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Blood transfusion-induced anaphylaxis and coronary artery spasm during general anesthesia

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Abstract
Anaphylactic reactions to blood transfusion can lead to life-threatening cardiovascular disruptions. We describe a case in which anaphylaxis due to blood transfusion during general anesthesia was the probable cause of coronary artery spasm. Thirty minutes after the transfusion of concentrated red blood cells, the patient's blood pressure had dropped to 70/40 mmHg and peak airway pressure had increased to 35 cmH_2O. The ST segment of the ECG was simultaneously elevated, and the left upper arm became extensively flushed. The tryptase concentration in the patient's plasma collected 3 h postoperatively was 13.9 $\mu g \cdot l^{-1}$ (normal range, 2.1–9.0 $\mu g \cdot l^{-1}$). This case report emphasizes that anaphylactic reactions to blood transfusion can potentially lead to coronary artery spasm.

Key words Blood transfusion · Anaphylaxis · Coronary artery spasm · Tryptase · Anesthesia

Introduction

Anaphylaxis has been identified as a potential, although infrequent, cause of coronary artery spasm [1,2]. Dramatic changes in cardiac function can result from both the systemic and local release of mediators from mast cells [3,4]. Coronary artery spasm has been previously linked to allergic reactions to wasp stings, antibiotics, dextran, and the administration of contrast agents [1]. We describe a patient in whom an anaphylactic reaction to blood transfusion during general anesthesia was the probable cause of coronary artery spasm.

Case report

A 75-year-old man weighing 40 kg underwent thoracotomy and resection of a right upper-lobe lung mass. His medical history included a 50-year long history of cigarette smoking. Results of laboratory tests prior to surgery were within normal limits, except for low blood hemoglobin (7.6 $g \cdot dl^{-1}$), plasma albumin (2.8 $g \cdot dl^{-1}$), and forced expiratory volume (59%). He had no history of allergic reactions nor any previous blood transfusions.

Anesthesia was induced with fentanyl and propofol, using vecuronium for neuromuscular blockade, and the patient was not premedicated. The trachea was intubated with a left double-lumen endotracheal tube, and proper positioning was confirmed by bronchoscopy. Anesthesia was maintained with a continuous infusion of propofol and intermittent infusion of fentanyl. The patient was placed in the lateral decubitus position. Hemodynamic values remained stable for the first 40 min after the induction of anesthesia (blood pressure [BP], 100/60 mmHg; heart rate, 80 bpm). One-lung ventilation was performed without any complications, and the peak airway pressure was 29 cmH_2O.

Two packs of concentrated red blood cells were transfused to treat anemia, as requested by the surgeon. Hypotension was noted without any surgical cause 30 min after the initiation of transfusion (BP, 70/40 mmHg), and peak airway pressure had increased to 35 cmH_2O. The patient was administered etilefrine (4 mg), ephedrine (5 mg), and methoxamine (10 mg total), but his BP remained low despite the administration of vasoconstrictive agents. At this time, the ST segment of the ECG became elevated (Fig. 1B). Two minutes later, the ST segment spontaneously returned to normal. However, the ST segment again became elevated 20 min after the first elevation. Isosorbide dinitrate and nicorandil were administered according to the standard procedures for treating coronary artery spasm [2]. Continuous infusion of dopamine ($5\ \mu g \cdot kg^{-1} \cdot min^{-1}$) and noradrenaline ($0.1\ \mu g \cdot kg^{-1} \cdot min^{-1}$) restored BP to 100/60 mmHg. The second ST segment elevation persisted for 9 min, and transesophageal echocardiography performed after its resolution did not

