

## Knowledge And Attitudes Toward The Safe Use Of Intravascular Contrast Media In Medical Imaging Among Clinicians: A Cross-Sectional Study

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### ABSTRACT

**Background:** Safe use of intravascular (IV) contrast media in medical imaging is important. We aimed to assess the clinicians' knowledge and attitudes toward safe use of IV contrast media in medical imaging regardless of their specialty and experience. **Methods:** A cross-sectional study was conducted using a self-administered questionnaire in selected hospitals at Makkah, Saudi Arabia. The participants were exposed to 30 items to assess their knowledge and attitudes toward safe use of contrast media. The mean percentage scores were correlated with the specialty, level of training, experience, and frequency of contrast study requisition. **Results:** A total of 227 participants enrolled in the study. Internal medicine and pediatric were the highest specialties among participants (26.4%). Nearly half of participants (40.5%) had more than 10 years of experience in their field. Majority of the participants had insufficient knowledge (85.9%) and negative attitudes (80.2%) toward safe use of contrast media. The results indicate some variations in level of knowledge in between different specialties in favor of internal medicine ( $p = 0.041$ ), and statistically significant association between the participants' attitudes and their perception of level of knowledge ( $p = 0.004$ ). Finally, there is a statistically significant relation between knowledge and attitudes ( $p < 0.01$ ) with correlation coefficient (0.331) that consider as low. **Conclusions:** The study confirms overall unsatisfactory knowledge and negative attitudes toward safe use of IV contrast media among clinicians. Such findings might interfere with patient's safety or postponing necessary study. Improving knowledge on contrast media safety is highly recommended through curricular or non-curricular activities.

**Keywords:** Safe use, intravascular contrast media, clinicians, Makkah, Saudi Arabia.

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## Introduction

The use of intravascular (IV) contrast media has dramatically increased during the last few decades, mainly due to the rapid increase in the use of different radiological tests, particularly computed tomography (CT) and magnetic resonance imaging (MRI) [1]. It is estimated that in the United States alone, approximately 88 million CT and 42 million MRI scans are performed per year for different body parts [2]. Some of these scans are eventually performed with contrast media. Not surprisingly, approximately 75 million doses of only iodinated contrast agents are administered annually worldwide [3].

Contrast media has revolutionized the radiological field since it was introduced in the 1950s [4]. It is essential to enhance radiological images to differentiate normal from abnormal conditions. Furthermore, many advanced techniques have been introduced or refined with the use of contrast media. Iodinated and gadolinium-based contrast media are currently considered safe and widely used in clinical practice [1]. Despite their daily use for the aforementioned essential benefits, contrast media cause a very low percentage of severe acute adverse reactions, estimated to be 0.04% in one study for low-osmolar contrast agents [5]. The rate of rarely occurring deaths attributed to contrast media ranged from 1.1 to 1.2 per million doses administered [6]. Hence, the benefits of the administration of contrast media should be clinically weighed against the hazards to minimize the patient's risk.

However, it is the radiologist's responsibility to confirm whether the patient is at risk from the administration of contrast media prior to the exam [7]. The referring clinicians should be aware of such potential risks to provide radiologists with all the necessary clinical information [8]. Furthermore, there are some precautionary measures that must be adopted by the referring clinicians prior to and after the administration of contrast media for patient safety. On the other hand, some clinicians had misconceptions about contrast media, which might interfere with the diagnostic accuracy of the radiological studies [9,10]. Up until now, no published study has evaluated the level of awareness of contrast media among clinicians in Saudi Arabia. Furthermore, this level of awareness was even limited worldwide. The aim of our study was to assess the current knowledge and attitudes of clinicians on the safe use of contrast media in medical imaging regardless of their field of specialty and training level.

## Methods

### Study design

A cross-sectional study was conducted using a self-administered questionnaire among clinicians working at selected governmental hospitals in the Makkah region, Saudi Arabia, during the period from March 2021 to March 2022. The hospitals were clustered according to their bed capacity, and four of the top five hospitals in the region were included in the study. According to the database of the Ministry of Health, approximately 900 clinicians worked in the four selected hospitals that were active in the administration of IV contrast media. All nonradiological clinicians working at these hospitals were eligible for inclusion. All clinicians who were on an extended leave of duty or declined to participate were excluded.

