Gadobutrol-induced acute respiratory distress syndrome rescued by intravenous immunoglobulin and extracorporeal membrane oxygenation

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Case report

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Abstract

Background

Gadobutrol-induced life-threatening allergies, such as acute respiratory distress syndrome (ARDS), is rarely reported. The severe allergies publishing in previous literature report involves IgE and tryptase-mediated immune responses. Gadobutrol-related non-IgE-mediated allergy has not been reported.

Case presentation

A 39-year-old woman underwent Gadobutrol-contrast magnetic resonance imaging of both lower limbs for clinically suspected vasculitis. One hour after injection of 8 ml Gadobutrol, the patient developed dizziness without respiratory symptoms. Eight hours after the contrast injection, she exhibited vomiting, dyspnea, and rapid progression of edema. She visited the emergency room, where chest imaging showed increased infiltration in both lungs. Arterial blood gas analysis revealed hypoxemia when she was given 100% inspired oxygen. The patient was admitted to intensive care unit and received inotropic agents. Extracorporeal membrane oxygenation was applied due to the diagnosis of ARDS and persistent hypoxia after using mechanical ventilation. Systemic intravenous glucocorticoid and antihistamine were prescribed for allergic reaction. Contrast-relevant non-IgE-mediated allergy was confirmed by detailed medical record and laboratory data. An additional 2 days of intravenous immunoglobulin was prescribed. By 3 days after admission, the patient's shock and acute respiratory distress syndrome had responded great. She was discharged 13 days after admission.

Conclusions

Here, we present the first case of gadobutrol-induced non-IgE-mediated allergy complicated by ARDS. This condition was successfully rescued by dual therapy of venovenous extracorporeal membrane oxygenation and intravenous immunoglobulin without any complications.

Background

Gadolinium-based contrast agents (GBCAs) for magnetic resonance imaging (MRI) enhancement is important imaging technique for disease diagnosis. GBCAs have very low adverse events. Gadobutrol-induced life-threatening allergies, such as acute respiratory distress syndrome (ARDS), is rarely reported [1]. The severe allergies publishing in previous literature report involves IgE and tryptase-mediated immune responses. Gadobutrol-related non-IgE-mediated allergy has not been reported. However, using clinical symptoms and laboratory data, we confirmed the first case of gadobutrol-induced non-IgE-mediated allergy complicated by ARDS. This condition was successfully rescued by venovenous extracorporeal membrane oxygenation (VV ECMO) and intravenous immunoglobulin (IVIG) without any complications. Clinicians should be aware that appropriate laboratory diagnosis may be needed to identify the mechanism responsible for gadobutrol-related adverse effects.

Case Presentation

A 39-year-old woman underwent gadobutrol-contrast MRI of both lower limbs for chronic cutaneous ulcers and clinically suspected vasculitis. Before the MRI examination, she did not have respiratory symptoms. One hour after injection of 8 ml (0.1 ml/kg) gadobutrol, the patient developed dizziness without respiratory symptoms. Eight hours after the contrast injection, she exhibited orthopnea, vomiting, exertional dyspnea, and rapid progression of edema in both lower limbs. The patient visited the emergency room, where hypotension (blood pressure of 69/42 mmHg), tachycardia (heart rate of 124/minute), and tachypnea (respiratory rate of 36/minute) were identified. Chest plain film (CXR) and computed tomography (CT) scans of the chest (Figs. 1 and 2) showed increased infiltration in both lungs. Arterial blood gas analysis revealed a pH of 7.22, partial pressure of oxygen (pO2) of 60.5 mmHg, and a PaO2/FiO2 ratio of 60.5, and she was given 100% inspired oxygen. Blood sampling showed a white blood cell count of 31.98 ×10^3/μL, but did not show abnormal levels of eosinophil count, serum IgE, or tryptase. The patient was admitted to the intensive care unit (ICU) and received intravenous inotropic agents, endotracheal intubation, mechanical ventilation, and VV ECMO for the diagnosis of ARDS. Systemic intravenous glucocorticoid and antihistamine were prescribed for a suspected allergic reaction.

After the patient's admission to the ICU, microbial examinations did not identify any pathogens. Leukocytosis with neutrophil predominant, normal level of, acute phase reactant (CRP), IgE and tryptase helped us to confirm the diagnosis of gadobutrol contrast-relevant non-IgE-mediated allergy. An additional 2 days of IVIG (total 2 g/kg) was prescribed. By 3 days after admission, the patient's shock and ARDS had responded to the IVIG and ECMO supplement. The endotracheal tube and ECMO were removed 4 days after admission based on the significant resolution shown on CXR and remission of hypoxemia (Fig. 2). She was discharged without any complications 13 days after admission.

Discussion

Here, we report on a rare and life-threatening gadobutrol-mediated non-IgE allergy complicated by ARDS, which was rescued by mechanical ventilation, VV ECMO, and IVIG treatment. Glucocorticoid and antihistamine are the first choice for IgE-mediated allergy. IVIG may be beneficial for patients who do not respond to conventional therapies [2]. In cases of critical anaphylaxis and ARDS, early lung-replacement therapy with ECMO has been shown to improve outcomes for patients with ARDS and has been used in selective patients as a rescue therapy to maintain systemic circulation and tissue oxygenation [3].

