

Contrast Media in Computed Tomography

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What is Computed Tomography?

- "Computed tomography(CT) is the process of creating a cross-sectional tomographic plane of any part of the body" (Wright & Johnson, 2019, p. 206).
- The x-ray tube rotates around the body part being evaluated, creating hundreds of images which can be reformatted into a 3D image.



CT Scanner (Pierce, 2020, para. 1)

What is Contrast Media?

- Contrast media, or contrast agents, are used in computed tomography procedures to increase the contrast and visibility of anatomic structures and pathologies (DeMaio, 2018).
- Contrast agents are materials with high x-ray attenuation, which makes them radiopaque or easily visible on an x-ray or CT image.
- Contrast media are most commonly administered orally or intravenously, but can also be used intramuscularly, intraarterially, or rectally.
- Before the use of contrast media, a detailed patient history should be obtained to determine any risk factors.

Intravenous Contrast Media

- The use of intravenous(IV) contrast media allows for better visualization of organs and blood vessels.
- A typical examination usually involves 100-150mL of contrast injected at a rate of 2-3mL per second, but can vary depending on the age, weight, and renal function of the patient (Haijo, 2021).
- IV administration of contrast media typically requires an IV bolus injection through an 18-23 gauge butterfly needle or angiocatheter.
- IV iodinated contrast agents are broken down into two categories: ionic and nonionic.

