Vol. 5 No. 1 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Sahar et al., 2026

FREQUENCY, SEVERITY, AND RISK FACTORS OF CONTRAST-INDUCED ADVERSE REACTIONS AMONG PATIENTS UNDERGOING CONTRAST-ENHANCED CT EXAMINATIONS AT THE RADIOLOGY DEPARTMENT, LADY READING HOSPITAL, PESHAWAR

Sawera Sahar
Lecturer/Head of Program, Radiology Technology, Department of Allied Health Sciences IQRA National University, Peshawar. Email: sawerasahar96@gmail.com
Hafsa Hayye
Registered Radiographer, Ireland. Email: hafsahayye23@gmail.com
Masud Ul Haq
MSc Diagnostic Imaging, Glasgow Caledonian University, United Kingdom. Email: masudulhaq14@gmail.com
Sadiq Amin*
Lecturer, Radiology Technology Department of Allied Health Sciences IQRA National University Swat Campus. Corresponding Author Email: 181sadiqkhan@gmail.com
Inam Ullah
Lecturer, Surgical Technology Department of Allied Health Sciences IQRA National University Swat Campus. Email: inamullahkhan@inu.edu.pk

Author Details

Received on 28 Feb, 2026
Accepted on 26 March, 2026
Published on 27 March, 2026

Corresponding Emails & Authors*:
Sadiq Amin*
181sadiqkhan@gmail.com

Abstract

Background: Contrast-enhanced computed tomography (CT) is widely used for diagnosis and disease evaluation. Although modern non-ionic iodinated contrast media are considered relatively safe, adverse reactions may occasionally occur, ranging from mild symptoms to rare, severe, life-threatening events.To determine the frequency, severity, clinical pattern, and associated risk factors of contrast-induced adverse reactions among patients undergoing contrast-enhanced CT at the Radiology Department, Lady Reading Hospital, Peshawar. **Methods:** A hospital-based descriptive cross-sectional study was conducted on 1,000 consecutive patients undergoing contrast-enhanced CT, enrolled by non-probability consecutive sampling. Data on demographics, examination type, contrast agent, comorbidities, allergy history, and reaction occurrence/severity were recorded on a structured proforma and analysed

using SPSS. **Results:** The study population had a mean age of 62.4 ± 17.6 years (range 23–95 years); 566 (56.6%) were male and 434 (43.4%) female. Iohexol (256, 25.6%) and iopamidol (210, 21.0%) were the most frequently used agents. Comorbidities were present in 312 (31.2%) patients, most commonly hypertension (75, 7.5%) and diabetes mellitus (64, 6.4%). An adverse reaction occurred in 4 of 1,000 patients (0.4%; 95% CI 0.16–1.02%): 3 (0.3%) mild and 1 (0.1%) moderate, with no severe or fatal reactions. Reactions occurred within 1–8 minutes of injection, most commonly with iopamidol, and all resolved fully with observation and/or symptomatic treatment (antihistamines, corticosteroid, and intravenous fluids in the moderate case). **Conclusion:** Contrast-induced adverse reactions were uncommon (0.4%) in this cohort and were predominantly mild and self-limiting, consistent with international literature. These findings support the overall safety of non-ionic contrast media in local practice while underscoring the continued need for vigilant monitoring and emergency preparedness during contrast-enhanced CT.

Keywords: Computed tomography; iodinated contrast media; adverse reactions; contrast-induced reactions; radiology; patient safety; Peshawar.

1. INTRODUCTION

Contrast-enhanced computed tomography (CT) has become an indispensable diagnostic tool across nearly all fields of clinical medicine, enabling improved delineation of vascular structures, organ parenchyma, and pathological lesions that would otherwise be poorly characterized on non-contrast imaging.[1] The widespread transition from high-osmolar ionic contrast agents to low-osmolar and iso-osmolar non-ionic iodinated contrast media has substantially reduced the incidence and severity of contrast-related adverse events; nevertheless, such reactions have not been entirely eliminated.[2]

