

A Survey on the Use of Premedication Prior to Iodinated and Gadolinium-Based Contrast Material Administration

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Purpose: The aim of this study was to assess Society of Uroradiology member use of premedication before the intravenous administration of low-osmolality iodinated contrast materials (LOCM) and gadolinium-based contrast materials (GBCM).

Methods: Society of Uroradiology members were invited to complete a Web-based survey concerning the use of premedication. The survey included scenarios concerning intravenous LOCM or GBCM injection in which respondents were asked whether they would recommend premedication or withhold contrast material injection. Results for LOCM questions were compared with those for GBCM questions. Question responses for LOCM were also compared with those from a similar Society of Uroradiology survey published in 1995.

Results: Sixty-two of 72 respondents (86%) used standardized premedication regimens. Fifty-nine of 61 described regimens (97%) included oral corticosteroids and 48 (79%) antihistamines. Twenty of 69 respondents (29%) had separate urgent premedication regimens. There was general agreement concerning premedication use; however, responses were inconsistent in patients with severe food or medication allergies, severe symptomatic asthma, or prior mild urticarial reactions. More respondents recommended premedication before LOCM than GBCM administration. More respondents recommended premedication or avoidance of contrast material injection in patients with prior contrast reactions in the current study compared with the 1995 study.

Conclusions: There is frequent agreement among urologists concerning the use of corticosteroid prophylaxis, but there is inconsistency in some clinical situations. The threshold for premedication is often lower for LOCM than GBCM. Since 1995, recommendations for use of premedication have become more widespread.

Key Words: Radiographic contrast media, iodinated contrast media, gadolinium-based contrast media, corticosteroids, premedication

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INTRODUCTION

Corticosteroid premedication regimens before intravascular contrast material administration have been used widely since the 1980s, at which time a series of reports

appeared by Greenberger et al [1-3] and Lasser et al [4] demonstrating their efficacy under certain circumstances. Unfortunately, data supporting the efficacy of corticosteroid premedication in preventing moderate or severe contrast reactions in high-risk patients are limited. Similarly, data concerning the efficacy of corticosteroids in lowering contrast reaction rates in specific subgroups of patients (with different types of allergies both to contrast media and other agents) are lacking. Because of this ambiguity, decisions concerning the use of corticosteroid prophylaxis are often deferred to "expert" opinion. Therefore, it is not surprising that publications such as the *ACR Manual on Contrast Media* [5] and the Euro-

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pean Society of Urogenital Radiology's [6] *Guidelines on Contrast Media* continue to be relied on heavily by radiologists when determining if and when premedication should be administered.

To assess current expert opinion on specific issues related to premedication use, we conducted a survey of members of the Society of Uroradiology (SUR), an organization that has long been involved in issues related to the use of both iodinated radiographic and gadolinium-based contrast media and whose membership includes many individuals with long-standing acknowledged expertise in this area, including 12 of the 13 members of the ACR's Committee on Drugs and Contrast Media. Our survey was formulated to assess (1) the specific corticosteroid premedication regimens that are currently being used, (2) in what specific clinical situations decisions are being made to administer corticosteroid premedication or to withhold contrast material injection altogether, and (3) whether recommendations on corticosteroid use have changed in the past 15 years since a similar survey on premedication use was published [7].

METHODS

The need for approval was waived by our local institutional review board committee. Members of the SUR were invited by e-mail in July 2009 to participate in an Internet-based survey (<http://www.surveymonkey.com>) regarding premedication and contrast media use. The questionnaire, which is not included in this report, can be obtained from the corresponding author. It assessed respondent demographics, including the country in which the responding radiologist practices; whether the responding radiologist practices at a hospital, an outpatient imaging center, or both; the size of any hospital at which the radiologist practices; and the nature of each responding radiologist's practice (private practice or academic). The remainder of the questionnaire addressed the use of premedication in patients before the administration of low-osmolality iodinated contrast materials (LOCM) and gadolinium-based contrast materials (GBCM). Respondents were asked to describe the details of the premedication regimens they use in patients before elective and urgent procedures. Respondents were then asked to choose a course of action (injection of contrast media without premedication, injection of contrast media with premedication, or no injection of contrast media) for a series of different clinical scenarios. Scenarios included patients with a variety of allergies to foods or medications, asthma of varying severity, or histories of prior reactions to contrast media.

Recommendations about when corticosteroid administration should be used were tabulated. Differences in response distribution for equivalent scenarios in which

patients were to be injected with LOCM vs GBCM were then compared. The results of the current survey dealing with premedication before iodinated contrast material administration were then compared to those from a survey of the SUR published in 1995 that included many similar questions [7].