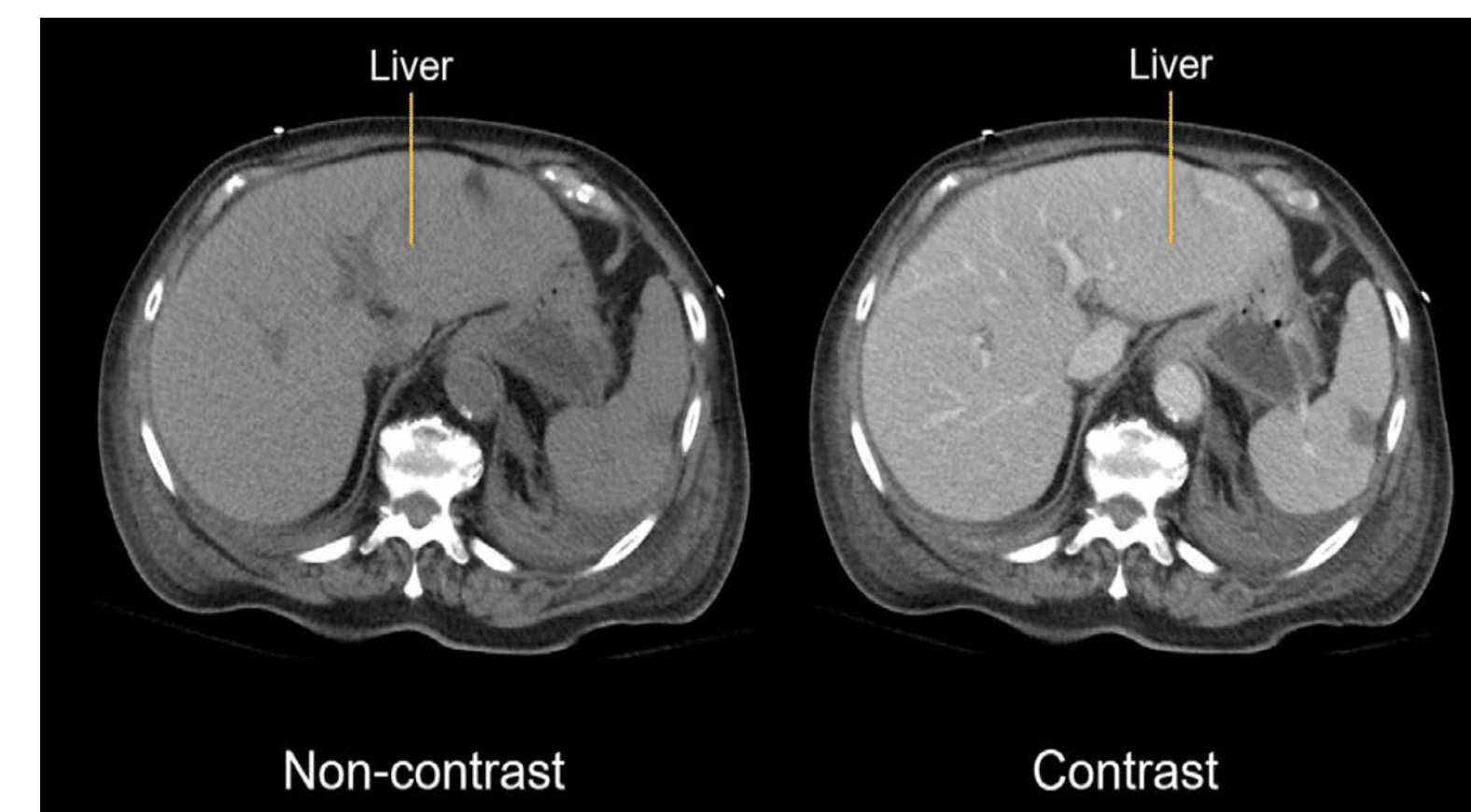
Oral Contrast Media

- Oral contrast media is used to better demonstrate the digestive tract.
- The type of oral contrast used for most examinations is a 2% barium mixture but may also consist of a water-soluble iodinated solution (DeMaio, 2018).

Common Procedures using Contrast Media

CT of the Abdomen/Pelvis

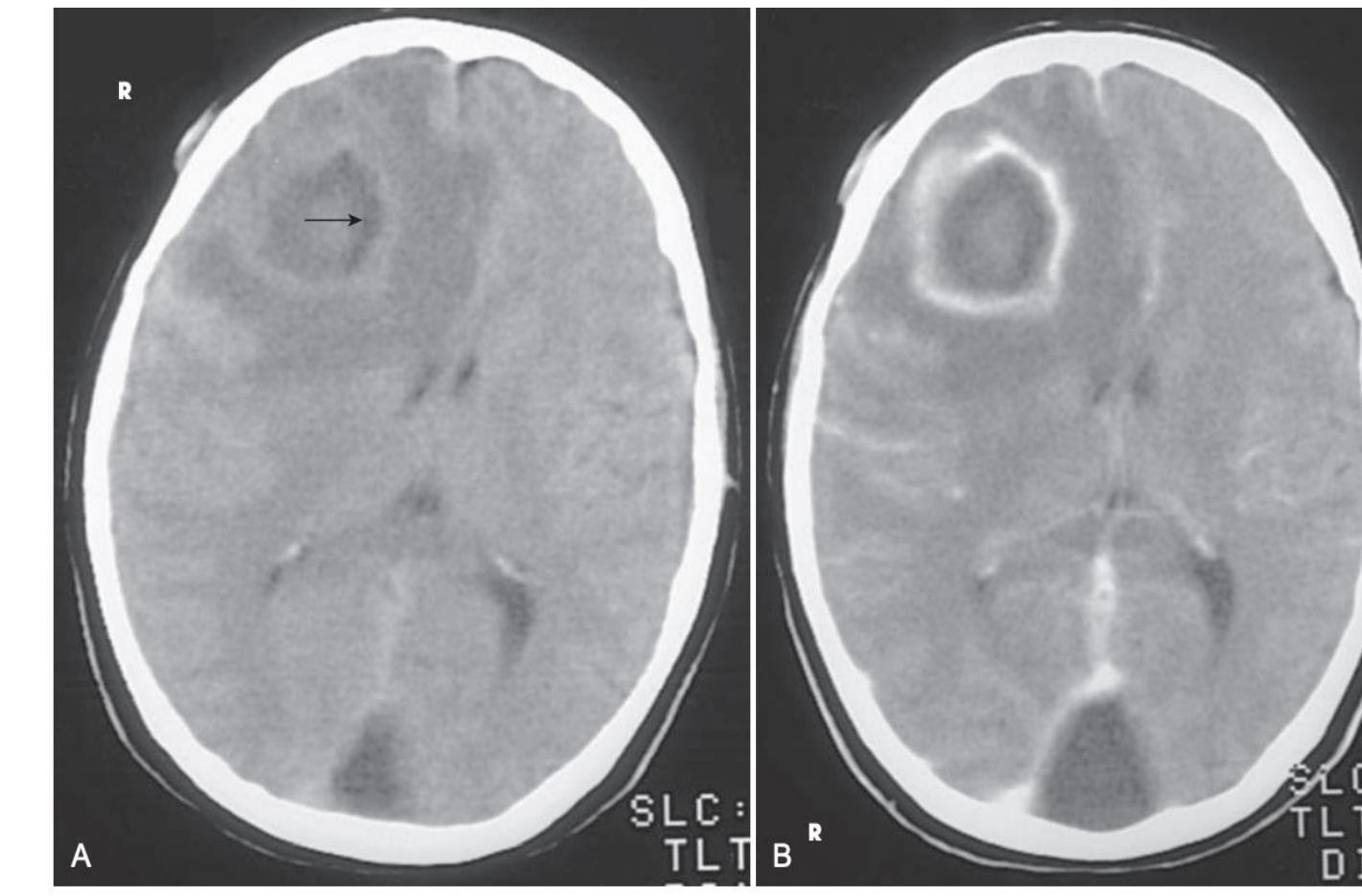
- For studies of the abdomen and pelvis, oral and/or intravenous contrast media is typically used in order for substantial opacification of the stomach and bowels.
- If only oral contrast is needed for an abdomen/pelvis scan the protocol includes 750-1500mL of oral contrast 30-120 minutes prior to the examination (DeMaio, 2018).
- If IV contrast media is indicated, approximately 50-150mL should be injected at a rate of 2.0-5.0mL per second (DeMaio, 2018).
- In some cases, both IV and oral contrast may be used during the same study, depending on the internal structures being evaluated.



