A Grade III Severe Hypersensitivity Caused by Gadopentatic Acid Injection: A Case Report

Authors: Qinlan Chen, MS, and Qian Qian, MS, Zhejiang, China

Contribution to Emergency Nursing Practice

- Gadopentetic acid is a common contrast agent for enhanced magnetic resonance imaging. Adverse reactions due to gadolinium-based contrast agents are rare.
- This case stresses the importance of being equipped with the medicines, items, supplies, and equipment needed for emergency medicines in all departments where contrast agents are used.
- Nurses and imaging technicians should be aware of the possibility of severe allergic reactions to GBCA, even if they are rare. Even mild adverse drug reactions (such as pruritus) should be taken seriously.

Abstract

Background: Gadopentetic acid is a common contrast agent for enhanced magnetic resonance imaging. Adverse reactions due to gadolinium-based contrast agents are rare and easily overlooked by medical staff. A patient developed a rash as the first symptom and quickly developed a severe allergic reaction after receiving gadopentetic acid.

Patient presentation: A 74-year-old female patient was admitted on January 11, 2022, for femur magnetic resonance imaging. At 12:05 PM, a routine intravenous rapid injection of gadopentetic acid (15 ml) was given. Two minutes after administration, the patient developed skin itching. No obvious rash was found, but a 10 mg intravenous injection of dexamethasone was given.

Recount of events: After 1 minute, skin pruritus had not improved significantly, saliva secretion had increased significantly, and a general discomfort appeared. At 12:10 PM, outside the scanning room, the patient suddenly became unconscious; 1 mg of EPINEPHrine was injected intramuscularly, and oxygen was given through a mask. Heart rate, blood pressure, and oxygen saturation steadily dropped. The patient was transferred to the intensive care unit. After EPINEPHrine, norepinephrine, terlipressin, and dexamethasone treatments, the vital signs eventually stabilized. The patient was judged to have had a grade III severe allergic reaction according to the first aid guidelines for severe allergic reactions in China. The patient was discharged from the hospital on the morning of January 14.

Conclusion: This case stresses the importance of being equipped with the medicines, items, supplies, and equipment needed for emergency treatments in all departments where contrast agents are used. Patients with apparently mild adverse reactions to contrast agents should not be overlooked.

Key words: Gadolinium DTPA; Hypersensitivity; Adverse drug reactions; Magnetic resonance imaging; Case report

Introduction

Magnetic resonance imaging (MRI) is an important imaging method. Enhanced MRI can provide more diagnostic information and has become an important evaluation method in clinical disease diagnosis and treatment.[1] Gadolinium-based contrast agents (GBCAs) are the most common MRI contrast agents in clinical practice. Currently, 9 GBCAs have been officially put into clinical use since the US Food and Drug Administration approved gadopentetic acid (Gd-DTPA) (the first GBCA on the market in 1987), and Gd-DTPA has become the most widely used and most frequently used GBCA in the world for MRI.[2] Immediate hypersensitivity reactions with GBCAs

Qinlan Chen is Head Nurse, Department of Radiology, the Second Affiliated Hospital Zhejiang University school of Medical, Zhejiang, China

Qian Qian is Nurse, Department of Radiology, the Second Affiliated Hospital Zhejiang University school of Medical, Zhejiang, China

For correspondence, write: Qinlan Chen, MS, Department of Radiology, the Second Affiliated Hospital Zhejiang University school of Medical, Zhejiang, China. E-mail: chenqinlan@zju.edu.cn.

J Emerg Nurs 2023;■:1-4.
0099-1767

https://doi.org/10.1016/j.jen.2023.02.009

are rare (0.3%), with only 0.018% for Gd-DTPA, and severe reactions were mostly reported with gadopenic acid (Gd-BOPTA).[3] This paper reports a patient with a grade III severe allergic reaction following using Gd-DTPA.