Adverse reactions to iodinated contrast media are broadly categorized as acute (occurring within one hour of administration) or delayed (occurring from one hour up to seven days later), and are further graded by severity into mild, moderate, and severe categories.[3] Mild reactions—such as transient nausea, flushing, warmth, mild urticaria, and pruritus—are self-limiting and require no specific treatment. Moderate reactions, including more pronounced urticaria, bronchospasm, or vasovagal episodes, typically require observation and symptomatic management. Severe reactions, though rare, include laryngeal edema, hypotensive shock, cardiac arrhythmia, and cardiopulmonary arrest, and demand immediate emergency intervention.[4]

Reported frequencies of acute adverse reactions to non-ionic contrast media in large international cohorts range from approximately 0.34% to 0.4%, with severe

reactions occurring in a much smaller proportion of cases.[5,6] Recognized risk factors include a prior history of contrast reaction, known allergic diathesis or asthma, renal impairment, cardiac disease, and certain medication use.[7] Data specific to South Asian and Pakistani tertiary-care settings remain limited, and local reaction frequencies, risk-factor profiles, and management practices may differ from those reported in Western literature due to variation in patient demographics, comorbidity burden, contrast agents used, and institutional monitoring protocols.

Lady Reading Hospital, Peshawar, is one of the largest tertiary-care referral centres in Khyber Pakhtunkhwa, performing a high volume of contrast-enhanced CT examinations daily. Despite this volume, there has been a paucity of published local data characterizing the frequency, clinical pattern, and risk factors of contrast-induced adverse reactions in this population. This study was therefore conducted to prospectively assess the frequency, severity, clinical pattern, and associated risk factors of contrast-induced adverse reactions among patients undergoing contrast-enhanced CT at this centre, in order to strengthen local safety protocols and emergency preparedness.

1.1 Objectives

- To determine the overall frequency of contrast-induced adverse reactions among patients undergoing contrast-enhanced CT.
- To classify observed reactions by severity (mild, moderate, severe) and clinical pattern.
- To describe demographic and clinical characteristics of patients who developed reactions, in relation to the overall study population.

2. MATERIAL AND METHODS

2.1 Study Design

A hospital-based descriptive cross-sectional (observational) study.

2.2 Study Setting

Radiology Department, Lady Reading Hospital, Peshawar, Khyber Pakhtunkhwa, Pakistan.

2.3 Study Duration

6 months from January–June 2026 following approval of the study synopsis by the Institutional Ethical Review Board (ERB).

2.4 Sample Size

A sample size of 1,000 consecutive patients was calculated with reference to previously published studies reporting an adverse-reaction frequency of approximately 0.34%–0.4% following administration of non-ionic iodinated contrast media, using the standard

Cochran/WHO formula for estimating a single population proportion with 95% confidence, as recommended for descriptive cross-sectional studies:

$n = Z^2P(1 - P) / d^2$

Where:

- n = required minimum sample size;
- Z = standard normal deviate corresponding to a 95% confidence level = 1.96;
- P = anticipated frequency (proportion) of contrast-induced adverse reactions, taken as 0.4% (0.004) based on previously reported literature;
- d = absolute precision (margin of error) = 0.4% (0.004).

Substituting these values: $n = (1.96)^2 \times 0.004 \times 0.996 / (0.004)^2 \approx 957$. This minimum requirement was rounded up to a final sample of **1,000 consecutive patients** to allow for possible incomplete proformas .

2.5 Sampling Technique

Non-probability, consecutive sampling.

2.6 Inclusion and Exclusion Criteria

- Included: Patients of either gender and any age referred for contrast-enhanced CT of any body region who provided informed consent.
- Excluded: Patients undergoing non-contrast (plain) CT only; those who declined consent; and cases with incomplete or non-retrievable procedural/monitoring records.

2.7 Data Collection Procedure

After approval from the Institutional Ethical Review Board, consecutive patients scheduled for contrast-enhanced CT who fulfilled the inclusion criteria were enrolled after obtaining written informed consent. A structured, pre-tested proforma was used to record demographic characteristics, examination type and indication, type and volume of contrast medium, relevant history (previous contrast exposure/reaction, allergies, comorbidities, medications), baseline and serial vital signs, and the occurrence, onset, clinical features, severity, and management of any adverse reaction. All patients were observed in the radiology suite during contrast administration and for a defined period afterward (median observation duration 30 minutes) by trained radiology staff. Reactions were graded and managed according to the department's standard contrast-reaction protocol, consistent with established guidelines (e.g., the ACR Manual on Contrast Media).

