

The Experience of General Anesthesia with Remimazolam in Patient with Cardiac Tamponade Due to Cardiac Injury by Bone Cement Embolism: A Case Report

Hyun Joo Heo¹, Ji Hye Lee^{1*}, Yu Yil Kim¹, Ji Hun Park¹, Hyung Gu Cho¹, Geonbo Kim¹

¹M.D., Department of Anesthesiology and Pain Medicine, Presbyterian Medical Center, Jeonju, Korea

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*Corresponding author: Ji Hye Lee

M.D., Department of Anesthesiology and Pain medicine, Presbyterian Medical Center, Jeonju, Korea

Abstract

Case Report

Background: In patients with cardiac injury, it is crucial to maintain hemodynamic stability during the induction and maintenance of general anesthesia. Remimazolam provides hemodynamic stability during anesthetic induction. **Case Presentation:** An 83-year-old female was transferred for emergency surgery after pericardiocentesis with cardiac tamponade resulting from aorta and right atrium injury from bone cement fragments after percutaneous vertebroplasty. She was admitted to the operation room with was given inotropes, vasopressors and blood. Remimazolam was used for induction (6.0 mg/kg/h) and maintenance (1 mg/kg/h) of general anesthesia. The patient underwent surgery without major hemodynamic concerns and later recovered. **Conclusion:** Remimazolam can be used in patient with cardiac injury with hemodynamic instability for the induction and maintenance of general anesthesia.

Keywords: Cardiac injury, Cardiac tamponade, General anesthesia, hemodynamic instability, Remimazolam.

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INTRODUCTION

Percutaneous vertebroplasty (PVP) is a common procedure for patients with vertebral fracture, but very rarely, cement leakage can cause serious complications. Cement leakage into the perivertebral venous system can result in pulmonary and intracardiac embolism or injury, which can cause fatal complications, such as cardiac tamponade (CT).

CT is a life-threatening emergency that can lead to death. Pericardiocentesis is performed under local anesthesia for pericardial effusion, but acute CT caused by traumatic hemopericardium requires surgical treatment [1].

General anesthesia can cause cardiac collapse in patients with CT, because anesthetic agents induce dose-dependently myocardial depression and vasodilation. Decisions on the method of anesthesia and the most appropriate anesthetic drug to maintain hemodynamic stability in patients with CT are crucial [2].

Remimazolam has recently been developed as ultra-short acting benzodiazepine (BZD), and has less cardiovascular and respiratory inhibition than other intravenous anesthetic agents. In addition, remimazolam can be used for maintenance as well as induction of anesthesia. Therefore, it is increasingly used in patients with severe cardiac dysfunction or in cardiac surgery [3, 4]. Herein, we report on our experience of performing general anesthesia using remimazolam in a patient who suffered acute CT due to a cardiac injury caused by a bone cement fragment after PVP.

CASE REPORT

This study was conducted with the approval of the Institutional Review Board of our hospital (IRB no. E2022-056). An 83-year-old female (155 cm/65kg) had developed chest pain and hypotension after the L2 PVP in a different hospital, a computed tomography scan showed intracardiac foreign body, cardiac penetration, and hemopericardium (Fig 1).

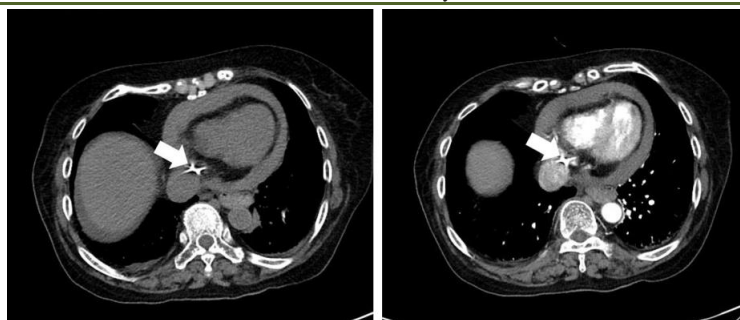


Fig 1: Computed tomography. Hemopericardium and bone cement emboli (arrow)

The patient was transferred for emergency surgery after percutaneous drainage at a different hospital. At the time of admission, blood pressure (BP) was 100/56 mmHg, heart rate (HR) was 78 beats/min, and she was receiving infusion of dopamine, norepinephrine solution and fresh-frozen plasma (FFP). She had a past medical history of dementia, hypertension, and hyperlipidemia. The preoperative laboratory results were hemoglobin, 9.9 g/dL; platelets,

104,000/ μ L; N-terminal pro b-type natriuretic peptide, 871.8 pg/ml (normal range: 0–526 pg/ml), and lactate 2.45 mmol/L (0.5–2.2). There were no other abnormal findings. Emergency surgery was decided to resolve the CT with aorta and right atrium perforation due to bone cement (Fig 2). Therefore, we planned to proceed with the operation after induction of general anesthesia using remimazolam.

