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ELEVATION OF IODINATED CONTRAST MEDIA REACTIONS IN PATIENTS UNDERGOING COMPUTED TOMOGRAPHY SCAN IN THE VICINITY OF ISLAMABAD AND RAWALPINDI REGIONS, PAKISTAN

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ABSTRACT
This observational study aimed to assess the occurrence of contrast reactions in 250 patients who underwent contrast-enhanced CT scans using low-osmolar iodinated contrast media between July 2022 and September 2022. Data collection involved a simple random sampling technique through a questionnaire to capture representative patient experiences. The study revealed that approximately 12% (30 patients) of the participants experienced contrast reactions post-CT scan, while 88% (220 patients) did not show any reaction. Prompt identification of contrast reactions is emphasized as critical for radiology personnel to facilitate rapid and appropriate treatment, ultimately minimizing adverse effects associated with intravenous iodinated contrast media administration. These findings underscore the importance of vigilant monitoring and proactive management of contrast-related adverse events to enhance patient safety during diagnostic imaging procedures.

KEYWORDS: Computed Tomography CT, Iodinated contrast media, contrast reaction, administration.

INTRODUCTION
Computed Tomography (CT) is an advanced imaging technology used in medical diagnostics, employing ionizing rays (X-rays) to produce detailed images of the body's soft tissue, blood vessels,

and bones [1]. The CT machine, shaped like a donut, rotates an X-ray beam around the body to capture multiple images of the same organ. These images are then processed by a computer to generate two-dimensional (trans-axial) pictures that can be reconstructed into three-dimensional (transverse, sagittal, and coronal) images [2].

CT scans, whether with or without contrast, are valuable in diagnosing various conditions such as cancers, masses, inflammation, bleeding, and internal injuries [3]. Contrast Enhanced Computed Tomography (CECT) utilizes contrast agents to highlight specific organs or tissues, aiding in the visualization of blood vessels and abnormalities. Contrast can be administered orally, intravenously (IV), or rectally, with IV being the most common method [4].

Two types of contrast agents are used in CT imaging: iodinated contrast media and non-iodinated contrast media (such as barium sulfate). Iodinated contrast media are further categorized into ionic and non-ionic with non-ionic agents being more commonly used due to their lower risk of adverse reactions. One example is Omnipaque, a nonionic contrast medium with various iodine concentrations [5].

Proper handling and maintenance of contrast media are crucial to avoid adverse reactions. Measures include maintaining the contrast at body temperature (37°C), using sterile procedures, checking for integrity before administration, and individualizing the administration volume and rate [6]. Adverse reactions to contrast can be immediate (within one hour) or delayed (6 hours to 3 days) and range from mild symptoms like headache and nausea to severe reactions such as cardiovascular collapse and laryngeal edema [7].

Despite advancements in contrast media formulations, acute contrast reactions can still occur, categorized into mild, moderate, and severe based on symptom severity. It is essential for healthcare providers to be vigilant in monitoring patients undergoing CT imaging with contrast to mitigate the risk of adverse reactions [8].

There is a paucity of writing on this subject in Pakistani contexts. The delivery of contrast is a crucial component of performing studies that are contrast-enhanced. A sound understanding of the likelihood of contrast allergies and the ability to identify contrast reactions are necessary for the efficient administration of contrast and the conduct of studies. Therefore, the purpose of the study is to acquire information on the frequency of contrast reactions [9]. We want to improve the departmental management of such cases by developing a work plan for the early and accurate detection of contrast reactions and their symptoms. Additionally, precautions will be taken to reduce the likelihood of a contrast reaction by carefully reviewing the history of allergies and prior reactions. Therefore, the purpose of this study is to bridge the gap [10].

Iodinated contrast materials are commonly used in medical procedures, with around 15 million contrast-enhanced investigations performed annually in the United States. Adverse reactions can be categorized as chemotoxic or anaphylactoid, with the latter being more common. The probability of adverse reactions with ionic contrast materials ranges from 4% to 12%, compared to 1% to 3% with nonionic contrast materials. Severe adverse reactions occur in 0.16% to 0.03% of cases. Anaphylactoid reactions account for over 90% of all adverse reactions to nonionic contrast materials [11].

