

Research Article

Understanding of Saudi Population on the Usage of Intravenous Contrast Media Injections in Radiology

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ABSTRACT

Background: Intravenous contrast media (IVCM) in radiology are extremely important for accurate diagnosis and are used daily all over the globe. These contrast media are very safe if administered correctly. However, adverse events have also been reported. This study was undertaken to determine the understanding of the patients towards the usage of IVCM in radiology.

Methods: This is a cross-sectional study conducted on patients recommended for IVCM-mediated radiological examinations. The data were collected by face-to-face interactions using the self-administered questionnaire before IVCM administration. The questionnaire was all about patient's information for IVCM usage, their associated benefits and risks.

Results: Out of 225 patients who participated, a majority (72%) had insufficient knowledge of IVCM-associated risks and benefits. Both male and female patients showed a similar understanding of IVCM ($p>0.05$). Educated patients showed better understanding than uneducated patients ($p<0.001$). Similarly, employed patients demonstrated a higher level of understanding of IVCMs compared to unemployed patients ($p<0.05$). Moreover, 63.5%, 45.3% and 62.2% of patients believed that IVCM caused cancer, cardiovascular disorders, and adverse allergic reactions, respectively. Moreover, 52.4%, 33.3% and 49.3% of patients believed that IVCM caused shortness in breath, loss of consciousness and increase of heart rate, respectively. In addition, 29.3%, 62.2% and 20.0% of patients also advised diarrhea, itching and convulsion, respectively.

Conclusion: Overall, patients' knowledge was unsatisfactory for understanding contrast media in radiology. This study recommends that the Ministry of Health, Saudi Arabia, should arrange frequent awareness programs on contrast media in Qassim.

1. INTRODUCTION

In the last two decades, intravascular contrast media (IVCM) applications in radiological examination have markedly increased due to the high imaging sensitivity in the diagnosis (Roditiet *et al.*, 2022). The magnetic resonance imaging (MRI) and computed tomography (CT) are the main techniques that utilize the use of contrast media (Heshmatzadehet *et al.*, 2018a). Although multiple approaches have been applied in advancing the use of IVCM applications in radiological based examinations, the onset of adverse reactions and their associated potential risks have also been reported (Andreucciet *et al.*, 2014; Kalleret *et al.*, 2023). Nevertheless, it has now been well established that the disadvantages of IVCM are extremely

rare and adverse events were reported in only 0.23% of administered patients (Roditiet *et al.*, 2022; Hwang *et al.*, 2018). Multiple severe acute adverse reactions such as allergy, asthma, renal insufficiency, cardiac arrest, anxiety, acute sickle crisis, necrosis, *etc.*, were estimated in 0.2% of administered patients (Roditiet *et al.*, 2022; Heshmatzadehet *et al.*, 2018b). Therefore, the benefits of the administration of contrast media have clinical weight over the risk of chances of adverse outcomes. In 2002, the European Society of Urogenital Radiology (ESUR) published modified guidelines on the use of IVCM injections in collaboration with the Contrast Media Safety Committee (CMSC) (Bellin *et al.*, 2002). Since then, many studies have been conducted on the management of safety against the use of IVCM injections in radiology (Amiri *et al.*, 2018; Bjällmarket *et al.*, 2021). Although the use of

IVCM in radiology was reported to have a low incidence of adverse events, obtaining patient's consent in Saudi Arabia is compulsory, regardless of the type of contrast media used and the possibility of adverse events.

This study determined the understanding of patients from the central region of Saudi Arabia to the use of contrast media in radiological examinations via CT and MRI. Before attempting IVCM-mediated radiologic imaging, all participating patients were interviewed and requested to complete the questionnaire, which was designed to analyze the opinion of participants for the use of IVCM in radiographic imaging. The data showed that only 28% of participating patients have sufficient knowledge of the use of IVCM in radiology. Both male and female patients showed similar knowledge, but the knowledge of educated patients was markedly higher as compared with uneducated patients. Similarly, employed patients also showed a better understanding of the use of IVCMs as compared with unemployed participating patients. In short, the study analyzed that a majority of patients in this study were unaware of the contrast media and strongly believed that IVCM induced adverse reactions.