Abdominal CT scan with and without contrast (Hartung & Cadogan, 2023, para. 7)

CT of the Head

- For CT studies of the head, the use of IV contrast media may be used in order to raise the attenuation values of the gray matter, which increases visualization and contrast.
- Some indications for a head CT scan with contrast media include neoplasm, inflammatory processes, and vascular abnormalities (DeMaio, 2018).
- The volume of IV contrast media administered ranges between 75-150mL with injection rates between 1-4mL per second (DeMaio, 2018).



CT scan of head with and without contrast (Wright & Johnson, 2019, p. 220)

Risk Factors and Adverse Reactions

- Some risk factors to undergoing a procedure using contrast media include anxiety, asthma, heart disease, history of allergic reactions, and renal insufficiency (Farquhar, 2019).
- A previous allergic reaction is the biggest risk factor for predicting future allergic events, as patients are 21%-60% more likely to have a reaction if they had one previously (Farquhar, 2019).
- Adverse reactions can range from mild reactions to severe life-threatening events.
- Reactions due to contrast media may be mild such as nausea, hives, and vomiting.
- Adverse reactions may also be severe, causing loss of consciousness, kidney damage, and anaphylactic shock.

Premedication

- If contrast media is required for a patient with a history of allergic reactions, premedication is considered to lessen the likelihood of another reaction.
- The common premedication route endorsed by the American College of Radiology includes a 12-13 hour preparation.
 - Consists of 50mg oral prednisone taken 13 hours, 7 hours, and 1 hour prior to the CT scan as well as 50mg diphenhydramine taken 1 hour before the CT scan and administration of contrast media (Farquhar, 2019).
 - Another option includes 32mg methylprednisolone by mouth 12 hours and 2 hours prior to the CT scan and an optional 50mg of diphenhydramine (Farquhar, 2019).

Computed Tomography Facts

- The first computed tomography scanner was invented in 1972 by British engineer Godfrey N. Hounsfield (Haijo, 2021).
- The first clinical CT scanners included a head scanner at Atkinson Morely Hospital in London, UK and a full body scanner at Georgetown University Medical Center, USA (Haijo, 2021).
- The first CT scan took hours or even days to produce an image, which now happens in seconds.

Contrast Media Facts

- "With the advancements in medical imaging, it is estimated that over 100 million procedures are performed worldwide each year using iodinated contrast media (ICM)" (Jiang et al., 2023, p. 2).
- The first iodinated contrast agent discovered was ethiodol, which was discovered in 1901 but not used clinically until the 1920s (Owens et al., 2023).
- Other early contrast agents used were silver colloids thorium compounds, and sodium iodide, which all are no longer used due to health risks (Owens et al., 2023).
- There are currently 48 contrast agents that are approved by the FDA for use in CT and x-ray imaging (Owens et al., 2023).

Future Developments

- Contrast agents used in CT have been unchanged for decades, with the last changes and FDA approved contrast media dating back to the 1990s (Owens et al., 2023).
- Current contrast agents have some drawbacks such as short circulation half-life, nephrotoxicity, and adverse reactions.
- It is estimated that the next advancements in contrast media technology will involve nanoparticles.
- Ideally, the future of contrast media consists of improved safety, non-toxic materials, and possible therapeutic effects.

Conclusion

- Contrast media is a useful tool in computed tomography that can aid in the diagnosis and treatment of pathologies.
- In many cases, the benefits of the scan and use of contrast media outweigh any negative aspects or risks involved.