Immediate adverse reactions, occurring within one hour of contrast injection, are mainly anaphylactoid. Delayed reactions can occur up to 7 days post-injection. Although newer contrast agents have reduced adverse reactions, they still occur, with most being self-limiting and dermatological [12].

Iso-osmolality contrast media are commonly used in computed tomography (CT) scans, with Ultravist-370 and Isovue-370 being frequently used iodine-based contrast media. Adverse events following their injection are relatively low, with mild reactions being the most common [13].

Hypersensitivity reactions to iodinated contrast media can occur immediately or up to two weeks after injection. Immediate reactions are more common, with severe reactions being rare. Pre-medication with corticosteroids and antihistamines is recommended for patients at high risk of allergic reactions [14].

Contrast-induced nephropathy is a known side effect of contrast media, particularly in patients with renal insufficiency. However, the incidence of contrast-medium-related permanent adverse outcomes is low in high-risk patients. Risk factors for adverse reactions to contrast media include a history of allergy, season, radiographic technique, age, surgery, or concomitant medications [15].

Fasting duration before contrast-enhanced CT scans does not significantly affect the occurrence of nausea and vomiting, but patients should be advised not to fast excessively to avoid dehydration [16].

METHODOLOGY:

The research is a cross-sectional observational study conducted to estimate the frequency of contrast reactions in patients after administrating iodinated contrast media. The CT scan was performed with standard protocols in the Radiology department in different hospitals of Islamabad and Rawalpindi. The data was collected ensuring the full clarity of research objectives using questionnaires.

Population size and sampling technique:

The population size was limited to 250 people. This observational study focused on individuals undergoing contrast-enhanced CT scans from July 2022 to September 2022 at Pakistan Institute of Medical Sciences (PIMS) and Islamabad Diagnostic Center (IDC). Patients with the age between 18 to 55 years with creatine level between 0.5 to1.5 mg/dl for both males and females are included. Patients were closely monitored for one hour after contrast administration. Data was gathered from patients by using simple random sampling technique.

Data collection tool:

Sequential sampling was employed to assess the frequency of contrast reactions following the administration of iodinated contrast media. The questionnaire consists of 11 items along with 7 additional demographic questions. This approach facilitates the rapid conclusion of our findings.

Simple frequency distribution graphs were employed to summarize the results. The questionnaire includes 11 items based on signs and symptoms reported by patients after one hour of receiving contrast. These symptoms include Any Reaction, Urticaria, Itching, Nausea, Vomiting, Low Blood Pressure, Lightheadedness or Dizziness, Erythema, Palpitations, and Shortness of Breath (SOB) [17]. Each item is rated on a Likert scale according to the intensity of reaction to contrast.

- for no reaction it is 0
- for reaction it is 1

MODELING AND ANALYSIS:

Data analysis will be conducted on SPSS version 21. In order to check the validity of data collection following Graphs were used

- Frequency distribution
- Percentage distribution

In this study, a total of 250 patients underwent CT examinations with Non-Ionic Contrast. Both genders were included, comprising 120 (48%) males and 130 (52.0%) females. Regarding the distribution of contrast reaction by age, 51 (20.4%) patients were in the 18-25 age group, 43 (17.2%) in the 26-35 age group, 38 (15.2%) in the 36-45 age group, and 118 (47.2%) in the 46-55 age group.

