

Clinical Assessment Of Iodinated Gadolinium Contrast Media: A Comprehensive Examination Of Creatinine Trends And Post-Procedural Complications In Radiology

Valluru Bhavya Sri¹, Kolamala Suguma Sri¹, Kudipudi Harinadha Baba²,
Dr. Baru Ramakrishna Rao³

¹Year Doctor Of Pharmacy, Department Of Pharmacy Practice, Narayana Pharmacy College, Nellore, Andhra Pradesh, India, ²principal, Narayana Pharmacy College, Nellore, Andhra Pradesh, India, ³professor And Hod, Department Of Radiology, Narayana Medical College And Hospitals, Nellore, Andhra Pradesh, India

Abstract

Radiology: This is the medical discipline that uses medical imaging to diagnose disease and guide their treatment, within the bodies of humans and other animals. It began with radiography (which is why its name has a route referring to radiation), but today it includes all imaging modalities, including those that use no electromagnetic radiation (such as ultrasonography and magnetic resonance imaging), as well as others that do, such as computed tomography (CT), fluoroscopy and nuclear medicine including positron emission tomography (PET), x-ray, IVP (intravenous pyelography). Interventional Radiology is the performance of usually minimally invasive medical procedures with the guidance of imaging technologies as mentioned above.

Radiology Department: The facility in the hospital where Radiological examinations of patients are carried out, using the range of equipment listed above.

Materials and Methods: Place of study: The study “clinical assessment of iodinated gadolinium contrast media: a comprehensive examination of creatinine trends and post-procedural complications in radiology” which was carried at “Department of Radiology” at Narayana Hospitals, Nellore, in collaboration with 1440 bedded multidisciplinary teaching hospital.

Discussion: In our study, out of 190 patients 200 are willing to provide the information in which maximum are male 90 (60%) and minimum were females 70 (40%)

Conclusion: In our extensive analysis of patient undergoing various radiological imaging procedures with iodinated gadolinium contrast media several significant findings emerged. We closely monitored creatinine levels at hourly intervals, and we observed a prevalent trend of elevated creatinine levels in most patients. Despite the use of prophylactic medications three individuals got ADR'S. This highlights the need of clinical pharmacists for better management strategies for these side effects and improved patient care in Radiological imaging.

Key words: Nephropathy, Inflammatory responses (Pruritis with/without urticaria), Elevated creatinine (kidney impairment), Bronchospasms, Nasal stuffiness, Interacted with interleukins-2 and biguanides.

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I. Introduction

In the Radiology Department the most commonly used injectable is Iodinated gadolinium contrast media. They are mostly administered in IV route, even though they are given after prophylactic treatment it might cause interactions and side effects at the time of administration or after few days or hours. They are given in the ratio of 1ml/kg body weight, as this takes 24 to 48 hours to get completely excreted from the body within this time it elevates the creatinine levels in body and in some patients, it leads to kidney retention which makes iodinated gadolinium to get deposited in the body and cause life threatening situations.





Assessment: It is the evaluation of health status by performing hourly creatinine analysis before and after taking iodinated gadolinium contrast media.

Complications: A secondary condition or an ADR might develop after using iodinated gadolinium contrast media in any of the Radiological procedures like X-ray, MRI, CT scan, Coronary angiogram and IVP. Especially IVP procedure (intravenous pyelography) is done in the patients who are already having kidney problems so it might cause renal retention and other side effects. And coronary Angiogram might cause hypertension in most patients with cardiac problems.

Chemistry of iodinated gadolinium: All of the now utilized ICM (iodinated contrast media) are chemical variations of 2,4,6 iodinated benzene rings. These are categorized according to their chemical and

physical properties which includes chemical structure, osmolality, iodine concentration, iodine concentration and ionization in solution. In clinical practice, osmolality-based categorization is commonly utilized. The osmotic effects of contrast media short term fluctuations in blood flow, filtration fraction, and glomerular filtration rate. Additional consequences include osmotically triggered diuresis, which has a drying impact. Radiologists and other clinicians must be aware of risk factors for contrast media reactions, make use of methods to minimize adverse events and be prepared to identify and handle any contrast media reactions as soon as they occur

Following is the picture showing normal creatinine levels

		mg/dL	mL/min
Men		0.6 to 1.2	107 to 139
Women		0.5 to 1.1	87 to 107
Teenager		0.5 to 1.0	
Children		0.3 to 0.7	

II. Materials and methods

Place of study: The study “**Clinical assessment of iodinated gadolinium contrast media: a comprehensive examination of creatinine trends and post-procedural complications in Radiology.**” which was carried out in the Department of Radiology at Narayana Hospitals, Nellore, in collaboration with a 1440 bedded multidisciplinary teaching hospital.

