# USES OF X-RAY CONTRAST MEDIA

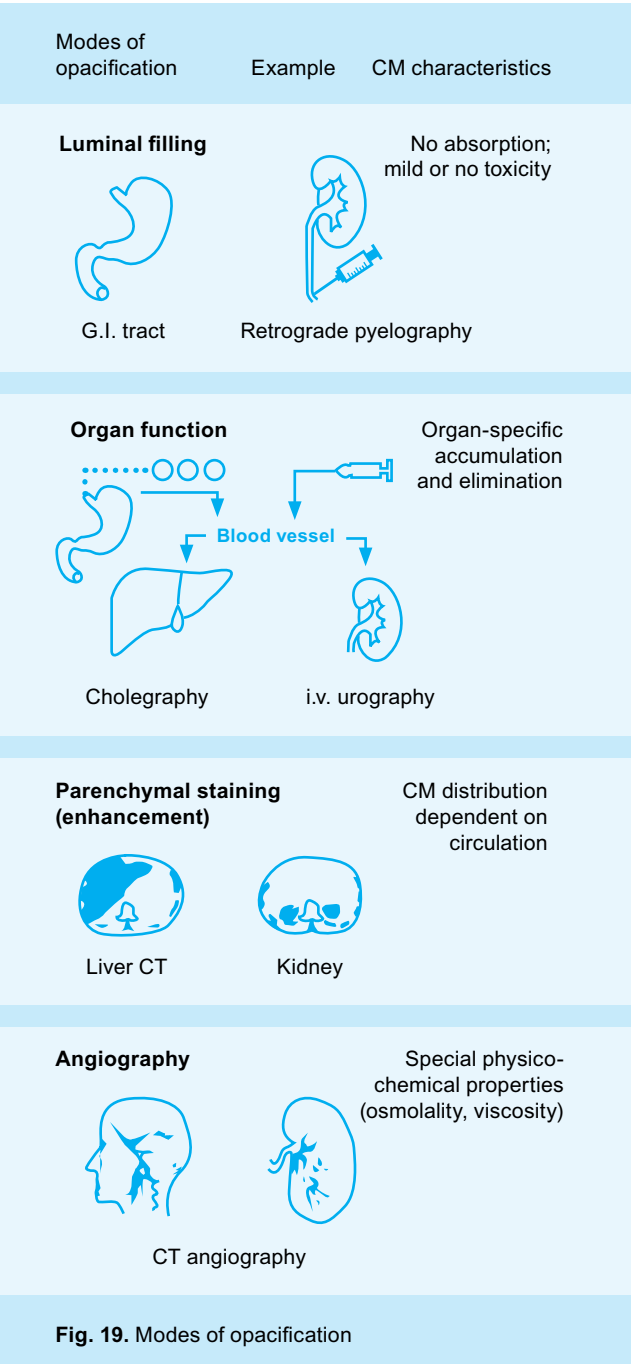


**Fig. 19.** Modes of opacification

The mechanisms of action of X-ray CM range from purely mechanical filling of certain cavities to opacification in a functional manner.

Functional opacification exploits the physiologic function of organs, such as the kidneys and liver, namely the elimination of metabolic endproducts or exogenous substances, to visualize the organ or its drainage pathways.

The most common uses of XCM are imaging of arteries and veins and enhancement of contrasts between tissues based on differences in blood volume, perfusion, capillary permeability, and size of the interstitial space (table 12 a-c).

## Modes of opacification

The identification of morphological structures is the main objective of direct luminal filling via a natural or iatrogenically (e.g., by puncture) created access; this permits the differentiation of superficial or mural changes. In addition, this mode of opacification can provide functional information, e.g., assessment of changes in tone or peristalsis in hollow passages (GI tract, ureters with retrograde filling, etc.) (fig. 19).


U. Speck, *X-Ray Contrast Media*, https://doi.org/10.1007/978-3-662-56465-3_8

In cavography, the concentration of the CM administered is decisive for the degree of contrast in the radiograph. In urography and cholegraphy, on the other hand, contrast density is essentially dependent on the functional capacity of the organs being examined. Consequently, assessment of both function and morphology is possible after CM administration.

Thus, the radiological evaluation of the kidneys and turinary tract or of the hepatobiliary system reveals both morphologic and functional changes of the respective organs.

The additional functional information can provide important clues for the differential diagnosis. For example, delayed elimination of renal CM can be interpreted to indicate impaired glomerular filtration due to an acute or chronic disease.

Another mode of action of XCM has gained importance in computed tomography: The transit and selective accumulation of CM in different organs or tissues (enhancement) improve the differentiation of morphological structures, particularly between normal and pathological tissue. This allows or at least facilitates the demonstration of pathological processes and occasionally of their etiology as well.

Fast multislice spiral CT and multi-detector CT, combined with fast image postprocessing, permits 3-dimensional imaging of the coronary arteries and other vessels after rapid i.v. injection of non-ionic contrast agents. This modality can replace invasive catheter-based angiography performed for diagnostic purposes alone.

Dynamic CT during the first pass of CM provides functional information based on pharmacokinetic behavior including contrast medium arrival, washout, and distribution.

In angiography, selective opacification can be achieved by direct CM injection into the vessel of interest, followed by evaluation of CM distribution and filling patterns including gaps in opacification of the target anatomy.

