

Clinical reports

Anaphylactoid shock in a patient following 5% human serum albumin infusion during off-pump coronary artery bypass grafting

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Abstract

A 59-year-old diabetic male patient undergoing off-pump coronary artery bypass grafting developed anaphylactoid shock after 5% human serum albumin (HSA) infusion started. During the first anastomosis, blood loss was more than 600 ml, with slightly decreased blood pressure. Therefore, 5% HSA, 250 ml, was infused against hypovolemia. However, as his blood pressure was decreasing continuously during the second anastomosis, another 250 ml of 5% HSA was added. The blood pressure rapidly dropped to 50/30 mmHg after the second 5% HSA administration started. As i.v. phenylephrine and ephedrine were not effective, norepinephrine was infused. Then we found a high cardiac output ($101 \cdot \text{min}^{-1}$) and peak airway pressure ($32 \text{ cmH}_2\text{O}$), with a decrease of oxygenation (P/F ratio, 82), and we suspected 5% HSA-caused anaphylactoid shock. Therefore, aminophylline was infused to treat bronchoconstriction. These treatments were effective, and the operation was successfully completed. Postoperatively, we noticed that these reactions may have been anaphylaxis, because the patient had a higher serum tryptase level ($16.2 \text{ ng} \cdot \text{ml}^{-1}$) than the reported nonanaphylaxis serum tryptase level ($8.23 \text{ ng} \cdot \text{ml}^{-1}$). HSA is a relatively safe colloid for use as a volume expander, because it has been reported that the risk of anaphylactoid reactions with HSA was much less than that with gelatins and dextrans, and similar to that with starches. However, the present case suggests that severe allergic reactions should be kept in mind with the use of any colloids.

Key words Anaphylactoid shock · Albumin · Tryptase

Introduction

Colloids such as dextrans, gelatins, starches, human serum albumins, and plasma protein fraction (PPF) are frequently used as volume expanders for the treatment of hypovolemia during anesthesia. Laxenaire and col-

leagues [1] reported a French multicenter prospective study ($n = 19593$) of anaphylactoid reactions to colloid plasma substitutes. In their report, 43 anaphylactoid reactions were recorded, and the overall frequency of the reactions was 0.219%. The frequency differed according to the substitute considered: 0.345% for gelatins, 0.273% for dextrans, 0.099% for human albumin, and 0.058% for starches. Therefore, albumin may be a relatively safer colloid. In addition, for patients undergoing cardiac surgery under cardiopulmonary bypass, 5% human serum albumin (HAS) is used rather than PPF, because 5% HSA contains less prekallikrein activator (which can induce hypotension with the generation of bradykinin) than PPF does [2,3]. We experienced a case of a patient undergoing off-pump coronary artery bypass grafting who developed anaphylactoid shock after 5% HSA infusion.

Case report

A 59-year-old man was scheduled for off-pump coronary artery bypass grafting surgery to improve his ischemic heart symptoms, because he had had an acute myocardial infarction 1 year before. Preoperative coronary angiography revealed 75% stenosis of the left main coronary trunk and 90% stenosis of the number 6, 7, and 9 branches of the left anterior descending coronary artery (LAD). He also had diabetes, and diet therapy had provided good blood sugar control, he did not have any history of drug or food allergic reactions. Regarding his surgical history, he had undergone a lumbar disk hernia operation 30 years previously.

Oral diazepam 10 mg and roxatidine, an H_2 -blocker, 75 mg, were used as premedication 90 min before the induction of anesthesia. Anesthesia was induced with propofol 40 mg, fentanyl 200 μg , and ketamine 40 mg. The trachea was uneventfully intubated following vecuronium 8 mg i.v. Anesthesia was main-

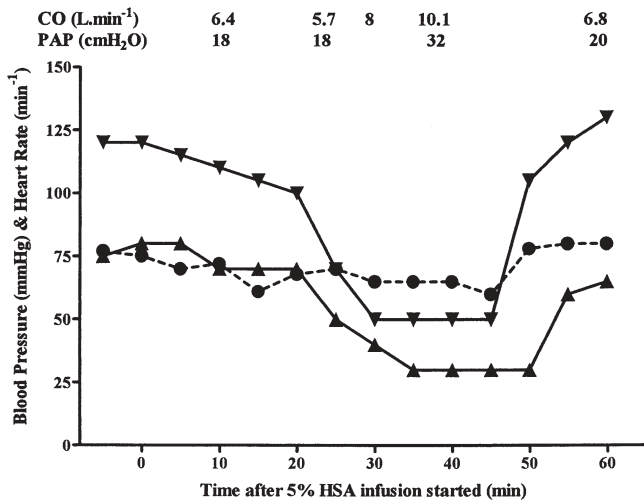


Fig. 1. Hemodynamic variables after 5% human serum albumin (HSA) infusion. Systolic blood pressure (*inverted triangle*), diastolic blood pressure (*triangle*), heart rate (*circle*), CO, cardiac output; PAP, peak airway pressure

tained with propofol 1–6 mg·kg⁻¹·h⁻¹ and ketamine 0.5–1 mg·kg⁻¹·h⁻¹. Vecuronium and fentanyl were given intermittently when needed.