Study Design: The study was a prospective observational clinical study conducted in the Department of Radiology of tertiary care teaching hospitals.

Study Population: This study was conducted in 200 patients who came to the Department of Radiology with several types of complications like trauma, tumors, infection, fractures, lesions, internal injuries, neurocystosis, spinal TB and so on.

Study Duration: The study was conducted for a period of 6 months.

Study criteria: Patients are considered for the study based on inclusion and exclusive criteria

Inclusion criteria:

1. Patients undergoing Radiological imaging Procedures Using iodinated gadolinium contrast media.
2. Patients of varying age groups and medical backgrounds ensure a broad representation.
3. Those who have provided informed consent to participate in the study.
4. Patients with different baseline creatinine levels assist the contrast effect on a diverse population.
5. patients willing and able to adhere to the study's monitoring and follow up schedule.

Exclusion criteria:

1. Patients with a known history of severe allergic reactions to gadolinium-based contrast media.
2. Patients with pre-existing severe renal impairment or chronic kidney disease, Where the use of contrast media is contraindicated.
3. Individuals who are pregnant or breastfeeding.
4. Patient with contraindications to the prophylactic medications being administered.
5. Patients with a history of noncompliance or inability to follow the studies protocol.
6. Those with severe medical conditions that would make participation in the study unsafe or impractical.
7. Those who are having abnormal creatinine levels which is more than 1.8
8. The patients with abnormal heartbeat.

Study Material:

1. Patient informed consent form.
2. Statistical software.
3. A specially designed questionnaire to gather additional data.
4. Patient medical records.
5. Ethical approval.
6. Data collection forms

Study Method:

The study was conducted after obtaining permission from the Head of the institution and Head of Department of Radiology.

The type of method used in the study you described, which examines the complications of elevated creatinine levels and adverse drug reactions due to creatinine elevation after using iodinated gadolinium contrast dye, primarily falls under the category of an **observational clinical study**.

To be more specific, this study could be considered a **prospective cohort study**. In a prospective cohort study, researchers follow a group of individuals over time, in this case, patients who receive iodinated gadolinium contrast media and monitor them for the development of complications and adverse reactions, as well as changes in the creatinine levels.

This study allows for the collection of data to observe relationships and trends but does not involve direct intervention or manipulation of variables, making it an observational approach to investigate the effect of the contrast dye on creatinine levels and associated complications.

Quantitative research involves the collection of numerical data and relies on structured and standardized instruments for measurement. In this case, the data collected would include numerical values such as creatinine levels, demographic information, and potentially other quantifiable variables related to the study, such as the timing of complications and adverse reactions.

Quantitative data collected in this study would then be subjected to statistical analysis to assess patterns, relationships and the significance of observed findings. This approach allows for a systematic and quantitative examination of the effects of the contrast media on creatine levels and related complications.

Results Table-1: Shows indications for Radiological procedures in various medical conditions

Reason for procedure	Type of procedure	No of patients	Frequency
Vascular imaging			
1. Renal artery stenosis	CT scan	10	5%
2. Atherosclerosis	CT scan	5	2.5%
3. Pulmonary embolism	CT scan	4	2%
4. Accident	CT scan	5	2.5%
5. Aortic aneurysms	CT scan	3	1.5%
6. Blockage	CT scan	5	2.5%
Infection or Inflammation			
1. Pneumonia	CT scan	6	3%
2.Osteomyelitis	CT scan	3	1.5%
3.Appendicitis	CT scan	4	2%
4.Sinusitis	CT scan	7	3.5%
5.Renal Abscesses	CT scan	6	3%
6. Tissue evaluation	CT scan	6	3%
Tumor detection			
1.Breast cancer	CT scan	7	3.5%
2. ovarian or uterine	CT scan	6	3%
3.Thyroid	CT scan	7	3.5%
4.Renal tumor	CT scan	5	2.5%
Neurological condition			
1.Parkinson's	MRI	4	2%
2.Brain lesions	MRI	7	3.5%
3.Stroke	MRI	8	4%
4.Neuromyositis	MRI	4	2%
Spinal cord abnormality	MRI		
1.Spinal cord lesions	MRI	3	1.5%
2.Tumors		5	2.5%
Renal lesions	MRI		
1.Renal vascular condition	MRI	4	2%
2.Renal mass evaluation		2	1%
Breast imaging	MRI		
1.Breast lesions	X-ray	3	1.5%
Coronary Angiogram	X-ray	25	12.5%
Cerebral Angiogram	X-ray	2	1%
Renal Angiogram	IVP	3	1.5%