Statistical Analysis

Contingency table analyses were performed. Exact χ^2 tests were used to determine the association between the two types of contrast agents (LOCM and GBCM), the two different survey times, and the 3 possible responses permitted in the survey (injection of contrast material without premedication, injection of contrast material with premedication, or no injection of contrast material). Fisher's exact tests were performed to further evaluate the association between the two types of contrast media for patients who would not receive any premedication and those who either would receive premedication or who would not receive intravenous (IV) contrast material injections. The grouping of the latter 2 responses was due to small cell counts for respondents who had made these treatment choices. P values $\leq .05$ were considered significant for all hypothesis tests. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to compare significant differences. Statistical testing was performed using SAS version 9.2 (SAS Institute Inc, Cary, North Carolina).

RESULTS

Response Rate

Ninety-nine of 349 SUR members (28%) participated in the survey. Many respondents (between 5 and 38 respondents) did not answer every question. This is reflected in the different denominators provided in the results.

Demographic Data

Ninety-four respondents provided demographic material and 5 did not. Most respondents (78 of 94) practice in the United States. Sixteen respondents located outside the United States practice in Europe ($n = 8$), Canada ($n = 4$), Asia (including the Middle East; $n = 3$), and South America ($n = 1$). Forty-eight of 95 respondents practice only at hospitals, 5 only at outpatient imaging centers, and 42 at both locations. Eighty-nine respondents who practice at hospitals provided information on the number of beds in their hospitals. Most ($n = 61$) practice at hospitals with ≥ 501 beds, while a smaller number practice at hospitals with 100 to 500 ($n = 27$) or < 100 ($n = 1$) beds. Sixty-six participants are academic radiologists, 7 are private practice radiologists, and 21 practice in mixed settings.

Premedication Regimens: Routine Preparation

Standardization. Seventy-two respondents indicated whether they used routine premедication regimens before the administration of IV contrast material. Of these, 64 (89%) had standardized premедication regimens and 8 did not.

Medications: Type, Route, and Dose of Corticosteroid Administration. Sixty-one of 64 respondents (95%) with standardized premедication regimens provided specific details concerning dose and frequency of use of corticosteroids. Fifty-nine of these 61 respondents (97%) used oral corticosteroids: prednisone ($n = 38$), methylprednisolone ($n = 19$), dexamethasone ($n = 1$), or either prednisone or methylprednisolone ($n = 1$). One respondent used IV or intramuscular hydrocortisone. The remaining respondent stated specifically that he or she did not use a corticosteroid for premедication, only an antihistamine (clemastine).

The 38 respondents who used oral prednisone provided specific dosing regimens. All but 3 administered 50-mg doses. The remaining 3 respondents each administered 40 mg of prednisone, either at 12 and 2 hours before contrast injection ($n = 2$) or 13, 7, and 1 hour before contrast material injection ($n = 1$). Twenty-five of the 35 (71%) respondents who used 50-mg doses of prednisone administered them at 13, 6 or 7, and 1 hour before contrast material injection. Of the 10 respondents who did not follow this dosing schedule, 5 administered only 2 doses of prednisone at 12 to 13 hours and 1 to 2 hours before contrast injection; 3 administered 3 doses at 24 to 25, 12, and 1 hour before IV contrast administration; and 1 administered 2 doses of prednisone at 13 and 6 hours before contrast injection. The remaining respondent prescribed 4 doses of prednisone, administered 18, 12, 6, and 1 hour before contrast material injection.

Of the 19 respondents who used methylprednisolone, 18 provided specific dosing regimens. All 18 of these respondents administered 32-mg tablets 12 and 2 hours before injecting contrast material.

Medications: Type, Route, and Dose of Antihistamine Administration. Forty-nine of 64 respondents stated that they used antihistamines as part of their premедication regimens. Forty-eight used oral antihistamines in conjunction with corticosteroids, and the remaining respondent administered only an antihistamine. Three of the 49 respondents who used antihistamines did not specify the type of antihistamine. Of the other 46 respondents who specified the type of antihistamine used, 43 (93%) used diphenhydramine, 2 used clemastine, and 1 used hydroxyzine. Thirty-eight of 43 respondents who administered diphenhydramine provided

doses, most commonly of 50 mg (30 respondents [79%]). Only a small number of respondents used lower doses, with 5 routinely using 25-mg doses and 3 using 25-mg to 50-mg doses. Clemastine and hydroxyzine dosing information was not provided.

No respondents described the use of an H_2 -receptor antagonist (eg, cimetidine or ranitidine) for premедication.

