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■ Case Report ■

Successful Hysterectomy and Therapeutic Hypothermia Following Cardiac Arrest due to Postpartum Hemorrhage

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Postpartum hemorrhage is a common cause of maternal mortality; its main cause is placenta accreta. Therapeutic hypothermia is a generally accepted means of improving clinical signs in postcardiopulmonary resuscitation patients. A 41-year-old pregnant woman underwent a cesarean section under general anesthesia at 37 weeks of gestation. After the cesarean section, the patient experienced massive postpartum bleeding, which led to cardiac arrest. Once spontaneous circulation returned, the patient underwent an emergency hysterectomy and was placed under therapeutic hypothermia management. The patient recovered without neurological complications.

Key Words: cardiac arrest; hypothermia; placenta accreta; postpartum hemorrhage.

Postpartum hemorrhage after delivery is an obstetric emergency leading to hemodynamic instability and has a high mortality rate unless treated immediately.[1,2] Factors such as uterine atony, placenta accreta, premature rupture of membranes (PROM), and amniotic embolism are the main causes of postpartum hemorrhage.[3] Placenta accreta occurs when the placenta attaches abnormally to the myometrium. Therapeutic hypothermia (TH) is a generally accepted means of improving clinical results in cardiac arrest survivors; the guidelines provided by the American Heart Association in 2010 are typically used.[4] We report the case of a pregnant woman who experienced postpartum hemorrhage after emergency cesarean section (C-section) and suffered a cardiac arrest. After cardiopulmonary resuscitation (CPR), she underwent hysterectomy and was put under TH. She recovered without neurological complications or organ failure.

Case report

A 41-year-old pregnant woman (gravida 3, abortion 2) at 37 weeks of gestation was hospitalized shortly after labor pain started. She had no previous history of antenatal care in our hospital. The non-stress test showed regular uterine contraction (2 min 40 sec) and the results of the nitrazine test for PROM were positive, so an emergency C-section was performed.

Preoperative laboratory tests were normal. Noninvasive blood pressure monitoring, electrocardiogram, pulse ox-

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imetry, and bispectral index were performed before the induction of anesthesia. After several minutes of preoxygenation, general anesthesia was induced with thiopental sodium and succinylcholine. After the baby was delivered, we maintained anesthesia with sevoflurane (0.5-1.5%), remifentanil (0.1-0.5 mcg/kg/min), and 50 mg of rocuronium. Placenta accreta was recognized after delivery. Because uterine contraction was maintained after administration of 20 IU of oxytocin and 200 mcg of methylergonovine maleate, hysterectomy was not performed. Immediately following the surgery, the patient was extubated and sent to the recovery room. Blood loss during the surgery was 1000 mL and no blood products were given. A total of 2950 mL of fluid was infused with hydroxyethyl starch and crystalloid. Patient urine output was about 175 mL.

The patient was hemodynamically stable in the postanesthesia recovery room. She was admitted to the intensive care unit (ICU) for close observation of postpartum bleeding. Two hours later vaginal bleeding was observed and laboratory results revealed a hemoglobin (Hgb) level of 8.2 g/dL. Two units of packed red blood cells were transfused. An hour later, uterine contraction weakened and remained unresponsive to uterotonics. An hour after that, sudden-onset massive vaginal bleeding occurred, so a large bore central venous catheter was selected for rapid blood transfusion.

While preparing for catheterization, the patient lost consciousness due to cardiac arrest and standard protocol CPR was performed immediately. Endotracheal intubation was done and after 11 minutes of CPR, and recovery of spontaneous circulation was achieved. Then, 7 and 9 Fr venous catheters were inserted into the left femoral and right subclavian veins, respectively. Norepinephrine was infused at a rate of 2-20 mcg/min. Arterial cannulation was done on the left femoral artery, allowing real-time hemodynamic monitoring. The blood pressure was maintained within 80/40 mmHg. Follow-up laboratory testing results showed a Hgb level of 4.9 g/dL, hematocrit (Hct) 14.4%, and a platelet count of 87,000/μL. Four units of packed red blood cells, 6 units of fresh frozen plasma, and 8 units of platelets were transfused via rapid infusion system (FMS 2000, Belmont Instrument Corporation, Billerica, MA, USA). The Pittsburgh Brain Stem score at this time was 6 points; there were no responses, including pupil, gag, and corneal reflex (Table 1). To control postpartum hemorrhage, an emergency hysterectomy was performed.