2. MATERIALS AND METHODS

2.1. Study type and design

This cross-sectional survey was performed on a general population of the Qassim region of Saudi Arabia who were recommended for IVCM-mediated radiographic examinations such as CT or MRI. The study was designed to determine the knowledge and awareness of patients towards the usage of IVCM in radiographic examinations.

2.2. Participants section, Research instrument and Ethical consideration

All participating patients were informed through a questionnaire, and their consents were taken exactly in the same ways as described in the international ethical guidelines (Minogue *et al.*, 2019; Davenport *et al.*, 2020). In addition, the ethical approval of this study was taken from the Qassim Regional Research Ethics Committee, registered at the National Committee of Bio & Med. Ethics (NCBE), Registration # H-04-Q-001, Ministry of Health General Directorate of Health Affairs, Al-Qassim region, KSA (Ethical approval # 44/607/10428). The 225 patients were selected from outpatients clinics of the Qassim region. The data were collected using a self-administrated questionnaire previously validated on patients from the Anatolian city of Turkey (Yücelet *et al.*, 2005). The questionnaire was designed to extract the knowledge and/or awareness of participants for the use of IVCM in radiographic imaging and their associated potential risks and serious side effects and also extract their opinion on the importance of IVCM in clinical examinations. The inclusion criteria of the participants were only adult patients who were recommended for IVCM-mediated radiographic imaging were included. Whereas infants, children, and pregnant women were excluded even though they were recommended for IVCM.

2.3. Sample size and statistical analysis

The sample size for this study was determined using the Raosoft online sample size calculator (Raosoft, Inc. (2004)). A confidence level of 95% and a margin of error of 5% were used, assuming a response distribution of 50% and a population size of 500. The calculated sample size was determined to be 218. Data analysis was performed using the statistical software GraphPad Prism 5 Software (Boston, MA, USA). Additionally, the data were analyzed using the online statistical calculator Giga (Georgiev 2023).

3. RESULTS

3.1. Social and demographic details of the studied subjects

This study was conducted on the general population of the Qassim region of Saudi Arabia, who were recommended for IVCM-mediated radiographic examinations such as CT and MRI. Before attempting IVCM-mediated radiologic imaging, all participating patients were interviewed and requested to complete the questionnaire, which was designed to analyze the opinion of participants for the use of IVCM in radiographic imaging. Table 1 summarizes the social and demographic details of the 225 patients who completed the given questionnaire. Out of them, 128 participants (56.9%) were males, and 97 participants (43.1%) were females. There was no statistical difference between the genders ($p > 0.05$). The results also analyzed that out of 225 participants, 56 (24.9%) were uneducated, whereas 88 (39.1%), 52 (23.1%) and 29 participants (12.9%) completed their education at the level of primary school, secondary school and graduation/post-graduation, respectively. The participants who completed education at primary school, secondary school, and graduation/post-graduation levels were considered educated. There was a significant difference in the number of uneducated and educated participants in the study ($p < 0.001$). Moreover, the demographic data of the participants were also characterized at the level of their employment. Out of 225 participating patients, 54 (24.0%) were unemployed, and the rest 171 participants (76%) were employed. The statistical analysis showed that there was a significant difference in the number of unemployed and employed participants ($p < 0.05$).

3.2. Understanding of participated patients for the usage of IVCM injections in radiology

Understanding of patients who participated in this survey was evaluated by several questions asked in the questionnaire, such as 'the aim of administration of IVCM is better visualization of tissues and diseases by enhancing them'; 'contrast materials play an important role in the diagnosis of diseases'; 'IVCM can be administered safely to every patient'; 'contrast materials can cause unimportant side effects such as nausea, vomiting or a rash'; 'allergic reactions against food or drugs'; 'contrast materials can cause serious side effects, although rarely'; 'contrast materials can cause death, although very rarely'.

