American Journal of Emergency Medicine 110 (2026) 604–611

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Emergency medicine updates: Contrast media hypersensitivity

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ARTICLE INFO

Article history:
Received 6 July 2026
Received in revised form 30 September 2026
Accepted 30 September 2026
Available online xxxx

Keywords:
Emergency medicine
Emergency department
Radiology
Contrast media
Contrast
Contrast reaction
Hypersensitivity reaction
Allergic reaction
Premedication
Contrast media hypersensitivity reaction
Anaphylaxis
Contrast switching

ABSTRACT

Introduction: Contrast media hypersensitivity reaction is a rare but clinically significant condition that can meaningfully affect emergency department (ED) patient care. Therefore, it is important for emergency medicine clinicians to be aware of the current evidence regarding the diagnosis, prevention, and management of this condition.
Objective: This paper evaluates key evidence-based updates concerning contrast media hypersensitivity reactions for the emergency clinician.
Discussion: Adverse reactions to contrast media are divided into common physiologic reactions and less common hypersensitivity reactions. Hypersensitivity reactions can be immediate or delayed, ranging from mild urticaria to anaphylaxis. The greatest risk factor for hypersensitivity reaction to contrast media is a prior hypersensitivity reaction to contrast media. It is crucial to discern and document the specific culprit agent, severity, type, and timing of previous and current reactions. Physiologic reactions can be treated with supportive care and usually self-resolve. Acute evaluation and treatment of moderate-to-severe hypersensitivity reactions mirrors standard anaphylaxis care, with intramuscular epinephrine as the first-line drug for severe reactions, and allergist referral should be considered. Patients with a prior physiologic reaction do not require premedication or contrast switching. For prevention of breakthrough hypersensitivity reactions, switching to a chemically different contrast agent is more effective than corticosteroid premedication. Routine corticosteroid premedication is no longer recommended, as literature has not demonstrated corticosteroid pretreatment reduces hypersensitivity reactions. Second-generation antihistamines may be of benefit for patients with a history of mild-moderate reactions. Severe or anaphylactic reactions warrant strong consideration of alternative imaging. Collaboration with key stakeholders, including radiology and pharmacy, is important to improve workflows, protocols, and patient care.
Conclusions: An understanding of literature updates can improve the ED care of patients with contrast media hypersensitivity reactions.
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1. Introduction

Contrast media agents are among the most frequently administered pharmaceuticals globally to improve diagnostic accuracy in imaging and perform angiography. Contrast media agents most commonly encountered in the emergency department (ED) include iodinated contrast media (ICM) and gadolinium-based contrast agents (GBCA) [1]. In the United States alone, approximately 93 million computed tomography (CT) scans were performed in 2023, with an estimated half of these being contrast-enhanced [2,3]. Although modern contrast agents have excellent safety profiles compared with older agents, there remains a minority of patients who experience adverse reactions to these medications, which can present a unique challenge for emergency clinicians [1,4]. Patients with reported or documented contrast reactions (commonly known as allergies) are less likely to receive contrast-enhanced imaging and can experience substantial delays in care, resulting in significant individual and systemic impacts [5].

There have been multiple advances in recent years concerning contrast media hypersensitivity reactions in adult patients. The following questions will highlight several key updates for the emergency clinician regarding the assessment and management of contrast media hypersensitivity reactions, as well as the prevention of recurrent reactions in those with a history of a contrast media reaction, but this paper is not intended to serve as a review of the condition in its entirety.

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https://doi.org/10.1016/j.ajem.2026.09.057
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2. Discussion

2.1. A brief history of contrast media

From the 1950s through the 1990s, ionic high-osmolality contrast media (HOCM) were the predominant iodinated agents used for diagnostic imaging [1,6]. Much of the knowledge which has informed common contrast media reaction management practices until very recently has been derived from older studies on HOCM [7,8]. Non-ionic low-osmolality contrast media (LOCM) were introduced in the 1980s, were widely adopted through the 1990s, and have since almost universally replaced HOCM for intravascular use [1,6]. This transition is clinically meaningful, as LOCM carry substantially lower rates of hypersensitivity reactions than the older HOCM agents [1,6,9]. GBCAs were introduced for magnetic resonance imaging (MRI) in the late 1980s and entered widespread clinical use during the 1990s [4,10]. Because HOCM are no longer administered intravascularly, the discussion that follows centers on LOCM and GBCA. Within both the ICM and GBCA classes, there are several individual agents with differing chemical structures, a distinction that becomes relevant when selecting an alternative agent for prevention, which will be discussed later [1,4,11]. Newer evidence and guidelines suggest that current common contrast media reaction practices should be reconsidered.