Emergent and Urgent Premedication Regimens

Sixty-nine respondents indicated whether they offered separate rapid or urgent premедication regimens in emergent or urgent settings. Of these 69 respondents, only 20 (29%) used separate emergent or urgent premедication regimens. Two did not provide details regarding their regimens. All 18 respondents who provided details indicated that they used either IV hydrocortisone (10 respondents) or IV methylprednisolone (8 respondents) for their rapid regimens.

Sixteen of these 18 respondents provided further information about the rapid premедication regimens they used, including 9 of the 10 respondents who used hydrocortisone and 7 of the 8 respondents who used methylprednisolone. Six respondents administered hydrocortisone in 200-mg doses and 3 in 100-mg doses. A variety of methylprednisolone doses were cited, including 125 mg ($n = 3$), 100 mg ($n = 2$), 200 mg ($n = 1$), and 60 mg ($n = 1$). Nine of the 16 respondents who described their rapid premедication protocols also prescribed antihistamines (always diphenhydramine; 50-mg doses in 8 instances and 25-mg doses in 1 instance) and 7 did not.

There was some variation in the timing of the rapid premедication regimens. The minimum premедication duration was ≤ 1 hour before contrast material injection in 10 of 20 respondents who had urgent premедication regimens. Other minimum durations were 2 hours ($n = 1$), 4 hours ($n = 4$), 4 to 6 hours ($n = 1$), 6 hours ($n = 3$), and 8 hours ($n = 1$). Dosing intervals were provided by 9 respondents who administered rapid premедication: every 4 hours ($n = 8$) or every 6 hours ($n = 1$) beginning >1 hour before injection. Two rapid premедication regimens also included postprocedural medication, with each of these regimens involving at least 1 dose of corticosteroids 4 hours after contrast material injection.

Use of Premedication in Specific Clinical Settings

Food or Medication Allergies. Details regarding the use of premедication in patients with allergies to food or other medications are included in Table 1. For both LOCM and GBCM, the vast majority of respondents would inject contrast material without premедication in patients with hay fever (61 of 64 [95%] and 58 of 59 [98%], respectively) or a single food (including shellfish)

Table 1. Precautions in patients with allergies to food or other medications (LOCM vs GBCM)

History	+LOCM		-LOCM	Total Responses	+GBCM		-GBCM	Total Responses
	No Premedication	Premedication			No Premedication	Premedication		
Hay fever	61 (95%) 95%	2 (3%)	1 (2%)	64	58 (98%)	1 (2%)	0 (0%)	59
To a single food or medication								
Mild	59 (92%)	4 (6%)	1 (2%)	64	57 (98%)	1 (2%)	0 (0%)	58
Severe	35 (56%)	25 (40%)	3 (5%)	63	41 (69%)	15 (25%)	3 (5%)	59
Shellfish								
Mild	58 (92%)	4 (6%)	1 (2%)	63	58 (98%)	1 (2%)	0 (0%)	59
Severe	38 (60%) (<i>P</i> = .05)	23 (37%)	2 (3%)	63	46 (78%) (<i>P</i> = .05); 2.3 (1.1-5.2)	12 (20%)	1 (2%)	59
To multiple foods and/or medications								
Mild to each	52 (81%)	12 (19%)	0 (0%)	64	53 (90%)	6 (10%)	0 (0%)	59
Some severe	28 (44%) (<i>P</i> = .05)	32 (50%)	4 (6%)	64	37 (63%) (<i>P</i> = .05); 2.2 (1.1-4.5)	19 (32%)	3 (5%)	59
Topical iodine (rash) (<i>P</i> < .0001)	48 (75%) (<i>P</i> = .002)	16 (25%) (<i>P</i> < .0001); 9.5 (2.0-87.7)	0 (0%)	64	56 (95%) (<i>P</i> = .002); 6.2 (1.6-34.8)	2 (3%) (<i>P</i> < .0001)	1 (2%)	59
GBCM								
Mild	52 (80%)	12 (18%)	1 (2%)	65				
Severe	31 (48%)	26 (40%)	8 (12%)	65				
LOCM								
Mild					50 (83%)	9 (15%)	1 (2%)	60
Severe					35 (58%)	21 (35%)	4 (7%)	60

Note: GBCM = gadolinium-based contrast materials; +GBCM = will administer GBCM; -GBCM = will not administer GBCM; LOCM = low-osmolality iodinated contrast materials; +LOCM = will administer LOCM; -LOCM = will not administer LOCM. Boldface type indicates statistically significant differences between responses, for entire category (on left) according to χ^2 test or for specific behaviors (in subsequent columns) according to Fisher's exact test, for LOCM vs GBCM; *P* values and odds ratios (95% confidence intervals) are shown.

or medication allergy when the allergy is characterized by a mild reaction (59 of 64 [92%] and 57 of 58 [98%]). In patients with significant allergies to a single food or medication, many fewer respondents would choose to inject either LOCM (35 of 63 [56%]) or GBCM (41 of 59 [69%]) without premedication.