The outcome results showed that out of 225 patients, only 28% of patients (n=63) had sufficient knowledge or understanding of the usage of IVCM in radiological imaging. Whereas 39.6% of patients (n=89) showed some knowledge their level was considered insufficient. However, 32.4% of patients (n=73) showed that they were completely unaware of the advantages and disadvantages of IVCM usage in radiology (Fig. 1). To analysis the results in more depth, the comparative analysis was performed on the basis satisfactory knowledge of IVCM usage in radiology between males versus females' patients. As illustrated in Figure 2, among the 128 male patients, only 27.3% (n=35) demonstrated satisfactory knowledge. Similarly, out of the 97 female patients, only 28.9% (n=28) exhibited satisfactory knowledge. The rest of the male and female patients didnot havesatisfactory knowledge ofthe usage of IVCM in radiological analysis. Furthermore, the results at the statistical level showed the level of knowledge among participatingmale and female patients was the same. The statistical parameters such as p-value (p>0.05), Z-score (-1.114890), significance level (13.24%) and absolute difference among the studied ganders (-0.07) confirmed that the understanding of participated males and females for IVCMs usage in the radiological analysis were same (Fig. 2). Moreover, a comparative analysis was also performed on the basis satisfactory knowledge of IVCM usage in radiology between educated versus uneducated patients. As shown in Fig. 3, out of 169 educated patients, 34.3% (n=58) showed satisfactory knowledge. However, among the 56 uneducated patients, only 8.92% (n=5) demonstrated satisfactory knowledge. Furthermore, the results at the statistical level showed that the level of knowledge in educated patients was markedly higher as compared with uneducated patients. The statistical parameters such as p-value (p=0.000), Z-score (-3.667), significance level in percentage (0.01%) and the absolute difference between uneducated and educated patients (-0.2538) validated that the understanding of educated patients towards IVCM was significantly higher as compared with uneducated patients (Fig. 3).Not only have these, a comparative analysis were also performed on the basis satisfactory knowledge of IVCM between employed patients versus unemployed patients. As shown in Fig. 4, out of 171 employed patients, 31.6% (n=54) showed satisfactory knowledge. However, out of the 54 uneducated patients, only 16.6% (n=9) exhibited satisfactory knowledge. The results at the statistical level showed the level of knowledge in employed patients was markedly higher as compared with unemployed patients. The statistical parameters such as p-value (p=0.01), Z-score (-2.1402), significance level in percentage (1.62%) and the absolute difference between the groups (-0.15) verified that the understanding of employed patients towards IVCM was significantly higher as compared with unemployed patients (Fig. 4). Table 2 summarizes the details comparative analysis on the basis satisfactory knowledge of IVCM usage in radiology between males versus females' patients; educated versus uneducated patients; and employed versus unemployed patients.

To further evaluate patients' insight towards the usage of IVCM in radiologic examinations, a question on risk associated with the use of IVCM was asked in the

questionnaire and participants were allowed to give multiple answers. Figure 5 summarizes the complete detailsof patients' understanding of the risk against IVCM. Out of all participated patients 225, 63.5% patients (n=143) believed that the use of IVCM in radiology might be associated with cancer onset, whereas 45.3% of patients (n=102) believed that it was associated with the risk of onset of cardiovascular diseases (CVD). Moreover, 62.2% of patients (n=104) thought that the use of IVCM initiates allergic reactions. However,in a large group of patients, 81.8% (n=184) assumed that IVCMs induce tuberculosis. Additionally, 23.1% of patients (n=52) were suggested to have a risk of developing asthma, while 30.7% of patients (n=69) were indicated to have a chance of developing renal disorders.