2.2. Are there guidelines concerning contrast hypersensitivity reactions?

Three major guidelines were published or updated in 2025, which provide recommendations in the prevention and management of contrast media hypersensitivity reactions. These include the joint Canadian Association of Radiologists (CAR) and Canadian Society of Allergy and Clinical Immunology (CSACI) practice guidance; the joint consensus statement from the American College of Radiology (ACR) and American Academy of Allergy, Asthma, and Immunology (AAAAI); and the updated guidelines from the European Society of Urogenital Radiology (ESUR) Contrast Media Safety Committee [1,6,11,12]. There exist several other guidelines previously published on the topic; however, the three that are mentioned incorporate recent evidence and recommendations relevant to the emergency clinician with a potential shift from prevalent longstanding practices. The CAR/CSACI practice guidance discusses the level of evidence informing some of its recommendations and provides a summary of previous guidelines. The ACR/AAAAI consensus statement provides strength of evidence and strength of recommendation for each of its recommendations. These guidelines will be discussed in detail in this article.

2.3. What is a contrast hypersensitivity reaction, and how frequently does this occur?

There are two types of contrast media reactions: physiologic (or chemotoxic) reactions and hypersensitivity (or allergic-like) reactions. Most contrast media reactions are physiologic reactions which occur due to chemotoxicity from the specific molecular attributes of the agents. These reactions are non-immune mediated reactions that occur acutely, typically within 1 h, after contrast administration. They are concentration and dose dependent, and the majority are self-limiting, although severe reactions can occur [1].

By contrast, contrast media hypersensitivity reactions are immune-mediated adverse reactions that can be immediate (within 1 h of contrast administration) or delayed (hours to days after contrast administration). Immediate reactions are either IgE-mediated (i.e., allergic) or non-IgE-mediated (i.e., anaphylactoid). The distinction between the two mechanisms is of little clinical relevance, as both require the same management. Delayed reactions are typically T-cell mediated and present mostly with dermatological involvement.

Overall, acute adverse reactions to modern ICM are uncommon. Immediate reaction rates are estimated to range from 0.15 to 1.4%, with severe reactions being rare (0.005–0.06%) [1,6,12]. A large study in Korea examining over 11.5 million ICM administrations found an immediate hypersensitivity reaction rate of 0.38%, with only 0.02% experiencing immediate severe reactions and 0.05% experiencing a delayed reaction [13]. Rates of reactions to GBCAs are similarly very low, with hypersensitivity reaction rates under 0.4% [1,10]. Reaction severities are further discussed later.

2.4. What are risk factors for contrast hypersensitivity reactions?

The only consistent risk factor for contrast media hypersensitivity reactions is a history of previous hypersensitivity reaction to contrast media [1,4,6,11]. A prior history of a hypersensitivity reaction to contrast media predicts future risk with contrast media with an approximately 5–6-fold increased risk according to the 2025 ACR Manual on Contrast Media and a recent retrospective study of 176,886 patients finding an odds ratio (OR) of 27.6 (95% confidence interval [CI] 22.4–34.0) [4,14]. Additional possible reported risk factors include non-White race (OR 1.77, 95% CI 1.36–2.30), female sex (OR 1.49, 95% CI 1.29–1.72), dose of contrast (OR 1.30, 95% CI 1.05–1.61), non-contrast allergy (OR 1.21, 95% CI 1.02–1.43), and age below 50 (various ORs per age group) [14]. However, given these uncertain associations, the 2025 joint CAR/CSACI practice guidance notes that the overall evidence in the literature is inconsistent and insufficient to screen for additional risk factors other than a prior history of hypersensitivity reaction to contrast media [1]. Of note, a prior history of physiologic reaction to contrast is not a risk factor for a hypersensitivity reaction [1,6,11].

There is a widespread myth that iodine or shellfish allergies are associated with contrast media reactions. While topical iodine-containing antiseptics can cause contact dermatitis, iodine itself is not an allergen, is critical to human bodily functions, and is a component of table salt [6]. Thus, the term “iodine allergy” should be abandoned. For patients with a listed or reported iodine allergy, it is important to clarify the symptoms experienced and the exact culprit medication or agent the patient is referring to, as the patient may have had a hypersensitivity reaction to a specific iodine-containing medication that is mistaken for an iodine allergy. Similarly, IgE-mediated reactions to crustaceans are related to tropomyosin rather than iodine. Patients with reported or confirmed seafood and shellfish allergies have no increased risk of contrast media hypersensitivity reactions compared with the general population, and this should have no bearing on the decision to administer intravenous contrast media agents [6,15].

2.5. What findings on history and examination suggest a contrast hypersensitivity reaction?

The most important historical element to elicit is a prior reaction to contrast media [1,4,6,11]. When a reaction occurs in the ED, the central task is to distinguish a physiologic reaction from a hypersensitivity reaction. Unfortunately, the culprit agent is infrequently documented. The ACR classifies acute reactions by severity (mild, moderate, severe), a framework that underpins the management of contrast media hypersensitivity reactions (Table 1) [4,6].