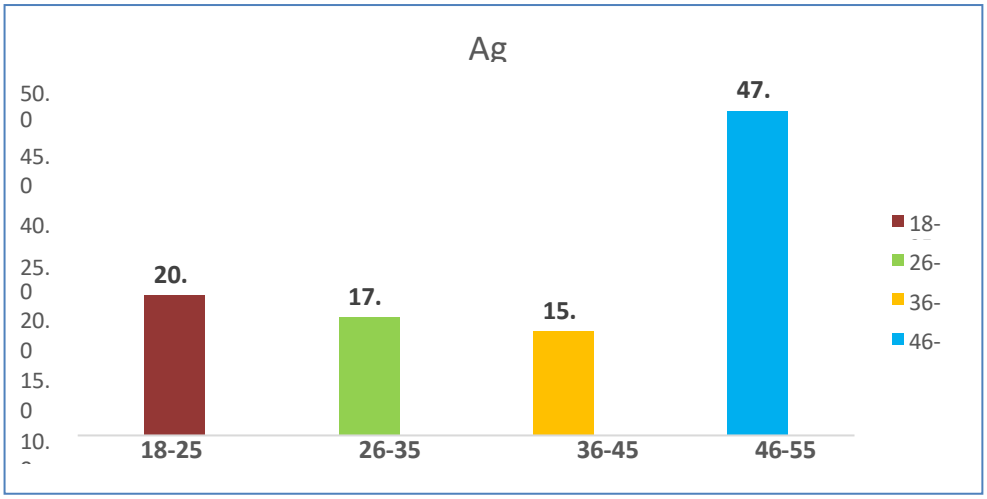

Fig1: Percentage distribution graph of Age

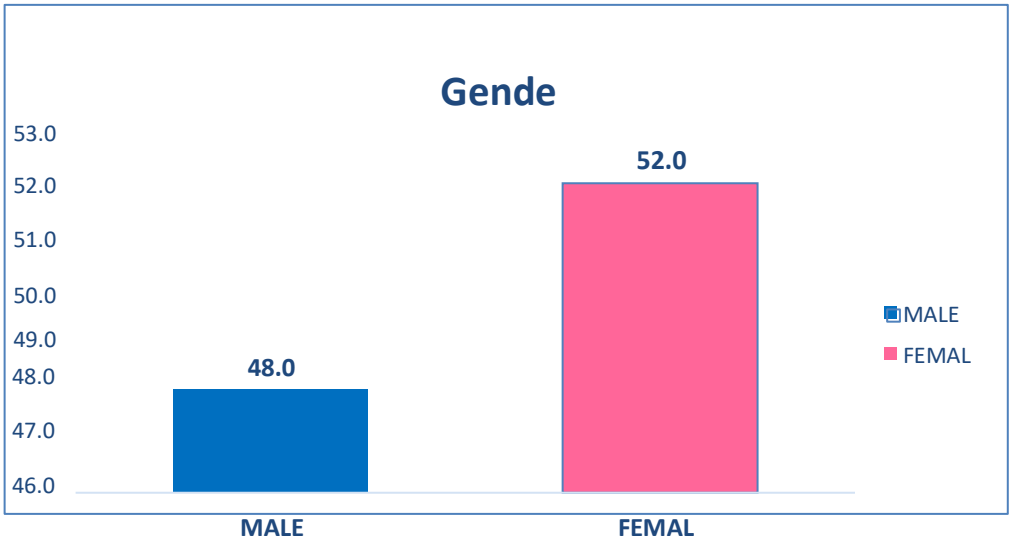

Fig 2: Percentage distribution graph of Gender

During the study, creatinine levels were also examined. The creatinine levels were categorized into three groups: <0.5 mg/dl, 0.5-1.5 mg/dl, and >1.5 mg/dl. The distribution of creatinine levels in each group was as follows: 9 (3.6%) for <0.5 mg/dl, 235 (94.0%) for 0.5-1.5 mg/dl, and 6 (2.4%) for >1.5 mg/dl.