In an attempt to further investigate the insights of patients for the use of IVCM in radiologic examinations, another question on serious side effects of IVCM was asked and again, participants were allowed to give multiple answers. As shown in Fig. 6, out of 225 patients, 52.4% of patients (n=118) assumed that the use of IVCM in radiology caused shortness in breath, whereas 33.3% of patients (n=77) believed that IVCM induced loss of consciousness. Moreover, 49.3% of patients (n=111) thought that IVCM caused an increase inheart rate, However, 29.3% of patients (n=66) were advised about the possibility of developing diarrhoea, while 62.2% of patients (n=140) were warned about the likelihood of experiencing itching. Additionally, 20.0% of patients (n=45) were advised regarding the potential onset of convulsions

Table 1. Demographic details of the Saudi participants in the study

Parameters	No. of Participants (n=225)	Percentage	P value
Gender			
Males	128	56.9	Males vs Females: P>0.05
Females	97	43.1	
Education Levels			
Uneducated	56	24.9	Uneducated vs Rest: P < 0.001
Primary School	88	39.1	
Secondary School	52	23.1	
Graduation/Post-Graduation	29	12.9	
Employment			
Unemployed	54	24.0	Unemployed vs Employed: P<0.05
Employed	171	76.0	

Table 2. Comparative analysis of satisfactory knowledge of IVCM usage in radiology between male versus females' participants; educated versus uneducated participants; and employed versus unemployed participants

Parameters	Total participants in studied group	Participants given a satisfactory response	Percentage of satisfactory response	P value
Gender				
Males	128	35	27.3	Males vs Females: P>0.05
Females	97	28	28.9	
Education Levels				
Uneducated	56	05	8.92	Uneducated vs Educated: P < 0.0001
Educated	169	58	34.3	
Employment				
Unemployed	54	09	16.6	Unemployed vs Employed: P<0.05
Employed	171	54	31.6	

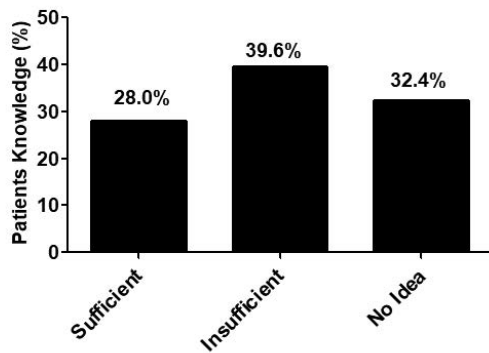


Figure 1. Levels of patients' knowledge of the use of IVCM in radiological examinations.

4. DISCUSSION

This is the first report from the central region of Saudi Arabia demonstrating of patients insights for using contrast media and their associated risks or benefits in radiological examinations. In the last few decades, there has been a significant technological advancement in CT and MRI, especially with the use of intravascular contrast media, which dramatically enhances the diagnosis (Heshmatzadehet *al.*, 2018a), but at the same time, multiple risks and side effects of contrast media have also been reported (Mandliket *al.*, 2019). Although the risk factors and side effects associated with the use of contrast media in radiological imaging are extremely rare, informed patients consent about the risk with contrast media before the IVCM administration is not only important to inform the patients but also important to update the knowledge of patients about IVCM (Pomaraet *al.*, 2015; Kopp *et al.*, 2022). Importantly, there is no sufficient available data on the patients experience of contrast media. This is highly impactful to be fully investigated as

the patients may refuse to have contrast media in the future (Pomaraet *al.*, 2015;Schlundet *al.*, 1996). However, these important areas remain fully unexplored and the research on these subjects would be merited. This study was performed on 225 patients from the Qassim region,