### Sample size and selection

The sample size was calculated using a standard sample size equation " $n = z^2 p(1-p)/e^2$ " and an assumed proportion of 50% (proportion of clinicians who had satisfactory knowledge of and positive attitudes toward the safe use of contrast media). Using a 95% confidence interval and a 5% margin of error, the sample size was estimated to be 269 and was adjusted to 275 to compensate for the nonresponse rate.

### Research instrument (questionnaire) and validation

All clinicians present at the time of data collection in the selected hospitals were included; hard copies of the questionnaires were delivered to the available clinicians. Without seeing it first, the clinicians were asked to complete the anonymous self-administered survey in English to assess their basic background knowledge.

The questionnaire was developed by the investigators based on the objectives of the study and after a literature review of similar studies [8,10,11,12]. A panel of two radiologists and one family physician assessed the questionnaire for appropriateness, accuracy, and relevance. The reviewers are familiar with the survey's development and the latest edition (2020) of the American College of Radiology (ACR) manual on contrast media [13]. To ensure the face validity of the questionnaire, it was presented to a sample of five participants in a pilot study and then finalized. The results of the piloted questionnaires were not included in the analysis.

The questionnaire is divided into four sections with a total of 18 questions. The first section pertains to demographic characteristics, including medical specialty, frequency of requesting contrast study, level of education, and prior attendance of contrast-related courses. The second section assesses the clinicians' knowledge regarding contrast administration and its side effects through multiple choice questions (MCQs). Correct answers were scored as 1, while incorrect answers and a response of "I do not know" were scored as 0. The total knowledge score ranges from 0 to 8 (8 items). A higher score indicates more knowledge of the subject. The third section assesses the attitudes of clinicians toward selected contrast-related situations through MCQs. Correct answers were scored as 1, while incorrect answers and a response of "I do not know" were scored as 0. The fifth question described 12 conditions with three possible answers. Correct answers were scored as 1, while incorrect answers were scored as 0. The total attitude score ranges from 0 to 16 (5 items), with higher scores indicating a higher degree of attitude.

Clinicians at or above the mean score were considered to have good knowledge, positive attitudes, or optimal practice, while clinicians under the mean score were categorized as having insufficient knowledge, poor attitudes, or unsuitable practice.

### **Data management and statistical analysis**

Data were coded and entered into Statistical Package for the Social Sciences (SPSS) version 25.0 statistical software. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to describe the quantitative and categorical variables. Pearson's chi-square test was used to assess the associations between the categorical variables. Nonparametric statistical tests (Mann-Whitney and Kruskal-Wallis) were applied to compare different groups since the score was abnormally distributed, as evidenced by the significant Shapiro-Wilk test. A p value of  $\leq 0.05$  was used to report the statistical significance and precision of the results.

## **Results**

### **Statistical tools and methods**

The Statistical Package of SPSS v.26 was used to describe the basic features of the data in the study, such as frequencies and percentages. Pearson's chi-squared test ( $\chi^2$ ) was used to find the association between the level of knowledge and attitudes (good-poor) and sociodemographic variables, since it is a statistical test that is applied to sets of categorical data to test the independence of two variables, expressed in a contingency table. Independence means that knowing the value of the row variable does not change the probabilities of the column variable (and vice versa). Another way to view independence is to say that the row percentages or column percentages remain constant [14].

### Sociodemographic data

Table 1 shows the total sample size was 227. Internal medicine and pediatric care were the most common specialties among participants, with 26.4%. Regarding job title, 38.8% of participants were registrars. 40.5% of participants had more than 10 years of experience. A total of 59.5% of participants had an average of one request for a contrast study per week. A total of 43.2% of participants believed their knowledge was somewhat sufficient on IV contrast media safety and its adverse reactions although 82.8% never attended any dedicated teaching programs, such as lectures, courses, or workshops.