Surgery proceeded uneventfully during the first anastomosis of the sequential left internal thoracic artery (LITA) graft to the LAD and the diagonal branch 1. As systolic blood pressure gradually decreased to 120 mmHg, with more than 600 ml of bleeding, the patient was given 250 ml of 5% HSA (ALBUMINAR-5%; CLS Behring, Danderyd, Sweden) (Fig. 1). However, blood pressure continued to decrease, to 100/70 mmHg, during the second anastomosis. Therefore, another 250 ml of 5% HSA was additionally infused. Suddenly, his blood pressure dropped to 50/30 mmHg, 5 min after the second 5% HSA administration started. Neither i.v. phenylephrine nor ephedrine was effective. Then norepinephrine infusion was started (finally at 0.15 µg·kg⁻¹·min⁻¹). Transesophageal echocardiography did not show low left ventricular ejection fraction or abnormal movement of the mitral valve. We found that the cardiac output and the peak airway pressure had increased, from 5.7 to 10.1 L·min⁻¹ and from 18 to 32 cmH₂O, respectively. In addition, the patient's face became red, and PaO₂ dropped to 82 mmHg under mechanical ventilation with 100% O₂. We suspected that these signs could have been caused by an anaphylactoid reaction to the albumin solution. As hemodynamics were stable with the norepinephrine infusion, we did not change to epinephrine. In addition, aminophylline was continuously infused, at 15 µg·kg⁻¹·min⁻¹, for the treatment of bronchoconstriction. Methylprednisolone 1000 mg was also given i.v. These treatments improved the patient's condition and the operation was completed successfully. Postopera-

tively, frozen serum samples were submitted for the measurement of mast-cell tryptase levels, and the levels at 20 min and 2 h after the anaphylactoid reaction were 16.2 and 13.1 ng·min⁻¹, respectively.

Discussion

In this patient, the clinical features were clearly typical of anaphylactoid shock, which could be induced by HSA. A French multicenter prospective study of anaphylactoid reactions to colloid plasma substitutes has suggested that HSA is relatively safer to use as a volume expander compared to other colloids such as dextrans and gelatins [1]. In addition, HSA is preferable to plasma protein fraction (PPF) for use in patients undergoing cardiac surgery, as PPF, which contains prekallikrein activator, generates bradykinin, which may induce hypotension with vasodilatation [2,3]. In addition, several case reports in Japan [4,5] have shown anaphylactoid shock with PPF. Therefore, we chose HSA as a volume expander in the present patient. However, we should know that HSA does contain a very small amount of prekallikrein activator [2,3]. Moreover, there is a case report showing cardiovascular collapse caused by anaphylactoid reactions to 5% HSA [6].

Anaphylaxis is an acute allergic reaction that results from the sudden immunoglobulin (Ig) E-dependent release of mast cells and basophile mediators after contact with an antigen. The onset of symptoms of anaphylaxis generally occurs within minutes of exposure to the antigen. However, in the present patient, the anaphylactoid reaction occurred 25 min after administration of the first bottle of 5% HAS had started. Why was the reaction delayed? Ellis and Day [7] have described that symptoms of anaphylaxis occasionally occur as late as 1 h after exposure to the antigen; thus, it seems feasible that the symptoms could have appeared 25 min after antigen exposure in the present patient. Another possibility is that only the second bottle of 5% HAS contained the offending antigen, whereas the first bottle did not.

It has been recommended that the term: "anaphylactoid reaction" should be used in general when the immune mechanism has not been confirmed by allergologic tests. Therefore, as we could not perform further allergologic tests, the present case should be classified as anaphylactoid shock. However, Enrique and colleagues [8] reported that the measurement of serum tryptase may be a useful tool for the diagnosis of anaphylaxis. They determined the best cutoff point for the tryptase level (using data from 30 consecutive patients presenting at the emergency room with a clinical allergic reaction) to confirm the diagnosis of anaphylaxis, and found that the best cutoff point for the tryptase level was

8.23 ng·min⁻¹, with 94.12% sensitivity and 92.31% specificity [8]. In the present patient, as the tryptase levels at 20 min and 2 h after the anaphylactoid reaction were 16.2 and 13.1 ng·min⁻¹, respectively, the reactions could be classified as anaphylaxis.

In the present patient we did not measure serum haptoglobin. However, it has been reported that severe anaphylaxis may occur after albumin infusion in patients with ahaptoglobinemia [9,10]. The incidence of ahaptoglobinemia among Japanese people has been reported to be approximately 1/4000 [9]. Thus, when a severe anaphylactic reaction to albumin or blood transfusion is revealed, the possibility of ahaptoglobinemia should be considered.

In general, epinephrine is the agent of first choice to treat anaphylactic shock, as epinephrine produces α_1 -adrenoceptor stimulation, which constricts dilated vessels and activates β_2 -adrenoceptors to relax the constricted airway smooth muscles. However, we did not use epinephrine for the treatment of anaphylactic shock in the present patient. We had already infused norepinephrine, which potently stimulates α_1 -adrenoceptors, to maintain the blood pressure. Therefore, we additionally gave aminophylline infusion to treat anaphylactoid bronchoconstriction, as aminophylline, similarly to β_2 -adrenoceptor agonists, increases intracellular cyclic adenosine monophosphate (cAMP) levels in airway smooth muscles, which induces bronchodilation. In addition, Yagi et al. [11] also successfully treated an anaphylactoid reaction, to vecuronium, with aminophylline.

In summary, we experienced suspected anaphylactoid reactions to HSA during off-pump coronary artery bypass grafting. We should keep in mind that severe

allergic reactions may occur with the use of any colloids.

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