This evaluation yields detailed diagnostic information regarding normal and abnormal morphology and function.

| Mode of opacification | Method | Contrast agent | Dose (ml) | Iodine concentration |
|---|---|---|---|---|
| Filling of the lumen | 1. Gastrointestinal tract Orally, projection imaging | $BaSO_4$<br>$+CO_2$ | 150 (-400)<br>variable | -<br>- |
| | | Nephrotrophic CM | 50-100 | 370<br>300<br>300/370<br>300/350<br>300/350 |
| | | Nephrotrophic CM | 500-1000 | 10-20 |
| | | Nephrotrophic CM | 800-2000 | 5-14 |
| | 2. Arthrography | Nephrotrophic CM<br>+ Air | 2-10<br>15-35 | 300 |
| | 3. Hysterosalpingography | Nephrotrophic CM | 5-10 | 300 |
| | 4. Fistulography | Nephrotrophic CM | variable | 300 |
| | 5. Sialography | Nephrotrophic CM | 1-3 | 300 |
| | 6. PTC*, ERCP** | Nephrotrophic CM | 20-40 (10-40) | 300 |
| | 7. Retrograde Pyelography, Cystography | Nephrotrophic CM | 10-15 (100-300)<br>2-300<br>2-20<br>10-20 | 150<br><br>240/300/370<br>300 |
| | 8. Myelography | Nephrotrophic CM | 15<br>5-15<br>4-12<br>10-15 | 240-300<br>200/300<br>240<br>240 |

**Table. 12a.** Overview of contrast media uses

| Mode of opacification | Method | Contrast agent | Dose (ml) |
|---|---|---|---|
| **Organ function** | 1. i.v. Urography | Nephrotrophic CM | 50-100 |
| | 2. Inf. Urography | Nephrotrophic CM | (250) |
| | 3. i.v. Cholegraphy | Liver passing CM | 20-30 |
| **Parenchymal enhancement** | 1. Bolusinjection | Nephrotrophic CM | 1 ml/Kg BW p.r.n. more |
| | 2. Infusion | | 50-125 |

**Table. 12b.** Overview of contrast media uses; * PTC: percutaneous transhepatic cholangiography,
** ERCP: endoscopic retrograde cholangiopancreatography

| | Commercial preparations/ Trademark/ Type of contrast agent | Comments |
|---|---|---|
| | HD preparations<br>Micropaque<br>$CO_2$ | Hypotonia due to butylscopolamine (20 mg i.v. or i.m.)<br>Faster gastrointestinal passage due to Paspertin |
| | Gastrografin<br>Isovist<br>Ultravist<br>Omnipaque<br>Imagopaque | No barium in patients with (suspected) perforation/ suture insufficiency |
| | Gastrografin 30-40 ml/L<br>Accupaque | For CT: fractionated administration 30 min – 6h before examination if necessary |
| | Isovist,<br>Ultravist,<br>Solutrast,<br>Omnipaque,<br>Imagopaque,<br>Imeron etc. | |
| | Ultravist etc. | |
| | Omnipaque,<br>Solutrast,<br>Imeron | |
| | Isovist etc. | |
| | Telebrix<br>Urografin 30 %<br>Ultravist<br>Imeron | |
| | Isovist<br>Iopamiron<br>Accupaque<br>Optitray | Iodine concentration of 200-300 mg/ml |

| Iodine concentration | Commercial preparations/ Trademark/ Type of contrast agent | Comments |
|---|---|---|
| 300 | Ultravist,<br>Omnipaque<br>Solutrast etc. | Dehydrogenation is dispensable with nonionic CM |
| 150-300 | | |
| 180 | | Injector for constant flow |
| 300-370 | Omnipaque<br>Solutrast<br>Ultravist etc. | Administration directly before the examination. Scan series begins approximately 20 sec after start of injection |
| 150-370 | | |

| Mode of imaging | Method | Contrast agent | Dose (ml) |
|---|---|---|---|
| **Conventional Vasography** | 1. Cardioangiography | Nephrotrophic CM | 40-60 |
| | 2. Coronary angiography | Nephrotrophic CM | 5-8 |
| | 3. Angiography | Nephrotrophic CM | 50 |
| | 4. Selective abdominal angiography | Nephrotrophic CM | 5-50 |
| | 5. Angiography of the Extremities | Nephrotrophic CM nonionic | 10-70 |
| | 6. Cerebral angiography | Nephrotrophic CM nonionic | 5-10 |
| | 7. Phlebography | Nephrotrophic CM | 40 |
| | 8. IA DSA | Nephrotrophic CM | As conventional angiography |
| | 9. Direct lymphography | Oily | 5-10 per extrememity |

**Table. 12c.** Overview of contrast uses

Digital subtraction angiography (DSA) allows selective evaluation of arteries and veins without interfering background (e.g., bone) and with a very much lower CM concentration in the vascular regions of interest.

DSA is based on the subtraction of an image obtained immediately before CM injection from a series of images obtained with maximum CM filling of the target vessels.

In DSA, electronic amplification of only slight differences between the precontrast and the contrast-enhanced images results in images highlighting vessel contrast.

| Iodine concentration | Commercial preparations/ Trademark/ Type of contrast agent | Comments |
|---|---|---|
| 370 | Omnipaque | |
| 370 | Solutrast<br>Ultravist etc. | |
| 300-370 | | |
| 300 | Omnipaque<br>Solutrast<br>Ultravist etc. | Dose, CM concentration and injection rate have to be the higher the better the spatial resolution, the faster the blood flow, and the larger the distance between the catheter tip and the vascular target territory is. |
| 300 | | |
| 300 | | |
| 150-300 | Omnipaque<br>Solutrast<br>Ultravist etc. | |
| 75-300 | As conventional angiography | Less selective injection or smaller volume or lower iodine concentration is possible due to higher sensitivity of DSA |
| 480 | Lipiodol | Administration into lymphatic vessels |

In addition, electronic data processing speeds up postprocessing of the DSA images, so that the results are immediately available.

DSA allows evaluation of larger arteries even after i.v. bolus injection of CM. In i.v. DSA and fast CT, high doses and rapid injection make particularly great demands on the tolerance of the CM. For more details see table 12 a,b and c.