

Impact of Contrast Media on Estimated Glomerular Filtration Rate in Patients Undergoing CT Imaging

Maimoona Rasool*

College of Allied Health Professionals, Government College University, Faisalabad.

Corresponding Author Email: maimoonamit@yahoo.com

Hamza Iftikhar

College of Allied Health Professionals, Government College University Faisalabad

Abdul Haseeb

College of Allied Health Professionals, Government College University Faisalabad

Dur e Adan

College of Allied Health Professionals, Government College University Faisalabad

Saqib Raza

College of Allied Health Professionals, Government College University Faisalabad

Zuha Arshad

College of Allied Health Professionals, Government College University Faisalabad

Mehak Qaiser

College of Allied Health Professionals, Government College University Faisalabad

Sabira Sultan

Department of Eastern Medicine, Government College University Faisalabad Pakistan

Muhammad Akram

Department of Eastern Medicine, Government College University Faisalabad Pakistan

Author Details

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Corresponding E-mail &

Authors*:

Maimoona Rasool

Abstract

Introduction: Although iodinated contrast media are commonly used to enhance the diagnostic accuracy of computed tomography (CT), there are still concerns that they may lead to acute renal impairment, which is especially evident in decreases in estimated glomerular filtration rate (eGFR). There is still conflicting evidence regarding renal effects in patients with normal baseline kidney function. The

short-term effects of intravenous iodinated contrast on eGFR in a general CT-referred population. Population are evaluated in this study. **METHODS:** 52 patients (59.6% female; mean age 52.57 ± 13.34 years) undergoing contrast-enhanced CT scans were performed as part of a prospective observational study. Values were measured before the administration of contrast and again 48 hours later. To assess changes in renal function, correlation analyses Paired samples t-tests were used. **RESULTS:** Prior to contrast exposure, the mean eGFR was 84.29 ± 16.71 mL/min/1.73 m²; after contrast exposure, it significantly dropped to 77.62 ± 17.85 mL/min/1.73 m² (mean reduction 6.67 ± 4.36 mL/min/1.73 m²; $t = 11.026$; $p < 0.001$). Pre- and post-contrast eGFR values showed a perfect positive correlation ($r = 0.970$; $p < 0.001$), demonstrating that renal function samples were consistent among individuals. In patients with usual baseline renal status, the decreased eGFR remained small and clinically mild despite being statistically meaningful. **CONCLUSION:** There is a detectable but slight short-term reduction in eGFR following the administration of iodinated contrast during CT imaging. These changes are indicative of temporary renal stress rather than clinically significant nephrotoxicity in individuals without prior renal impairment. The results highlight the need for ongoing attention and hydration-based precautions in vulnerable groups while supporting the general safety of contemporary contrast agents in low-risk populations.

Introduction

Computed tomography (CT) has an essential innovation in diagnostic medicine which conveys high definition cross-sectional visuals enabling health care professionals to assess diverse array of illness with precision and correctness[1]. To intensify its quality contrast media is frequently given[2]. Contrast media functions by improving a absorption of x-rays, making circulatory system, organ, and abscess highly remarkable[3].

In spite the fact that contrast agent importantly increase diagnostic accuracy, their utilization is not without threat. Contrast-induced nephrotoxicity (CIN), often indicated as a reduce in a kidney function which is its most negative effect[4].

Nephric role lies typically assessed by the estimated glomerular filtration rate (eGFR), computed parameter which indicated to what extent renal function act as a purifying body fluid eGFR is obtained through plasma creatinine value accompanied by individual chronological age , gender as well as ancestry[5]. Therefore, estimating variation in estimated glomerular filtration rate later contrast augmented computed tomography is a trustworthy technique to acquire kidney impact of iodine base contrast agent[6].

Pathogenesis of iodinated agent triggered renal disorder affect several physiopathology functions[7]. Initially nephric blood rate is lowered (decreased) by the nephric vessels constriction due to radiocontrast dose, especially in external medulla, major cause of oxygen deprivation at tissue level (hypoxia, anoxemia) [8]. following elevated osmolar osmotic solute concentration and fluid resistance of imaging agent can cause tubulopathy that impairs renal tubular epithelial cells. Later, the generation of reactive oxygen species (ROS) play role in oxidant mediated strain subsequently aggravating cellular damage (cytotoxicity) along with inflammation. Jointly, these procedures reduce glomerular filtration rate, decrease urinary fluid volume, and result in reversible and irreversible decline in eGFR[8].