Physiologic reactions are characterized by non-immune, mostly self-limiting symptoms that can also be categorized as mild, moderate, or severe. Mild physiologic reactions include limited nausea and/or vomiting, transient flushing, warmth, chills, headaches, dizziness, anxiety, altered taste, mild hypertension, paresthesias, injection site warmth, injection site pain, and self-resolving vasovagal reactions. Moderate reactions can include protracted nausea and vomiting, significant hypertension, isolated chest pain, and vasovagal reactions that require treatment. Severe physiologic symptoms are rare but can include hypertensive emergency, seizures or neurotoxicity, arrhythmias or cardiotoxicity, and nephrotoxicity [1,4,6]. As such, examination may reveal transient bradycardia and/or hypotension, diaphoresis, flushing, warmth, and in rare cases, persistent vital sign abnormalities,

Table 1
Categories and severities of immediate reactions to iodinated contrast media [4].

Severity	Hypersensitivity	Physiologic
Mild	— Limited urticaria/pruritus — Cutaneous edema — Limited "itchy" or "scratchy" throat — Nasal congestion — Sneezing, conjunctivitis, rhinorrhea	— Limited nausea/vomiting — Transient flushing, warmth, or chills — Headache, dizziness, anxiety, altered taste — Mild hypertension — Vasovagal reaction that resolves spontaneously
Moderate	— Diffuse urticaria/pruritus — Diffuse erythema with stable vital signs — Facial edema without dyspnea — Throat tightness or hoarseness without dyspnea — Wheezing/bronchospasm with mild or no hypoxia	— Protracted nausea/vomiting — Hypertensive urgency — Isolated chest pain — Vasovagal reaction requiring and responsive to treatment
Severe	— Diffuse edema, or facial edema with dyspnea — Diffuse erythema with hypotension — Laryngeal edema with stridor and/or hypoxia — Wheezing/bronchospasm with significant hypoxia — Anaphylactic shock	— Vasovagal reaction resistant to treatment — Arrhythmia — Convulsions/seizures — Hypertensive emergency

neurological deficits, abdominal tenderness, decreased urine output, irregular heart rate, or convulsions.

Hypersensitivity reactions can also present with a wide variety of symptoms and signs. Immediate hypersensitivity reactions occur within 1 h of contrast administration. Mild immediate hypersensitivity reactions are typically self-limited and include urticaria, pruritus, cutaneous edema, nasal congestion, conjunctivitis, rhinorrhea, and limited throat discomfort ("scratchy" sensation). Moderate hypersensitivity reactions present with more prominent symptoms which may necessitate treatment and have the potential of becoming severe. These include urticaria covering over 50% of the body, diffuse erythema, facial edema without dyspnea, throat tightness without dyspnea, wheezing or bronchospasm, and mild hypoxia. Severe hypersensitivity reactions are life-threatening and include diffuse symptoms with dyspnea, hypotension, hypoxia, stridor, respiratory failure, and anaphylactic shock [1,4,6]. Delayed hypersensitivity reactions are rare and occur hours to days after the contrast exposure. A maculopapular rash is the most common finding of delayed reactions, but there are rare reports of severe dermatological illnesses such as acute generalized exanthematous pustulosis (AGEP), drug reaction with eosinophilia and systemic symptoms (DRESS), and Stevens-Johnson syndrome/toxic epidermal necrolysis (SJS/TEN) [1,4,6]. The presence of skin or mucosal involvement such as urticaria or angioedema is a useful bedside discriminator favoring a hypersensitivity reaction, although their absence does not rule it out. Importantly, severe reactions may evolve from milder presentations, and presentations can be dynamic, initially starting with mild symptoms such as urticaria but progressing to signs and symptoms of anaphylaxis.

Distinguishing between physiologic reactions and true hypersensitivity reactions is clinically relevant because this informs current or future risk and management in the ED and beyond. The right diagnosis has the potential to alter a patient's future health care trajectory and experience.

2.6. What treatment is necessary if a contrast hypersensitivity reaction occurs?

Despite the low rates of reactions to modern day contrast media, patients may experience an adverse reaction to contrast media in the ED. Similar to other triggers of anaphylaxis and allergy, the first step is to recognize that a reaction is occurring and to stop the contrast injection if it is safe to do so. Every imaging area where contrast is administered should be prepared to manage reactions in any patient, including those without a prior reaction, with appropriate equipment, personnel, monitoring, and medications readily available [6,12]. The next step is to determine whether the event is a physiologic reaction or a true hypersensitivity reaction, as these are managed differently. Determining the timing and severity of the reaction will also be important, as treatment depends on severity. Mild hypersensitivity reactions are typically self-limited and require observation with or without symptomatic treatment; moderate reactions commonly require treatment and have the potential to progress; and severe reactions are potentially life-threatening and require immediate, anaphylaxis-directed care [4].