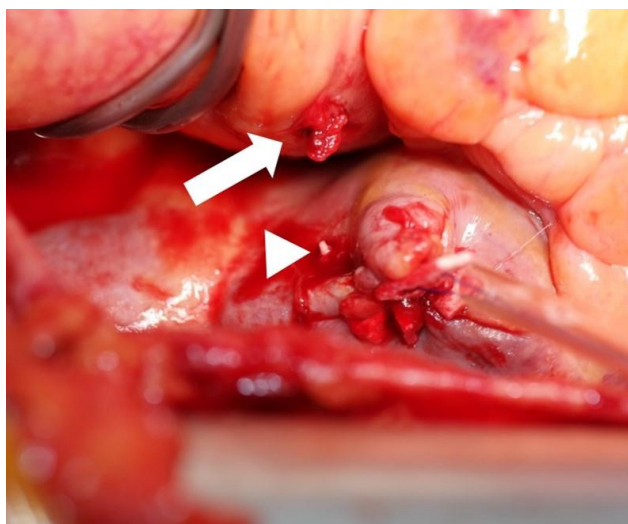


Fig 2: Bone cement emboli in right atrium (arrow head) and aorta perforation (arrow)

No pre-medications were administered. non-invasive blood pressure, 5-lead electrocardiogram, pulse oximeter, patient state index (PSI), regional cerebral oxygen saturation, and a pulse CO-oximeter were conducted. The consciousness of the patient was difficult to confirm due to the patient suffering from dementia, but she was near alert upon entering the operating room, she was receiving infusion of dopamine, norepinephrine solution and FFP via right subclavian central line. BP was 124/68 mmHg, HR was 78 beats/min, and pulse oxygen saturation was 93%. Arterial cannula was inserted into the radial artery to monitor invasive blood pressure, and an EV1000[®] (Edwards Lifesciences, Irvine, CA, USA) monitor was

used to check the cardiac index, stroke volume variation, and systemic vascular resistance. Induction was performed after preoxygenation. While checking PSI, continuous infusion of remimazolam was administered at a rate of 6 mg/kg/h, and 1 ng/ml of remifentanyl was infused as the target concentration effect. Following loss of consciousness, remimazolam was reduced to 1 mg/kg/h, endotracheal intubation was performed after administering muscle relaxants, and another central venous catheter was inserted into the right internal jugular vein under ultrasound guidance, before installing a trans-esophageal echocardiogram probe. The intraoperative hemodynamic changes of the patient are as shown in Fig 3.