While modern hypo-osmolality and isotonic radiocontrast was engineered to reduce contrast reaction, although it do not completely eradicate the exposure[9]. The intensity of kidney effect as well relay on patient medical condition including hypohydration, fluid deflect, water loss , initial kidney performance, and diabetes

mellitus along with receiving renal toxic drugs simultaneously such as cyclooxygenase inhibitors (NSAIDs) or aminoglycosides drugs [10].

In spite of comprehensive investigation on CIN and eGFR, various voids are still present[11]. Numerous investigations have aimed mainly on high risk populations like those with CKD or diabetes mellitus, frequently overlooking the general public go through routine contrast enhanced CT[12]. Furthermore, most of current information is backdated, with uneven conformity in timing and frequency of post-contrast eGFR calculations[13]. Limited investigations have analyse how contrast exposure influence on eGFR in patient with normal kidney function, leaving unreliability regarding actual level of risk in diagnostic imaging[14]. Dealing with these gaps is pivotal for progressing evidence-based instructions to confirm patient protection without vainly limiting the utilization of contrast enhanced imaging[15].

The present study's objectives to assess **the effect of iodinated contrast media eGFR among patient undergoing CT scans**. Particularly it aims to;

- Calculate pre and post contrast eGFR values to determine any major changes in kidney efficacy
- Evaluate the connection between eGFR difference and patient demographics like age, gender, and pre-existing kidney function.
- Provide improved medical data to the prolonged dispute on whether latest contrast media profoundly influence kidney performance, Renal efficiency during common diagnostic procedures.

By pursuing these aims, it helps to explain actual renal risks related with contrast enhanced CT and gives awareness in preventing and monitoring methods

Materials and Methods

This study was designed as an observational, prospective analysis conducted in the radiology department of a tertiary-care hospital. The primary objective was to evaluate the effect of iodinated contrast media on estimated glomerular filtration rate (eGFR) in patients undergoing contrast-enhanced computed tomography (CT). Ethical approval was obtained from the institutional review board, and written informed consent was secured from all participants prior to enrollment.

Study Population

A total of 52 consecutive patients who underwent contrast-enhanced CT examinations were included in the study. Data were collected without any missing entries. Both male and female patients between **13 and 80 years of age** were eligible, with a mean age of **52.57 ± 13.34 years**. The sample comprised **31 females (59.6%)** and **21 males (40.4%)**.

Inclusion Criteria

- Patients undergoing any contrast-enhanced CT study (e.g., abdomen, pelvis, chest, CAP, triphasic liver, KUB).
- Patients with available pre-contrast and post-contrast serum creatinine/eGFR values.
- Individuals who provided informed consent for participation.

Exclusion Criteria

- Known chronic kidney disease stage 4 or 5.
- Dialysis-dependent patients
- Patients with obstructive nephropathy, acute dehydration, or concurrent use of nephrotoxic medications.
- Patients with a history of contrast exposure within the preceding two weeks.

(These criteria parallel standard CIN risk-exclusion parameters and align with the methodology of the reference study.)

Contrast Administration and CT Procedures

All patients underwent intravenous contrast-enhanced CT using standard departmental protocols. Contrast dose varied according to the type of CT study (e.g., CECT abdomen, CAP, biphasic, triphasic liver protocol). Individual contrast volumes recorded in the dataset reflect routine clinical dosing for body CT studies.

No special hydration protocol was applied beyond routine clinical practice. Patients were clinically assessed before contrast administration for hydration status, comorbidities, and risk factors.

Renal Function Assessment

Renal function was assessed by measuring serum creatinine values before contrast exposure and again after the CT scan. Using these values, **pre-contrast eGFR** and **post-contrast eGFR** were calculated using standard laboratory automated equations (CKD-EPI method routinely used in the hospital).

Mean pre-contrast eGFR: 84.29 ± 16.71 mL/min/1.73m²

Mean post-contrast eGFR: 77.62 ± 17.85 mL/min/1.73m²

The difference between pre- and post-contrast eGFR served as the primary measurement for determining renal function change after contrast exposure.

This study focused on changes in renal function that might be associated with the administration of contrast. A post-contrast decrease in eGFR was thus considered clinically significant when statistically significant changes occurred between measurements taken pre- and post-contrast. While classically, CIN is defined by

threshold increases in serum creatinine, for this study the change in eGFR pre- and post-contrast was used as the primary indicator of renal impact.