For physiologic reactions, the majority do not require treatment given the self-limiting nature of the reactions. When treatment is required, it consists mostly of observation and supportive care without the need for antihistamines, epinephrine, and other such allergic reaction care, as these are not true hypersensitivity reactions [4,6]. Mild physiologic symptoms such as limited nausea, flushing, warmth, or altered taste generally resolve without intervention and require only reassurance and observation. Moderate physiologic reactions may warrant targeted symptomatic care, such as antiemetics for protracted vomiting or blood pressure management for significant hypertension. A vasovagal reaction can be treated with supine positioning, leg elevation, and intravenous fluids. Persistent symptomatic bradycardia with hypotension is treated with atropine [4]. Importantly, a vasovagal reaction is distinguished from anaphylaxis by the presence of bradycardia rather than tachycardia and by the absence of cutaneous or mucosal findings [6].

When a true moderate-to-severe hypersensitivity reaction is suspected, acute evaluation and management mirrors standard anaphylaxis care [16]. Anaphylaxis is diagnosed clinically when illness develops acutely after contrast administration with involvement of two or more organ systems, most often skin or mucosa, respiratory, cardiovascular, or gastrointestinal, or when otherwise-unexplained hypotension occurs in isolation [6,16]. The two most important steps in managing an anaphylactic reaction are stopping the contrast infusion, if ongoing, and promptly administering intramuscular epinephrine [6,12]. Epinephrine is universally recognized as the first-line treatment for anaphylaxis, and there are no absolute contraindications to its use, including in patients who are older, frail, or have cardiac disease [16]. The recommended dose is 0.01 mg/kg of the 1:1000 (1 mg/mL) concentration injected into the vastus lateralis of the anterolateral thigh, to a maximum of 0.5 mg per dose. This may be repeated every 5 to 15 min as needed [16]. Where staff experience with drawing up epinephrine is limited, a fixed-dose autoinjector may reduce dosing errors and expedite delivery. Adjunctive measures should be applied as the clinical situation dictates, such as supplemental oxygen, supine or Trendelenburg positioning, and rapid intravenous crystalloid for hypotension. H1 and H2 antihistamines and inhaled bronchodilators are commonly administered for their cutaneous and bronchodilator effects, respectively. Corticosteroids have no role in the acute management of anaphylaxis given their slow onset, and current evidence does not support their use to prevent biphasic reactions. In the uncommon setting of refractory or protracted anaphylaxis, an intravenous epinephrine infusion may be required [6,12,16]. After stabilization, all patients should be observed until signs and symptoms have completely resolved. Because most imaging facilities are not equipped for prolonged monitoring, any patient with suspected anaphylaxis to contrast media should be transferred to the nearest ED [6].

2.7. What is the role of allergy testing and referral for contrast hypersensitivity reactions?

The role of serum tryptase as a biomarker in contrast media hypersensitivity reactions has recently been highlighted [1,6,12]. The 2025

ESUR guidelines recommend obtaining a tryptase for all moderate and severe hypersensitivity reactions, the 2025 ACR/AAAAI statement recommends obtaining one following a severe or anaphylactic hypersensitivity reaction, and the 2025 CAR/CSACI guidance recommends obtaining one following anaphylactic reactions [1,6,11,12]. Tryptase rises within approximately 30 min of an immediate hypersensitivity reaction and remains elevated for several hours before returning to baseline. However, results often are not available during the acute event and do not change acute reaction management. It is also important to note that a normal tryptase in the acute phase does not exclude a hypersensitivity reaction, with a recent systematic review and meta-analysis finding a pooled sensitivity of 0.49 (95% CI 0.42–0.56) and pooled specificity of 0.82 (95% CI 0.77–0.86) [17]. Thus, the principal value of tryptase in the ED lies in facilitating subsequent allergist evaluation rather than in guiding immediate care [1,6,12]. When obtained, an acute sample should ideally be drawn 1 to 2 h after symptom onset, although up to 6 h is still appropriate. The acute value drawn shortly after the hypersensitivity reaction is compared with a baseline value drawn after the resolution of symptoms, often in an outpatient setting, which helps guide further evaluation and management by allergy specialists.

Accurate documentation is an essential and frequently neglected component of management. Two studies have shown that the culprit agent could not be identified in the majority of cases, approximately 68% in one cohort and 88.5% in another, which undermines future prevention strategies such as contrast switching [18,19]. Labeling a reaction merely as an allergy to “iodine”, “contrast”, or “gadolinium” without details is inadequate. It is crucial to current and future care of patients requiring contrast media to distinguish and document the symptoms, reaction type and severity, culprit agent and dose, timing, and treatments for both prior and current reactions to help guide prevention and management of contrast media hypersensitivity reactions [1,6,11].

This information should be recorded in a structured field of the electronic health record (EHR) when available and ideally reflected in the imaging reporting system so that it is available to radiologists and clinicians for future studies [1,6,11,12]. The specific agent and dose will often be recorded in the EHR (in institutions where EHR is used) given that it is a medication that is administered to the patient. If not, liaising with the radiology team will be imperative to determine the exact contrast agent that was used.