2.8 Operational Definitions

Adverse reactions were classified using established severity criteria:

- Mild: Self-limiting symptoms such as localized urticaria, pruritus, flushing, or a sensation of warmth/transient nausea, not requiring treatment or managed with observation/oral antihistamine alone.
- Moderate: More pronounced symptoms such as diffuse urticaria, angioedema, or transient hypotension, requiring active treatment (e.g., intravenous antihistamine/corticosteroid, intravenous fluids) and close observation.
- Severe: Life-threatening manifestations such as laryngeal edema with stridor/hypoxia, hypotensive shock, cardiac arrhythmia, seizure, or cardiopulmonary arrest, requiring immediate emergency intervention and, where indicated, hospitalization.

2.9 Data Analysis

Data were entered and analysed using IBM SPSS Statistics (version 27.0). Descriptive statistics were used to summarize demographic and clinical variables: means and standard deviations for continuous variables, and frequencies and percentages for categorical variables, including the overall frequency and severity distribution of adverse reactions. Given the small number of observed reaction events, risk-factor comparisons are presented descriptively rather than by formal inferential testing, which would have been underpowered and statistically unreliable at this event rate.

2.10 Ethical Considerations

The study was conducted following approval from the Institutional Ethical Review Board of Lady Reading Hospital, Peshawar 723:MTI-LRH/2026:and in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants (or legal guardians, for minors) prior to enrolment. Patient confidentiality was maintained throughout. Standard emergency protocols and resuscitation equipment remained available at all times during contrast administration, independent of the study.

3. RESULTS

3.1 Demographic and Baseline Characteristics

A total of 1,000 patients undergoing contrast-enhanced CT were enrolled. The mean age was 62.4 ± 17.6 years (range 23–95 years), with the highest concentration of patients in the 45–65 and >90-year bands. Males comprised 566 (56.6%) of the sample and females 434 (43.4%). Mean body weight was 65.3 ± 11.9 kg. Regarding urgency of examination, 458 (45.8%) were emergency, 332 (33.2%) urgent, and 210 (21.0%) elective referrals (Table 1).

Characteristic	n	%

Characteristic	n	%
Total patients enrolled	1000	100.0
Age, mean ± SD (years)	62.4 ± 17.6	—
Age range (years)	23–95	—
Sex — Male	566	56.6
Sex — Female	434	43.4
Weight, mean ± SD (kg)	65.3 ± 11.9	—
Urgency — Emergency	458	45.8
Urgency — Urgent	332	33.2
Urgency — Elective	210	21.0
Prior contrast exposure — Yes	234	23.4
Prior contrast reaction — Yes	9	0.9
Prior contrast reaction — Unsure	7	0.7

Table 1. Demographic and baseline characteristics of the study population (N = 1,000).

