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ORIGINAL ARTICLE

Non-ionic contrast material in pediatric ct scans: A statistical analysis of mild allergic reactions.

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ABSTRACT… Objective: To assess allergic reactions to IV non-ionic contrast media in children. **Study Design:** Cross-sectional study. **Setting:** Faisal Hospital, Faisalabad, and Children Hospital, Faisalabad. **Period:** June 2022 to September 2022. **Methods:** A total of 310 patients (males and females) under the age of 14, referred for a CT scan with non-ionic contrast material were included in the study, Data were collected at the Children's Hospital and the Faisal Hospital Faisalabad for over 4 months and statistically analyzed by SPSS V22. The Chi-square test was used to measure the association between the age of children and mild allergy reactions. **Results:** This study included 310 patients, 183 (59%) males, and 127 (41%) females, who received the non-ionic contrast agent. Thirteen patients (6 males and 7 females) experienced mild allergic responses including 5 cases of rash, 3 cases of itching, 2 cases of nausea, and 1 case of vomiting, flushing, and swelling. There were 10 reactions for children under five, 1 for children between five to ten years, and 2 for children older than ten years. Out of 13 reported allergic reactions, the brain region observed seven while the chest, head, and neck regions observed none. **Conclusion:** According to the findings of this study, imaging young children with low-osmolality non-ionic contrast material is relatively safe and has few side effects. Out of 310, only 13 children experienced mild allergic responses to non-ionic contrast material. This study found an association between the age of children (<5 years) and mild allergic reactions (skin rash and itching) which was found to be statistically significant (p=0.005).

Key words: Allergic Reactions, Computed Tomography Scans, Non-ionic Contrast Material.

INTRODUCTION

Tomographic images (virtual 'slices') of specified portions of the scanned object are created using computer-processed x-rays, allowing the user to see in cross-section without cutting it.[1] A contrast medium (or contrast agent) is a material that is used in medical imaging to improve the contrast of structures or fluids within the body so that they may be seen more clearly.[2] It's widely used to make blood vessels and the gastrointestinal tract more visible.[2] Contrast medium is introduced into a patient's body in two ways; orally and Intravenously (IV).[3]

The gastrointestinal (GI) organs in the abdomen and pelvis are highlighted with oral contrast. If oral contrast is utilized during an examination, the patient will be requested to fast for many hours prior to receiving the medication.[3] Gastrografin is a yellowish, iodine-fortified water drink. Organs that have "taken up" the contrast appear as prominent white spots on CT scans.[3] However, Intravenous contrast is used to improve the anatomy of organs such as the brain, spine, liver, and kidney by highlighting blood arteries.[4] After being injected into the bloodstream, the contrast travels throughout the body. This procedure enhances these structures, making them look radio-opaque or bright on the image. When the test is over, the contrast is promptly removed from the body via the kidneys and liver.[4]

There are 2 types of contrast medium; Ionic contrast medium and Non-ionic contrast medium.[5] Ionic contrast medium deteriorates into ions, and has a higher osmolality than

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blood while having more side effects, such as diatrizoate (Urograffin, Hypaque), Metrizoate (Isopaque), Iothalmate (Conray).[5] Non-ionic contrast media do not dissolve into ions, and have a lower or equal osmolality as blood while having fewer side effects, such as iopamidol (Isovue), Iohexol (Omnipaque), Ioxilan (Oxilan), Iopromide (Ultravist), Iodixanol (Visipaque).[5,18]

The reactions are categorized into mild, moderate, and severe reactions. Mild reactions include nausea, vomiting, and swelling. Itching, flushing. and skin hives.[6] Moderate reactions include persistent vomiting, abnormal heart rhythms, high or low blood pressure, shortness of breath, wheezing, facial edema, and laryngeal edema.[7] Severe reactions include difficulty in breathing, pulmonary edema, cardiac arrest, convulsions, and contrast-induced nephropathy.[8] However, some medical disorders (pregnancy, renal failure, coronary artery disease, etc.) are contraindicated to iodine-based contrast materials.[9]

METHODS

Study Design and Setting

This is a descriptive (cross-sectional) study conducted for a duration of four months at Faisal Hospital, Faisalabad, and Children Hospital, Faisalabad.

Sample Size and Technique

A total of 310 patients were selected from two settings via a convenient sampling technique. All the patients (males and females) under the age of 14 years referred for CT with non-ionic contrast media were included in the study. However, all other patients who were not fulfilling the above-mentioned criteria were excluded.