Case Presentation

A 74-year-old female patient was admitted on January 11, 2022, for osteoporosis and presence of left hip pain for more than 1 year. The patient had a history of cholecystectomy, subtotal thyroidectomy, hypertension, and osteoporosis. The patient was scheduled to undergo an enhanced MRI examination of the femur.

After the absolute contraindications to GBCA were excluded, a routine intravenous rapid injection of Gd-DTPA (15 ml/7.04 g, Guangzhou Kangchen Pharmaceutical Co, Ltd, Guangzhou, China) was given at 12:05 PM. Two minutes after injection, the patient developed skin itching. No obvious rash was found, but a 10 mg intravenous injection of dexamethasone was given.

After 1 minute, skin pruritus had not improved significantly, saliva secretion had increased significantly, and a general discomfort appeared. The examination was stopped immediately, and the patient was transferred outside the scanning room. The patient was irritable during the transfer.

At 12:10 PM, outside the scanning room, the patient suddenly became unconscious. Their head was turned to 1 side, 1 mg of EPINEPHrine was injected intramuscularly, and oxygen was given through a mask. The heart rate was 88 bpm, blood pressure could not be measured, and oxygen saturation was 96%. The hospital emergency team was called. At 12:13 PM, blood pressure was 65/35 mm Hg (systolic blood pressure/diastolic blood pressure), and oxygen saturation was 85%. At 12:15 PM, heart rate dropped to 51 bpm, blood pressure was 76/42 mm Hg, blood oxygen saturation was 76%, and the Glasgow coma scale score was 3. The patient was transferred to the emergency intensive care unit and received emergency tracheal intubation, ventilator-assisted ventilation, sedation, analgesia, norepinephrine 1 mg booster, methylPREDNISolone (40 mg), and other anti-anaphylaxis treatments. By 12:30 PM, they received three 1-mg EPINEPHrine intravenous boluses. At 12:40 PM, norepinephrine (10 mg) was given. At 12:55 PM, methylPREDNISolone (40 mg) combined with norepinephrine and terlipressin (with normal saline 50 ml, 5 ml/h) were given to maintain blood pressure. The electrocardiogram revealed atrial fibrillation, premature ventricular contractions, and extensive anterior ST-segment elevation. The electrocardiogram at 3:13 PM after continuous medication showed sinus rhythm with no abnormality, and terlipressin was stopped. At 4:15 PM, the patient's vital signs were stable under ventilator assistance and analgesic and sedative drugs (fentaNYL citrate 0.3 mg and dexmedetomidine 0.2 mg); blood pressure was maintained at 106-126/58-67 mm Hg, heart rate was 87 to 96 bpm, and blood oxygen saturation was 98% to 99%.

The patient's family revealed that the patient had a history of allergy to antipyretic analgesics (allergic manifestations were shock), pollen, and alcohol. The patient was judged to have had a grade III severe allergic reaction according to the first aid guidelines for severe allergic reactions in China after receiving Gd-DTPA. On January 13, the patient was awake, the analgesic and sedative drugs were stopped, the tracheal intubation was removed, and spontaneous breathing resumed. The patient was discharged from the hospital on the morning of January 14.

Discussion

Strengths in the case reported here include the prompt response of the radiologists, nurses, and technicians, the presence of peripheral venous access in advance, and the timely initiation of the hospital's emergency response team. Patients with apparently mild adverse reactions (ADRs) to contrast agents should not be overlooked. This case stresses the importance of having the medicines, supplies, and equipment needed for emergency care in all departments where contrast agents are used.