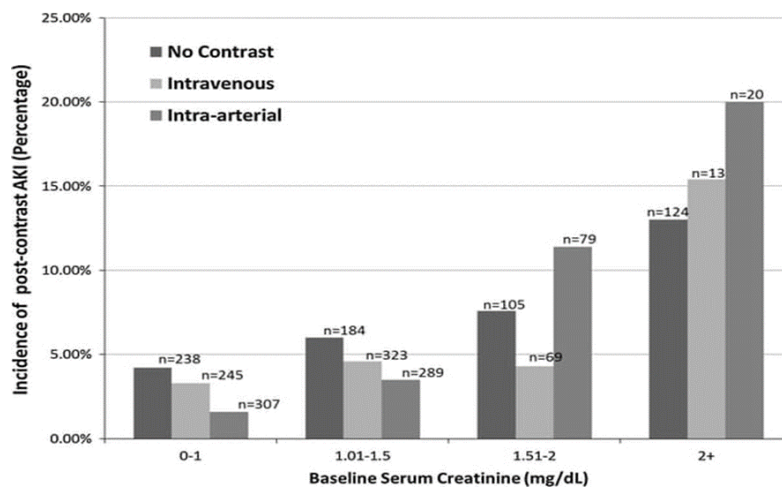
Renal calculi	IVP	8	4%
Uteral obstruction		5	2.5%
UTI	IVP		
1.cystitis	IVP	2	1%
2.Urethritis	IVP	6	3%
3.pyelonephritis	IVP	3	1.5%
Hematuria	IVP	7	3.5%
Traumatic obstruction	IVP	4	2%
Uteral clots		2	1%
Pelvic inflammatory disease	IVP	3	1.5%

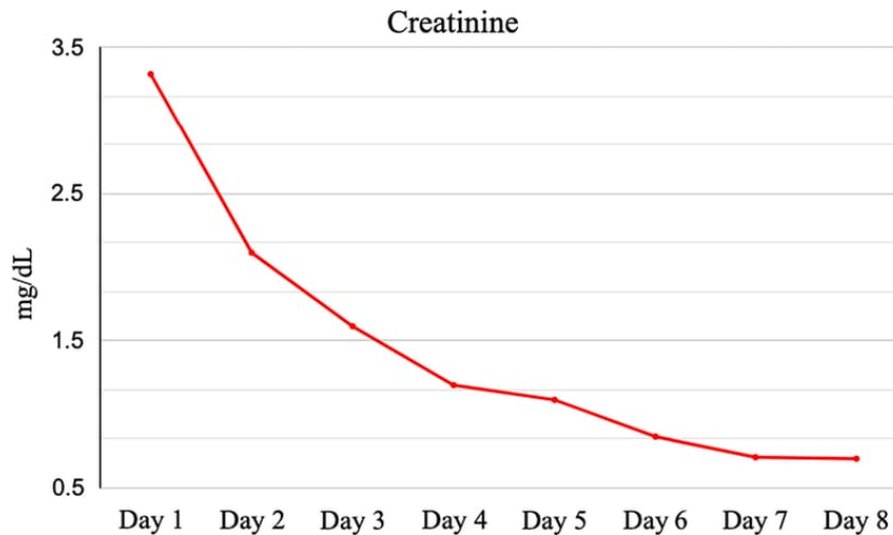
MILD	MODERATE	SEVERE AND DELAYED REACTIONS
<ul style="list-style-type: none"> Nausea and vomiting Headache Dizziness Metallic taste Cough Palpitations Itching Edema Fatigue chills 	<ul style="list-style-type: none"> Urticaria Pruritis Diaphoresis Respiratory reactions Fatigue Congestion Abdominal pain Fever Laryngeal edema Tachycardia 	<ul style="list-style-type: none"> Contrast induced nephropathy/nephrogenic fibrosis Constipation Upper respiratory tract infection Abdominal pain Seizures Myasthenia gravis Thyroid Bronchospasms Asthma Anaphylactic and cutaneous reactions

RISK FACTORS:

RISK FACTOR	PERCENTAGE OF RISK
• Age >65	• 78%
• Nephrotoxic medication	• 59%
• Renal impairment	• 46%
• Multiple GBCA doses	• 31%
• Diabetes mellites	• 29%
• Hypotension/ hypertension	• 13%
• Low GFR	• 9%
• Anemia	• 6%
• Thyroid	• 5%
• Congestive heart failure	• 5%

