



Patients, Policy and Practice Improvements

Patients have very limited knowledge of their contrast allergies

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ABSTRACT

Purpose: To quantify patients' knowledge of their iodinated contrast allergies; and to compare this data to literature estimates of patient knowledge of other medication allergies.

Methods: Using a key word search of 15,715 patients undergoing a total of 19,043 CT studies over a six-month period, a cohort of 307 adult patients claiming prior allergic reaction to iodinated intravenous contrast was identified. A patient questionnaire with the CT studies inquired about the specifics of their contrast allergy, including the symptoms of their prior allergic reaction; when and where the reaction occurred; and if patients could name the contrast agent to which they claim to be allergic.

Results: In the cohort of 307 patients claiming a prior allergic reaction to iodinated contrast, 86.6% could describe their prior allergic reaction symptoms. Only 36.8% could provide an approximate year of the reaction, with an additional 6.5% claiming that their reactions were remote, for a total of 43.3% providing some information when their reaction occurred. 56.7% provided no information on the year of their reaction. 40.7% named either the facility or the city where the reaction occurred, while 59.3% could not. Only 5 of 307 (1.6%, $p < 0.00001$) could name the contrast agent to which they believed they were allergic.

Conclusion: Other studies have reported inconsistencies, limited documentation, and limited ability to confirm patients' pharmacologic allergies, estimating that patients prior to pharmacist consultation are approximately 60–70% accurate in listing their drug allergies by name. Nevertheless, patients' knowledge of their iodinated contrast allergies is markedly more limited when compared to expected patient knowledge of medication allergies in general.

1. Introduction

Iodinated contrast agents may cause allergic-like reactions in some patients. The mechanism of immune-related allergic reaction to iodinated contrast agents is incompletely understood and may result from a basophil or mast cell mediated response, rather than a true antibody mediated reaction.¹

Iodinated contrast is a class of pharmacologic agents, rather than a single drug. Earlier versions of iodinated intravenous contrast historically were ionic, hyperosmolar, and more allergenic than the low-osmolar nonionic contrast agents that first became commercially available after U.S. Food and Drug Administration approval of iohexol (Omnipaque, GE, Boston, MA, USA) in 1985, with additional low-osmolar and similarly less allergenic contrast agents approved in subsequent years.^{1–7,18–21}

Although never quantified and reported to our knowledge before this

study, it has been the authors' observation for years that patients, in addition to ordering providers, typically consider the label of an iodinated contrast allergy to apply equally to all iodinated contrast agents, rather than documenting and particularly avoiding a specific agent that triggered a prior allergic-like reaction. The scenario would be similar to e.g. a patient claiming to be allergic to antibiotics, and physicians being wary to prescribe any antibiotic in a patient with a prior allergic-like reaction to Penicillin G, even when newer and potentially less allergenic alternatives exist.

The potential for confusion and misinformation of contrast allergies is compounded further when the nonsensical term “iodine allergy” is used informally by some patients and medical staff to refer to iodinated contrast; as well as refer to iodine-containing povidone soap, an unrelated allergy; or when referring to shellfish, an unrelated allergy likely to the muscle protein tropomyosin, which is not a component of intravenous contrast.^{8–12}

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Knowing one's allergies is critical for knowing what drugs a patient may be prescribed with probable safety. Patients labeled with an undetermined iodinated contrast allergy may have delays in diagnostic scanning due to the time required for unnecessary premedication. Other patients may not have contrast studies ordered at all if there is concern for a potentially serious complication risk, despite frequently lacking specific allergy knowledge to determine potential risk severity.

Other studies have shown that patients with a prior drug reaction have a high likelihood of being able to describe the symptoms experienced at the time of their allergic reaction, estimated at greater than 80% prior to pharmacist consultation, and up to 99% in patients who receive pharmacist counseling. Yet patients are less successful in being able to name the actual drugs their medical records list as their allergies. Various investigations involving chart review and primary care provider consultation have shown inconsistencies with allergy reporting, documentation, and accuracy in medical records. Studies estimate that patients are approximately 60–70% accurate in naming their medication allergies in general prior to pharmacist consultation, and up to 80–94% accurate in naming their medication allergies after pharmacist consultation.^{13–17}

Given the confusion about intravenous iodinated contrast and potential allergy, we sought to identify a group of adult outpatients reporting a prior iodinated contrast allergy, and to assess their knowledge of their contrast allergy, particularly their ability to name the contrast agent, in comparison to expected identification of other medication allergies.

2. Methods

Data was acquired at Fairfax Radiology Centers, the largest private practice in the Washington, DC metropolitan area, headquartered in Fairfax, Virginia, USA. Standard protocols and paperwork are utilized throughout the practice for continuity, and the practice uses central scheduling and information technology (MedInformatix) for all of its centers.

In 2019, a retrospective data search was performed for the six-month period from July 1, 2018 through December 31, 2018. Patients were identified by a medical information system search of *contrast*, *iodine*, and *shellfish* allergy. Any mention of these possible allergies throughout the patients' association with the radiology practice identified them as initially potential candidates for study inclusion.