located in the central of Saudi Arabia. Prior to attempting contrast-mediated radiologic imaging, all patients were interviewed and requested to complete the questionnaire, which was designed to analyze the patients' knowledge of the use of contrast media in radiographic imaging. The questionnaire used in this study was successfully implemented in other populations and fully validated (Yücelet *al.*, 2005). The questionnaire comprised a number of questions related to the testing of patients' knowledge of the contrast media, such as 'the aim of administration of IVCM is better visualization of tissues and diseases by enhancing them; 'contrast materials play an important role in the diagnosis of diseases'; 'IVCM can be administered safely to every patient'; 'contrast materials can cause unimportant side effects such as nausea, vomiting or a rash'; 'allergic reactions against food or drugs'; 'contrast materials can cause serious side effects, although rarely'; 'contrast materials can cause death, although very rarely'. Interestingly, the data showed only 28% of patients had sufficient knowledge of IVCM, whereas the rest 72% of patients either had insufficient knowledge or had no idea about contract media. These findings have also been supported in other investigations performed in different regions of the world, where insufficient patients' knowledge of the use of contrast agents in radiology was reported (Tohidnia *et al.*, 2017). In order to explore these findings in depth, the comparative analysis was performed between male and female patients' knowledge. The data showed out of 128 male patients, only 27.3% of males showed satisfactory knowledge. However, among the 97 female patients, only 28.9% exhibited satisfactory knowledge. These data clearly indicated that the levels of understanding of male and female patients were almost the same. These findings have also been supported by other reports that showed no significant difference in the levels of knowledge of contrast media among male and female'patients (Hendiet *al.*, 2020). However, few reports found that female patients had lower knowledge than males (Yücelet *al.*, 2005). These findings indicate that region-to-region knowledge of

contrast media among males and females varies. Not only these, but this study also performed a comparative analysis between educated versus uneducated patients' knowledge. The data showed the level of knowledge among educated patients was significantly higher than uneducated participants. These findings have also been supported by other studies that reported that educated patients were more aware of the use of contrast media in radiology than the knowledge among uneducated patients (Yücelet *et al.*, 2005; Hendi *et al.*, 2020). In addition, this study also compared the knowledge of IVCM between employed and unemployed patients. The findings showed the level of knowledge among employed patients was significantly higher than unemployed patients. These findings have also been supported by other studies (Yücelet *et al.*, 2005; Hendiet *et al.*, 2020). To further determine patients' insight towards the usage of IVCM in radiologic examinations, a question on risk associated with the use of IVCM was asked in the questionnaire, and participants were allowed to choose multiple answers. Interestingly, 63.5%, 45.3% and 62.2% of patients believed that IVCM caused cancer, cardiovascular disorders, and adverse allergic reactions, respectively. Moreover, 52.4%, 33.3% and 49.3% of patients believed that IVCM caused shortness of breath, loss of consciousness and increase of heart rate, respectively. In addition, 29.3%, 62.2% and 20.0% patients also advised diarrhea, itching and convulsion, respectively. These patients' experiences of intravascular contrast media are novel and have never been investigated in Saudi Arabia. In spite of these useful information provided in this article, but the study still has few limitations such as moderate sample size and the data from all patients were obtained from the single hospital.

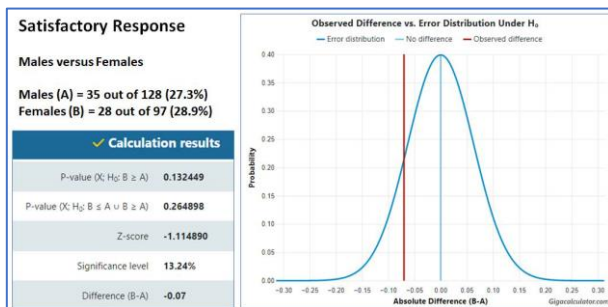


Figure 2. Comparative analysis of males versus female patients' satisfactory knowledge for the use of IVCM in radiological examinations.

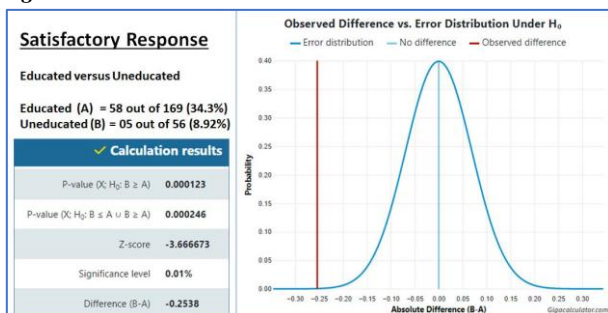


Figure 3. Comparative analysis of educated versus uneducated patients' satisfactory knowledge for the use of IVCM in radiological examinations.