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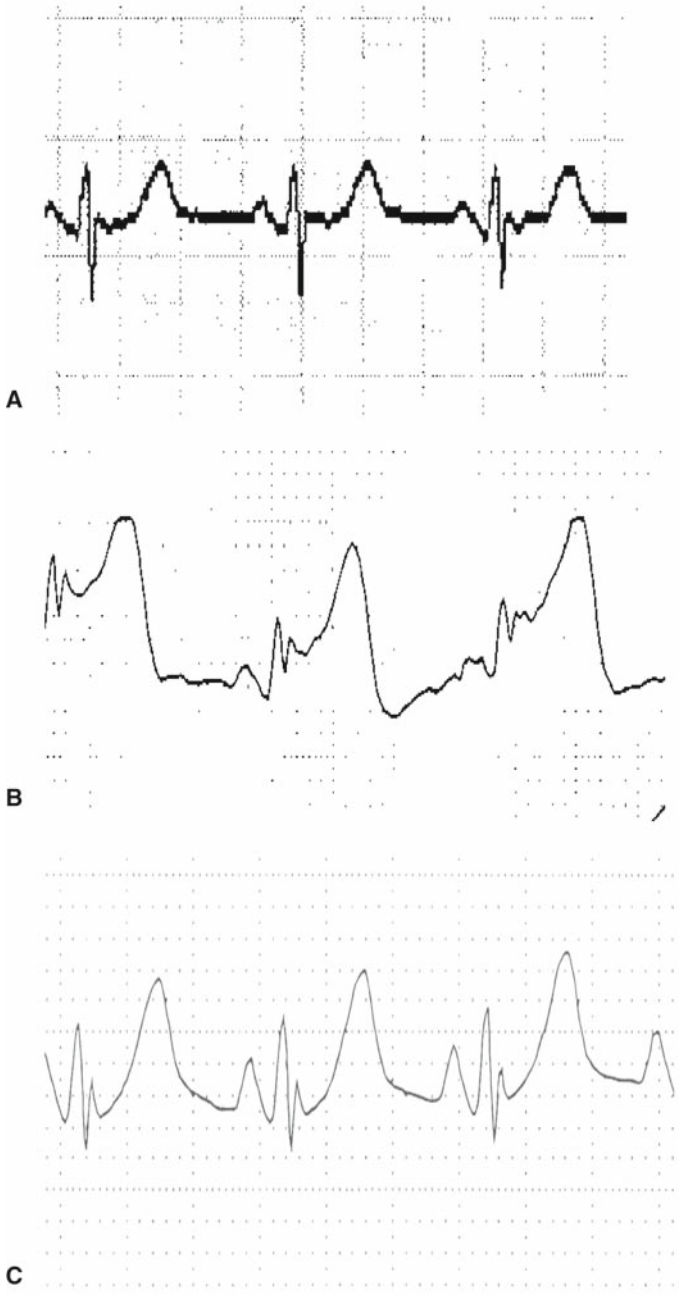

Fig. 1A–C. Electrocardiograms (ECGs) in lead II, recorded **A** before the induction of anesthesia (blood pressure [BP] 100/60 mmHg), **B** at the onset of circulatory collapse during surgery, with the first ST segment elevation (BP, 70/40 mmHg), and **C** after normalization of the second ST segment elevation (BP, 100/60 mmHg). The bundle branch block found in the ECG **C** had completely resolved in the ECG recorded a week after surgery

show any significant hypokinesis of the ventricular wall. Extensive flushing of the left upper arm was also noted, and methylprednisolone (1 g) was administered. The patient was transferred to the intensive care unit (ICU) after surgery and was extubated 3 h after admission into the ICU. Chest radiograph showed no significant findings postoperatively. He was closely monitored overnight and transferred from the ICU to the surgical ward on the next day. He was discharged from the hospital 17 days postoperatively after an uneventful subsequent postoperative course.

The patient's plasma tryptase concentration (normal range, 2.1–9.0 $\mu g \cdot l^{-1}$) sampled 3 h after the first ST segment elevation was 13.9 $\mu g \cdot l^{-1}$. The tryptase concentration in plasma collected the day before the surgery, as a reference value, was 4.1 $\mu g \cdot l^{-1}$. The concentration of plasma creatine kinase (CK)-MB sampled at the same time was within the normal range (10 $U \cdot l^{-1}$; normal range, <23 $U \cdot l^{-1}$). Coronary artery angiography performed postoperatively revealed 50% stenosis in segments 2 and 7. Immunological tests performed postoperatively did not reveal any plasma protein abnormalities or any antiplasma protein antibodies, either in the patient's plasma or in the transfused blood.