Contrast Material and Procedure

Non-ionic contrast material (Iopromide) was used in the study. The contrast medium was inserted via a 19 or 20-gauge butterfly needle inserted into an antecubital vein. After the scan, patients were assessed for allergic reactions for 30 minutes.

Data Collection and Analysis

Data were collected by performa from 310 patients after they had a CT procedure with contrast media, immediately when they reported allergic reactions. Data were analyzed by using Statistical Package for Social Sciences (SPSS) version 22 in the form of mean, percentage, and standard deviation. The Chi-square test was used to measure the association between the age of children and mild allergy reactions.

Ethical Consideration

This study had no ethical issues because the client was not put on the experiment and no medication was given during the study. However, consent was obtained from the patient. Moreover, the study was duly approved by the ethics committee of Faisal hospital (FIHS), Faisalabad, Pakistan. (FIHS/2022/16)

RESULTS

A total of 310 patients were included in the study and a performa was used to collect information about allergic reactions to non-ionic contrast media from the patients.

Table-I. Descriptive statistics of age with a mean of 4.861 ± 4.11.

Total number of patients	310
Mean age (years)	4.86
Maximum age	13
Minimum age	1.5
Std. Deviation	4.11

Table-I. Descriptive statistics of age

The frequency distribution of gender showed that 183 patients (59%) were male and 127 patients (41%) were female. (Figure-1)

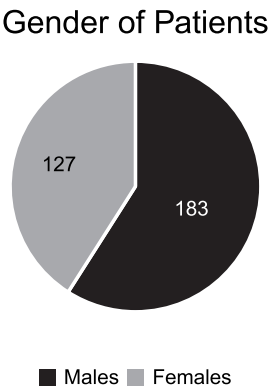

Figure-1. Pie chart of gender distribution

In the given study, maximum scans were of the brain region (47.1%), and minimum in the head and neck region (0.3%). (Table-II).

Scan Region	Frequency (%)
Brain	146 (47.1 %)
Head+Neck	1 (0.3 %)
Abdomen	45 (14.5 %)
Chest+Abdomen	14 (4.5 %)
Abdomen+Pelvis	15 (4.8 %)
Neck+Chest+Abdomen	47 (15.2 %)
Total	310 (100 %)

Table-II. Frequency distribution of scan regions

None of the patients experienced acute allergic reactions over this study period. Mild acute allergic reactions occurred in 13 patients which included; 5 instances of skin rash, 3 of itching, 2 of nausea, and 1 of vomiting, flushing, and swelling. (Table-III)

Reaction Type	Frequency (%)
Swelling	1 (7.6 %)
Skin rash	5 (38.4 %)
Itching	3 (23 %)
Flushing	1 (7.6 %)
Nausea	2 (15.3 %)
Vomiting	1 (7.6 %)
Others	0 (0%)
Total	13 (100 %)

Table-III. Frequency distribution of allergic reactions

Allergic reactions to IV administration of low-osmolality non-ionic iodinated contrast material were documented in 13 pediatric patients including 6 males and 7 females. 10 reactions were observed from the age group <5 years, 1 from the age group 5-10 years, and 2 from the age group >10 years. (Figure-2)

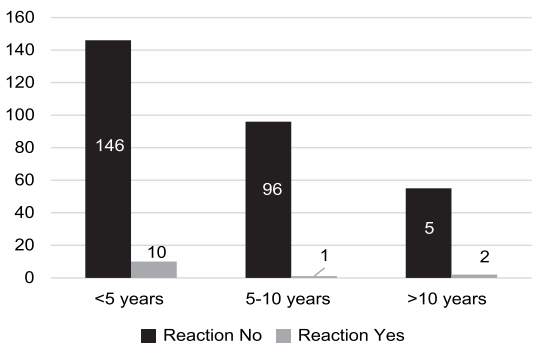

Figure-2. Frequency distribution of age and reactions frequency

The study shows that most of the scans were of the brain (47.1%). Out of 13 documented allergic reactions, a maximum was observed in the brain region, i.e. 7, and no reactions were observed in the chest, head, and neck region. (Table-IV)

Scan Region	Reaction		Total
	Yes	No	
Brain	7	140	147
Head+Neck	0	1	1
Abdomen	3	42	45
Chest	0	41	41
Chest+Abdomen	1	13	14
Abdomen+Pelvis	1	14	15
Head+Chest+Abdomen	1	46	47
Total	13	297	310

Table-IV. Frequency of reaction according to scan region

The cross-tabulation of age and reaction type illustrates that the incidence rate of allergic reactions is low in pediatrics (Table-V). There was a maximum of 5 allergic reactions of skin rash, 3 of itching, 1 of flushing, and vomiting at <5 years of age, and 1 reaction of nausea at 5-10 years. At age >10 years, 1 reaction of swelling and 1 of nausea was observed.