	n	%	
Specialty (top five)	Internal medicine	60	26.4
	Pediatrics	60	26.4
	General Surgery	27	11.9
	OB/Gyn	18	7.9
	Orthopedic Surgery	12	5.3
Job title	Registrar	88	38.8
	Consultant	61	29.9
	Resident	67	29.5
	Fellow	11	4.8
Experience	0-2 years	44	19.4
	3-5 years	44	19.4
	6-10 years	46	20.3
	>10 years	92	40.5
How frequently did you request a radiological study, such as a CT or MRI scan, with IV contrast media (Average number of requests/per week)?	< 2	135	59.5
	2-5	66	29.1
	6-10	16	7.0
	>10	10	4.4
How would you describe your knowledge on IV contrast media safety and its adverse reactions?	Sufficient	63	27.8
	Somewhat sufficient	98	43.2
	Somewhat insufficient	32	14.1
	Insufficient	12	5.3
	I don't know	20	8.8
Did you ever attend any dedicated teaching programs on IV contrast media safety and its adverse reactions such as lectures, courses, or workshops?	Yes	39	17.2
	No	188	82.8

Table 2 shows the participant's responses to the eight questions regarding their knowledge about the safe use of IV contrast media in medical imaging and its adverse reactions. Correct answers were coded as (1), and incorrect answers were coded as (0). The total score was recorded as 0, 1, 2, 3, 4, and 6. Poor levels were considered for the total score as 0, 1 and 2, and good levels were considered for the total score as 3, 4 and 6. The results show that 195 participants out of 227, which represented 85.9% of the total sample, had insufficient knowledge, whereas 32 participants, which represented 14.1%, had good knowledge. (See Table 2)

	n	%	
Which one of the following age groups has a higher reaction rate to IV contrast media (one answer only)?	Infants	30	13.5
	Children	13	5.8
	Middle-aged people <sup>a</sup>	15	6.7
	Elderly people	99	44.4
	I don't know	66	29.6
Which of the following medical condition/s, increased the risk of adverse reactions to IV contrast media?	Asthma <sup>a</sup>	88	38.8
	Myasthenia gravis <sup>a</sup>	9	4.0
	Prior allergy to contrast media <sup>a</sup>	123	54.2
	Hypothyroidism	8	3.5
	Cardiovascular disease <sup>a</sup>	20	8.8
	Renal insufficiency <sup>a</sup>	155	68.3
	Open angle glaucoma	6	2.6
	I don't know	16	7.1
Which of the following symptom/s are labeled as delayed adverse reactions following IV contrast media administration?	Persistent rash <sup>a</sup>	84	37.0
	Nausea and vomiting <sup>a</sup>	50	22.0
	Headache <sup>a</sup>	41	18.1
	I don't know	77	33.9
Corticosteroid premedication may be considered prior to IV contrast media in which of the following scenario/s?	Asthma	100	44.1
	Patient on Beta-blockers	13	5.7
	Prior allergy to contrast media <sup>a</sup>	115	50.7
	Food allergy	32	14.1
	I don't know	40	17.6
Which of the following medical condition/s, are known risk factor/s for contrast induced nephropathy?	Asthma	22	9.7
	Renal insufficiency <sup>a</sup>	166	73.1
	Dehydration <sup>a</sup>	102	44.9
	Hyperthyroidism	6	2.6
	Diabetes mellitus <sup>a</sup>	75	33.0
	Hypertension <sup>a</sup>	34	15.0
	Age > 60 <sup>a</sup>	71	31.3
	I don't know	16	7.1
Which of the following medical condition/s, are known risk factor/s for nephrogenic systemic sclerosis?	End stage renal disease <sup>a</sup>	59	26.0
	End stage renal disease with dialysis <sup>a</sup>	49	21.6
	Acute kidney injury <sup>a</sup>	53	23.4
	I don't know	98	43.2
A renal function test is routinely requested before the	All patients	194	85.5
	Only patients at high risk for nephropathy <sup>a</sup>	17	7.5

administration of an iodinated contrast medium in which of the following scenarios (one answer only)?	I don't know	16	7.1
Contrast deposition in the tissue has recently been reported following the administration of multiple doses of gadolinium-based contrast agents. Which areas of the body are involved?	Liver	54	23.8
	Eye	10	4.4
	Brain <sup>a</sup>	21	9.3
	Soft tissue	38	16.7
	I don't know	128	56.4