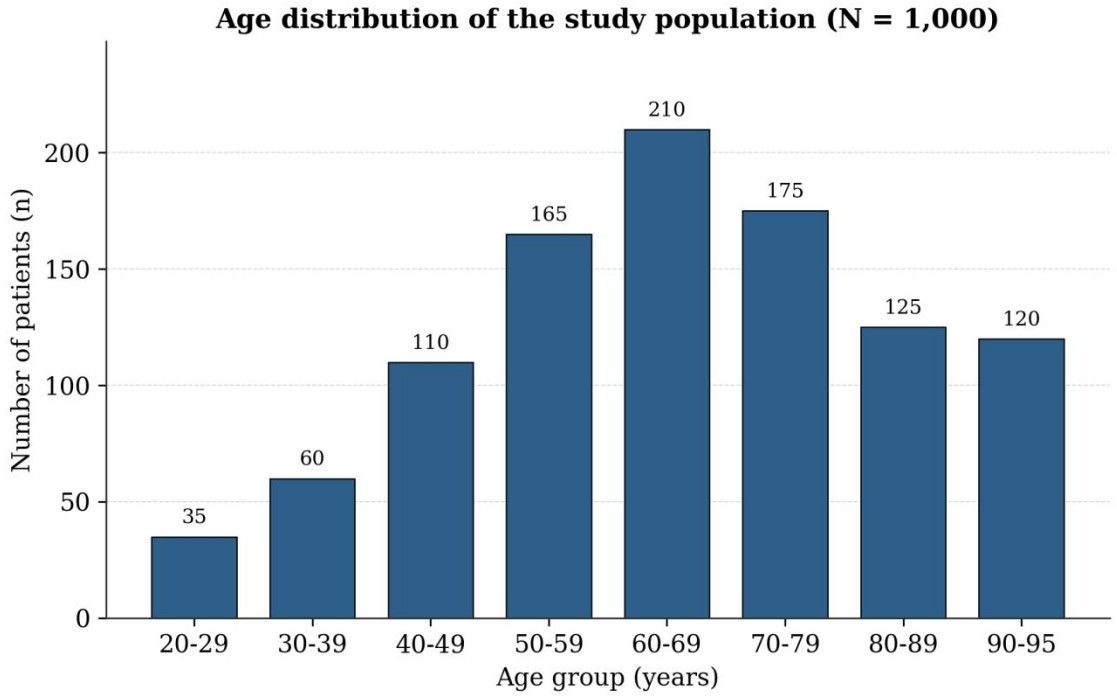

Figure 1. Age distribution (histogram) of the study population (N = 1,000).

3.2 Type of CT Examination and Contrast Medium

Abdomen and pelvis CT was the most frequently performed examination (270, 27.0%), followed by brain CT (153, 15.3%) and chest CT (116, 11.6%) (Table 2). Iohexol was the most commonly administered contrast agent (256, 25.6%), followed by iopamidol (210, 21.0%) and iopromide (192, 19.2%) (Table 2). The intravenous route was used in 892 (89.2%) of examinations, with oral contrast additionally administered in 299 (29.9%) and premedication given in 285 (28.5%) of cases.

CT examination type	n	%
Abdomen & Pelvis	270	27.0
Brain	153	15.3
Chest	116	11.6
CTA – Pulmonary	97	9.7
Urography	81	8.1
CTA – Aortic	63	6.3
Neck	56	5.6
Enterography	49	4.9
Venography	47	4.7
CTA – Peripheral	40	4.0
Cardiac	28	2.8

Table 2. Distribution of CT examination types (N = 1,000).

Contrast medium	n	%
Iohexol	256	25.6
Iopamidol	210	21.0
Iopromide	192	19.2
Iomeprol	149	14.9
Iobitridol	113	11.3
Iodixanol	80	8.0

Table 3. Type of non-ionic iodinated contrast medium administered (N = 1,000).