Table 1. The pittsburgh brain stem score

Brain stem reflex	Finding	Points
Lash reflex	Present either side	2
	Absent both sides	1
Corneal reflex	Present either side	2
	Absent both sides	1
Doll's eye and/or ice water calorics	Present either side	2
	Absent both sides	1
Right pupil reaction to light	present	2
	absent	1
Left pupil reaction to light	present	2
	absent	1
Gag and /or cough reflex	present	2
	absent	1

In the operating room, the patient's blood pressure and heart rate were 44/20 mmHg and 130 beats/min; 200 mcg of epinephrine was immediately given. A rapid infusion system was applied and general anesthesia was maintained with sevoflurane (0.5-1.5%), remifentanil (0.2-0.8 mcg/kg/min), and rocuronium. The initial arterial blood gas analysis (ABGA) results were pH 6.99, pO_2 365 mmHg, pCO_2 39 mmHg, base excess –21, and Hct 15.0%. 100 mEq of Sodium bicarbonate and 1200 mg of calcium chloride were given, along with continuous infusion of packed red blood cells and fresh frozen plasma. To compensate for metabolic acidosis and electrolyte imbalance (hypocalcemia, hyperglycemia) caused by massive transfusion, 100 mEq of sodium bicarbonate, 1200 mg of calcium chloride were given. Blood pressure was maintained between 90/50 and 150/80 mmHg, body temperature between 34 and 36℃, and arterial saturation between 95 and 100%. At the end of surgery, ABGA results were pH 7.15, pO_2 99 mmHg, pCO_2 33 mmHg, Hgb 12.2 g/dL, and Hct 36%. The total operation time

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was an hour and thirty minutes, the total amount of blood loss was 4500 mL, and total urine output was 150 mL. A total of 7750 mL of crystalloid and 7520 mL of blood products (16 units of packed red blood cells and 16 units of fresh frozen plasma) were infused.

After surgery the patient returned to the intensive care unit. Mechanical ventilation was applied and, to prevent possible brain damage caused by cardiac arrest, a cool line catheter (The alsius coolGard and catheter thermal regulation system, Alsius Corporation, CA, USA) was inserted through the right femoral vein for therapeutic hypothermia. The target body temperature of 33 ± 2℃ was maintained for 24 hours. After 24 hours, the patient's body temperature was raised at a rate of 0.3℃ per hour until it reached 36℃. Due to massive transfusion, adult respiratory distress syndrome, pulmonary edema, and disseminated intravascular coagulation (DIC) occurred. On postoperative day 1, ABGA results showed pH 7.22, pO_2 105.4 mmHg, pCO_2 47.7 mmHg, and BE -8.3 under a FiO_2 of 1.0. Other laboratory results revealed antithrombin III 31, fibrin degradation product (FDP) 130.32 μg/mL, D-dimer 13,774 ng/mL, international normalized ratio (INR) 2.24, fibrinogen 199 mg/dL, and a platelet count of 75,000/μL. To correct DIC, antithrombin III was given. Packed red blood cells were continuously infused due to wound bleeding. Multiorgan dysfunction occurred, leading to oliguria due to acute renal failure (blood urea nitrogen [BUN]/Cr 35.2/ 5.49 mg/dL) and acute hepatic failure (increased aspartate aminotransferase/alanine aminotransferase [AST/ALT], 5525/3837 U/L).