Consistently fewer respondents chose to inject patients with severe food or medication allergies without premedication before LOCM than GBCM injection, with several differences being statistically significant. For example, 28 of 64 respondents (44%) would administer LOCM without premedication to patients with multiple allergies to foods or medications (some of which are severe), compared with 37 of 59 (63%) who would inject GBCM without premedication ($P = .05$). Sixty percent of 63 respondents ($n = 38$) would administer LOCM without premedication to patients with prior severe reactions to shellfish, compared with 78% of 59 respondents ($n = 46$) who would inject GBCM without premedication ($P = .05$).

Asthma. Results concerning premedication in patients with histories of asthma are provided in Table 2. Only a few respondents would premedicate patients with “mild” asthma who do not take daily medications for this disease before injection of LOCM (1 of 64 [2%]) or GBCM (2 of 61 [3%]). The use of premedication increased as asthma severity increased, so that about one-third of respondents would withhold LOCM (22 of 64 [34%]) or GBCM (19 of 61 [31%]) in asthmatic patients who are acutely symptomatic.

When premedication recommendations in patients with all but mild asthma were compared between LOCM and GBCM injections, respondents were consistently more likely to recommend premedication before LOCM administration. Comparisons were statistically significant for patients who required the daily use of an inhaler. Eighteen percent of 65 respondents ($n = 12$) would premedicate before LOCM injection in asthmatic patients who required daily inhalers compared with 7% of 60 ($n = 4$) before GBCM injection ($P = .05$).

Prior Contrast Material Reactions. Respondents frequently recommended the use of premedication or the withholding of contrast material injection altogether in patients with prior adverse reactions to the same type of contrast material (Table 3). For example, 55% of 62 respondents ($n = 34$) would administer premedication for patients who developed 1 or 2 hives after LOCM injection before a repeat injection of LOCM compared with 45% of 60 respondents ($n = 27$) who would administer premedication for patients with prior similar reactions to GBCM before a repeat GBCM injection. For patients who developed 3 to 5 hives on their face and neck after prior contrast media administration, 75% (46

Table 2. Precautions in asthmatics (LOCM vs GBCM)

Asthma	+LOCM			+GBCM			Total Responses	Total Responses
	No Premedication	Premedication	–LOCM	No Premedication	Premedication	–GBCM		
Mild	62 (97%)	1 (2%)	1 (2%)	59 (97%)	2 (3%)	0 (0%)	64	61
Daily inhaler	51 (78%) ($P = .05$)	12 (18%) ($P = .05$); 3.2 (0.96-14.2)	2 (3%)	55 (92%) ($P = .05$); 3.0 (1.01-9.0)	4 (7%) ($P = .05$)	1 (2%)	65	60
One medication daily	49 (75%)	14 (22%)	2 (3%)	53 (87%)	6 (10%)	2 (3%)	65	61
≥2 medications or ≥1 combo medication	39 (61%)	20 (31%)	5 (8%)	45 (75%)	12 (20%)	3 (5%)	64	60
Currently symptomatic	21 (33%)	21 (33%)	22 (34%)	29 (48%)	13 (21%)	19 (31%)	64	61

Note: GBCM = gadolinium-based contrast materials; +GBCM = will administer GBCM; –GBCM = will not administer GBCM; LOCM = low-osmolality iodinated contrast materials; +LOCM = will administer LOCM; –LOCM = will not administer LOCM. Boldface type indicates statistically significant differences between responses for LOCM vs GBCM using Fisher's exact test; P values and odds ratios (95% confidence intervals) are shown.