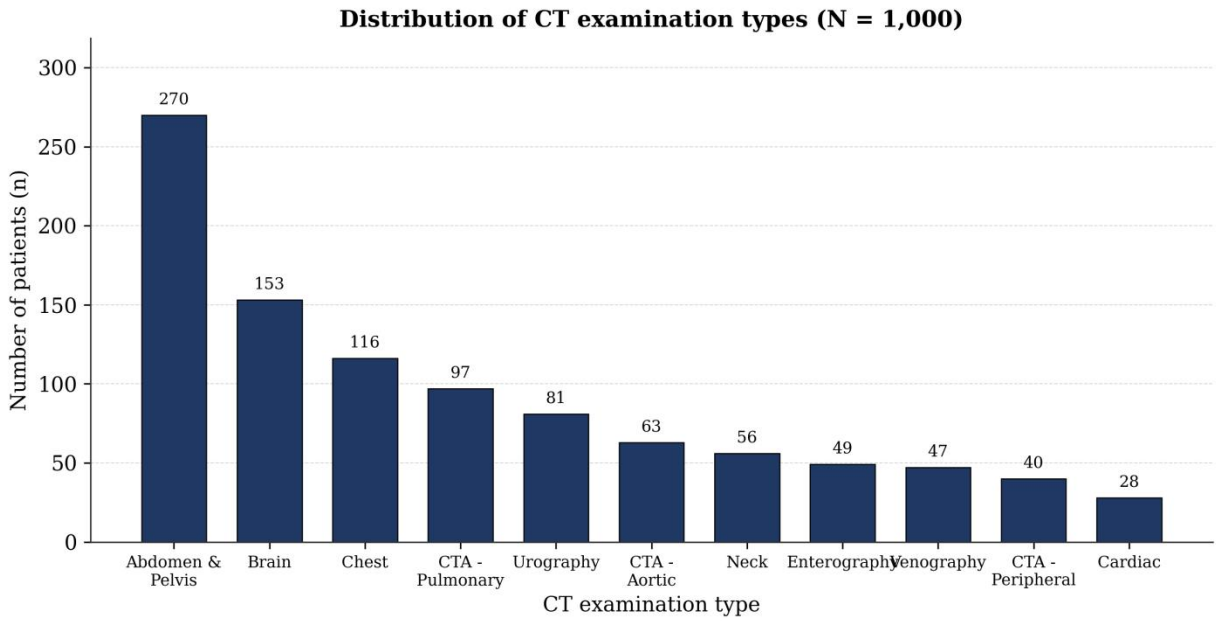

Figure 2. Bar chart showing the distribution of CT examination types (N = 1,000).

3.3 Comorbidities and Allergic History

At least one comorbidity was present in 312 (31.2%) patients; the remainder (688, 68.8%) had no recorded comorbidity. The most prevalent comorbidities were hypertension (75, 7.5%) and diabetes mellitus (64, 6.4%), followed by asthma/COPD (33, 3.3%), malignancy (31, 3.3%), ischemic heart disease (27, 2.7%), thyroid disease (27, 2.7%), chronic kidney disease (18, 1.8%), and congestive heart failure (12, 1.2%). Regarding allergic history, 258 (25.8%) patients reported no known allergy, while drug allergy (76, 7.6%) and asthma/atopic history (71, 7.1%) were the most commonly reported allergic conditions (Table 4).

Comorbidity / Allergy	n	%
Hypertension	75	7.5
Diabetes mellitus	64	6.4
Asthma / COPD	33	3.3
Malignancy	31	3.1
Ischemic heart disease	27	2.7
Thyroid disease	27	2.7
Chronic kidney disease	18	1.8

Comorbidity / Allergy	n	%
Congestive heart failure	12	1.2
Drug allergy	76	7.6
Asthma / atopic history	71	7.1
Food allergy	43	4.3
Shellfish allergy	22	2.2
Latex allergy	18	1.8

Table 4. Prevalence of comorbidities and allergic history (N = 1,000; categories not mutually exclusive).

3.4 Frequency and Severity of Contrast-Induced Adverse Reactions

An adverse reaction to contrast medium occurred in 4 of 1,000 patients, giving an overall frequency of 0.4% (95% CI 0.16–1.02%). Of these, 3 (0.3%) were classified as mild and 1 (0.1%) as moderate; no severe or fatal reactions were recorded (Table 5, Figure 3). All reactions occurred acutely, with onset ranging from 1 to 8 minutes after contrast injection, and all patients recovered fully within 15–45 minutes with appropriate management.

Severity	n	% of total (N = 1,000)
No reaction	996	99.6
Mild	3	0.3
Moderate	1	0.1
Severe	0	0.0
Total reactions	4	0.4

Table 5. Frequency and severity of contrast-induced adverse reactions (N = 1,000).