Data Handling and Statistical Analysis

All patient data were drawn out into a structured datasheet and analyzed by using SPSS. Continuous variables were summarized as mean ± standard deviation, and categorical variables as frequencies and percentages.

A **paired samples t-test** was applied to compare pre- and post-contrast eGFR values. The correlation between the two measurements was also calculated. Results indicated:

Mean reduction in eGFR: **6.67 mL/min/1.73m²**

Paired t-test: **t = 11.026, p < 0.001**, indicating a statistically significant decline in eGFR following contrast administration.

Correlation between pre- and post-eGFR: **r = 0.970, p < 0.001**.

A significance level of **p < 0.05** was used for all analyses.

Result

Demographic Characteristics

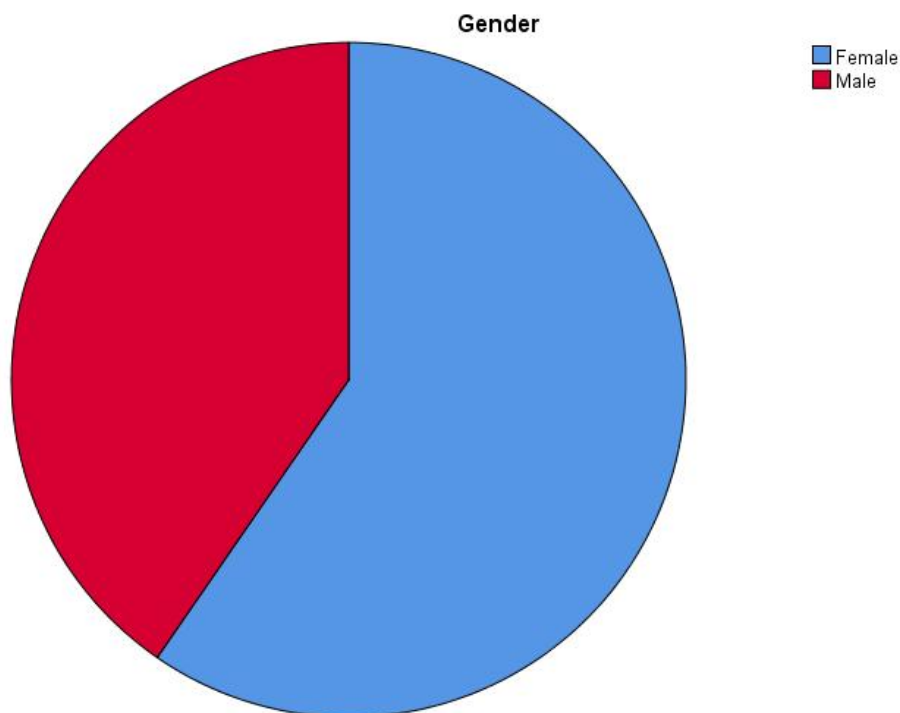
A cohort of 52 patients was examined, all of whom received an IV contrast enhancement computed tomography CT. The mean patient age in this cohort was 52±13.35 years (range 13-80 years). Within cohort showed modest female prevalence with 31(59.6%) females and 21 (40.4%) males. The age distribution demonstrated that majority of patients were in the age span of 40-60 years. Demonstrating the predominant portion of cohort.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	31	59.6	59.6	59.6

Male	21	40.4	40.4	100.0
Total	52	100.0	100.0	

Distribution of participants by gender shown in Table 1.



Gender distrubtion of study participants shown in figure 1

Renal Function Changes Before and After Contrast Administration

The mean estimated glomerular filtration rate (eGFR) before contrast administration was $84.29 \pm 16.71 \text{ ml/min/1.73m}^2$, whereas the decline was observed after contrast administration therefore post eGfr was $77.62 \pm 17.86 \text{ ml/min/1.73m}^2$. The paired sample t-test ($t=11.026$, $df=51$, $p>0.001$) showed a statistically significant decline. The mean variation before and after contrast exposure Egfr was $6.67 \pm 4.36 \text{ ml/min/1.73m}^2$, with confidence interval (CI) of 5.46-7.89, demonstrating homogenous reduction in egfr after

contrast administration. The paired sample test statistically clearly confirmed the reduction as shown in table 2.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre eFGR[mL/min/1.73m2]	84.2885	52	16.71132	2.31744
	Post eFGR[mL/min/1.73m2]	77.6154	52	17.85580	2.47615

Paired sample statistics for pre-contrast and post -contrast eGFR values shown in Table 2.

