Angiography description

Angiography means examination of blood vessels by imaging. The term itself in the narrower sense means classical angiography, in which the artery is sciagraphically displayed after filling with a contrast agent. Imaging must be performed in at least two X-ray bone projections, as stenosis may be asymmetric and may not be imaged in one projection.

Renal artery angiography

In addition to morphological diagnostics, it is possible to perform selective blood sampling from blood vessels (eg in endocrine active pancreatic or adrenal tumors), selective insertion of catheters, eg for local chemotherapy (eg into the hepatic artery) and others.

- **Arteriography**: imaging of the arteries;
- **Phlebography**: depiction of veins.
  - Cavography: imaging of a vena cava;
  - Portography: imaging of the portal venous system.

Procedurs and contrast medium (agent)

Most often, the catheter is inserted into the femoral artery so that the examiners enter the left ventricle. Everything is monitored on the monitor throughout the examination. Most often using Digital Subtraction Angiography - DSA of 2-3 images / sec. However, it is not used in the heart, it is necessary to monitor 15-30 fps. It is important to realize that the more images, the more radiation penetrates the body.

CT angiography of the blood vessels of the hand

Contrast agents used in angiography

Iodine contrast medium

- The base is a benzene nucleus with 3 iodine atoms attached;
- Excreted by the kidneys;
- Ionic (dissociation into electrically charged ions) and neoinic (no dissociation, better compatibility).

Gadolinium contrast medium

- Designed for MR, MRA;
- Significantly lower allergenicity.

Alternative KL: Carbon dioxide

- Designed primarily for patients at risk of allergic reactions and for people with impaired kidney function;
- Examination of the abdominal aorta and arteries of the lower limbs;
- Difficult application.

Digital Subtraction Angiography - DSA

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Iron
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The classic invasive method of angiographic examination, where it is possible to perform angioplasty surgery at the same time, such as dilation of narrowed blood vessels by stent implantation.

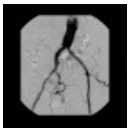
Process

The native image mask is subtracted from the DSA. This means that the scanning itself takes place in two phases, so that we can remove the image of the "shielding" tissue from the image, through which it would be impossible to see the image of the examined vessel, vascular bed (bone tissue, etc.).

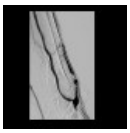
We use subtractions, ie subtraction of images:

- The first scan takes place without the use of any substance and is then converted into a negative;
- Furthermore, a contrast agent (this is the so-called intraarterial DSA) is inserted directly into the artery, followed by a second X-ray scan. Then, using computer technology, both images can be **subtracted** (subtraction) and an accurate image of the vessel is created. The contrast agent is most often iodine in nature.

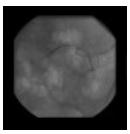
The most common access point is the *arteria femoralis communis.*



DSA: stenosis of the common iliac artery, stent (http://atlas.mudr.org/Case-images-Stenosis-of-common-iliac-artery-stent-892)



DSA: dialysis shunt stenosis, PTA (http://atlas.mudr.org/Case-images-Shunt-stenosis-angioplasty-native-shunt-787)



DSA: embolization of colonic bleeding (http://atlas.mudr.org/Case-images-Bleeding-in-sigmoid-colon-embolization-847)

Selective coronarography– SCG

SCG is an angiographic examination of the coronary arteries during their selective injection of an iodine-based contrast agent. The skin is locally anesthetized and a catheter is inserted into the femoral or radial artery. Once the catheter is in place, a variety of procedures can be performed: angioplasty, hematoma removal, electrophysiological studies, or release of another contrast agent.

CT angiography

Non-invasive method of angiographic examination of the bloodstream. In this case, the most common access point is the peripheral vein, ie often the elbow socket.

We distinguish between CT angiography of arteries and CT phlebography (ie angiography of veins).

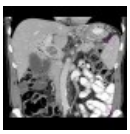
CT artery angiography (angio-CT / CTA)

CT examination in the arterial phase, when the artery has the best contrast medium. Various methods are used to time the scan to run correctly:

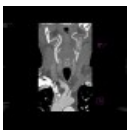
- *Bolus tracking* automatically starts the examination when the required filling (density) of the lumen is reached. (In practice, a modification is often used in which the change in artery lumen density is monitored visually and, in the case of a sufficient rise, scanning is started manually).
- *Bolus timing* - after administration of a small bolus of contrast agent, the curve of densities from the lumen of the artery is determined in time, from which the most suitable time to start scanning is then derived;
- Estimated - the fastest, with the greatest risk of suboptimal timing.