Discussion

The elevated concentration of plasma tryptase 3 h after the onset of ST segment elevation in our patient suggests that an anaphylactic reaction had actually taken place. Because the biological half-life of tryptase is approximately 2 h [5], it is reasonable to assume that the tryptase concentrations during the period of ST segment elevation may have been higher than the concentrations measured postoperatively. An increase in plasma tryptase concentration may signify the systemic activation of mast cells [5]. Histamine released from activated mast cells could have resulted in the persistent hypotension, elevated airway pressure, and the extensive flushing of the left upper arm seen in our patient. Although immunological tests failed to identify any plasma protein abnormalities or antiplasma protein antibodies, these null findings are not surprising, because the cause of most allergic reactions to blood products remains unknown [6]. We therefore deduce that the blood transfusion was the most plausible cause of the anaphylaxis, because no specific agents, such as neuromuscular blocker agents or antibiotics, were given during the 40-min period prior to the event.

The normal plasma CK-MB concentration 3 h after the operation indicates that acute myocardial infarction was not the cause of the ST segment elevation. Rather, recurring episodes of ST segment elevation are consistent with a diagnosis of coronary artery spasm. However, postoperative coronary angiography indicated preexisting stenosis of the coronary artery, and coronary artery spasm typically occurrs in the absence of coronary artery stenosis [1,3]. Nonetheless, a review summarizing

115 Japanese cases of perioperative coronary spasm [2] indicated that 9 of 16 patients who underwent postoperative coronary angiography exhibited significant stenosis of coronary arteries. Attacks of coronary artery spasm are frequently related to inadequate depth of anesthesia, the use of vasopressors, and vagal reflex [2]. Light anesthesia was unlikely in our patient, because the bispectral index was 49. Vagal reflex was also unlikely, because the timing of the ST segment elevation was unrelated to any specific surgical manuever.

The most plausible explanation for the coronary artery spasm was thus an anaphylactic reaction to the blood transfusion. The hypothesized mechanism for this reaction is that histamine is released from mast cells secondary to anaphylaxis, and provokes vasoconstriction of large-capacitance coronary arteries. Moreover, activated mast cells can induce plaque activation in patients with underlying coronary stenosis, and thus locally weaken inflamed atherosclerotic lesions to erode the plaque [4]. This process might have also been a factor in our patient, considering his premorbid coronary stenosis. A final possibility is that the aggressive use of vasopressors to treat the prolonged hypotension served to worsen the coronary artery spasm by increasing α-agonistic activity [1,4]. Because it is clinically difficult to discriminate coronary spasm induced by anaphylaxis from that mediated by vasoconstrictive agents, it is reasonable to assume that both of these factors had contributed to the development of coronary spasm in our patient. The incidence of anaphylactic reactions to blood transfusion ranges from 1 per 170000 to 1 per 18000 [6]. The literature in Japan suggests that 3.5% of the cases had been caused by allergic reactions [2]. The case reported here highlights the importance of remaining vigilant for the rare occurrence of coronary artery spasm due to anaphylactic transfusion reactions.

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References

1. Fujita Y, Chikamitsu M, Kimura M, Toriumi T, Endoh S, Sari A. An anaphylactic reaction possibly associated with an intraoperative coronary spasm during general anesthesia. J Clin Anesth. 2001;13:221–6.
2. Koshiba K, Hoka S. Clinical characteristics of perioperative coronary spasm: reviews of 115 case reports in Japan. J Anesth. 2001; 15:93–9.
3. Conraads VMA, Jorens PG, Ebo DG, Claeys MJ, Bosmans JM, Vrints CJ. Coronary artery spasm complicating anaphylaxis secondary to skin disinfectant. Chest. 1998;113:1417–9.
4. Del Furia F, Querceto L, Testi S, Santoro GM. Acute ST-segment elevation myocardial infarction complicating amoxicillin-induced anaphylaxis: a case report. Int J Cardiol. 2007;117:e37–9.
5. Mertes PM, Laxenaire M-C, Alla F; Group d'Etudes des Réactions Anaphylactoïdes Peranesthésiques. Anaphylactic and anaphylactoid reactions occurring during anesthesia in France in 1999–2000. Anesthesiology. 2003;99:536–45.
6. Gilstad CW. Anaphylactic transfusion reactions. Curr Opin Hematol. 2003;10:419–23.