Within the six-month period of the retrospective study, 15,715 patients underwent a total of 19,043 CT studies (non-contrast and contrast). Of these 15,715 patients, 454 patients (2.9%) were initially detected via the key word (*contrast*, *iodine*, *shellfish*) allergy search, as having at least one of these terms listed as a potential allergy. Of these 454 patients, 6 were removed for having no questionnaire scanned into PACS, and 15 were removed for having been given a different questionnaire, yielding 433 patients with valid study contrast questionnaires. An additional 19 subjects were removed for having had a first-time allergic reaction to contrast (ioversol) the day of the study, with no prior contrast allergy history.

Of these remaining patients, 39 were removed for shellfish allergy, denying any allergy to intravenous contrast. 12 subjects were removed for other allergies, not IV contrast, and 31 subjects denied any allergies. Three subjects claiming IV contrast allergy were removed for reporting symptoms from a prior injection that are considered physiologic but not allergic-like, including two for nausea/vomiting, and one for warm flushing sensation only. Ten people were removed for claiming allergy to iodine-based topical soap, not intravenous contrast. Eight more patients were removed for claiming to be “unsure” if they had a contrast allergy. 311 patients remained with a confirmed belief in a prior contrast allergy. Four of these were removed for stating that they were allergic to gadolinium-based MRI contrast, not iodinated contrast. A cohort of 307 adult patients (2.0% of all CT patients in the study period) remained who confirmed their belief in an allergic reaction to previously administered

iodinated contrast.

Specific data points in the patient questionnaire are outlined in Table 1.

3. Results

3.1. Symptom naming

Of our cohort of 307 patients with prior iodinated contrast allergy, 266 (86.6%) were able to name their symptoms at the time of their prior reaction, consistent with prior studies (Table 2). The most commonly reported symptoms were hives and/or rash 153 (49.8%); dyspnea 30 (9.8%); anaphylaxis/throat closure 27 (8.8%) (Table 3).

3.2. Estimate of when prior reaction occurred

Only 113 of 307 (36.8%) could name the approximate year their allergic reaction occurred. An additional 20 (6.5%) reported their allergy as being “a long time ago” without specifying the year. The other 174 subjects (56.7%) provided no information on when their prior reaction occurred (Table 4).

3.3. Naming the location where the prior reaction occurred

When asked where the prior allergic reaction occurred, 126 of 307 (40.7%) could name either the facility or the city. 181 of 307 (59.3%) could not name where the reaction occurred (Table 5).

3.4. Naming their contrast allergy

Again, other studies estimate that patients prior to pharmacist consultation are 60–70% accurate when asked to name their specific medication allergies. For Chi-square statistical analysis, the low end estimate of 60% would predict that 184 of the 307 patients in the cohort with an iodinated contrast allergy might be able to specify their contrast allergy by name.

However, of the 307 subjects in the cohort, only 5 (1.6%, $p < 0.00001$) could name the contrast agent to which they were allergic (Table 6). Three of these five patients reported allergy to ioversol, and two reported allergy to iodixanol. One additional patient could not name his allergy but was able to specify “non-ionic contrast.” 302 of the 307 (98.4%, $p < 0.00001$) were unable to name the specific contrast agent to which they are allergic. (Tables 6–7).

4. Discussion

Other studies have estimated that patients prior to pharmacist counseling are approximately 60–70% accurate in their ability to name their medication allergies in general.^{13–17} By comparison, we found that only 1.6% of patients with an iodinated contrast allergy could name the actual contrast agent to which they had an allergic-like reaction ($p < 0.00001$).

Our practice questionnaire asks patients to list their other medication allergies. In our cohort of people with a reported iodinated contrast allergy, some patients have no other known allergies, while others list one

Table 1
Patient questionnaire wording.

Are you allergic to iodine-based intravenous contrast (previously sometimes called “x-ray dye” or “iodine”)?
If yes, what was your allergic reaction symptom:
When and where was the study done when the reaction occurred?
If you know the name of the specific contrast agent to which you may be allergic, please list:
Please list any other drug allergies you may have:

Table 2
Patient ability to describe contrast allergy symptoms.

Patients who described their contrast allergy symptoms	266 (86.6%)
Patients who provided no symptom description	41 (13.4%)

n = 307.

Table 3
Most common prior contrast reaction symptoms.

Hives and/or rash	153 (49.8%)
Dyspnea	30 (9.8%)
Anaphylaxis/throat closure	27 (8.8%)

Table 4
When did prior contrast reaction occur.

Able to estimate approximate year	113 (36.8%)
"A long time ago"	20 (6.5%)
No information provided	174 (56.7%)

n = 307.

Table 5
Where did prior contrast reaction occur.

Named either the facility or city	125 (40.7%)
No information provided	182 (59.3%)

n = 307.

Table 6
patient ability to name the contrast allergy.

Yes	5 (1.6%)
No	302 (98.4%)

n = 307.

p < 0.00001.