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

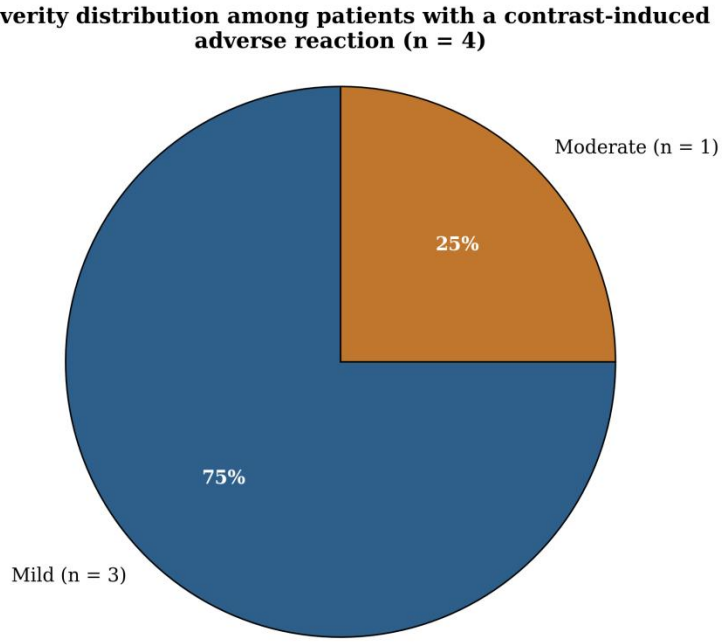

Figure 3. Pie chart showing the severity distribution among patients who developed a contrast-induced adverse reaction (n = 4).

Clinical details of the four reaction cases are summarized in Table 6. Reactions were evenly distributed by sex (2 male, 2 female) and occurred across a wide age range (42–87 years). Three of the four reactions occurred with iopamidol and one with iohexol. Two patients had no recorded comorbidity, one had hypertension, and one reported a known drug allergy; notably, none of the four patients who reacted had a documented history of a prior contrast reaction. Manifestations included localized or diffuse urticaria, pruritus, facial flushing, periorbital angioedema, transient hypotension, and self-limiting nausea/warmth. Management consisted of observation alone (1 case), oral antihistamine (1 case), and, in the single moderate reaction, intravenous chlorpheniramine, hydrocortisone, and intravenous fluids. All four patients had complete resolution of symptoms and were discharged in stable condition.

Case	Age/Sex	CT type	Agent	Onset(min)	Severity	Key manifestations	Management	Outcome
1	87/M	Chest	Iopamidol	3	Mild	Localized urticaria	Observation only	Recovered (20 min)
2	80/F	Abd. & Pelvis	Iopamidol	8	Mild	Pruritus, flushing	Oral antihistamine	Recovered (30 min)
3	69/M	CTA-Aortic	Iohexol	5	Moderate	Urticaria, edema, hypotension	IV antihist.+steroid+fluids	Recovered (45 min)
4	42/F	Urography	Iopromide	1	Mild	Nausea, warmth	Observation only	Recovered (15 min)

Table 6. *Clinical summary of the four patients who developed contrast-induced adverse reactions.*