Table 3 shows the participant's responses to the 16 questions regarding their attitudes about safe use of IV contrast media in medical imaging and its adverse reactions. Correct answers were coded as (1), and wrong answers were coded as (0). The total score ranged between 0 and 12. A poor attitude level was considered for a total score between 0 and 6, and a good attitude level was considered for a total score between 7 and 12. The results show that 182 participants out of 227, which represented 80.2% of the total sample, had poor attitudes and 45 participants, which represented 19.8% of the sample had good attitudes. (See Table 3)

	n	%	
A patient with prior allergy to IV iodinated contrast agent during a CT exam, requires a new similar contrast study. What is your course of action?	Contrast study is contraindicated	30	13.2
	The exam can be performed without precautions	4	1.8
	Request a skin test	17	7.5
	Prescribe corticosteroid premedication <sup>a</sup>	62	27.3
	Request non-contrast study <sup>a</sup>	47	20.7
	Request an alternative contrast study like MRI with gadolinium <sup>a</sup>	83	36.6
	I don't know	57	25.1
A patient complains of swelling and burning at site of injection of contrast media caused by contrast extravasation. What is your course of action?	Elevate the affected extremity <sup>a</sup>	55	24.2
	Warm over cold compresses <sup>a</sup>	52	22.9
	Aspirate the extravasated contrast media	16	7.0
	A local injection of corticosteroid	22	9.7
	Medical consultation for change in sensation in the affected limb <sup>a</sup>	43	18.9
	Provide documentation in the medical report <sup>a</sup>	86	37.9
	I don't know	66	29.1
A patient at high risk for	Contrast study is contraindicated	27	11.9

nephropathy requires an IV contrast study. What is your course of action?	The exam can be performed without precautions	4	1.8
	Consider alternative imaging strategies such as non-contrast study <sup>a</sup>	98	43.2
	Oral or Intravenous hydration prior to contrast administration <sup>a</sup>	82	36.1
	Administration of N-acetylcysteine	25	11.0
	Administration of diuretics	8	3.5
	I don't know	52	22.9
A diabetic patient, with chronic kidney disease, using oral metformin requires a radiological study with IV iodinated contrastmedia. What is your course of action?	Contrast study is contraindicated	22	9.7
	The exam can be performed without precautions	13	5.7
	Metformin should be temporarily discontinued <sup>a</sup>	77	33.9
	Prescribe corticosteroid premedication	10	4.4
	Request hydration <sup>a</sup>	59	26.0
	Administration of N-acetylcysteine	10	4.4
A patient has a prior allergy to contrastmedia	I don't know	84	37.0
	Use without specific precautions	5	2.2
	Specific precautions such as requesting a prior lab test orconsider alternative imaging <sup>a</sup>	117	51.5
	Absolutely contraindicated	79	34.8
A patient has a food allergy	I don't know	26	11.5
	Use without specific precautions <sup>a</sup>	70	30.8
	Specific precautions such as requesting a prior lab test orconsider alternative imaging	127	55.9
	Absolutely contraindicated	5	2.2
A patient has asthma	I don't know	25	11.0
	Use without specific precautions <sup>a</sup>	46	20.3
	Specific precautions such as requesting a prior lab test orconsider alternative imaging	148	65.2
	Absolutely contraindicated	4	1.8
A patient has sever cardiac disease	I don't know	29	12.8
	<b>n</b>		<b>%</b>
	Use without specific precautions <sup>a</sup>	42	18.5
	Specific precautions such as requesting a prior lab test orconsider alternative imaging	117	51.5
A patient has Myasthenia gravis	Absolutely contraindicated	27	11.9
	I don't know	41	18.1
A patient has Myasthenia gravis	Use without specific precautions <sup>a</sup>	57	25.1