Table 3. Precautions in patients with prior contrast reactions (LOCM vs GBCM)

History	+LOCM			+GBCM			Total Responses	Total Responses
	No Premedication	Premedication	–LOCM	No Premedication	Premedication	–GBCM		
1 or 2 hives	27 (44%)	34 (55%)	1 (2%)	29 (48%)	27 (45%)	4 (7%)	62	60
3-5 hives	14 (23%)	46 (75%)	1 (2%)	17 (28%)	39 (65%)	4 (7%)	61	60
Many hives	3 (5%)	53 (85%)	6 (10%)	3 (5%)	47 (80%)	9 (15%)	62	59
Bronchospasm	1 (2%)	37 (59%)	25 (40%)	1 (2%)	31 (52%)	28 (47%)	63	60
Throat hoarseness/tightness	2 (3%)	32 (51%)	29 (46%)	2 (3%)	24 (40%)	34 (57%)	63	60
Facial edema	1 (2%)	28 (44%)	34 (54%)	0 (0%)	24 (40%)	36 (60%)	63	60
Severe laryngeal edema	0 (0%)	14 (22%)	49 (78%)	0 (0%)	8 (13%)	52 (87%)	63	60
Hypotension and tachycardia	2 (3%)	15 (25%)	44 (72%)	1 (2%)	11 (18%)	48 (80%)	61	60
Cardiac arrest	1 (2%)	5 (8%)	57 (90%)	1 (2%)	4 (7%)	55 (92%)	63	60
Hypotension and bradycardia	10 (16%)	15 (25%)	36 (59%)	9 (15%)	14 (23%)	37 (62%)	61	60
Delayed reaction (rash, fever)	7 (11%)	49 (79%) ($P = .05$); 2.3 (1.1-5.2)	6 (10%) ($P = .01$)	5 (8%)	37 (62%) ($P = .05$)	18 (30%) ($P = .01$); 4.0; (1.5-11.0)	62	60
Unknown prior reaction	7 (11%)	43 (70%)	11 (18%)	8 (14%)	34 (58%)	17 (29%)	61	59

Note: GBCM = gadolinium-based contrast materials; +GBCM = will administer GBCM; –GBCM = will not administer GBCM; LOCM = low-osmolality iodinated contrast materials; +LOCM = will administer LOCM; –LOCM = will not administer LOCM. Boldface type indicates statistically significant differences between responses for LOCM and GBCM using Fisher's exact test; P values and odds ratios (95% confidence intervals) are shown.

of 61) would recommend premedication before a subsequent injection of LOCM. For the same clinical scenario involving GBCM, 65% (39 of 60) would recommend premedication before a subsequent injection of GBCM.

There was greater consensus for patients with prior moderate or severe allergic-like reactions to contrast material. In patients with prior reactions consisting of bronchospasm, laryngeal edema, or throat tightness, only 1 or 2 respondents would be willing to administer LOCM or GBCM without premedication. In fact, many respondents (40%-87%) in these scenarios recommended that no contrast material be readministered. In cases of prior cardiopulmonary arrest to LOCM or GBCM, >90% (57 of 63 and 55 of 60, respectively) of respondents would withhold repeat injections of the same type of contrast material.

When comparisons were made concerning recommendations before LOCM vs GBCM injection in patients with previous contrast reactions, only one statistically significant difference was identified. This was for patients who had delayed contrast reactions consisting of a rash or fever developing ≥ 2 hours after contrast material injection. In this group, respondents were significantly more likely to recommend premedication before repeat injection of LOCM (49 of 62 [79%]) than GBCM (37 of 60 [62%]) ($P = .05$) and to avoid repeat injection of GBCM (18 of 60 [30%]) than LOCM (6 of 62 [10%]) ($P = .01$).

Comparison of Premedication Use Before Iodinated Contrast Media Injection: 1995 vs 2009

Changes in Dose and Timing of Oral Corticosteroid Administration (Standard Regimen). The data summarizing our comparison of the 1995 and 2009 surveys are provided in Table 4. The 1995 survey did not question respondents about GBCM. In 1995, reported premedication regimens before iodinated contrast material administration were more variable than they are now. In 1995, 47 of 74 respondents (64%) whose premedication regimens included oral corticosteroids used prednisone. Only 27 of these 47 respondents (57%) used 50-mg doses, while the others used prednisone doses that ranged from 10 to 60 mg (excluding 50 mg). In the current survey, a similar percentage of respondents whose premedication regimens included oral corticosteroids used prednisone (38 of 59 respondents [64%]); however, 35 of the 38 respondents (92%) who used prednisone in 2009 used 50-mg doses (OR for 2009 vs 1995, 8.6; 95% CI, 2.2-48.8; $P < .001$).