Reactions	Age			Total
	<5 Years	5-10 Years	>10 Years	
Swelling	0	0	1	1
Skin Rash	5	0	0	5
Itching	3	0	0	3
Flushing	1	0	0	1
Nausea	0	1	1	2
Vomiting	1	0	0	1
Others	0	0	0	0

Table-V. Distribution of reaction types in different age

In children <5 years of age, the most common were mild allergic reactions (skin rash and itching) and the association between the age of children and the mild reaction of contrast material was found to be statistically significant (p=0.005).

DISCUSSION

Allergic reactions of low-osmolality nonionic contrast material were rare in children. Non-Ionic contrast media are considered to be safe and have fewer side effects. Only 13 juvenile patients (6 men and 7 women) had allergic reactions

to intravenous injection of nonionic iodinated contrast material in this sample of 310 patients. The response rate of non-ionic contrast material has been studied extensively.

Wolf et al. in 1989 investigated the negative effects of ionic and nonionic contrast agents. 600 patients who got IV ionic contrast and 7170 individuals who received nonionic contrast for the identical exams were compared. The rate of ill effects in patients who received ionic contrast material was substantially higher (4.17 %) than in those who received nonionic contrast material (0.69 %). It was concluded that non-ionic contrast agents had fewer and milder side effects.[11] Non-ionic contrast material (iopromide) was used in the study.

Jonathan et al. in 2012 investigated the frequency, intensity, and risk factors of acute hypersensitivity reactions to IV non-ionic contrast in CT scans. Out of 29,962 patients who received non-ionic contrast, 47 suffered hypersensitivity responses out of which three were severe reactions.[10] In a given study, allergic reactions were recorded in 13 patients and none was recorded as a severe allergic reaction.

Chand et al. in 2013 investigated the occurrence of adverse responses to intravenous non-ionic iodinated contrast medium in CT scans in the United States. Only 17 of the 423 adverse reactions he discovered were mild including nausea, vomiting, dizziness, and rashes.[12] However, in the current study, 13 patients experienced mild reactions out of 310.

Carolyn et al. in 2008 also looked at how common acute allergic responses are. Allergic reactions occurred in 545 of the 84,928 patients who received a non-ionic iodinated contrast medium while 418 were mild allergic responses out of 545 total.[13] However, in the given study, 310 patients received non-ionic iodinated contrast media and only 13 of them experienced mild allergic reactions.

Jung et al. in 2012 conducted a similar study in Korea, looking at Cutaneous Adverse Responses (CARs) to nonionic contrast media. CARs were assigned to 50 cases out of 47,338 examinees. CARs were found in 24 males and 26 women in the study.[14] In the given study, out of 13 documented patients who experienced mild reactions, 8 of them were assigned to CARs.

Dillman et al. in 2007 investigated to determine the frequency and severity of acute allergic reactions to nonionic contrast medium in children. Allergic responses were recorded in 20 out of the 11,306 participants, only 16 of them were categorized as mild, 1 as moderate, and 3 as severe.[15] In the given study, allergic reactions were recorded in 13 patients out of 310 patients, and all of them were mild reactions, none was recorded as a severe allergic reaction.

Michael et al. in 2008 studied the severity of nonionic IV contrast material responses in pediatric patients. A total of 57 patients out of 12,494 had an allergic response. A mild reaction occurred in 47 whereas a moderate reaction occurred in 10 patients.[16] However, in the current study, 13 experienced allergic reactions out of 310, and all of them were mild, none experienced severe or moderate.

CONCLUSION

Allergic reactions to nonionic contrast material occurred in 13 cases. Allergic reactions were common in children under the age of five years and mild in nature. The study found an association between the age of children (<5 years) and mild allergic reactions (skin rash and itching) which was found to be statistically significant ($p=0.005$). The study concludes that using low-osmolality non-ionic iodinated contrast material for imaging juvenile patients is rather safe and has fewer negative effects.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Abdul Maajid Khokhar	Study concept, Drafting, Data collection, Methodology, Data analysis, Writing.