	ific precautions such as requesting a prior lab test or consider alternative imaging	103	45.4
	Absolutely contraindicated	15	6.6
	I don't know	52	22.9
A patient has hyperthyroidism	Use without specific precautions <sup>a</sup>	85	37.4
	ific precautions such as requesting a prior lab test or consider alternative imaging	82	36.1
	Absolutely contraindicated	13	5.7
	I don't know	47	20.7
A patient has chronic kidney disease	Use without specific precautions	6	2.6
	ific precautions such as requesting a prior lab test or considering alternative imaging <sup>a</sup>	122	53.7
	Absolutely contraindicated	56	24.7
	I don't know	43	18.9
An anuric patient with end-stage renal disease on dialysis requires a contrast CT scan	Use without specific precautions <sup>a</sup>	25	11.0
	ific precautions such as requesting a prior lab test or consider alternative imaging	70	30.8
	Absolutely contraindicated	103	45.4
	I don't know	29	12.8
An anuric patient with end-stage renal disease on dialysis who requires contrast MRI scan	Use without specific precautions	35	15.4
	ific precautions such as requesting a prior lab test or consider alternative imaging <sup>a</sup>	93	41.0
	Absolutely contraindicated	67	29.5
	I don't know	32	14.1
A pregnant patient requires a contrast CT scan	Use without specific precautions <sup>a</sup>	14	6.2
	ific precautions such as requesting a prior lab test or consider alternative imaging	63	27.8
	Absolutely contraindicated	122	53.7
	I don't know	28	12.3
A pregnant patient requires a contrast MRI scan	Use without specific precautions	74	32.6
	ific precautions such as requesting a prior lab test or consider alternative imaging	82	36.1
	Absolutely contraindicated	40	17.6
	I don't know	31	13.7
A patient is breast feeding	Use without specific precautions	88	38.8
	ific precautions such as requesting a prior lab test or consider alternative imaging	83	36.6
	Absolutely contraindicated	22	9.7
	I don't know	34	15.0



Table 4 shows the results of the chi-square tests, which indicate that there is a statistically significant association between clinicians’ knowledge on contrast media and their specialties ( $p < 0.05$ ), with 21.7% of the clinicians with specialties in internal medicine and having good knowledge levels compared to 8.3% of clinicians with specialties in pediatrics. Otherwise, there was no statistically significant association between knowledge levels and other demographic variables ( $p > 0.05$ ). This is due to the convergence of percentages among groups (See Figure 1). Table 4 shows the results of the chi-square tests, which indicate that there is a statistically significant association between clinicians’ attitudes toward the safe use of contrast media in medical imaging and its adverse reactions (“How would you describe your knowledge on intravascular contrast media safety and its adverse reactions?”). The clinicians who rated their knowledge as sufficient had the highest percentage of good attitude levels of 33.3% compared to clinicians who rated their knowledge as insufficient that had poor attitude levels of 100%. Otherwise, there was no statistically significant difference between other demographic variables ( $p > 0.05$ ). This is due to the convergence of the mean score among groups (See Figure 2).

Table 4 shows the results of the correlation test between clinicians’ knowledge and attitudes on the safe use of IV contrast media in medical imaging and its adverse reactions. The strength of the correlation is described as follows: 0.20-0.39 “low”, 0.40-0.69 “moderate”, 0.70- 0.89 “high” and 0.90 and above “very high” [15]. The results indicate that there is a statistically significant relationship between clinicians’ knowledge and attitudes ( $p < 0.01$ ). The correlation coefficient between knowledge and attitudes was 0.331, which indicates a small relationship (See Table 4).

	Knowledge	Attitudes		
Knowledge	Pearson correlation		1	0.331a
	Sig. (2-tailed)			0.000
	N		227	227
Attitudes	Pearson correlation		0.331a	1
	Sig. (2-tailed)		0.000	
	N		227	227

