blood volume by stabilizing plasma oncotic pressure in the perioperative period. When perioperative blood loss is replaced partly with plasma expanders, impairement in haemostasis may be anticipated. The administration of large amounts of colloid solutions cause a dilutional coagulopathy, regardless of the kind of colloid used. In contrast with gelatins, all hydroxyethyl starch (HES) solutions have recomended upper dose limit because of their effects on coagulation factors, platelet and fibrin formation. Also gelatin solutions up to 15 L do not have any specific effect on clotting, apart from the dilutional effect (12).

Synthetic colloids may have detrimental effects on renal function. Kumle et al (13) reported that gelatin and HES solutions can be used safely for volume replacement without risking significant renal dysfunction.

In conclusion, transfusion thresholds developed as part of a massive transfusion protocol and based on coagulation monitoring may provide guidelines for the administration of blood or blood components. Trauma centers and those institutions with the periodic need to administer large quantities of blood should develop massive transfusion protocol and clinical management guidelines to help facilitate and coordinate massive transfusions.

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