Correlation between Pre- and Post eGFR

Pre and post contrast eGFR values observed a significant positive correlation ($r=0.970$, $p<0.001$) between them, referring to those patients with elevated initial kidney function commonly maintained elevated level after contrast exposure. Table 3 displayed the relationship, illustrating the similar linear association between the values.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre eFGR[mL/min/1.73m2]	52	.970	.000
	Post eFGR[mL/min/1.73m2]			

Correlation between pre and post contrast eGFR values shown in table 3

Paired Sample Test

The paired samples t-test verified that the decline in eGFR following contrast delivery was statistically significant, as seen in Table 4. For

Individuals with normal baseline renal function showed that while the deterioration was uniform across participants, with its magnitude

remained small and clinically manageable.

Paired Samples Test

		Paired Differences				95% Confidence Interval of the Error Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	Lower	Upper				
Pair 1	Pre eGFR[mL/min/1.73 m2] - Post eGFR[mL/min/1.73 m2]	6.673084	4.36439	.60523	5.45802	7.88813	11.026	51	.000	

Paired sample t-test comparing pre-contrast and post-contrast eGFR values shown in table 4.

Summary of Findings

All the data indicate a statistically significant, though slight, reduction of eGFR values after iodinated contrast medium administration. This result, indicative of the temporary nephric influence of contrast, was constant for all patients.

Discussion

The decreased in eGFR can be related to various mechanisms, this includes transient renal vasoconstriction resulting in medullary hypoxia, osmotic tubular injury, and oxidative stress induced by reactive oxygen species. These pathophysiological processes can temporarily reduce glomerular filtration, explaining the observed eGFR decline without resulting in sustained renal damage.

This study found that administering iodinated contrast during CT imaging resulted in a statistically significant drop in eGFR. Even in patients without preexisting kidney illness, the mean falls of roughly 6.7 ml/min/1.73 m² indicates that contrast exposure momentarily affects renal function. The extent of reduction was often small despite this statistically significant change, suggesting that contrast-induced nephropathy is still very uncommon in low-risk people.

The results are in line with several studies that show slight, temporary declines in renal function after contrast therapy. The danger of contrast-induced nephropathy (CIN) was overstated in earlier research, but more recent studies with low- and iso-osmolar agents have shown that substantial nephrotoxicity is uncommon when appropriate measures are taken. In sensitive groups, especially those with eGFR <60 mL/min/1.73 m², even little reductions in eGFR can be clinically significant, according to Weisbord and Palevsky (2008). Their view is supported by the current results, which further demonstrate that these decreases are typically self-limiting and reversible in the general population.

Osmotic tubular damage, oxidative stress brought on by reactive oxygen species, and temporary renal vasoconstriction resulting in medullary hypoxia are some of the mechanisms that may be responsible for the decrease in eGFR. The observed drop in eGFR can be explained by these pathophysiological processes, which can momentarily lower glomerular filtration without causing long-term renal damage. These findings highlight the significance of patient selection and preventative care from a clinical perspective. Contrast-enhanced computed tomography is safe for patients with normal baseline renal function since there is little chance of clinically significant kidney damage. However, pre-and post-procedure hydration and renal monitoring remain important for

individuals with impaired renal function, diabetes mellitus, dehydration, or those on nephrotoxic drugs. The results also highlight the importance of measuring eGFR 48 hours after contrast, as this study did, to capture the temporary renal response accurately at this time and be consistent with accepted standards of monitoring CIN.

Future research is required with larger populations, and results stratified by Comorbidities and baseline renal function are considered, and the influence of Preventive measures include iso-osmolar contrast medium and antioxidant, medication and hydration therapy. The study of contrast related renal consequences can also be furthered by the inclusion of long-term follow-up for eGFR recovery and clinical outcomes: length of hospital stay, need for dialysis.

Conclusion

Iodinated contrast material causes a slight but noticeable reduction in eGFR levels 48 hours after the exposure to CT contrasts. In patients with normal baseline kidney function, such a temporary drop simply reflects mild renal stress rather than true nephrotoxicity. Available preventive approaches and monitoring techniques reduce renal outcomes for at-risk patients while making diagnostic imaging safe.

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