Dosing intervals have also become more uniform since 1995. In the 1995 survey, 27 of 73 respondents (37%) prescribed corticosteroids starting >12 to 13 hours before contrast injection. In comparison, of those who pro-

Table 4. Comparison of 1995 and 2009 surveys on LOCM use in high-risk patients

History	No Premedication		Premedication		No Contrast	
	1995	2009	1995	2009	1995	2009
Hay fever	71 (92%)	61 (95%)	6 (8%)	2 (3%)	0 (0%)	1 (2%)
Food or medication						
Mild	64 (85%)	59 (92%)	11 (15%)	4 (6%)	0 (0%)	1 (2%)
Topical iodine (rash)	56 (82%)	48 (75%)	12 (18%)	16 (25%)	0 (0%)	0 (0%)
Multiple reactions						
Mild to each	62 (82%)	52 (81%)	14 (18%)	12 (19%)	0 (0%)	0 (0%)
Prior reaction to LOCM						
1 or 2 hives ($P < .0001$)	57 (75%) ($P < .0001$); 3.9 (1.8-8.9)	27 (44%) ($P < .0001$)	19 (25%) ($P < .0001$)	34 (55%) ($P < .0001$); 3.6 (1.7-7.5)	0 (0%)	1 (2%)
Many hives	25 (32%) ($P < .0001$); 9.3 (2.6-34.5)	3 (5%) ($P < .0001$)	52 (67%) ($P < .01$)	53 (85%) ($P < .01$); 2.9 (1.2-7.8)	1 (1%)	6 (10%)
Bronchospasm ($P = .005$)	11 (14%) ($P = .01$); 10.0 (1.3-80.0)	1 (2%) ($P < .01$)	51 (65%)	37 (59%)	17 (22%) ($P = .03$)	25 (40%) ($P = .03$); 2.4 (1.2-5.0)
Facial edema ($P < .01$)	6 (8%)	1 (2%)	48 (61%)	28 (44%)	25 (32%) ($P = .01$)	34 (54%) ($P = .01$); 2.5 (1.2-5.3)
Hypotension and tachycardia* ($P < .0001$)	21 (28%) ($P < .0001$); 11.5 (2.6-51.2)	2 (3%) ($P < .0001$)	39 (52%) ($P = .002$); 3.3 (1.5-7.5)	15 (25%) ($P = .002$)	15 (20%) ($P < .0001$)	44 (72%) ($P < .0001$); 10.4 (9.4-24.9)
Cardiac arrest ($P = .02$)	5 (6%)	1 (2%)	18 (22%) ($P = .02$); 3.3 (1.1-11.9)	5 (8%) ($P = .02$)	59 (72%) ($P = .01$)	57 (90%) ($P = .01$); 3.7 (1.3-11.9)
Hypotension and bradycardia ($P < .0001$)	51 (68%) ($P < .0001$); 10.8 (4.7-24.9)	10 (16%) ($P < .0001$)	21 (28%)	15 (25%)	3 (4%) ($P < .0001$)	36 (59%) ($P < .0001$); 34.6 (10.0-122.0)

Note: LOCM = low-osmolality iodinated contrast materials. Boldface type indicates statistically significant differences between responses, for entire category (on left) according to χ^2 test or for specific behaviors (in subsequent columns) according to Fisher's exact test, for 1995 vs 2009 surveys; P values and odds ratios (95% confidence intervals) are shown.

vided details regarding timing on the current survey, only 4 of 56 respondents (7%) began their premedication >13 hours before contrast injection (OR for 1995 vs 2009, 7.6; 95% CI, 2.4-31.8; $P < .0001$).

Changes in Antihistamine Use (Standard Regimen). Antihistamine use has decreased since 1995. In 1995, 70 of 76 respondents (92%) included antihistamines in their standard premedication regimens. In the current study, only 49 of 64 respondents (77%) included antihistamines (OR for 2009 vs 1995, 3.5; 95% CI, 1.2-12.5; $P = .02$). Of those who reported using antihistamines in their standard premedication regimens, diphenhydramine was more prevalent in 2009 than in 1995. Of the 70 respondents in 1995 who included antihistamines in their premedication regimens, 46 (66%) used diphenhydramine. In the current study, 44 of 46 respondents (96%) who both used antihistamines and provided the names of the antihistamines they used administered diphenhydramine (OR for 2009 vs 1995, 7.5; 95% CI, 2.0-41.0; $P < .0001$). The use of H_2 -receptor antagonists in premedication regimens has greatly diminished since 1995. In 1995, H_2 -receptor blockers were prescribed as part of a premedication regimen by 23 of 76 respondents (30%), but they were not used by any respondents in the current survey ($P < .0001$).

