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Case Report

Combined use of extracorporeal membrane oxygenation and hemodialysis in the case of contrast-induced biphasic anaphylactic shock

Abstract

Anaphylactic shock is the most critical iodine contrast media-mediated adverse reaction. Although nonionic iodine contrast media is widely used and is less likely to induce adverse reactions compared with ionic contrast media, patients with a history of contrast-induced allergic reactions provide a dilemma to interventional cardiologists because of the greater risk of nonionic or ionic contrast media-induced allergic reactions [1]. Most episodes of anaphylaxis develop early and resolve completely with appropriate treatment; however, approximately 10%–20% of these cases present with delayed onset of symptoms, follow a biphasic or protracted course, and create a very critical situation that requires immediate intervention [2,3]. We herein report a critical case of iodine contrast media-induced biphasic anaphylactic shock that required extracorporeal membrane oxygenation (ECMO) for hemodynamic stabilization with hemodialysis to retrieve contrast media.

A 63-year-old man was hospitalized for staged percutaneous coronary intervention (PCI). The patient had a history of acute urticaria induced by iodine contrast media (Iomeron 350®) during the previous PCI two weeks before. Therefore, another iodine contrast media (Omnipark 350®) that did not induce any allergic symptoms during coronary angiography one month ago was deemed safe for use in staged PCI. In addition, preprocedural intravenous hydrocortisone infusion was administered as prophylaxis. Nonetheless, the patient complained of head discomfort and altered mental status 40 min after the first injection of contrast media and developed pulseless electrical activity (PEA) (Figure). Immediate cardiopulmonary resuscitation with epinephrine, corticosteroid, histamine blockers, volume loading, and intubation was performed. However, multiple intravenous doses of epinephrine and norepinephrine were required to improve ongoing hemodynamic instability following resuscitation. Electrocardiogram revealed ST elevation in the inferior leads and depression in the anterior leads, suggesting either stent thrombosis or coronary spasm. Coronary angiogram revealed a severe spasmogenic reaction at the proximal left circumflex artery, suggesting Kounis syndrome, which was resolved by an intracoronary injection of isosorbide dinitrate. Intra-aortic balloon pumping (IABP) was performed to enhance coronary perfusion, and the patient's hemodynamics improved with arterial systolic blood pressure rising above 150 mmHg one hour after the PEA episode. The patient was transferred to the intensive care unit (ICU) with continuous intravenous infusion of catecholamine to maintain blood pressure.

One hour after admission to ICU, the patient's systolic blood pressure suddenly dropped to approximately 50 mmHg (Figure); thus, contrast media-induced biphasic anaphylactic shock was considered as the underlying cause. Despite multiple catecholamine doses, his

hemodynamic condition worsened. ECMO for hemodynamic support and hemodialysis for the clearance of the contrast media were performed, which led to improvements in his hemodynamic status.

The patient was successfully weaned from the ECMO circuit and IABP two days later. Six days after admission to ICU, he was transferred to the general ward. The patient fully recovered and left the hospital 10 days after the initial admission without any serious complications or neurological deficits.

To the best of our knowledge, this is the first report on the effectiveness of combined use of ECMO and hemodialysis for iodine contrast media-induced biphasic anaphylactic shock, which is an extremely critical complication.

Recently, ECMO was shown to be effective as a salvage treatment to inpatients or outpatients with cardiac arrest. The application of ECMO for biphasic and profound anaphylactic shock may be a pivotal procedure, as shown in previous studies [4,5]. There are six case reports of successful use of ECMO for anaphylactic shock (Table 1). All of them involved severe allergic reactions, i.e., cardiopulmonary arrest, left ventricular dysfunction, and respiratory failure [6–11]. Furthermore, a previous study has found that the initial severity of the reaction was associated with the incidence of biphasic reaction [12]. Therefore, considering an immediate utilization ECMO is crucial for biphasic and profound anaphylactic shock.

Although the use of hemodialysis for anaphylactic shock has seldom been reported, the clearance of the contrast media may play a pivotal role in the pathophysiological mechanism of biphasic anaphylactic shock. Delayed release of cytokines and platelet activating factor (PAF) are thought to have a pivotal role for mechanism of biphasic anaphylaxis [13–16]. Finkelman and Choi et al. demonstrated an alternative pathway of anaphylaxis that is mediated by IgG antibody and PAF in murine model. Continuous exposure to large amounts of antigen leads the binding of IgG antibodies to the macrophages and stimulates release of PAF. In addition, late increase in PAF levels was shown to cause a late reaction of anaphylaxis [13,14]. Interestingly, a significant increase in serum PAF levels was also seen in human with severe anaphylaxis [14,17]. Considering the many similarities between the murine and human immune systems, this IgG pathway has been suggested to mediate PAF release and lead to disease in humans as well. Consequently, hemodialysis can decrease internal contrast media levels, thereby limiting the induction of the IgG pathway of anaphylaxis.

In conclusion, the combined use of ECMO and hemodialysis is effective in cases with critical, contrast media-induced anaphylactic shock.

ECMO; extracorporeal membrane oxygenation, CPA; cardio pulmonary arrest, LV; left ventricular, RV; right ventricular, IABP; intra aortic balloon, ACS; abdominal compartment syndrome.

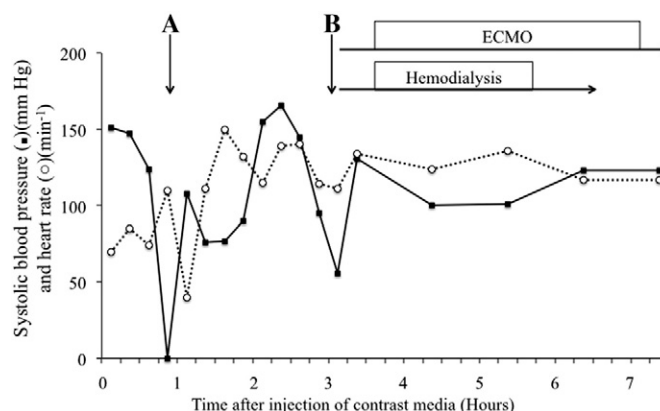


Figure. Hemodynamic changes of systolic blood pressure and heart rate after injection of contrast media. Biphasic hemodynamic collapse (A; 40 min after injection of contrast media, B; 3 h after injection of contrast media) occurred and utilization of extracorporeal membrane oxygenation and hemodialysis led to improvements in the hemodynamic status.

Table 1

Published reports of ECMO in patients with anaphylactic shock

Study	Antigen	Onset	CPA	LV dysfunction	Other complications	Device
Zhi-ping Zhang et al., 2015	Contrast	Immediate	Yes	Yes	No	IABP/ECMO
Weiss et al., 2015	Cefazolin	Immediate	Yes	Yes	No	ECMO
Konstantin et al., 2015	Amiodarone	Immediate	Yes	Yes	No	ECMO
Chan Dominy et al., 2014	Peanut	Unknown	Yes	No	Respiratory failure	ECMO
Feltom et al., 2006	Ca2+ gluconate	Immediate	No	Yes (RV)	Respiratory failure	ECMO
Lafforgue et al. 2005	K+ phosphate Atracurium	25 min late	Yes	No	ACS	ECMO

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