CT flebography – cavography, portography

CT examination in the portal phase (portography), late venous phase (veins), venous pre-phase (peripheral veins).



CT of the abdomen: portal vein thrombosis (http://atlas.mudr.org/Case-images-Thrombosis-of-portal-vein-895)



Angio-CT carotid: internal carotid stenosis (http://atlas.mudr.org/Case-images-Stenosis-of-internal-carotid-artery-427)

Cerebral artery CTA: aneurysm (http://atlas.mudr.org/Case-images-Aneurysm-of-the-internal-carotid-artery-36)

MR angiography – MRA

Non-invasive method of angiographic examination. The advantage is the absence of ionizing radiation.

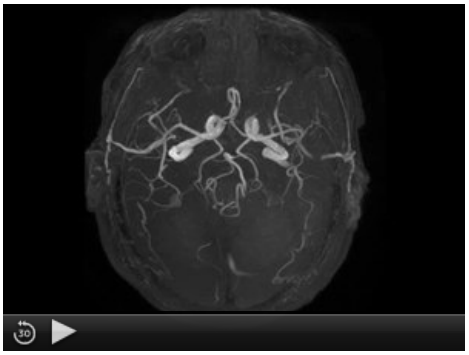
MRA is used to examine possible problems such as stenosis (narrowing of blood flow), blockage or aneurysm (weakening of the blood vessel wall and risk of rupture). It is often used to visualize the neck, brain and more.

Display options

- Natively by time-of-flight (TOF) or phase contrast without contrast agent application;
- Or as a post-contrast examination after the application of a contrast agent (contrast MRA) - we use paramagnetic chelates of gadolinium, which enhances the contrast, and thus achieve clearer images.

At present, contrast MRA is a very suitable mini-invasive method for the detection of pathological conditions of the thoracic aorta, abdominal aorta and its branches (arteritis, dissection, occlusion), as well as small circulatory anomalies (arteriovenous shunts, anomalous venous return, etc.). Contrasting MRA achieves excellent results in imaging the major carotid arteries and renal arteries. [1]

3D tissue imaging is also possible, eg using maximum intensity projection (MIP), where the results from the lateral and axial planes are combined. The difference from CT angiography is that it does not show the lumen.



Brain MR angiography by TOF method (pay attention especially to high resolution and contrast)

Benefits

- Minimal nephrotoxicity and allergenicity compared to iodine contrast agents;
- Possibility of use in patients with diabetes, in whom there is a strong calcification of the arterial walls and also nephropathy, which can be exacerbated by the administration of an iodine contrast agent, as in the case of DSA or CT angiography.

Complications

Caused by the procedure

Bleeding from the injection site into the subcutaneous tissue - hematoma - most often occurs in patients, when spontaneous absorption occurs if it is smaller. Major bleeding occurs less frequently due to incorrect removal of the loader or due to non-compliance with the recommended regulations, especially bed rest.

Other complications are very rare. Cases of arrhythmia, thrombus loosening or embolism leading to stroke, bleeding are described. Rarely, nerve damage occurs, which is manifested by tingling.

Caused by contrast agents

Adverse reactions caused by a contrast agent are among the so-called **systemic complications**.

In practice, we can divide it as follows:

IODINE CONTRASTING SUBSTANCES

- Allergoid: mild to severe (convulsions, hypotension, tachycardia), independent of KL administered, histamine and serotonin release;
- Chemotoxic: proportional reaction of the amount administered KL, occurs after affecting a certain organ → nephrotoxicity, cardiotoxicity, neurotoxicity

Other KL used in angiography (gadolinium, carbon dioxide) do not have significant risks in triggering an adverse reaction of the organism.

Links

Related articles

- Sciagraphy
- Contrast agents
- Magnetic resonance (MRI)
- Magnetic Resonance Imaging
- Computed tomography (CT)

References

1. DOC. MUDR. ŽIŽKA, PH.D, Jan. *Současnost MR angiografie* [online]. [cit. 2012-12-27]. <https://web.archive.org/web/20160331222721/http://zdravi.e15.cz/clanek/postgradualni-medicina/soucasnost-mr-angiografie-170739>.