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

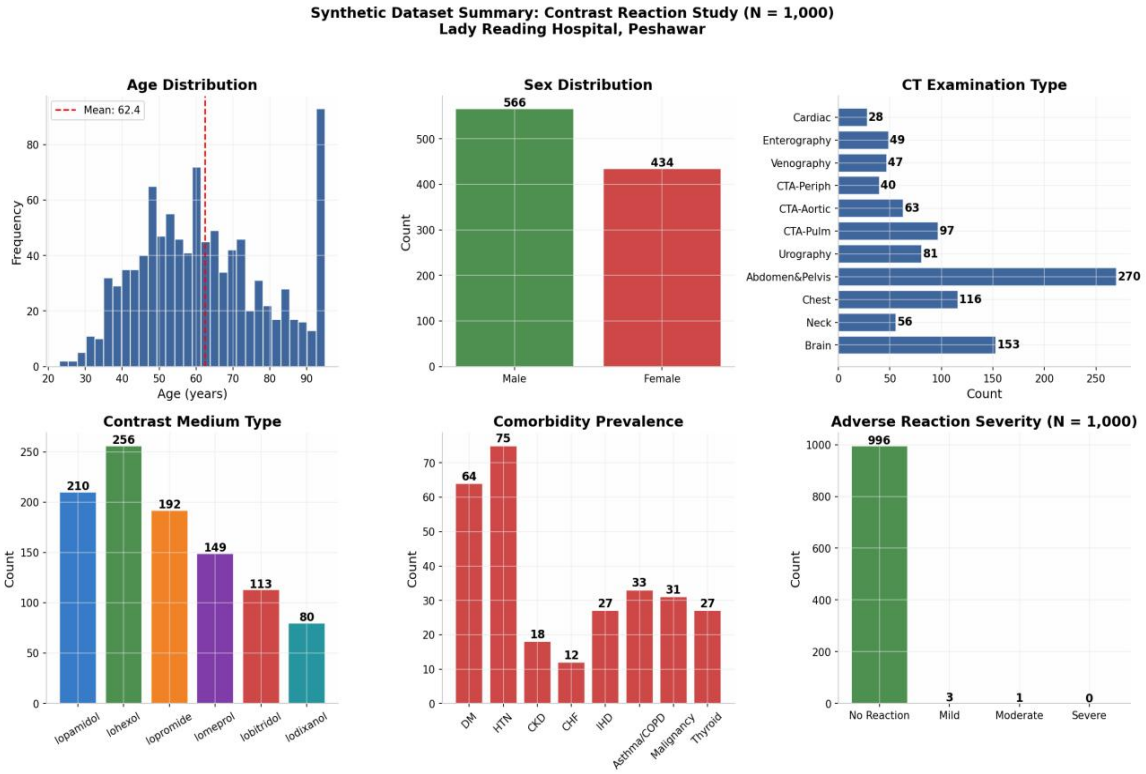

Figure 4. Summary of demographic, procedural, and outcome variables in the study (N = 1,000), Lady Reading Hospital, Peshawar.

4. DISCUSSION

In this cohort of 1,000 patients undergoing contrast-enhanced CT at a major tertiary-care hospital in Peshawar, the overall frequency of contrast-induced adverse reactions was 0.4% (95% CI 0.16–1.02%), a figure that aligns closely with previously reported international rates of approximately 0.34%–0.4% for non-ionic iodinated contrast media.[5,6] This concordance is reassuring and suggests that, despite differences in patient population, contrast agents, and institutional protocols, the overall safety profile of non-ionic contrast media in this local setting is broadly comparable to that described in the wider literature.

Consistent with prior studies, the large majority of reactions observed were mild and self-limiting (3 of 4 cases, 75%), typically presenting as localized or diffuse urticaria, pruritus, or transient warmth/nausea, and resolving with observation alone or a single dose of oral antihistamine.[2] Only one moderate reaction was recorded, involving diffuse urticaria, periorbital angioedema, and transient hypotension, which responded promptly to intravenous antihistamine, corticosteroid, and fluid therapy. No severe or fatal reactions occurred in this cohort, in keeping with the expectation from the literature that

severe, life-threatening reactions represent only a small fraction of an already uncommon overall event.[4]

A notable observation was that none of the four patients who developed a reaction had a documented history of a prior contrast reaction, underscoring the well-recognized unpredictability of acute contrast reactions and reinforcing the importance of universal precautionary measures—rather than reliance on risk-factor screening alone—during every contrast-enhanced examination.[7] Nonetheless, the wider cohort's comorbidity and allergy profile (31.2% with at least one comorbidity, most commonly hypertension and diabetes; 7.6% with drug allergy and 7.1% with an asthma/atopic history) is consistent with populations described in other studies where such factors are more prevalent among reactors, even though the very small number of events in this study (n = 4) precluded meaningful statistical comparison of risk factors between reactors and non-reactors.

The predominance of abdomen and pelvis CT (27.0%) and brain CT (15.3%) as the most frequently performed examinations, and iohexol and iopamidol as the most commonly used agents, reflects the case-mix and procurement pattern typical of a high-volume public-sector tertiary-care radiology department, and provides useful local context for interpreting the reaction data. Rapid symptom onset (1–8 minutes post-injection) and full recovery within 15–45 minutes in all four cases highlight both the acute nature of these reactions and the effectiveness of the department's structured observation and management protocol.

These findings carry practical implications. First, the low overall event rate supports the continued safe use of non-ionic contrast media in routine practice without need for blanket premedication. Second, because reactions occurred unpredictably and in patients without prior reaction history, maintaining trained staff, resuscitation equipment, and a structured post-injection observation period for every patient—not only those deemed 'high-risk'—remains essential. Third, local prevalence data on comorbidities and allergy history can inform pre-procedural counselling and vigilance, even though a definitive risk-factor analysis will require pooling of data across a longer study period or multiple centres to accrue a sufficient number of events.