In addition to traditional treatment of allergy, IVIG is also effective for treating life-threatening non-IgE-mediated allergy. In previous studies, high-dose IVIG has been used as an anti-inflammatory agent for the treatment of allergic diseases [4]. IVIG potentiates the effects of steroids by increasing steroid-binding affinity to the glucocorticoid receptor and reducing the number of circulating neutrophils by up regulating their apoptosis [5]. IVIG is considered to be an effective therapy for IgE-related allergy, as well as neutrophil-dominant or non-IgE-mediated allergic diseases.

ARDS has a mortality rate of 30–45% depending on the severity of the condition and may have prolonged effects on morbidity and complications [6]. The average length of stay in the ICU and hospitalization for ARDS is longer than 1 month. Our patient stayed only 8 days in the ICU and 13 days total in the hospital and had no further complications. The simultaneous combination therapy of IVIG, mechanical ventilation, and VV ECMO was effective for treating this critical non-IgE-mediated allergy and ARDS. Prompt laboratory and imaging examinations helped us to confirm the diagnosis and to exclude infections and other medical problems, and to provide proper treatment.

Conclusions

Gadolinium-based contrast agents have a very low adverse event rate. Most induced life-threatening allergies involve circulating IgE and tryptase-mediated immune responses. We present a case of gadobutrol-induced non-IgE-mediated severe allergic reaction. Dual therapy of VV ECMO and IVIG beneficial to this case. Further research might be performed to validate these findings. Obtaining detailed medical records and prompt laboratory test results helped us to make a precise diagnosis and effective treatment.

Abbreviations

IgE: Immunoglobulin E; ARDS: Acute respiratory distress syndrome; IVIG: Intravenous immunoglobulin;

VV ECMO: Venovenous extracorporeal membrane; GBCAs: Gadolinium-based contrast agents;

CT: Computed tomography; pO2: partial pressure of oxygen; ICU: intensive care unit

Declarations

Acknowledgements

Not applicable

Authors' contribution

Dr. Chen YC has collected all data of the case and written the manuscript. Dr. Lyu SY help read all imaging and contributed to patient’s care. Dr. Chen HC help take care of the patient and reviewed the literature. Dr. Lu CC was in charge of the primary care of this case and edited the manuscript.

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Ethics approval and consent to participate

The consent to participate has been given by the patients. This study was approved by the Institutional Review Board of Tri-Service General Hospital.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report.

Availability of data and materials

Not applicable' in this section.

Competing interests

The authors declare no conflict of interest.

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Figures

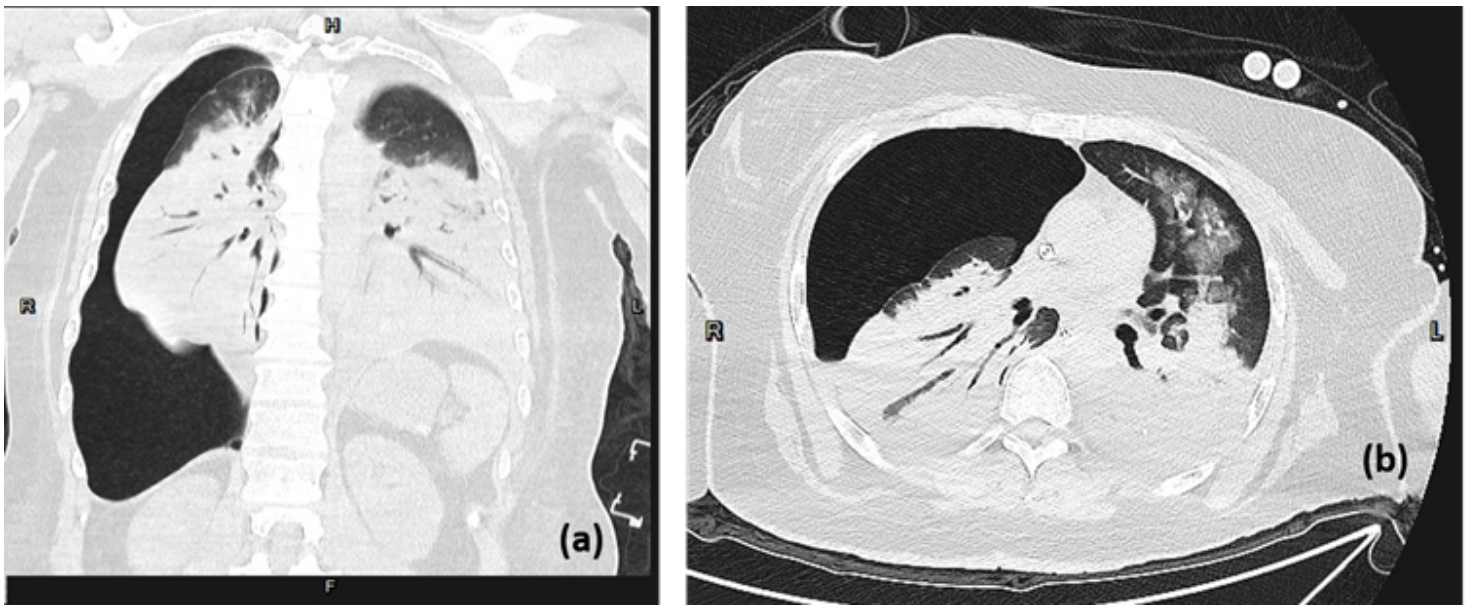

Figure 1

Coronal (a) and transverse imaging of computed tomographic scans of chest (b) obtained on the admission date showed bilateral multiple patchy consolidation and ground-glass opacities.

