What you should know about contrast agents?

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Learning objectives

• Understand the safe use of contrast media
• Recognize the difference between allergy and physiological events.
• The best oral contrast, be that negative or positive, for each study
• When to use colorectal contrast
• The correct selection of iodine concentration for each study
• How to use the correct timing for each phase
• When to evaluate each organ
Background

- Contrast IV
  - Safe use of Contrast IV
  - Physiology from Allergies (Fig. 3)
  - The contrast had different effects, from minor physiologies and mild allergic reactions to rare severe effects. (1) The identification of a patient’s experience with contrast adverse effects should occur before the examination. (1, 2) It is important to remember that a patient history of a previous severe reaction increases the overall risk of a subsequent event approximately 5-6 fold. (1) It is true that minor allergies are common and do not appear to increase overall risk, yet previous severe atopy, like multiple allergies or a previous major anaphylactic response, should be of concern. Patients with a controlled asthma may not present an increased in risk of allergy when using contrast. (2)
  - Distinguishing allergies from physiologic reactions is important because many of the patients with physiologic reactions do not require premedication in the future. (Fig. 2) Mild reactions are typically self-limited and do not progress, and they can sometimes be symptomatic. A mild reaction on occasion can become more severe and the patients should be observed briefly to ensure recovery. Severe reactions are rare, unpredictable and potentially fatal. (1, 2) They must be recognized promptly and treated to prevent permanent morbidity or death. (1)

- Contrast Medium-induced Renal Failure
  - Induced Renal Failure is defined as a rise in the serum creatinine concentration to at least 0.5 mg/dL (44.2 mol/L) or a relative increase of at least 25% from the baseline value. (1, 2, 3) The serum creatinine rise will peak 48-72 hours after contrast administration before returning to the baseline level. The incidence of this is low among the general population, calculated to be less than 2%. The risk increases if the patient has renal impairment or diabetes, more so if they have both, and the incidence reaches the range of 12%-50%. (1, 3)
  - The serum creatinine level of 2.0 mg/dL or 1.8 mg/dL does not prove the glomerular filtration rate, although it is clearly reduced. This information can’t predict the risk of increased morbidity or mortality after injection of iodinated contrast media. (1, 2, 4, 5) The glomerular
filtration rate is a better form to predict the risk of renal failure. (Fig. 1) The incidence for patients with an estimated filtration of less than 45 mL/min/1.73 m² is yet to be defined. If contrast-induced AKI exists after IV contrast administration, patients with an estimated glomerular filtration rate of less than 30 mL/min/1.73 m² are at the highest risk. (4,5)

- Pregnancy
  - Iodinated contrast material crosses the placenta and has been demonstrated to be present in fetal tissues, but there is no hypothyroidism or teratogenic effects reported. Although it is not necessary to interrupt breast feeding, depending on personal preference, mothers may still choose to drain and discard breast milk for 12 to 24 hours after they are given contrast agents. (1)

- Metformin
  - Metformin can precipitate lactic acidosis, which is seen most often in patients with several comorbidities, such as renal and cardiovascular disease. It should be discontinued for 48 hours after contrast medium application. Any decrease in renal function, like acute renal failure, could result in an accumulation of lactate and subsequently cause lactic acidosis. (1)

- Concentration and volume, IV contrast
  - The volume of the contrast medium is calculated according to the diagnostic and the patient's body weight. The average is of 1-2 mL/kg for contrast-enhanced studies of the abdomen or of the whole body, but a smaller volume should be considered for studies such as skull and pulmonary vessels. For aortic dissection or vascular alteration cases, a higher contrast volume may be required. (6,7) (Fig. 8)
  - The iodine concentration of a contrast medium increases its ability to absorb radiation. The absorption of radiation shows a greater interface between the contrast and the tissue that contains it. Higher concentrations are used for angiographies because they allow better visualization of vascular pathways and their contents. (10,11,12)

- Phases
  - Non-enhanced
    - Identification of a basal state of the body and the component of the lesion or the structure to evaluate,
  - Angiography, bolustrackig 90 HU at the proximal abdominal aorta
    - The contrast is in the artery and you can evaluate obstruction in the arteries or modification in the artery structure. (5,13,14)
  - Arterial phase - 35-40 seconds post contrast injection. (15)
• Evaluation of the perfusion to the different organs or masses.
 • Portal phase - 50-70 post contrast injection.
 • Used to evaluate the liver parenchyma enhances, the blood supply by the portal vein and visualization of some of the hepatic veins.
 • Nephrographic phase 70-90 seconds post contrast injection.
 • All of the renal parenchyma, including the medulla, enhances. Only during this phase will be able to detect small renal cell carcinomas. (Fig.7)
 • Venous phase 90-120 seconds post contrast injection
 • Visualization of all the organs, parenchyma and abscess wall.
 • Delayed venous phase or renal excretion 6-10 minutes sec post contrast injection. (16,17) (Fig. 9)
 • The contrast washes out from all the abdominal structures except the fibrotic tissue and beginning with the renal excretion to the collector system.