Figure 1

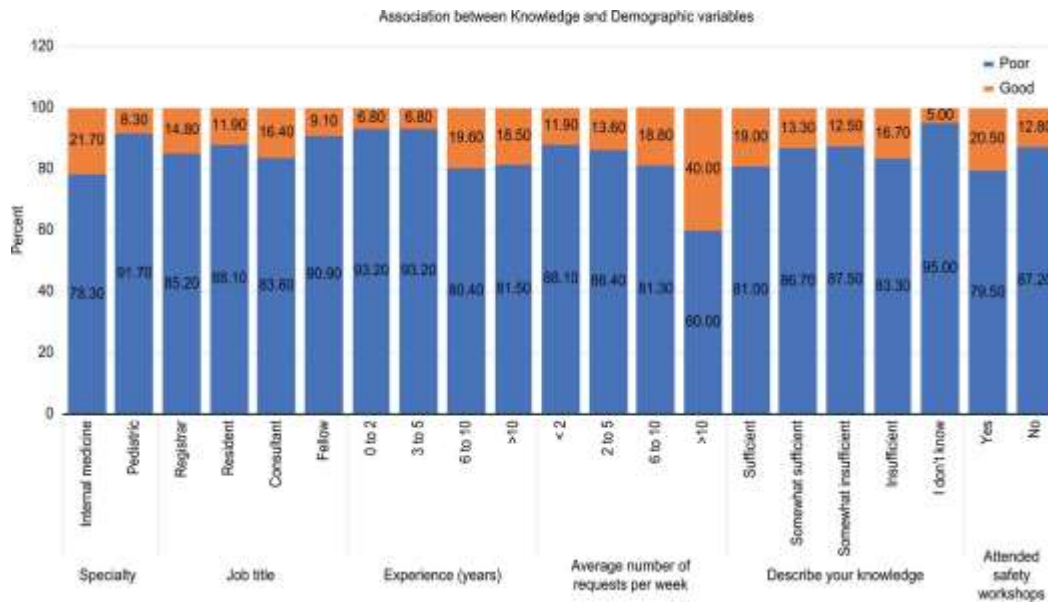
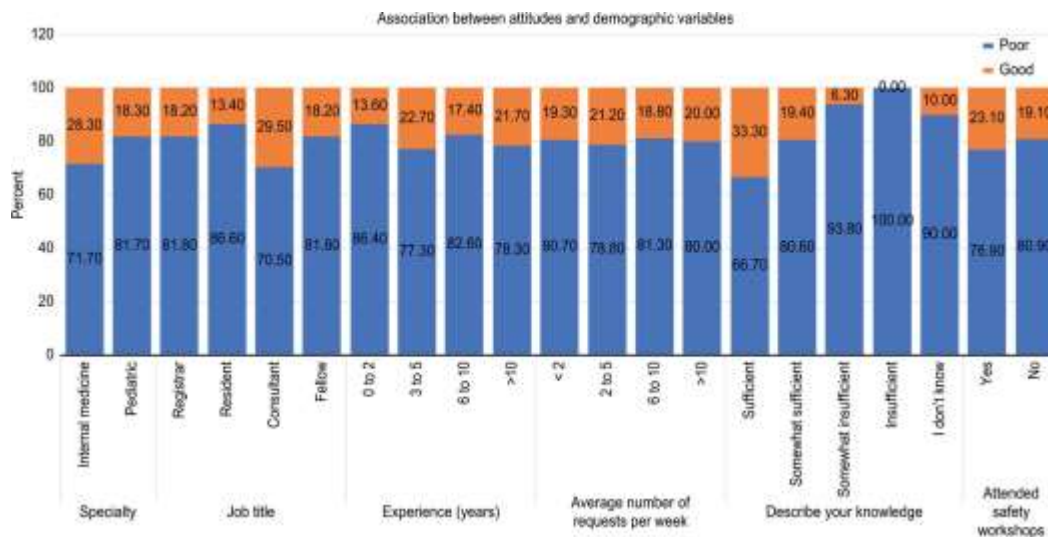


Figure 2:



## Discussion

The dramatic increase in the utilization of IV contrast media makes it likely that clinicians from almost all specialties will encounter a patient scheduled to receive or has recently received IV contrast media in their daily practice [16]. Hence, it is vital that all referring clinicians have sufficient knowledge of contrast media, including its indication, contraindications, and management of adverse reactions to it. Although the majority of our participants (71%) felt they had sufficient or somewhat sufficient knowledge on contrast media, only 14.1% and 19.8% demonstrated sufficient knowledge and positive attitudes on the quantitative survey, respectively. The main results of our study were comparable to those of prior studies that demonstrated unsatisfactory levels of knowledge and profound misconceptions on contrast

media among clinicians [9-12].

There are some confounding factors that we previously thought might affect the level of awareness on contrast media among clinicians, such as academic degree, professional experience, number of contrast study requisitions, speciality, and attendance of dedicated contrast-related courses. However, the present study documented no statistical significance in level of awareness with the academic degree and professional experience, similar to prior studies [10,11,12]. Trindade et al. [10]. and Confino-Cohen et al. [11]. attributed this to the interdisciplinary discussion between consultants and their trainees during contrast study requisition. Regarding speciality, the higher satisfactory knowledge of clinicians in internal medicine compared to clinicians in pediatric medicine ( $p = 0.041$ ) among our participants can be explained by the higher frequency of contrast study requisitions. Nearly half of internists in our study (45%) requested an average of  $\geq 2$  contrast studies per week compared to 31.7% of pediatricians. However, the overall frequency of requisitions and other specialties does not show a significant correlation with the level of awareness, similar to prior studies [10,11]. Furthermore, clinicians in internal medicine were ranked higher in knowledge about contrast media safety in one study and the lowest in another study, which indicates sample variability [9,11]. The majority of our participants (82.8%) never attended any dedicated training on contrast media, such as lectures, courses, or workshops, and mainly attributed their knowledge to daily practice. This can explain the relative increase in the mean correct response for consultants compared to residents although the difference was statistically insignificant. Furthermore, similar to our study Mutala et al. [12] documented a lack of significant difference between formally trained and untrained clinicians, which further validates the effects of daily practice.