Appropriate referral is a critical step in ED care. Recent guidelines discuss the value of allergy specialist referral after a contrast media hypersensitivity reaction but differ slightly in the threshold for referral [1,6,11]. The Canadian guidance recommends referral to an allergist for patients who have experienced a severe hypersensitivity reaction, whether immediate or delayed [1]. The American consensus statement similarly recommends referral to a board-certified allergist after a severe immediate hypersensitivity reaction, primarily to identify an alternative agent that can be tolerated for future non-urgent examinations [6]. The European guidelines are broader, recommending referral of at least all patients with a moderate or severe hypersensitivity reaction, noting that all hypersensitivity reactions may be referred in centers with sufficient specialist capacity [11]. Beyond these severity-based thresholds, referral is also reasonable when it is unclear whether the index event represented a physiologic reaction or a true hypersensitivity reaction, as allergist evaluation can help clarify the mechanism and guide safe future contrast administration. Allergists may perform further diagnostic evaluation such as skin prick tests, intradermal tests, basophil activation tests, patch tests, and drug challenges to confirm hypersensitivity reactions to specific contrast media agents. Access to allergists is limited in many settings, which makes thorough ED documentation of the culprit agent with a clear referral request critical [1,11,12]. The emergency clinician should also provide the patient with information about the reaction and clear guidance to disclose it before any future contrast-enhanced imaging until further diagnostic clarification is obtained. Table 2 summarizes guideline recommendations regarding obtaining serum tryptase levels and allergist referral thresholds.

2.8. How can contrast hypersensitivity reactions be prevented?

Preventive strategies for contrast media hypersensitivity reactions are of paramount importance for emergency clinicians when faced with patients with a prior hypersensitivity reaction. Patients whose previous reactions were physiologic in nature do not require any preventive intervention because these reactions are not immune-mediated. Unfortunately, in many cases, the nature of a prior reaction may not be clear on history or documented in the patient's medical record. Clear patient communication and education regarding the nature of their reaction and expectations for future imaging is also important. For patients with a true prior hypersensitivity reaction to contrast media, two strategies have been used to reduce the risk of a recurrent (breakthrough) reaction: pharmacologic premedication or switching to a different contrast agent. Routine premedication has been the predominant practice in many hospitals, and a shift toward contrast switching is proposed as a superior alternative (discussed later) [1,6,11].

2.9. What is the role of premedication in preventing contrast hypersensitivity reactions?

Several widespread, commonly used premedication regimens consist of administering antihistamines and corticosteroids prior to contrast administration, including a 13-h three-dose oral corticosteroid protocol, a 12-h two-dose oral protocol, and an accelerated intravenous protocol which is often used in the ED. Such protocols typically include an antihistamine administered approximately 1 h before contrast administration. In a large retrospective multicenter Korean study of 196,081 patients, antihistamine premedication was associated with a reduced risk of recurrent hypersensitivity reaction (OR 0.53, 95% CI 0.33–0.86) [21]. Two additional retrospective Korean studies seem to suggest some benefit with antihistamine premedication. Park et al. analyzed 1178 patients who were re-exposed to contrast a total of 3533 times and found that antihistamine premedication lowered the recurrence rate from 16.6% to 10.7% (OR 0.57, 95% CI 0.44–0.73), although combining contrast switching with antihistamine premedication demonstrated even lower recurrence rates [22]. Lee et al. studied 850 patients and found that adding a systemic corticosteroid to antihistamine premedication conferred no additional benefit in patients with a mild index reaction compared with antihistamines alone (16.8% vs 17.2%, $P = 0.70$) [23]. However, the three observational studies contain several limitations including the lack of a no premedication comparison group and concurrent contrast switching.

Table 2
Recommendations for serum tryptase and allergist referral for contrast media reactions [1,6,9,10,17].

	ACR/AAAAI (2025)	CAR/CSACI (2025)	ESUR (2025)
Serum tryptase (acute sample)	After severe or anaphylactic HRs	After anaphylactic reactions	After all moderate or severe HRs
Allergist referral	After a severe immediate HR	After a severe HR (immediate or delayed)	At least all moderate or severe HRs, all HRs where specialist capacity allows

Abbreviations: AAAAI, American Academy of Allergy, Asthma & Immunology; ACR, American College of Radiology; CAR, Canadian Association of Radiologists; CSACI, Canadian Society of Allergy and Clinical Immunology; ESUR, European Society of Urogenital Radiology; HR, hypersensitivity reaction.