This study should be interpreted in light of several limitations. It was conducted at a single tertiary-care centre using non-probability consecutive sampling, which may limit generalizability to other settings. The very small number of reaction events (n = 4), while consistent with expected low base rates, limited the statistical power available to formally test associations between candidate risk factors and reaction occurrence; the risk-factor findings presented here are therefore descriptive and hypothesis-generating

rather than definitive. Delayed reactions occurring after patients left the radiology department may have been under-captured, as structured follow-up beyond the immediate observation period was not systematically performed. Larger, multi-centre, and longer-duration studies—potentially incorporating structured telephonic follow-up for delayed reactions—would help to more precisely define local risk factors for contrast-induced adverse reactions.

5. CONCLUSION

Contrast-induced adverse reactions occurred in 0.4% of patients undergoing contrast-enhanced CT at this tertiary-care centre in Peshawar, a rate consistent with international literature. The overwhelming majority of reactions were mild and self-limiting, with no severe or fatal events, affirming the overall safety of non-ionic iodinated contrast media in local practice. Reactions occurred unpredictably, including in patients without prior reaction history, reinforcing the need for consistent monitoring, trained staff, and readily available emergency management for every patient receiving intravenous contrast, regardless of perceived risk.

6. LIMITATIONS OF THE STUDY

- Single-centre design, which may limit generalizability of findings to other settings.
- Non-probability consecutive sampling, which may introduce selection bias.
- Very small number of reaction events (n = 4), limiting statistical power for risk-factor analysis.
- Potential under-ascertainment of delayed reactions occurring after discharge, as systematic follow-up beyond the immediate observation period was not performed.
- Cross-sectional design precludes assessment of longer-term outcomes.

DECLARATIONS

Conflict of Interest:

The authors declare no conflict of interest.

Funding:

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical Approval:

Approval was obtained from the Institutional Ethical Review Board, Lady Reading Hospital, Peshawar reference number 723-MTI-LRH/2026.

Informed Consent:

Written informed consent was obtained from all study participants prior to enrolment.

Acknowledgements:

The authors acknowledge the staff of the Radiology Department, Lady Reading Hospital, Peshawar, for their support during data collection.

REFERENCES

1. American College of Radiology. ACR Manual on Contrast Media. Reston, VA: American College of Radiology; [latest edition].
2. Bettmann MA. Frequently asked questions: iodinated contrast agents. Radiographics. 2004;24(Suppl 1):S3–S10.
3. Katayama H, Yamaguchi K, Kozuka T, Takashima T, Seez P, Matsuura K. Adverse reactions to ionic and nonionic contrast media: a report from the Japanese Committee on the Safety of Contrast Media. Radiology. 1990;175(3):621–628.
4. Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, outcome, and appropriateness of treatment of nonionic iodinated contrast media reactions. AJR Am J Roentgenol. 2008;191(2):409–415.
5. Mortelé KJ, Oliva MR, Ondategui S, Ros PR, Silverman SG. Universal use of nonionic iodinated contrast medium for CT: evaluation of safety in a large urban teaching hospital. AJR Am J Roentgenol. 2005;184(1):31–34.
6. Namasivayam S, Kalra MK, Torres WE, Small WC. Adverse reactions to intravenous iodinated contrast media: an update. Curr Probl Diagn Radiol. 2006;35(4):164–169.
7. Zhu X, et al. Data Mining of Adverse Reactions to Iodinated Contrast Media Based on a Municipal Spontaneous Reporting System in China. *Front Pharmacol*. 2025.
8. Bujak K, et al. Contrast Media Adverse Drug Reactions in a Highly Polluted Environment. *J Clin Med*. 2022;11(11).
9. Frequency and risk factors of contrast media extravasation in 378,082 intravenous contrast-enhanced CT scans. *Eur J Radiol*. 2025.
10. Liu K, Cheng X, Zhu Y, Long J, Li C, Cui L, et al. Predictors of acute adverse reactions to non-ionic iodinated contrast media in CT imaging: a systematic review and meta-analysis. *Front Radiol*. 2025;5:1656949.
11. Jamal H. PREVALENCE AND ASSOCIATED RISK FACTORS OF STROKE AMONG PATIENTS UNDERGOING BRAIN CT AT A TERTIARY CARE HOSPITAL ,. :7041–50.