Our participants demonstrated satisfactory knowledge about some risk factors for IV contrast media, such as renal insufficiency, prior allergy to contrast medium, and asthma. However, only 8.8% and 4% identified cardiac disease and myasthenia gravis as risk factors, respectively. Patients with severe cardiac disease maybe at increased risk, and the ACR recommends the non-restriction of contrast use or premedication based only on the patient's cardiac status [13]. Regarding myasthenia gravis, the effect of the use of IV iodinated contrast medium remains controversial. Mehrizi et al. [17] documented no significant immediate increased risk, and another study documented a delayed exacerbation of its symptoms [18]. Rath et al. [18] recommended that the use of contrast media should not be withheld and that the patient requires monitoring, particularly for acute disease. More than one-quarter of our participants (33.9%) were unfamiliar with delayed adverse events to iodinated contrast media. Such delayed symptoms are mostly encountered by clinicians and occur from 1 hour up to 1 week following the administration of an IV contrast medium [19,20].

The clinicians' knowledge was satisfactory, and their attitudes were positive toward common risk factors for contrast-induced nephropathy. However, 37% of the participants were unfamiliar with routine practice in patients who are receiving metformin and scheduled for iodinated contrast study. The ACR recommended no need to discontinue metformin in patients who have no evidence of acute kidney injury or an eGFR greater than or equal 30 ml/minute/1.73 m<sup>2</sup>. Furthermore, 43.2% of our participants were unfamiliar with the known risk factors for nephrogenic systemic fibrosis (NSF). There are some suggested risks for developing NSF that warrant renal function assessment in patients scheduled for Group I and III gadolinium-based contrast agents, such as history of renal disease, hypertension, and diabetes mellitus [13,22,23]. Another contrast-related topic that clinicians demonstrated a lack of considerable knowledge in (90.7%) was gadolinium deposition in the brain following the administration of repeated doses. The extent of deposition varies between agents, and its clinical significance remains unknown [24]. Mithal et al. [25] reported that 74% of pediatricians

in their survey were unfamiliar with brain gadolinium deposition, and they recommended further education for clinicians.

The responsibility of referring clinicians is not limited to identifying patients at risk from contrast media administration; it extends to the preparation of patients scheduled for contrast study and the management of adverse reactions if encountered. Approximately half of our participants (44.1%) believed that routine premedication was necessary in asthma patients prior to the contrast study. Westermann-Clark et al. [9] reported similar common misconceptions, with 37% of their clinicians reporting they would premedicate patients with shellfish allergies prior to contrast administration. Apart from prior allergies to contrast media, the ACR recommends no routine premedication for patients who have allergic reactions to other substances, such as shellfish or asthma [13]. Furthermore, intradermal skin testing with contrast media has not been shown to be useful in predicating severe reactions [21]. Another misconception held by the majority of our participants (85.5%) is that routine renal function prior to IV contrast administration is necessary for all patients. Although traditional practice varies between different institutions, it is costly and time-consuming. There are some suggested risk factors that may warrant renal function assessment, such as age >60, a history of renal disease, hypertension, diabetes mellitus, and the use of metformin [13,22,23].

There are some limitations in our study which include the small sample size. The recruitment of more centers is advised for a national survey. Although the sample size was heterogeneous and covered different specialties and training levels, the lower numbers of fellows can be explained by the limited regional fellowship programs. Furthermore, the lack of educational interventions and posttest assessments are other limiting factors in our study design.

## Conclusion

The study confirms overall unsatisfactory knowledge levels and negative attitudes toward the safe use of IV contrast media in medical imaging among clinicians, comparable to prior reports. Such findings might interfere with patient safety or postpone necessary studies. Further education for clinicians on contrast media is highly recommended through curricular or noncurricular activities, which include lectures, courses, or workshops.

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