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Intravenous Imaging Contrast Media Complications: The Basics That Every Clinician Needs to Know

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ABSTRACT

Intravenous contrast is commonly used in noninvasive imaging procedures such as magnetic resonance imaging and computed tomography and can evaluate blood vessels and better characterize soft-tissue lesions. Although the incidence of adverse events after administration of contrast is low, it is important that clinicians and radiologists minimize risks and respond quickly and effectively when reactions occur. We will discuss a range of adverse events to iodinated and gadolinium-based contrast agents, including allergic-like reactions, nephrotoxicity, extravasation, and nephrogenic systemic fibrosis. We will review risk stratification for patients, as well as premedication and treatment of adverse events.

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Intravenous contrast is used in many radiologic studies to visualize and evaluate blood vessels and to delineate and characterize soft-tissue lesions, which are less conspicuous on noncontrasted imaging. Although the incidence of adverse events after administration of contrast is low, it is important that clinicians and radiologists minimize risks and respond quickly and effectively when reactions occur. The first step is to decide that a contrast study is necessary and will provide clinically useful information. When a contrast-enhanced study is required, risk stratification based on the patient's history of allergies and renal status should be assessed. Here we will discuss a broad range of adverse events to iodinated and gadolinium-based contrast, including allergic-like reactions, nephrotoxicity, and nephrogenic systemic fibrosis. We will review risk stratification for patients, premedication, and treatment of adverse events.

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IODINATED CONTRAST REACTIONS

Iodinated contrast has been used in radiographic studies for almost a century and is usually well tolerated. Adverse reactions are divided into 2 categories: allergic-like and physiologic. Allergic-like reactions are usually divided into 3 grades; mild, moderate, and severe (**Table 1**). The majority of reactions are non-life threatening, and 70% occur within the first 5 minutes of injection.[1,2] Early iodinated contrast agents were high-osmolarity, ionic compounds, and as a result, associated with a relatively high incidence of adverse reactions, with some studies reporting reactions in 12% of injected patients.[3] The now widespread utilization of low-osmolar or iso-osmolar, nonionic contrast has lowered the adverse reaction rate to 0.7%-3.1% of administrations, with severe grade 3 reactions reduced from 0.22% to 0.02%-0.04%.[1,2]

Physiologic reactions, such as nausea, headache, flushing, hypertension, and altered taste, may be caused by direct chemotoxicity of contrast media or adverse effects due to the changes in vascular volume if the contrast is hyperosmolar.[4] These are typically self-limited and rarely require treatment but, unlike allergic-like symptoms, are not responsive to or prevented by steroid administration.[4,5]

In current practice the majority of contrast reactions are non-allergic anaphylactoid-type reactions likely caused by

histamine release from mast cells and basophils due to osmolar effects and nonspecific binding of contrast to membrane receptors.[2] However, the exact pathogenesis of reactions is not completely clear. Generally, pretreatment with steroids and antihistamines can reduce the risk of these reactions,[6,7] but a small cohort with true IgE-mediated anaphylaxis may have more severe reactions and may experience "breakthrough reactions" even when premedicated.[2]

Minimizing the risk of reactions requires stratification of the patient's risk. A thorough history, including past adverse events during contrast administration as well as a general medical history of asthma and noncontrast allergies, should be obtained. If the patient has experienced a prior adverse event during contrast administration, the description of the symptoms should be documented. Patients with multiple allergies and asthma have an increased risk for contrast reaction, so description of type and severity of these allergies should be documented.[1,3-5,8,9] Patients with allergy to shellfish are at 3-fold relative risk of an adverse reaction to contrast media; however, the relative risk is similar to other food allergies and asthma and should be treated similarly.[10]

When a history of contrast reaction or other high-risk indicators is present, the risk/benefit of performing an iodinated contrasted study should be considered. An alternative study, such as ultrasound or magnetic resonance imaging (MRI), could be obtained. If iodinated contrast is necessary, a steroid premedication protocol should be considered, although caution should be taken in patients with uncontrolled hypertension, diabetes, tuberculosis, and fungal infections.[11] The American College of Radiology (ACR) recommends oral administration of either prednisone or methyl prednisolone, because they are equally effective.[12]

CLINICAL SIGNIFICANCE

- Intravenous contrast is used commonly owing to the widespread use of computed tomography and magnetic resonance imaging to help better evaluate vasculature and soft tissues.
- Although rare, adverse events after contrast media can present, such as allergic-like reaction, extravasation, contrast-induced nephropathy, and nephrogenic systemic fibrosis.
- Clinicians should be aware of patient risk stratification, premedication when indicated, and treatment of adverse events to decrease the risk, and be prepared for adverse events.

Table 2 includes 2 frequently recommended steroid protocols. Antihistamine is often added because it may reduce the frequency of grade 1 symptoms.[13] In an emergent clinical setting, intravenous (IV) steroids can be administered, but this has been shown to be effective only when given 4-6 hours before contrast injection. Even with appropriate premedication, approximately 10% of high-risk patients will experience a breakthrough reaction.[14] The symptoms are usually similar to the initial reaction, but in 8%-11% of patients the breakthrough reactions are more severe.[14] As noted above, most breakthrough reactions probably occur in patients with an IgE-related allergy in which premedication with steroids is less effective.[2]

When a reaction occurs, early recognition of symptoms and appropriate interventions are imperative to prevent progression to a serious or even fatal outcome. Appropriate medications should be easily and quickly accessible by medical personnel. Intravenous access should be established in case fluids or IV medications need to be administered. The patient's severity of reaction, medical history, and vital signs determine the optimal response. For mild reactions, such as a few scattered hives, usually no treatment is necessary, and the patient should be monitored for progressive symptoms. Because the majority of reactions are mediated by histamine and basophil release, diphenhydramine is commonly effective for mild to moderate adverse reaction and can be given orally or IV with a recommended dose of 25-50 mg.[4]

For more severe or rapidly progressive symptoms of hives, edema in the mouth or tongue, and erythema in adults, the ACR recommends consideration of intramuscular epinephrine. The intramuscular dose is a 0.01 mg/kg 1:1000 dilution (or 0.01 mL/kg), with a maximum of 0.3 mg

Table 1 Allergic-like Contrast Reactions, by Grade

Mild Allergic-like Reaction	Moderate Allergic-like Reaction	Severe Allergic-like Reaction
Limited urticaria/pruritis	Diffuse urticaria	Diffuse edema or facial edema
Limited cutaneous edema	Diffuse erythema, stable vital signs	Diffuse erythema with hypotension
Limited itchy, scratchy throat	Facial edema without difficulty breathing	Laryngeal edema with stridor and/or hypoxia
Nasal congestion	Tightness of the throat without difficulty breathing	Bronchospasm with significant hypoxia
Sneezing	Bronchospasm with no or mild difficulty breathing	Anaphylactic shock
Conjunctivitis		

See also references.[1,2]
Adapted from table in reference.[12]