Drug-induced anaphylactic shock (DIAS) is a type I hypersensitivity reaction involving the cardiovascular, respiratory, nervous, and digestive systems and the skin and mucosal tissues within minutes to hours after drug use. This leads to whole body capillary expansion and permeability increase, cardiac output drops sharply, and blood pressure drops to shock level.[4] DIAS can be life-threatening in the case of failure of timely rescue. The patient reported here had a Glasgow coma scale of 3, undetectable blood pressure, cyanosis, and decreased blood oxygen saturation, indicating grade III severe allergy according to the grading standard in the Chinese guidelines for first aid for severe allergic reactions. In the case of DIAS, an intramuscular injection of adrenaline is recommended as the first-line treatment by the European Society of Allergy and Clinical Immunology and the World Allergy Organization.[5,6] Adrenaline takes effect quickly and can quickly relieve the clinical symptoms and hemodynamic

abnormalities of patients with anaphylactic shock.[7] The attending clinician should inform the patient of the possible ADRs before examination and how to warn the technician or physician that an abnormal event is happening. The medical informed consent form of GBCA administration should be signed by the patient after understands the possible risks associated with MRI and GBCAs. In addition, the patient should be closely observed during the examination and within 30 minutes after the examination for ADRs. The radiology department should have a team available to deal with the emergency response for treating GBCA ADRs.

Allergy tests cannot predict the possibility of allergic reactions following the use of contrast agents,[8] and the international consensus on drug allergy clearly states that H1 receptor antagonists and glucocorticoids cannot prevent systemic allergic reactions mediated by IgE.[9] Therefore, it is very important to ask about the patient's allergy history and closely monitor the early stage of medication administration.

The absolute contraindications to MRI are excluded when prescribing an enhanced MRI examination. The patient was allergic to antipyretic analgesics, but it is not a contraindication to gadolinium contrast agents. It was the only allergy the patient had. The relationship of that allergy to the grade III event reported here is unknown. Still, the ADR observed in the reported case began with an apparently mild ADR of skin pruritus but very rapidly evolved into a life-threatening ADR. Therefore, patients with apparently mild ADRs to contrast agents should not be overlooked.

Gd-DTPA is a paramagnetic, ionic, and non-specific extracellular fluid contrast agent. Gadolinium ions are surrounded by chelates and form gadolinium chelates with significantly reduced toxicity. The common ADRs of Gd-DTPA are nausea, vomiting, dizziness, headache, and other ADRs.[3,10,11] Moreover, Gd-DTPA has rare serious ADRs, including anaphylactic shock, coma, disturbance of consciousness, cardiac arrest, shock, increased or decreased blood pressure, respiratory distress, and acute renal failure.[3,10,11] The incidence of acute ADRs with GBCAs is low at around 0.3%.[3,10,11] An early study suggested that patients with previous GBCA allergy history were 8 times more likely to have hypersensitivity than the general population.[12] It has also been reported that patients with a previous GBCA allergy history account for 30% of the GBCA ADR population.[13] The incidence of ADRs to GBCA was slightly higher in patients with asthma and other allergies.[13]

Implications for Emergency Nurses

Medical personnel should ask the patient about their disease and allergy history in detail and determine whether to perform an enhanced MRI examination after fully evaluating the possible advantages and disadvantages of MRI for the specific patient. The radiology department should have the medicines, supplies, and equipment needed for emergency treatments in workplaces where contrast agents are used. Nurses and imaging technicians should be aware of the possibility of severe allergic reactions to GBCAs, although they are rare. Even apparently mild ADRs (such as pruritus) should be considered suspicious.

Patient Recount of Events

I selected to undergo MRI in January 2022 because of left hip pain for more than 1 year and to determine whether a hip replacement would be necessary. I lay down on the machine table, and the technician prepared me. At some point, the technician told me that the contrast agent would be injected. Shortly after, I sensed my skin itching, which I told the technician, and she gave me something for the itching. But I rapidly began to feel sick, and then I had no real recollection of the events except for a few flashes. I finally woke up in the intensive care unit.

Conclusion

Preparedness, rapid response, and careful monitoring of patients who experience any sign of ADR after gadolinium injection are the key to emergency care if an ADR occurs. Patients with apparently mild ADRs to contrast agents should not be overlooked.