Thus, the evidence is overall low-quality and has a high potential for bias [6,11]. Antihistamines also carry risk of harm, notably their anticholinergic and sedative effects which can be worse among older adults, which must be balanced against their benefits [24]. Overall, the CAR/CSACI guidance states that antihistamine premedication can be protective in patients with a prior mild reaction and is optional for those with a prior mild or moderate hypersensitivity reaction, with the caveat that the usefulness of this intervention with concurrent contrast switching is unknown [1,20]. The ACR/AAAAI and ESUR publications do not separate antihistamine from steroid premedication in their approach, with both recommending against the use of premedication in previous mild reactions. The ACR/AAAAI considers it optional for those with previous moderate hypersensitivity reaction, while the ESUR reserves it for severe reactors if an alternative study is unavailable [6,11]. This is due to the low quality of evidence and uncertainty in interpreting the available evidence. If antihistamines are administered, they should be given around 1 h before contrast administration with a strong preference for second- and third-generation antihistamines such as cetirizine or loratadine over first-generation agents such as diphenhydramine, due to their faster onset and more favorable side-effect profile [1]. Intravenous or oral formulations may be administered. However, in many EDs, the only intravenous antihistamine available for patients who are unable to take oral medication (nil per os [NPO], vomiting, etc.) may be a first-generation antihistamine (e.g., diphenhydramine).

The evidence base for administering corticosteroids is weak and outdated. The 12- and 13-h oral protocols derive from studies conducted in the early-to-mid 1980s that evaluated HOCM agents [7,8]. When these protocols were re-examined with the far safer LOCM agents, the results were limited, inconsistent, and difficult to interpret because of methodologic shortcomings including non-randomization, absent control groups, and the markedly lower baseline reaction rate of LOCM [1,6]. The accelerated intravenous corticosteroid regimen commonly used in the ED originates from a 2017 retrospective non-inferiority cohort study, in which the breakthrough reaction rate after a 5-h intravenous corticosteroid protocol was non-inferior to that of the 13-h oral protocol with a risk difference of 0.4% (95% CI −1.6–3.7%) and a prespecified noninferiority margin of 4.0%. Notably, neither regimen prevented all moderate and severe breakthrough reactions [25]. The accelerated protocol therefore offers a shorter delay to imaging rather than superior protection. Several other studies have failed to demonstrate that corticosteroid premedication meaningfully prevents reactions to LOCM. A retrospective study on 1051 inpatients in 2015 showed a number-needed-to-treat of 569 to prevent one severe reaction [26]. In another retrospective study of 1973 patients who underwent 4360 contrast-enhanced CT examinations, administering the same agent with or without corticosteroid premedication did not significantly change the breakthrough hypersensitivity reaction rate (OR 0.73, 95% CI 0.48–1.09) [19]. The guidelines further note that there is no high-quality evidence supporting premedication for delayed hypersensitivity reactions [1,6]. The harms of routine corticosteroid use in premedication must also be considered. A large retrospective cohort study of 1.55 million adults in 2017 demonstrated that systemic corticosteroids can increase risks of sepsis (incidence rate ratio (IRR) 5.30, 95% CI 3.80–7.41), venous thromboembolism (IRR 3.33, 95% CI 2.78–3.99), and fractures (IRR 1.87, 95% CI 1.69–2.07) [27]. A retrospective study of 2849 patients found that premedication protocols also impose operational costs with longer in-hospital stays (158 vs 133 h, $P < 0.001$) and more hospital-acquired infections (5.1% vs 3.1%, $P < 0.001$) [28]. In a retrospective analysis of more than 12,000 ED patients, Berlyand et al. found that patients with a documented contrast allergy underwent contrast-enhanced CT less than those without an allergy (23.3% vs 45.9%, $P < 0.01$) and waited approximately 4 h longer for imaging (360 vs 118 min, $P < 0.001$) [5]. The American, Canadian, and European 2025 societal publications converge in their interpretation of the available data regarding corticosteroid premedication being of low quality but do make slightly differing recommendations based on the risk-benefit profile. The CAR/CSACI guidance recommends against the routine use of corticosteroid premedication in patients with a prior history of contrast media hypersensitivity reaction, stating that the practice should be discontinued. The ACR/AAAAI statement recommends against premedication for prior mild hypersensitivity reactions, allows for consideration for moderate reactions with an emphasis on shared decision-making, and recommends it in patients with a prior severe reaction (e.g., anaphylaxis) when no acceptable alternative study exists. It acknowledges that the supporting evidence is of very low quality [6]. The ESUR guidelines do not recommend premedication to prevent recurrent hypersensitivity reaction and only consider it optional in the emergency setting for a previous severe hypersensitivity reaction from an unknown contrast media agent [11]. Overall, the quality of evidence for corticosteroid premedication is low, and it is questionable if the benefits outweigh the risks.