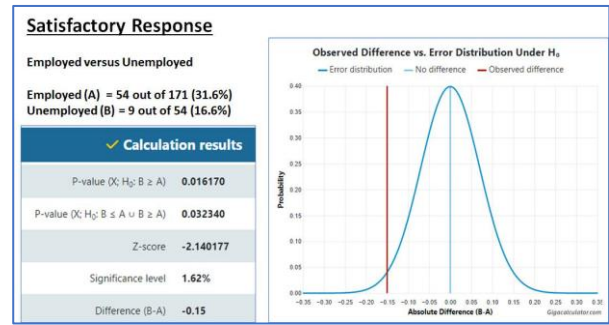


Figure 4. Comparative analysis of employed versus unemployed patients' satisfactory knowledge for the use of IVCM in radiological examinations.

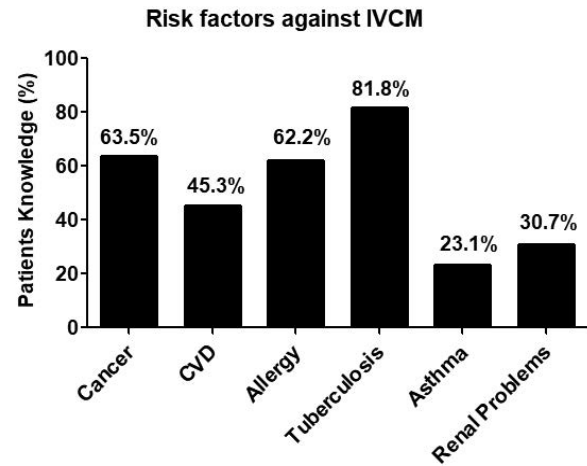


Figure 5. Levels of patients' knowledge for the risk factors against IVCM in radiological examinations.

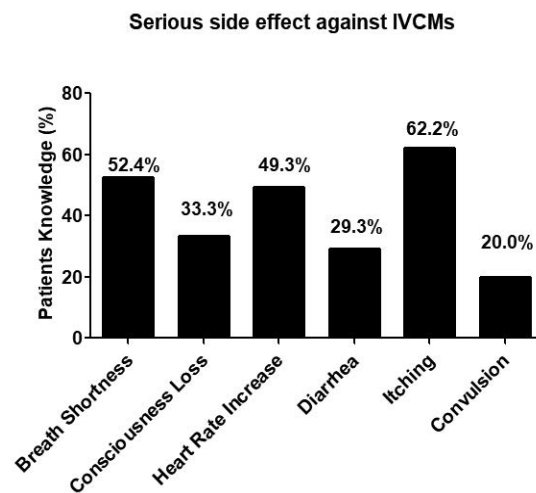


Figure 6. Levels of patients' knowledge of the onset of serious side effects against IVCM in radiological examinations.

5. CONCLUSION AND RECOMMENDATION

This is the first report from the central region of Saudi Arabia demonstrating the insights of patients toward contrast media and their associated risks and benefits in radiological examinations. The findings showed that the overall patients' knowledge was unsatisfactory for the understanding of contrast media in radiology.

Interestingly, no difference in the patient's knowledge was observed at the gender level. Importantly, the patients with higher education levels and employed showed more knowledge about intravascular contrast media injections. Whereas patients with lower education levels and unemployed were not aware of the risks and side effects of contrast media. These findings clearly indicate that all patients must be informed about the risk factors and potential adverse reactions of contrast media before the radiological examinations, not only for ethical considerations but also to increase the levels of knowledge and understanding of patients toward the potential risks associated with contrast media. This study also recommends the Ministry of Health, Saudi Arabia to arrange frequent awareness programs on contrast media in Qassim region.

Abbreviations

Intravenous contrast media, IVCN; computed tomography, CT; magnetic resonance, MR; European Society of Urogenital Radiology, ESUR; Contrast Media Safety Committee, CMSC

AUTHOR CONTRIBUTION

It's a single author study.

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CONFLICT OF INTEREST

The author has no conflict of interest to declare.

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