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COMPARING DSA WITH CTA IN CAROTID ARTERY IMAGING IN RATS: AN EXPERIMENTAL STUDY

Radiology

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ABSTRACT

Introduction:
The aim of our study is to compare DSA with CTA, determine advantages to each other in carotid radiologic imaging.
Materials and Methods:
In the first group (n=10); DSA was used, in the second group (n=10) CTA was used for carotid artery imaging.
Conclusion:
DSA is an invasive method, it should be performed under sterile conditions. The risks that may occur during the procedure vary according to the pathology and the experience of the team. CTA is a non-invaziv, high resolution, current imaging method for carotid artery imaging. In our study according to the carotid imaging even if in pathological circumstances like vasospazm, there was no difference between the DSA and CTA methods and both of them could be used.

KEYWORDS

INTRODUCTION AND OBJECTIVE:

The brain is supplied by two internal carotid and two vertebral arteries with a complex anastomosis system. While internal carotid arteries supply the cerebral hemispheres except for the anterior brain and the occipital lobes, the vertebral arteries supply the occipital lobes, the brain stem and the cerebellum. These arteries and their branches are present at the subarachnoid space and their rupture for any reason causes subarachnoid hemorrhage (11).

Originating from the arteria carotis communis, the internal carotid artery travels upward through the neck and enters the carotid canal, which is situated in the temporal bone. This part is called the cervical part. In its subsequent course, it is divided into petrous, cavernous and cerebral segments and gets thinner. The petrous segment is situated in the petrous part of the temporal bone. The artery is surrounded by the carotid autonomic plexus, which is derived from the superior cervical ganglion (15).

The cavernous segment is situated within the cavernous sinus and reaches the subarachnoid space by perforating the dura mater on the sinus ceiling. The cerebral part is the part that pursues its course after perforating the dura mater. It is situated between the optic nerve and the oculomotor nerve. The carotid artery branches into the ophthalmic artery as it leaves the cavernous nerve. The posterior communicating artery anastomoses with the posterior cerebral artery to complete the circle of Willis. The anterior choroidal artery supplies the choroid plexus situated in the lower horn of the lateral ventricle (also supplies the globus pallidus, nucleus caudatus, amygdala, hypothalamus, tuber syneresis, nucleus ruber, substansia nigra). The anterior and middle cerebral arteries are terminal branches of the internal carotid artery (15).

The circulation system in rats is similar to that of other mammals. Exiting the left ventricle, the aorta branches, in the curved part, into the brachiocephalic truncus, the left carotid communis and the left subclavian artery. The brachiocephalic truncus branches into the right carotid communis and the right subclavian artery. The right and left carotid communises travel on the both sides of the trachea and divide into internal and external branches at the upper edge of the thyroid gland. While the internal carotid spreads into the skull base and the brain, the external branch spreads into the head and neck (16).

Subarachnoid Hemorrhage (SAH) is bleeding with an acute onset, spreading into the cerebral subarachnoid space, the area between the arachnoid membrane and the pia mater, having usually an arterial or occasionally a venous origin (1,2,3). Especially, the mechanism of accompanying pathologies such as vasospasm is still unknown in spite of a number of experimental and clinical studies (4). Post-SAH cerebral vasospasm is seen in 30%-70% of patients in spite of successful surgical or endovascular treatment (5,6).

While its clinical description is neurological deterioration that is caused by cerebral ischemia post-SAH, radiologically it is described as a narrowing of the luminal diameter of the intracranial arteries (11,12). Although most of the patients have angiographic vasospasm, an important part of these patients are asymptomatic due to collateral supply paths in the affected area (1,14). Even severe arterial constrictions are asymptomatic (13). Radiological vasospasm occurs in 70% of patients, whereas symptomatic vasospasm occurs in approximately 20-40% of patients (9).

DSA is an invasive imaging technique, which is performed by introducing intraarterial contrast agent with a selective catheterization to visualize arteries of the brain, neck and the spinal cord. Digital Subtraction Angiography (DSA) imaging is generated digitally. DSA's difference from conventional angiography is that only those images including vascular beds are provided. In cerebral angiography, the main arteries from the aortic arch to the cerebral circulation are catheterized to different positions (17).