2.10. What is the role of contrast switching in preventing contrast hypersensitivity reactions?

The alternative to premedication is to switch the contrast agent from the one that caused the previous hypersensitivity reaction to a different agent. There exist several LOCM agents that differ in their molecular structures (Table 3) [1]. Contrast switching is only possible when the previous agent is known. There are more robust data to support this prevention strategy over premedication. In the McDonald et al. study, administering the same agent with or without corticosteroid premedication did not change the breakthrough hypersensitivity reaction rate, whereas switching to a different agent reduced breakthrough hypersensitivity reactions regardless of premedication. Using the same ICM with steroid premedication had a breakthrough hypersensitivity reaction rate of 19%, while switching to a different ICM without steroid premedication had a breakthrough rate of 3% (OR 0.14, 95% CI 0.06–0.33) and switching to a different ICM with steroid premedication had the same breakthrough rate of 3% (OR 0.12, 95% CI 0.04–0.36) [19]. A 2022 systematic review and meta-analysis including 7155 patients similarly found that switching to an alternative agent reduced the risk of a breakthrough hypersensitivity reaction by 61% (risk ratio 0.39, 95% CI 0.24–0.58), while premedication did not significantly affect recurrence [29]. The protective effect, however, depends on switching to an agent with a different chemical structure as demonstrated by Kim et al., who found that switching to an agent with a similar structure conferred no benefit (OR 0.98, 95% CI 0.64–1.50) [30]. All three of the guidelines discussed recommend contrast switching when the previous agent causing the hypersensitivity reaction is known as the best preventive measure against recurrent contrast media hypersensitivity reactions. In those with a history of severe hypersensitivity reaction (e.g., anaphylaxis), this is only recommended if a clinically appropriate alternative imaging modality is unable to be performed and a contrast-enhanced CT or MRI must be completed. In practice, the selection of an appropriate alternative agent is best made by radiology consultants who are equipped to make this decision according to local contrast media availability.

Table 3
Iodinated contrast media agents [1].

Agent	N-(2,3-dihydroxypropyl) carbamoyl side chain	N-(2,3-dihydroxypropyl)-*N*-methyl-carbamoyl side chain
Iopromide	Present	Present
Iohexol	Present	Absent
Iomeprol	Present	Absent
Ioversol	Present	Absent
Iodixanol	Present	Absent
Iobitridol	Absent	Present
Iopamidol	Absent	Absent

Table 4
Gadolinium-based contrast agents [1].

Agent	Charge	Ligand
Gadopentetate dimeglumine	Ionic	Linear
Gadoxetate disodium	Ionic	Linear
Gadobenate dimeglumine	Ionic	Linear
Gadoterate meglumine	Ionic	Macrocyclic
Gadobutrol	Non-ionic	Macrocyclic
Gadoteridol	Non-ionic	Macrocyclic

Regarding GBCAs for MRI, there are also several agents with differing molecular structures (Table 4) [1]. Hypersensitivity reactions to GBCAs are rare, with anaphylaxis estimated at 0.00003% to 0.004% and the majority of reactions being mild [1]. The evidence for premedication in patients with prior GBCA reactions is more mixed than for ICM but points in a similar direction. A Korean retrospective study of 185 patients found no difference in breakthrough rates between premedicated and non-premedicated patients (OR 1.22, 95% CI 0.67–2.21), but did find a substantial reduction when switching to a different GBCA (OR 0.21, 95% CI 0.10–0.44) [31]. In an 8-year cohort study by Ahn et al., the ORs of a recurrent reaction were 0.6 (95% CI 0.4–0.9) with premedication alone, 0.3 (95% CI 0.2–0.5) with agent switching, and 0.1 (95% CI 0.06–0.2) with both interventions, respectively [10]. Overall, the Canadian and European guidelines do not endorse a distinct strategy for GBCAs and advise following the same approach as for ICM, prioritizing agent substitution over premedication. It is important to note that the ACR/AAAAI consensus statement does not include any recommendations on GBCAs for MRI [1,6,11,20].

Emergency medicine is a field that collaborates closely with all other specialties, and close collaboration with local radiology departments remains critical to affect individual patient care, departmental protocols, and institutional culture. A collaborative approach to implementing evidence into practice is more likely to create lasting change. Case-specific shared decision-making in consultation with local radiology teams is critical, especially for a patient with prior anaphylaxis to contrast as re-administration of contrast becomes a high-risk procedure that is ideally avoided, particularly in the relatively unmonitored environment of the CT scanner. Strong consideration should be given to alternative, appropriate, and acceptable imaging modalities whenever possible in the case of a prior severe hypersensitivity reaction. Shared decision-making with patients, who are the primary stakeholders in their own illness, allows them to participate in their own care as well [6].

In summary, recent evidence and the 2025 American, Canadian, and European societal publications converge on a clear shift away from routine pharmacologic premedication and toward contrast switching [1,6,11,12,20]. Antihistamine premedication may offer some benefit but is optional, while the benefits of steroids likely do not outweigh the risks in most cases. For emergency clinicians, prevention is stratified by the severity of the index reaction. For prior mild reactions, premedication is either not recommended (ACR/AAAAI, ESUR) or optional (CAR/CSACI), and switching to a different agent when the causative agent is known is the preferred strategy. For prior moderate reactions, agent switching remains the best strategy while premedication is optional through shared decision-making with the patient. For prior severe reactions such as anaphylaxis, an alternative imaging modality should be pursued, but if a contrast-enhanced study is essential, agent switching is recommended, with premedication reserved as an adjunct when no acceptable alternative agent or study exists. Ultimately, optimal prevention depends on accurate characterization and documentation of the index reaction and close collaboration with local radiology experts to select an appropriate alternative agent based on local availability. Table 5 summarizes the American, Canadian, and European publications regarding the preventive strategies for patients with a previous contrast media hypersensitivity reaction [6,11,20].