Table 7
Contrast allergy agents named by our cohort.

Ioversol (Optiray; Guerbet, Villepinte, France)	3
Iodixanol (Visipaque; GE, Boston, MA, USA)	2
Unknown but knew "nonionic contrast"	1
Unable to name specific contrast allergy	302

or multiple drug allergies. Given the multitude of referring doctors and hospital systems in our region, it is not feasible for this study to verify all other medication allergies listed by the members of our cohort. The authors did observe that other medication allergies listed by our cohort members were specific drug names, with the exceptions of sulfanamide class antibiotics, often listed as "sulfa" allergy; and penicillin class antibiotics, commonly listed simply as "penicillin" allergy. All other medication allergies listed were specific drug names, despite 98.4% of these cohort members being unable to list their own contrast allergy by name.

The majority of our cohort (86.6%) could describe the allergic-like symptoms experienced at the time of their prior reaction, consistent with other studies.

The location of a facility where a prior allergic reaction occurred may be useful information, if records can be retrieved to clarify which agent caused a patient's allergic reaction. However, only 40.7% of patients could name either the facility or the city where their allergic reaction occurred, markedly limiting the ability of current care providers to track down information on prior reactions.

With regard to iodinated contrast allergy, knowing the year of the reaction may also be useful, since currently used nonionic/low-osmolar

agents were not commercially available in the U.S. before 1985. Due in part to the initial expense of nonionic/low-osmolar agents, older ionic agents continued to be widely used into at least the early to mid 2000s, now replaced in most practices with less allergenic nonionic/low-osmolar agents. Yet over half (56.7%) of our cohort was unable to recall the year their reactions occurred.

The five patients in our cohort who were able to name their contrast allergy agent were telephoned after study data was assessed, to ask how they knew this information when most patients in our cohort did not know. Three of these five knowledgeable patients were successfully contacted. They replied that a technologist or radiologist simply told them the name of the contrast agent they had received when they had their prior allergic reaction, and provided the information in writing.

Knowing one's specific iodinated contrast allergy is important, as alternative agents may be used in patients with prior allergic reaction when a contrast enhanced CT is warranted. Recent studies suggest that switching contrast agents from the prior allergic agent is an effective means of decreasing subsequent reactions, and more effective than steroid premedication.^{5,6,18–20}

With the increasing use of electronic medical records, precise documentation in a patient's chart of a specific contrast agent allergy and the specific reaction is strongly recommended, in addition to providing the patient with written documentation, and specification in the radiology report. A general "iodinated contrast" allergy entry ideally would only be used when the specific agent cannot be determined. If the allergenic agent can at least be determined to be ionic or nonionic, this information should be included, as the risk of future reaction with current nonionic contrast differs depending on the previous offending agent.

Patient allergies to topical povidone and to shellfish should be specified as such, as these are unrelated to intravenous contrast. Finally, it is the authors' belief that electronic medical records should not allow "iodine" to be a valid allergy choice, since iodine is an essential element needed to live, and "iodine allergy" is a nonsensical term used informally to refer to at least three unrelated allergens, making the term meaningless and confusing, with potential for adverse patient care.

Recommendations

Given the findings of this investigation, the authors recommend:

1. Patients having a current allergic reaction to intravenous contrast should be given the name of the contrast agent in writing, and be advised to list that specific contrast agent by name whenever asked their medication allergies.
2. The specific contrast agent used for a study should be documented in the report, and an adverse reaction to a specific agent be documented in the facility's medical records.
3. Electronic medical record systems going forward should not allow "iodine" to be listed as an allergy option, given that the term is nonsensical and confusing, informally referring to different things by different people. To update medical records and replace "iodine" as a previously accepted listed allergy, dropdown choices could allow clinical staff to select a more accurate allergen, including intravenous contrast agents, povidone soap, and shellfish as distinct options.
4. An allergic reaction to an intravenous contrast agent before 1985 (the year that the first nonionic contrast agent was approved in the U. S.) could be listed as an allergy to ionic iodinated contrast, if the name of the contrast agent is unavailable. The severity of that reaction can help determine if the patient may be a candidate to receive current nonionic/low-osmolar agents.
5. Educational efforts can be made to care providers ordering studies, and to patients scheduling exams. Practices can provide information clarifying the differences in older vs. currently utilized contrast agents, and the lack of any demonstrated cross-reactivity to unrelated allergens such as povidone soap or shellfish.

Author's contribution

Cullen Ruff: Study conception and design; data gathering, processing, analysis; consultation; writing/revision; references; manuscript approval.

Elliot Banayan: Study design input; data gathering, processing, analysis; database maintenance; consultation; writing/revision; references; manuscript approval.

Daniel Overdeck: Study design input; data analysis; consultation; writing/revision; references; manuscript approval.

Declaration of competing interest

The authors declare no conflict of interest.

The authors declare that they had full access to all of the data in this study and the authors take complete responsibility for the integrity of the data and the accuracy of the data analysis.

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