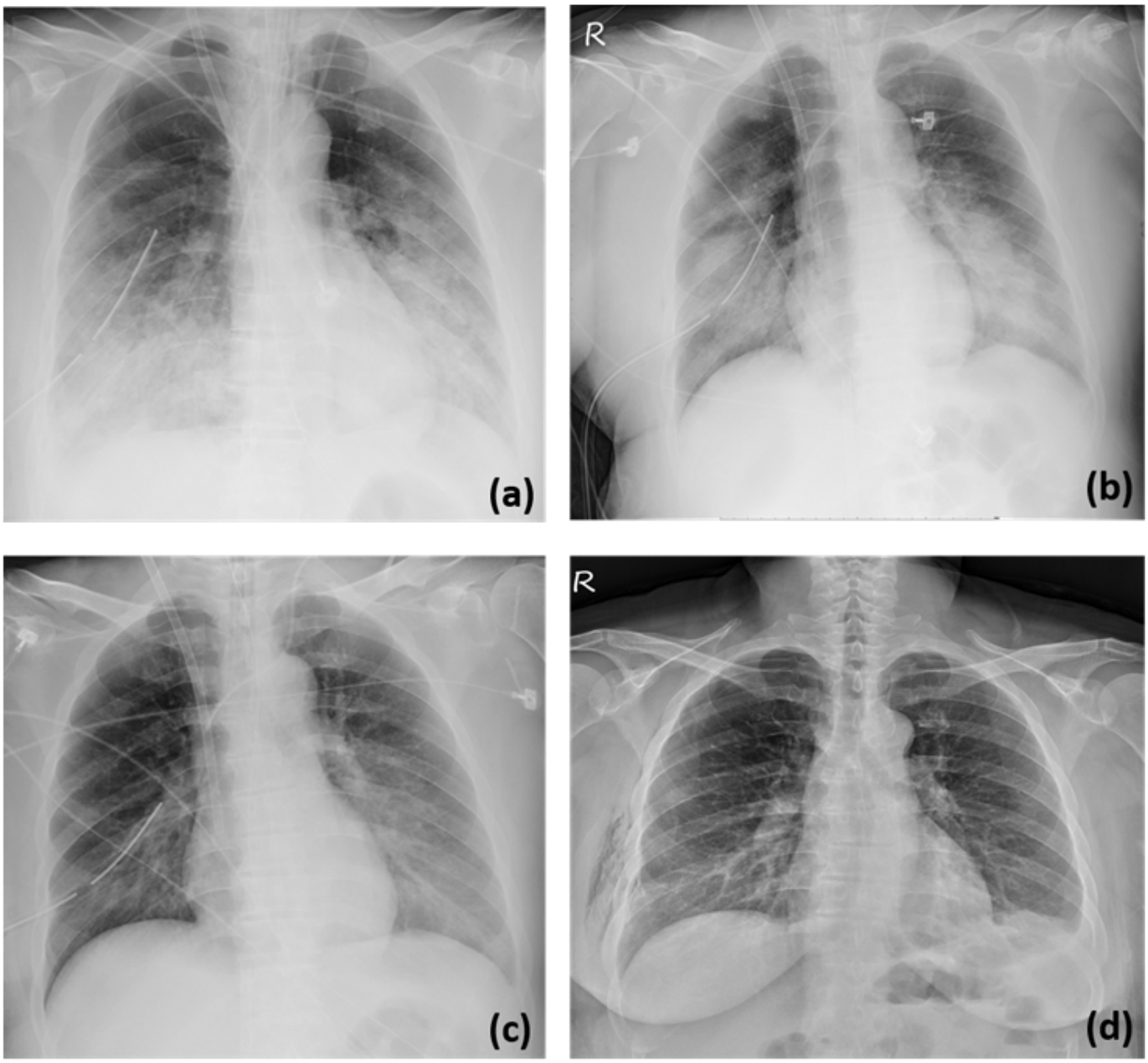

Figure 2

Serial chest radiograph imaging demonstrated the rapid progression and gradual remission of acute respiratory distress syndrome at bilateral lungs. (a) Day 1: The chest radiograph image on the admission date showed infiltration and subtle consolidations at both lungs. (b) Day 2: Chest radiograph image revealed partial remission of infiltration at both lungs. (c) Day 4: Chest radiograph image demonstrated significant remission of consolidations at both lungs. The endotracheal tube and extracorporeal membrane oxygenation had been removed after this plain film of chest. (d) Day 10: Infiltrations and consolidations at both lungs had been in complete remission, compared to the admission.