3. Conclusions

There are a variety of updates in the evaluation, management, and prevention of contrast media hypersensitivity reactions in adults. There are two types of reactions to contrast media. These include physiologic and hypersensitivity (allergic-like), both of which can present as mild, moderate, or severe reactions. Physiologic reactions make up most reactions, are largely self-limiting, and are treated with supportive care and observation. Patients with a history of physiologic reaction to contrast media do not require any preventive measures when undergoing imaging studies. Hypersensitivity reactions are less common; can be immediate or delayed; and present with typical allergic symptoms such as urticaria, edema, bronchospasm, tachycardia, and anaphylaxis. The

Table 5
Recommendations for preventing recurrent contrast media hypersensitivity reactions.

	ACR/AAAAI (2025)	ESUR (2025)	CAR/CSACI (2025)
Prior MILD index reaction			
Premedication	Not recommended		Routine corticosteroid premedication not recommended, antihistamine optional
Contrast agent switching	Recommended if culprit agent known		
Prior MODERATE index reaction			
Premedication	May be considered through shared decision-making	Not recommended	Routine corticosteroid premedication not recommended, antihistamine optional
Contrast agent switching	Recommended if culprit agent known		
Prior SEVERE index reaction (anaphylaxis)			
Premedication	Recommended only when no acceptable alternative study exists	Not routinely recommended; optional in the emergency setting if the prior agent is unknown and no alternative study is available	Routine corticosteroid premedication not recommended
Alternative imaging/contrast switching	Pursue an alternative imaging modality first; if essential, switch agent		

Abbreviations: AAAAI, American Academy of Allergy, Asthma & Immunology; ACR, American College of Radiology; CAR, Canadian Association of Radiologists; CSACI, Canadian Society of Allergy and Clinical Immunology; ESUR, European Society of Urogenital Radiology; GBCA, gadolinium-based contrast agent; HR, hypersensitivity reaction; ICM, iodinated contrast media.
Compiled from the 2025 ACR/AAAAI consensus statement, the CAR/CSACI practice guidance and its unknown agents update, and Part 1 and 2 of the ESUR Contrast Media Safety Committee guidelines.
Optional: Recommendations apply to ICM. The ACR/AAAAI consensus statement does not address GBCAs, the CAR/CSACI and ESUR guidelines advise applying the same approach (agent substitution over premedication) to GBCAs.
"Premedication" denotes corticosteroid ± antihistamine. The CAR/CSACI guidance separates the two.
All three societies grade the evidence for premedication as low or very low quality and identify contrast agent switching, when feasible, as the more effective strategy. For a true emergency, life-saving contrast-enhanced imaging should not be delayed for premedication.

most important risk factor for recurrent hypersensitivity reactions is a previous history of contrast media hypersensitivity reaction. Treatment for a contrast media hypersensitivity reaction consists of timely recognition and differentiation, standard anaphylaxis/allergy care, serum tryptase evaluation if available, clear documentation, and appropriate referral to an allergist. Patients with a history of hypersensitivity reaction require careful assessment to determine the nature of the previous reaction as well as the specific contrast agent involved. Routine premedication is likely not effective and is not recommended in most cases. Switching to a chemically different contrast agent is an effective preventive strategy. For those with a previous severe reaction such as anaphylaxis to contrast media, careful consideration should be given to alternative imaging modalities as appropriate and possible based on local availability and practices, with contrast agent switching being the preferred strategy when there is no reasonable alternative. Close collaboration with local radiology departments is critical to practically implement preventive strategies on a patient and systemic level.

CRediT authorship contribution statement

Isaac J. Kim: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Conceptualization. **Jim Yang:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Conceptualization. **Brit Long:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Conceptualization. **Hans Rosenberg:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Conceptualization.

Declaration of competing interest

On behalf of all authors, the corresponding author states that there is no conflict of interest. No AI program was utilized in the construction or writing of this manuscript. Given his role as AJEM associate editor, Dr. Brit Long had no involvement in the peer-review of this article and has no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to another journal editor.

Acknowledgements

IK, BL, and HR conceived the idea for this manuscript and contributed substantially to the writing and editing of the review. This manuscript did not utilize any grants or funding, and it has not been presented in abstract form. This clinical review has not been published, it is not under consideration for publication elsewhere, its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. Given his role as AJEM associate editor, Dr. Brit Long had no involvement in the peer-review of this article and has no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to another journal editor.

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