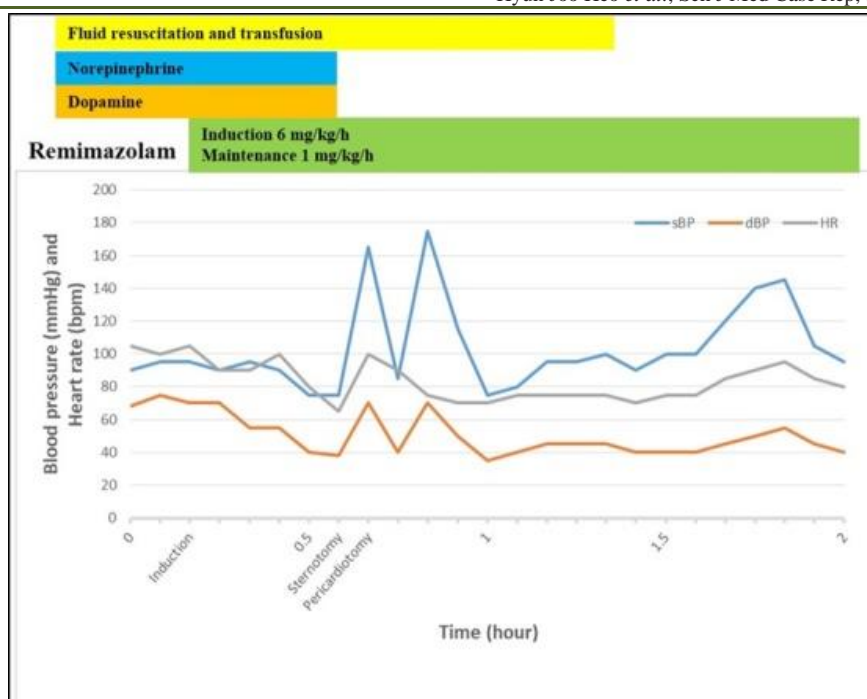


Fig 3: Intraoperative hemodynamic changes

After median sternotomy, pericardial hematoma and a cement fragment were removed and repaired both right atrium and aorta without cardiopulmonary bypass. After operation, she was transferred to the intensive care unit (ICU). There were no signs of delirium. She was discharged 15 days after surgery without any particular concerns.

DISCUSSION

The acute CT requires a rapid diagnosis and immediate decompression using an appropriate method. Although pericardiocentesis is mainly used for pericardial drainage, acute CT caused by bleeding due to cardiac injuries require surgical treatment under general anesthesia. Here, the patient suffered a CT as a result of a cardiac rupture caused by cement that was used in PVP. Therefore, surgical treatment was required under general anesthesia.

When performing general anesthesia for an acute CT, anesthesiologists must have a good understanding of the hemodynamic changes of CT. The goal of general anesthesia for patients with CT is to maintain an adequate preload, afterload, cardiac contractility, and heart rate [2]. In this regard, it is important to select an appropriate anesthetic agent. Various drugs used during general anesthesia can cause myocardial suppression, systemic vasodilation, decrease HR and preload, and positive pressure ventilation also reduces venous return. Ketamine, which is commonly used for anesthesia in patients with cardiac tamponade, can increase the systemic vascular resistance and the heart rate and maintain cardiac contractility. Ketamine also has the advantage of enabling the patient to

maintain spontaneous breathing during anesthesia. As alternatives, etomidate and midazolam can be used.

Remimazolam is a novel ultra-short-acting benzodiazepine with gamma-aminobutyric acid agonist properties, and becomes rapidly hydrolyzed into inactive metabolites in the body through tissue esterases. Therefore, the sedative effect of remimazolam disappears rapidly once the administration is ceased, unlike midazolam [5]. In a continuous infusion for 3 h, the context sensitive half time of the remimazolam is approximately 7.5 min, which is 1/5 shorter than that of midazolam [6]. Remimazolam also has various advantages, including a low risk of malignant hyperthermia, postoperative nausea and vomiting that can occur during inhalation anesthesia, as well as the absence of injection pain [7]. Additionally, remimazolam has an antagonist, flumazenil, so the effect can be reversed even when overdosed.

A recent report on a case of general anesthesia management reported no hemodynamic issues by using remimazolam for the induction and maintenance of general anesthesia. It has been reported that the use of remimazolam as anesthesia in the American Society of Anesthesiologists physical status (ASA-PS) 1 and 2 patients showed fewer incidents of hypotension than propofol, and demonstrated that it can even be safely used as anesthesia for high-risk ASA-PS3 patients [8, 9]. Additionally, during the induction of anesthesia in ASA-PS3 patients undergoing valve replacement surgeries, the remimazolam group remimazolam had fewer mean arterial pressure fluctuations and less hypotension than the propofol group, and the use of

norepinephrine was lower [10]. Another study on total mastectomy reported the use of remimazolam for the induction and maintenance of general anesthesia in a patient with severe aortic valve stenosis [11]. Evidently, remimazolam is a new drug that can be used for general anesthesia in patients who are expected to be hemodynamically unstable.

We used remimazolam, a new drug, for the induction and maintenance of general anesthesia to CT with hemodynamic instability. Remimazolam was used for Anesthesia induction and maintenance with 6 mg/kg/h and 1 mg/kg/h, respectively. Vital signs were relatively stable until pericardial decompression. In addition, hemodynamic stability was maintained during surgery. Our patient was continuously administered inotropes and vasopressor. Accordingly, there seems to be a limit to accurately confirm that the use of remimazolam prevented the occurrence of hypotension. However, the dosage of these drugs was not increased during the induction of anesthesia, and was reduced and discontinued after the CT was resolved. This confirms that there were no problems such as hypotension or cardiovascular suppression in the induction and maintenance of the anesthesia with remimazolam.

CONCLUSION

Remimazolam, which has a rapid onset and offset, minimal cardiorespiratory suppression, and an available antagonist, can be considered a new induction and maintenance agent for general anesthesia in hemodynamically unstable patients. Further clinical studies should be conducted to confirm the impact of remimazolam.

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