Continuous renal replacement therapy was done three times a week to rectify acute renal failure and pulmonary edema. On postoperative day 7, the patient's mental state recovered from coma to drowsy; on day 10 she was alert enough to understand her situation, and on day 11, she was weaned and extubated. Manual muscle test results were fair for both extremities, reflecting slight muscles weakness. A total of 17 units of packed red blood cells, 15 units of fresh frozen plasma, and 36 units of cryoprecipitate were given during ICU care.

On day 15, the patient's overall symptoms and hemodynamic condition improved, so she was sent to the general ward. Her kidney function recovered and she was able to urinate. On day 35, her overall organ function recovered, so the patient was transferred to the rehabilitation department where she participated in gait and muscle strengthening programs. On day 85, the patient's manual muscle test results for both extremities were good. There were no further neurological sequelae or organ failure and the patient was discharged.

Discussion

Hemorrhage after c-section is the most common cause of maternal mortality. Placenta accreta is a main cause of peripartum hemorrhage and the most common indication for peripartum hysterectomy.[5] A recent review reported that 90% of hemorrhage-associated maternal death can be avoided.[6] The use of ultrasonography and magnetic resonance imaging for prenatal diagnosis of placenta accreta can help prevent complications and plan further treatment.[7] In this case, the patient underwent emergency c-section without prior suspicion of placenta accreta.

Previous c-section delivery is the most important risk factor for placenta accreta. Other factors include old age, high gravidity, multiparity, placenta previa and a history of curettage.[8] In this case, the patient was 41 years old and had a history of abortion and curettage. It is difficult to predict blood loss in patients with placenta accreta. Also, there is no correlation between the degree of uterine invasion and blood loss. A preoperative diagnosis of placenta accreta may facilitate advanced planning and preparation, reducing the total transfusion amount.[9] On average, the mean blood loss from placenta accreta is 3 L and the mean transfusion amount is 10 units of packed red blood cells. If massive hemorrhage occurs, instead of crystalloid or colloid infusion, transfusion of packed red blood cells, fresh frozen plasma, and platelets at a ratio of 1:1:1 (so called damage control resuscitation) is recommended.[10] In our case, the patient lost 1,000 mL

of blood during c-section and, as there was no further bleeding, hysterectomy was not performed at that time. After c-section, however, postpartum uterine atony occurred, leading to placenta bleeding. Remnant placenta accreta might have worsened the bleeding. We believe transfusion and hysterectomy should have taken place earlier. During emergency hysterectomy, total blood loss was 5000 mL, and 16 units of packed red blood cells were transfused, more than the usual amount.

Therapeutic hypothermia has been reported to be an effective measure in patients with cardiac arrest.[11] Mild (33-36°C) or moderate (28-32°C) hypothermia is safe, and may provide a significant neuroprotective effect. Therapeutic hypothermia guideline recommends keeping the body temperature between 32-34°C.[12] Since the Pittsburgh brain stem score was 6 after cardiac arrest, we performed TH, limiting it to within 24 hours. In addition we felt that blood loss could be compensated with blood transfusion.

TH may cause complications such as reduced platelet function and coagulation cascade because of hypothermia may lead to coagulopathy. Therefore, TH may exacerbate occult hemorrhages in patients with bleeding tendency.[13] However, since TH may improve the microcirculation flow in the cerebral cortex, it may provide cerebral protection.[14] In this case, the patient was transfused with 17 units of packed red blood cells after the operation; DIC in this patient might have led to more bleeding. In a recent meta-analysis, hypothermia was not associated with total blood loss; still, we must consider gains and losses when applying therapeutic hypothermia.[15] In this case, we considered restoration of brain function after cardiac arrest a priority. Thus, hypothermia therapy was performed with satisfactory results.

Placenta accreta is a pregnancy complication leading to massive postpartum bleeding. Clinicians should be prepared for massive perioperative bleeding and emergency hysterectomy; blood products should be prepared for transfusion and hemodynamic monitoring is needed.

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