CTA is a non-invaziv, high resolution, current imaging method for carotid artery imaging (19).

The aim of our study is to compare DSA with CTA, determine advantages to each other in carotid radiologic imaging.

MATERIALS AND METHODS:

The experimental part of this study was conducted in the Dumlupınar University, Faculty of Medicine Experimental Animal Laboratory, and the angiography procedures were performed in the Dumlupınar University, Faculty of Medicine, Interventional Radiology Department.

In this study, 20 adult Sprague Dawley female rats, weighing 200 to 250 grams were used and was divided two groups. All the rats were maintained in cages at 22 °C and fed with the same amount of standard animal feed throughout the study. In the first group (n=10); DSA was used, in the second group (n=10) CTA was used for carotid artery imaging.

Radiological Imaging and Procedure:

The carotid angiography was performed in the Dumlupınar University, Faculty of Medicine, Interventional Radiology Department, using the Siemens Artis Zee angiography device. The aortic arch catheter application and the contrast material dose applied during the procedure were predetermined as standard and the procedure was performed by the research team in this direction. In the first group, filling in the aortic arch, bilateral carotid arteries were monitored through contrast material injection after aortic arch catheterization (Figure 1). In the second group CTA was performed and the obtained images were processed (Figure 2).

Carotid Angiographic imaging was performed with this procedure to the first group. The rats were fastened on the work bench in supine position under general anesthesia (60 mg/kg ketamine im, 10 mg/kg Xylazine im). After the left side of the sternum was shaved and the area was cleaned using povidone iodine, the rats were thoracotamized. After the heart rate was monitored, a sterile 22G cannula was inserted into the aorta from the left ventricle. The prepared contrast material (diatrizoic acid, 100 ml) was injected into the artery by means of the cannula, and angiographic imaging of the aortic arch and the bilateral carotid artery was performed. After the procedure, all the subjects were sacrificed by draining blood from the heart.

The radiographic data obtained in order to monitor the carotid arteries were processed using the radiological program and the right and left carotid arteries were observed with reference to the catheter used for intervention.

DISCUSSION:

Until today, a number of hypotheses about the pathogenesis of vasospasm have been suggested and drugs considered to be effective at prevention have been used in experimental studies (7,8,9,10).

DSA is an invasive method, it should be performed under sterile conditions. The risks that may occur during the procedure vary according to the pathology and the experience of the team. The risk of complications that may result in permanent neurological damage was reported to be 0.1% (12). In our study, there was no complication during the DSA procedure in rats.

In arterial imaging, catheterization is provided with an 18-22 G cannula in a way similar to opening of a normal vascular route. During carotid catheterization, it is likely that the cannula will pierce the carotid and exit from the posterior wall. In order to remove the possibility of carotid rupture in our study, the largest vessel leading to the site of angiography was selected and the left ventricular catheterization was performed to inject contrast material into the aortic arch (18).

DSA procedure, approximately 75-100 ml contrast material is sufficient for an average 250-300 gr rat. In CTA imaging comparing with DSA, contrast media amount that used in is significantly lower. We used approximately 25-50 ml contrast media for screening the carotid artery. Contrast media induced nephropathy (CIN) is a iatrogenic complication that sudden impairment of renal function 24–48 h or up to 72 h after using contrast medium in a CT scan or angiography (35,36). We believe that administrate low dose contrast agent will be lower CIN rates.

In our study according to the carotid imaging even if in pathological circumstances like vasospazm , there was no difference between the DSA and CTA methods and both of them could be used. Nowadays with the help of computer based programmes, CTA is a sufficient diagnostic tool for the carotid artery imaging. Reflection of our study to the clinic, even if there is no complication in both procedures, CTA will be the prior method in the first applied of the patients because it is an invasive and rapid method. We believe that it will be required for current scientific studies on this subject.

FIGURES:

Figure 1: Bilateral carotid artery imaging with DSA



Figure 2: Bilateral carotid artery imaging with CTA



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