Changes in Use of Premedication Regimens. Since 1995, respondents have become consistently more likely to use premedication or to withhold iodinated contrast material injection in patients who have had prior allergic-like reactions to iodinated contrast media, with statistically significant results noted for all 7 scenarios included in both surveys. For patients with histories of prior mild allergic-like reactions to contrast material (1 or 2 hives), 75% of the 1995 respondents (57 of 76) would not have premedicated their patients before repeat injections of iodinated contrast material, and none would have withheld repeat injections. In comparison, only 44% of the 2009 respondents (27 of 62) would not have premedicated such patients (OR for 1995 vs 2009, 3.9; 95% CI, 1.8-8.9; $P < .0001$), and 2% (1 of 62) would withhold repeat injections. A similar pattern was identified for reactions to iodinated contrast material that were greater than mild in severity. For example, for bronchospasm, 14% of respondents (11 of 79) would have administered repeat contrast material injections without premedication in 1995. Only 2% (1 of 63) would do so now (OR for 1995 vs 2009, 10.0; 95% CI, 1.3-80.0; $P = .01$). In patients with histories of hypotension and tachycardia after contrast material injection, 28% of respondents (21 of 75) would have reinjected contrast material in these patients without premedication in 1995 compared with only 3% of respondents (2 of 61) who would have done

so now (OR for 1995 vs 2009, 11.5; 95% CI, 2.6-51.2; $P < .0001$).

DISCUSSION

Corticosteroid and antihistamine premedication before contrast material injection has been used for many years [1-4]. Greenberger's group suggested that adverse reactions to iodinated contrast material could be reduced in high-risk patients when they received 50 mg of oral prednisone (13, 7, and 1 hour prior) with 50 mg of oral diphenhydramine (1 hour prior) before the administration of high-osmolality ionic iodinated contrast materials (HOCM) [1-3]. In these studies, high-risk patients premedicated with this regimen had a reaction rate of 9%, which was lower than the historical reaction rate of 17% to 35% encountered in earlier publications [3]. In a double-blind, randomized study, Lasser et al [4] assessed changes in reaction rates to HOCM when all patients (both high and low risk) received premedication with corticosteroids before contrast material injection. In that study, patients received 32-mg tablets of oral methylprednisolone or placebo 12 and 2 hours or just 2 hours before contrast material injection. Adverse reactions were reduced significantly only in the group that received the 2-dose corticosteroid regimen (from 9.0%-9.9% to 6.4%). The same 2 groups of researchers also published support for corticosteroid prophylaxis before the administration of LOCM, but this was in smaller studies [8,9].

Several limitations of these studies should be mentioned. The studies published by Greenberger et al [1-3] did not contain control groups. In the double-blind series of Lasser et al, [4] statistical significance for differences in moderate and severe reaction rates could only be obtained in the HOCM study and then only by combining 2 groups assessed in that study (those receiving no steroids or 1 dose of steroids). There have been few additional published data since that time. Thus, it can be argued that the efficacy of premedication regimens in preventing moderate or severe contrast reactions in high-risk patients is not known because it has never been explicitly tested in a well-controlled trial. It is not surprising that even now, some investigators question the need for any corticosteroid premedication regimen [10,11].

In such a situation, practicing radiologists are forced to rely on the opinions of expert radiologists to help them in establishing their own practices. Such recommendations have a huge effect on clinical practice and may even serve to establish a standard of care. Thus, documents such as the *ACR Manual on Contrast Media* [5] and the European Society of Urogenital Radiology's [6] *Guidelines on Contrast Media* continue to be consulted widely for their highly regarded recommendations. However, these documents address the use of corticosteroid premedication

in only a general sense. Accordingly, it would be helpful for radiologists to know the opinions of expert radiologists in more detail. This was the motivation for the survey whose results are presented here.

Not surprisingly, the types and doses of corticosteroids used in the studies of Lasser et al [4] and Greenberger et al [1-3] continue to be the most frequently used by SUR members today. In our survey, 53 of 61 respondents who provided information concerning the type and dose of corticosteroids used either 50 mg of prednisone or 32 mg of methylprednisolone. Fifty-two administered the first dose of corticosteroids 12 to 13 hours before anticipated contrast material injection. The choice of 50 mg of diphenhydramine by 30 of 46 respondents in our survey is likely because this dose and drug combination was used by Greenberger et al [1-3,12]. Although there are even fewer data available on the efficacy of corticosteroid prophylaxis before GBCM administration, the decision to use identical premedication regimens for MRI is understandable. It is presumed that such an approach would have similar efficacy to premedication before iodinated contrast material injection.

Even though there are few data concerning the efficacy of rapid IV premedication regimens, one-quarter of respondents in our survey stated that they used separate premedication regimens when emergent or urgent studies were needed. Only one small published series (9 patients) has suggested that rapid IV premedication may be of some benefit [12].