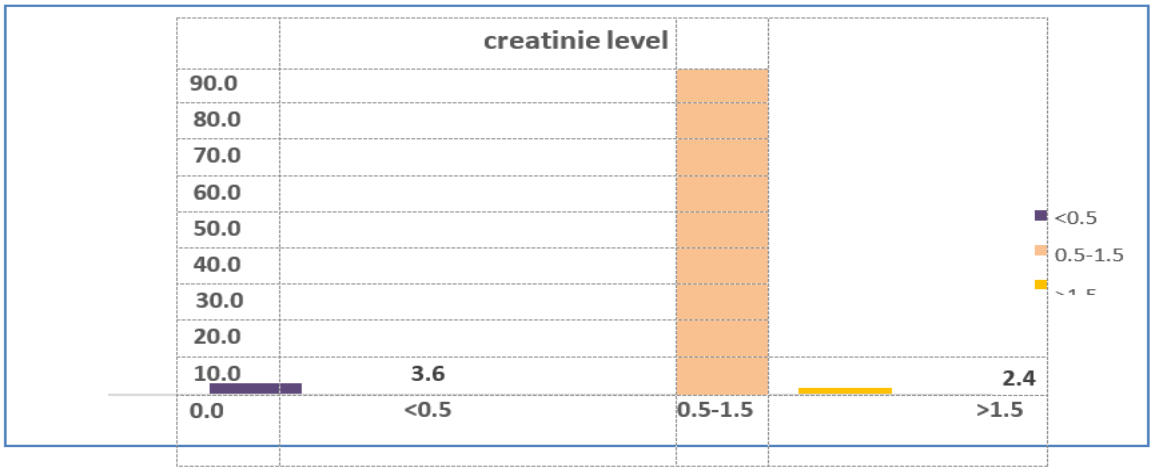

Fig 3: Percentage distribution graph of creatine level

RRESULTS AND DISCUSSION:

Out of 250 patients, mild contrast reactions occurred in 25 (10%), while 225 (90%) patients did not exhibit any reaction. Among cases with various clinical histories, the occurrences of contrast reactions were as follows: Urticaria in 1 (0.4%), Itching in 2 (0.8%), Headache in 3 (1.2%), Nausea in 4 (1.6%), Vomiting in 5 (2.0%), Low blood pressure in 2 (0.8%), Dizziness or Lightheadedness in 2 (0.8%), Erythema in 1 (0.4%), and Shortness of breath in 4 (1.6%). The percentage distribution of contrast reactions is depicted in both tables and graphs.

CONTRAST REACTION	REACTION	NO REACTION
Urticaria	0.4%	99.6%
Itching	0.8%	99.2%
Headache	1.2%	98.8%
Nausea	1.6%	98.4%
Vomiting	2.0%	98.0%
Low blood Pressure	0.4%	99.6%
Dizziness	0.8%	99.2%
Erythema	0.4%	99.6%
Palpitations	0.4%	99.6%
SOB	1.6%	98.4%

Table 1; table shows the overall percentage of contrast reactions.

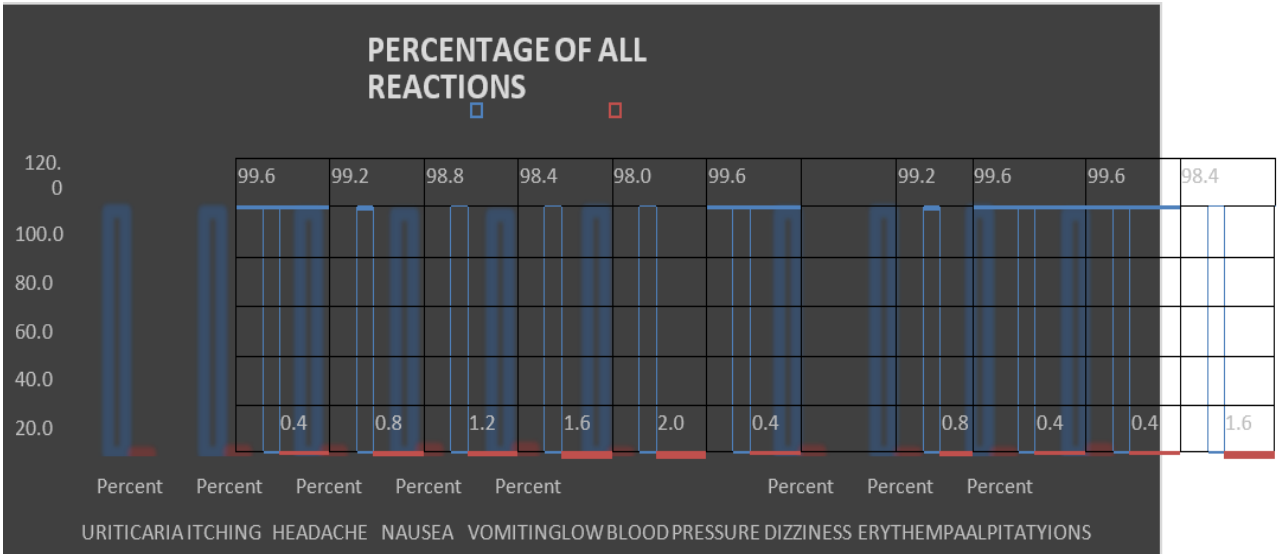

Fig 4: percentage distribution graph of all reactions

To enhance visualization of various organs, contrast media are commonly employed in Contrast Enhanced Computed Tomography (CECT) scans, with non-ionic contrast media being frequently used. The severity of contrast reactions may vary from mild to severe.