• Oral and rectal contrast
 • The best coating of the mucous membranes is achieved with barium sulfate. Water-soluble contrast media should be used when there is a possibility of an opening in the intestinal lumen or the possibility of one. (7) (Fig. 10)
 • For the optimum evaluation of the gastric walls and bleeding, negative contrast must be used, such as water. (7) (Fig.6)
Findings and procedure details
Fig. 1: Source.-Reference (1,4,5,6)

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Fig. 2: Source.-Reference (1,4)
### Allergic reactions

<table>
<thead>
<tr>
<th></th>
<th>General</th>
<th>Cardiovascular</th>
<th>Gastrointestinal</th>
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</thead>
<tbody>
<tr>
<td><strong>Mild</strong></td>
<td>• Urticaria</td>
<td>• Mild hypertension</td>
<td>• Nauescas</td>
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<td></td>
<td>• Pruritus</td>
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<td>• Vomiting</td>
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<td>• Skin edema</td>
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<td></td>
<td>• Sneezing</td>
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<td></td>
<td>• Rhinorrhea</td>
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<td></td>
<td>• Nasal Congestion</td>
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<tr>
<td><strong>Moderate</strong></td>
<td>• Generalized erythema</td>
<td>• Hoarseness</td>
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<tr>
<td></td>
<td>• Urticaria</td>
<td>• Throat tightness</td>
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<tr>
<td></td>
<td>• Pruritus or edema</td>
<td>• Hypoxia</td>
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<tr>
<td><strong>Severe</strong></td>
<td>• Severe edema: Facial and laryngeal edema</td>
<td>• Hypotension</td>
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<tr>
<td></td>
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<td>• Hypoxia</td>
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**Fig. 3:** Source.-Reference (1,4)

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![Medication Table](https://via.placeholder.com/150)

**Fig. 4:** Source.-Reference (1,4)

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<table>
<thead>
<tr>
<th>Abdomen</th>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>Angiography</td>
<td>Bolustrackig 90 HU at the proximal abdominal aorta</td>
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<tr>
<td>Arteria phase</td>
<td>35-40 seconds post injection</td>
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<tr>
<td>Portal phasa</td>
<td>50-70 seconds post injection</td>
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<tr>
<td>Nephrographic phase</td>
<td>70-90 seconds post injection</td>
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<tr>
<td>Venouse phase</td>
<td>90-120 seconds post injection</td>
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<tr>
<td>Delayed venouse phase</td>
<td>6-10 minutes post injection</td>
</tr>
<tr>
<td>Brains</td>
<td>Time</td>
</tr>
<tr>
<td>Angiographic</td>
<td>Bolustraking 90 HU at ascendent aorta</td>
</tr>
<tr>
<td>Arterial</td>
<td>10 seconds post injection</td>
</tr>
<tr>
<td>Venosa</td>
<td>40 seconds post injection</td>
</tr>
<tr>
<td>Thorax</td>
<td>Time</td>
</tr>
<tr>
<td>Angiographic</td>
<td>13 seconds post injection or Bolustraking 60 HU at left ventricle</td>
</tr>
<tr>
<td>Venosa</td>
<td>40 seconds post injection</td>
</tr>
</tbody>
</table>

**Fig. 5:** Source.-Reference (15,16,17,18,19,20)

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**Fig. 6:** Gastric tumor Gastric and duodenal mucose evaluation with negative contrast (water and air) Gatric wall thickening

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**Fig. 7:** Renal Tumor in different IV contrast phases

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**Fig. 9:** Post- hysterectomy surgery fistula Bladder to vagina fistula Excretory phase with a saline solution IV bolus. The bladder pressure shows the fistula

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Fig. 8

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Fig. 10: Small bowel wall evaluation Negative contrast (water) for small bowel distention and IV contrast for wall thickness
Conclusion

- Patients should be questioned to know if they have had prior contact with intravenous contrast medium, and if they recognize previous allergy events.
- If they have been previous allergy events, determine the need for preventive treatment or avoid application.
- The radiologist should be capable of recognizing patients with risk factors associated with contrast-induced renal failure.
- All patients at risk for induced renal failure due to contrast should be evaluated with creatinine clearance calculated by formula.
- It is fundamental to know the diagnosis with which a patient is received in the tomography room to plan the contrasted studies and thus determine the phases that will be performed during the study.
- The volume should be selected according to each patient and the study to be performed.
- The use of oral and rectal negative or positive contrast should be determined according to the pathology of the patient.
- The iodine concentration of a contrast should be high when it is desired to highlight a structure of intense shape for a better visualization.
References


2 Bettmann M. Frequently Asked Questions: Iodinated Contrast Agents. Radiographics 2004;24(suppl_1)