Although there were many consistent responses in our survey regarding the use of premedication before the IV administration of LOCM and GBCM, there were some areas in which no consistent opinion existed. Respondents varied in their opinions concerning the need to premedicate patients with severe food or medication allergies (including to other types of contrast materials and shellfish), severe asthma treated with multiple medications, currently symptomatic asthma, and prior contrast reactions to the same type of agent manifested by 1 or 2 hives. There was much disagreement about the appropriate response in these settings (see [Tables 1-3](#)).

When comparisons were made of the responses for anticipated LOCM vs GBCM injection, a number of differences were identified. Premedication was significantly less likely to be administered before GBCM injection in patients with severe food or medication allergies, topical iodine allergies, asthma requiring the use of an inhaler daily, or prior delayed reactions. This tendency is probably due to the overall lower frequency of acute adverse reactions to GBCM compared with LOCM [13].

Our survey respondents were more careful about iodinated contrast material administration in patients who have had prior iodinated contrast material reactions in comparison with respondents to a similar survey pub-

lished in 1995 [7]. Respondents today were significantly more likely to request premedication or to withhold contrast material injection from their patients for every prior contrast reaction symptom that was assessed in both surveys. This change is surprising because at the time the prior survey was performed, HOCM were still being widely used, and therefore allergic-like contrast material reactions were much more common. One might expect that the criteria used to determine the need for corticosteroid prophylaxis might have become more (not less) stringent. Exactly the opposite behavior has occurred.

There are several possible explanations for this shift. First, the corticosteroid regimens promulgated by Greenberger et al [1-3] and Lasser et al [4] may have gained popularity over the years, as they have been repeatedly discussed and recommended at radiology meetings and in postgraduate courses. It is conceivable that surveys of experts (eg, the 1995 survey of the SUR [7]) become self-reinforcing. Second, it is possible that current radiologists are practicing more defensively in fear of the medicolegal consequences of not administering corticosteroid prophylaxis to patients who retrospectively might be determined to have needed this precaution. Third, radiologists see fewer reactions now than in the past because of the conversion from HOCM to LOCM and may feel less comfortable managing them. Corticosteroid prophylaxis may be being used to minimize the likelihood of having to treat a severe reaction. The fourth and arguably most intriguing explanation for the observed change in behavior may have little to do with corticosteroid prophylaxis at all. In 1995, many radiologists were required to make another decision concerning contrast material injection in each of their patients: whether to have their patients injected with HOCM or LOCM. In 1995, LOCM use was often restricted to high-risk patients [14]. A radiologist confronted with a high-risk patient (generally agreed on as any patient with an allergy to another substance, asthma, or a prior contrast reaction [15]) was able to make 2 separate determinations: (1) whether the patient should be injected with HOCM or LOCM [15] and (2) whether the patient required premedication before injection. In 1995, a radiologist might decide to administer LOCM rather than HOCM but not to request premedication. In 2009, in the era of universal use of LOCM for intravascular injection, the first of these decisions has been eliminated. A radiologist desiring to do "something" to decrease patient risk can now decide only to request premedication or withhold contrast material. This alteration in the decision making process might lead to a subconscious tendency to request prophylaxis more frequently.

The results of this study must be interpreted with some caution because of its methodologic limitations. A minority of SUR members responded, and the sample of

responders was not randomized. It must be remembered that the results reported here reflect the practice of a limited segment of the radiology population: a group of radiologists with an interest in contrast media and genitourinary radiology. Also, as is true for any survey, a consensus of opinion does not necessarily mean that there is scientific proof supporting that opinion.

CONCLUSIONS

Our survey has identified several features concerning the current use of prophylaxis in the attempt to prevent acute allergic-like contrast material reactions. The currently used regimens are increasingly similar to one another (in comparison with the greater diversity reported in 1995). Routine use of H₂-receptor blockers in premedication regimens has disappeared. Responding SUR members generally agree that premedication is not needed in patients who have mild asthma or mild allergies to foods or medications. There is also consensus that premedication should be administered or contrast material injection withheld in patients who have had any but the mildest of prior allergic-like reactions to the same type of contrast media. However, there is a range of opinion regarding the use premedication of patients who have had prior mild urticarial contrast reactions (1 or 2 hives) or those with severe food or medication allergies. Overall, our respondents are more likely to inject patients with GBCM than LOCM in the absence of premedication. Finally, responding SUR members are more likely to require premedication before LOCM injection or to withhold repeat LOCM injection in patients who have had prior contrast material reactions than SUR members were in 1995. This change in behavior has occurred in spite of the now universal use of LOCM and the resulting substantial decrease in the rate of allergic-like contrast reactions to iodinated contrast media.

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