In our study, conducted over one month, 250 patients underwent CECT scans, with only 25 (10%) experiencing contrast reactions, all of which were mild. No severe reactions were observed. These findings align with previous investigations, such as one where only 17 out of 423 patients exhibited mild contrast reactions [18].

The introduction of Low Osmolar Contrast Media in diagnostic radiology has significantly reduced the likelihood of contrast reactions. In a study involving 137,473 individuals using non-ionic contrast material [19], 82 (0.06%) mild reactions and 16 (0.01%) severe reactions were recorded. However,

our investigation did not observe any severe or mild reactions, possibly due to the effective handling and small size of the contrast media.

Previous studies have suggested that factors such as injection technique, contrast administration speed, and volume of contrast may influence the incidence of adverse reactions, but these results remain controversial [20]. Our study found no significant influence of automatic contrast injection or manual administration on contrast reactions.

We also observed that increased awareness among patients regarding contrast-enhanced CT scans and among radiological personnel regarding efficient diagnostics and treatment can significantly reduce the occurrence of contrast reactions. Thus, we conclude that thorough patient history assessment, monitoring of creatinine levels, and proper storage and handling of contrast media are crucial in managing contrast reactions.

Recommendations:
Given that this study was limited to specific hospitals in Islamabad and Rawalpindi, future research should expand to include various cities to assess the frequency of contrast reactions across different regions.
Further investigation is warranted to correlate the incidence of contrast-related reactions with patients' baseline conditions.
It is advisable to gather data from a broader range of hospitals to overcome privacy regulations and obtain more comprehensive insights.
Ensuring the production and availability of contrast agents is crucial, particularly since Low Osmolar Contrast Media exhibits a lower percentage of contrast reactions.

CONCLUSION:

Non-ionic contrast media, particularly low-osmolar contrast media (LOCM), are indeed considered the preferred choice for diagnostic imaging procedures such as Contrast Enhanced CT scans. This preference stems from their lower risk of triggering contrast reactions compared to ionic contrast media. Contrast reactions can range from mild to severe, including anaphylaxis, and minimizing their occurrence is crucial for patient safety.

Non-ionic contrast media are preferred and medical professionals can handle contrast materials to reduce the incidence of contrast reactions:

Non-ionic contrast media, particularly LOCM, have lower osmolarity compared to their ionic counterparts. This means they exert less osmotic pressure on the body's cells and are less likely to cause adverse reactions such as dehydration or kidney damage. Non-ionic contrast media are less likely to trigger contrast reactions in patients of all age groups and genders. While no contrast agent is entirely risk-free, non-ionic media have been shown to have a lower incidence of adverse reactions, including allergic responses. Medical professionals administering contrast media must follow proper techniques to minimize the risk of reactions. This includes verifying patient histories for any known allergies or previous reactions to contrast agents, ensuring appropriate dosage based on patient weight and condition, and using correct injection techniques to prevent extravasation (leakage of contrast material outside the blood vessel). Handling contrast material safely is essential to prevent contamination and ensure patient safety. Medical professionals should adhere to strict protocols for storing, preparing, and administering contrast media to minimize the risk of contamination and adverse reactions. Medical professionals involved in diagnostic and therapeutic procedures using contrast media must be knowledgeable about the signs and symptoms of contrast reactions and prepared to effectively treat patients who experience such reactions. This includes having access to emergency medications and equipment to manage severe reactions promptly. Informing patients about

the procedure, potential risks, and what to expect during and after contrast administration can help alleviate anxiety and enable them to report any adverse symptoms promptly.

In summary, non-ionic contrast media, particularly LOCM, are preferred for diagnostic imaging procedures due to their lower risk of triggering contrast reactions. Medical professionals must follow proper techniques and safe handling practices to minimize the incidence of adverse reactions and be prepared to manage any reactions promptly and effectively.

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