Data, Code, and Research Materials Availability

A written informed consent was obtained from the patient regarding the publication of this case report, use of the personal statement, and any/all accompanying images. A copy of written consent is available for review by the editor-in-chief of this journal.

This work has been carried out in accordance with the Declaration of Helsinki (2000) of the World Medical Association. This study was approved by the Second Hospital Affiliated to Medical School of Zhejiang University Human Research Ethics Committee (20220912), and all participants provided written informed consent.

Author Disclosure

Conflicts of interest: none to report.

The patient care evaluated in this case report was performed in the radiology department where both authors are currently employed.

Development and application of Nursing Information Management System in Radiology Department (DEYF-001-20191011).

REFERENCES

1. ACR Committee on Drugs and Contrast Media. *ACR Manual on Contrast Media*. Reston: American College of Radiology; 2020.
2. Do C, DeAguero J, Brearley A, et al. Gadolinium-based contrast agent use, their safety, and practice evolution. *Kidney360*. 2020;1(6):561-568. https://doi.org/10.34067/kid.0000272019
3. Granata V, Cascella M, Fusco R, et al. Immediate adverse reactions to gadolinium-based MR contrast media: a retrospective analysis on 10,608 examinations. *BioMed Res Int*. 2016;2016:3918292. https://doi.org/10.1155/2016/3918292
4. Ring J, Grosber M, Brockow K, Bergmann KC. *Anaphylaxis*. Chem Immunol Allergy. 2014;100:54-61. https://doi.org/10.1159/000358503
5. Muraro A, Roberts G, Worm M, et al. Anaphylaxis: guidelines from the European Academy of Allergy and Clinical Immunology. *Allergy*. 2014;69(8):1026-1045. https://doi.org/10.1111/all.12437
6. Kemp SF, Lockey RF, Simons FE. World Allergy Organization ad hoc Committee on Epinephrine in Anaphylaxis. Epinephrine: the drug of choice for anaphylaxis-a statement of the world allergy organization. *Allergy*. 2008;63(8):1061-1070. https://doi.org/10.1097/WOX.0b013e31817c9338
7. Simons FE, Ardusso LR, Dimov V, et al. World Allergy Organization Anaphylaxis Guidelines: 2013 update of the evidence base. *Int Arch Allergy Immunol*. 2013;162(3):193-204. https://doi.org/10.1159/000354543
8. Morzycki A, Bhatia A, Murphy KJ. Adverse reactions to contrast material: a Canadian update. *Can Assoc Radiol J*. 2017;68(2):187-193. https://doi.org/10.1016/j.carj.2016.05.006
9. Demoly P, Adkinson NF, Brockow K, et al. International Consensus on drug allergy. *Allergy*. 2014;69(4):420-437. https://doi.org/10.1111/all.12350
10. Bruder O, Schneider S, Pilz G, et al. 2015 Update on Acute Adverse Reactions to gadolinium based Contrast Agents in cardiovascular MR. Large multi-national and multi-ethnical population experience with 37788 patients from the EuroCMR registry. *J Cardiovasc Magn Reson*. 2015;17(1):58. https://doi.org/10.1186/s12968-015-0168-3
11. McDonald JS, Hunt CH, Kolbe AB, et al. Acute adverse events following gadolinium-based contrast agent administration: a single-center retrospective study of 281 945 injections. *Radiology*. 2019;292(3):620-627. https://doi.org/10.1148/radiol.2019182834
12. Foley MJ, Ghahremani GG, Rogers LF. Reappraisal of contrast media used to detect upper gastrointestinal perforations: comparison of ionic water-soluble media with barium sulfate. *Radiology*. 1982;144(2):231-237. https://doi.org/10.1148/radiology.144.2.7089273
13. Jung JW, Kang HR, Kim MH, et al. Immediate hypersensitivity reaction to gadolinium-based MR contrast media. *Radiology*. 2012;264(2):414-422. https://doi.org/10.1148/radiol.12112025