Following is the graph showing the time taken to get normal creatinine levels in a healthy person after going into contrast induced procedure





III. PATHOPHYSIOLOGY

The contrast media is induced in IV route through vein of arm or hand. Once injected it goes into circulation and enters the blood stream and is carried by circulatory system throughout the body. It mixes in the blood and becomes diluted. If the patient is having anemia or any circulatory problems, then the oxygen carrying capacity potentially decreases due to contrast media and further leads to tissue hypoxia. If the patient is having both circulatory issue and anemia, then it leads to contrast induced nephropathy. Impaired kidney function can lead to reduced ability to filter and excrete contrast media, which increase the risk of kidney damage. It causes additional stress in the circulatory system by potentially causing fluctuations in blood pressure and heart rate. In patients with compromised circulation, this added stress can be problematic.

The speed of distribution of contrast is dependent on blood flow, cardiac output and vascular network within each organ, tissue perfusion, and contrast agent 's affinity for different tissues. If the patient is taking nephrotoxic medications they can interfere with the process of filtration and excretion by causing direct renal toxicity, reduced glomerular filtration rate or affecting renal tubules. When this combines with contrast media this can alter renal hemodynamics, constricting blood vessels within kidneys and reducing oxygen supply to renal cells. This contrast induced vasoconstriction can lead to temporary renal ischemia. This increases the production of reactive oxygen species, leads to oxidative stress and mounts an inflammatory response and leads to damage of vascular endothelial cells and tubular cells which causes apoptosis. This increases urinary viscosity in tubules and slow flow causes prolonged contrast exposure. If the patient is diabetic, they experience excessive urination which leads to dehydration it further stresses the kidney and increase contrast concentration which potentially raise the risk of CIN and then leads to serious condition known as nephrogenic systemic fibrosis. Gadolinium is iodinated if the patient is having hyperthyroidism, then using contrast increases the risk of thyroidism .

IV. RESULT AND DISCUSSION

Here in this study, we have collected the hourly creatinine samples from the patients for every 12,24,48 and 72 hours (about 3 days) as it takes 24-48 hours (about 2 days) for a healthy individual to eliminate the contrast media out of the body. Based on the results we can tell that it took 1-3 days for a healthy individual to eliminate the contrast media and 3-7 days for diseased or unhealthy population without nephrotic damage. Coming to renally impaired patients, patients using nephrotoxic drugs and old age people it took an average period of 10-14 days (about 2 weeks) for complete elimination of contrast media.

The patients who have undergone CT scan has increased creatinine levels of >0.5mg/dl - >2.5mg/dl and more than 38.6% of people has increased levels of creatinine from 2.5mg/dl – 4mg/dl in 72hours (about 3 days). The patients who have undergone angiogram has an increased creatinine of >2.25mg/dl – 3.15mg/dl in less than 24 hours. The patient's undergoing MRI has increased creatinine levels of 0.5mg/dl – 1 mg/dl and the patients who have undergone IVP has drastic increase of 2.58mg/dl – 4.41mg/dl in 24 hours as they are mostly kidney disease patients.

Results

The study involved 200 patients undergoing various radiological procedures with iodinated gadolinium contrast media. Out of 250 patients 200 approached, 200volunteered, with a male majority of 60% (120 individuals) and 40% females (80 individuals).

Creatinine Trends: Hourly monitoring revealed consistent elevation in creatinine levels post-administration in most patients.

Adverse Drug Reactions: Despite prophylactic measures, three individuals experienced adverse drug reactions (ADRs).

Discussion

Creatinine Levels: The findings indicate a prevalent trend of increased creatinine levels following contrast media administration, emphasizing the potential impact on kidney function.

Complications: The observed ADRs despite prophylactic measures underscore the necessity for enhanced strategies to manage side effects in radiological imaging.

Administration and Excretion: The iodinated gadolinium contrast media, administered intravenously in a 1ml/kg ratio, takes 24 to 48 hours for complete excretion, leading to elevated creatinine levels.

Specific Findings in Radiological Procedures: Different procedures exhibited varying degrees of creatinine level elevation. CT scans showed increases ranging from >0.5mg/dl to >2.5mg/dl, while angiograms exhibited elevations of >2.25mg/dl to 3.15mg/dl within 24 hours. MRI procedures indicated milder increases from 0.5mg/dl to 1mg/dl. In contrast, IVPs among kidney disease patients showed significant surges from 2.58mg/dl to 4.41mg/dl within 24 hours.

V. Conclusion:

The study's findings highlight the importance of monitoring creatinine levels and managing complications arising from iodinated gadolinium contrast media administration during radiological procedures