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Original Article

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Comparison of 64 Dedector Cranial CT Angiography with Intra-Arterial DSA For Detection of Intracranial Aneurysms

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ABSTRACT

The purpose of our study was to compare findings of 64 detector cranial computed tomographic angiography (CTA) and conventional digital subtraction angiography (DSA) mainly in patients with acute subarachnoid hemorrhage (SAH) headache and diplopia. Between March 2007 and May 2009, 65 consecutive patients were admitted with clinical symptoms and signs of intracranial aneurysm. 44 of 67 detected aneurysms were confirmed during surgery or endovascular embolization. DSA was performed in the 3 days after CTA. CT angiograms and conventional angiographies were studied by two radiologists, who performed aneurysm detection and characterisation of morphological features. Using CTA and DSA, we detected 67 aneurysms in 50 patients. 15 patients did not have any aneurysms in both DSA and CTA. There was no difference between the two modalities in the number of the detected aneurysms. But two aneurysms were falsely located before surgery with CTA. They were located in posterior communicating artery (PcoA) but, had been thought to be located at the internal carotid artery supraclinoid segment at CTA. CTA has an equal sensitivity as DSA in the detection of intracranial aneurysms. It has 100% detection rate in anterior communicating artery and middle cerebral artery bifurcation aneurysms, but aneurysms at some locations, like the ones at PcoA, were hard to detect with CTA. DSA preserves its diagnostic value for detection of posterior circulation aneurysms.

Key words: *Intracranial aneurysm, subarachnoid hemorrhage, multislice computed tomography, digital subtraction angiography*

İntrakranyal Anevrizmaların Saptanmasında 64 Kesitli Kranyal BT Anjiyografi İncelemesi ile İntraarteryel DSA'nın Karşılaştırılması

ÖZET

Çalışmamızın amacı esas olarak akut subaraknoid kanaması, baş ağrısı ve diplopisi olan hastalarda 64 kesitli kranyal bilgisayarlı tomografi anjiyografi görüntüleri ile konvansiyonel dijital çıkarmalı anjiyografi görüntülerinin karşılaştırılmasıdır. Mart 2007 ve Mayıs 2009 tarihleri arasında intrakranyal anevrizma düşündüren klinik semptom ve bulguları olan 65 hasta kabul edilmiştir. Saptanan 67 anevrizmanın 44'ü cerrahi veya endovasküler tedavi ile doğrulanmıştır. Dijital çıkarmalı anjiyografi incelemesi, bilgisayarlı tomografi anjiyografi yapıldıktan sonraki 3 gün içinde gerçekleştirilmiştir. Bilgisayarlı tomografi anjiyografi ve dijital çıkarmalı anjiyografi incelemeleri iki radyolog tarafından değerlendirilmiştir. Bilgisayarlı tomografi anjiyografi ve dijital çıkarmalı anjiyografi incelemelerinde 50 hastada 67 anevrizma saptanmıştır. 15 hastada bilgisayarlı tomografi anjiyografi ve dijital çıkarmalı anjiyografide anevrizma izlenmemiştir. Saptanan anevrizmaların sayısı bakımından her iki inceleme arasında fark izlenmemiştir. Ancak 2 anevrizma bilgisayarlı tomografi anjiyografi ile yanlış lokalize edilmiştir. Posterior komünikan arter yerleşimli olmalarına rağmen internal karotis arter supraklinoid segment yerleşimli oldukları düşünülmüştür. İntrakranyal anevrizmaların saptanmasında bilgisayarlı tomografi anjiyografinin duyarlılığı dijital çıkarmalı anjiyografi ile eşittir. Anterior komünikan arter ve orta serebral arter bifurkasyon anevrizmalarını saptama oranı %100 iken, posterior komünikan arter gibi bazı bölgelerdeki anevrizmaları bilgisayarlı tomografi anjiyografi ile lokalize etmek güçtür. Dijital çıkarmalı anjiyografinin arka dolaşım anevrizmalarının saptanmasındaki tanısal değeri devam etmektedir.

Anahtar kelimeler: *İntrakranyal anevrizma, subaraknoid kanama, çok kesitli bilgisayarlı tomografi, dijital çıkarmalı anjiyografi*

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INTRODUCTION

Cranial computed tomograph-angiography (CTA) has been increasingly used during the last 10-15 years for the early diagnosis of ruptured intracranial aneurysms (1-7). CTA is more dependent on the technical parameters used, than being patient-dependent. Total scanning time is less than a minute, so it is well-tolerated by most of the patients with subarachnoid hemorrhage (SAH). CTA can be performed after the plain CT. A positive CTA result can guide the treatment procedure.

Digital subtraction angiography (DSA) is the gold standard method for the assessment of intracranial aneurysms; however it is an invasive method, may be time consuming, operator dependent and carries a 4% complication risk (9). The reported rate of negative angiography in SAH ranges from 10 to 20% (10). The subtracted images may fail to depict some of the morphological features of the aneurysm, like the neck, vessels arising from the sac, mural calcifications or luminal thrombus (1).

The purpose of our study was to compare diagnostic accuracy of 64 detector CTA in with DSA for the detection of intracranial aneurysms in patients with symptoms or signs indicating the presence of aneurysms.

MATERIALS AND METHODS

Between March 2007 and May 2009, 65 consecutive patients were admitted, with clinical symptoms and signs of intracranial aneurysm. Criteria for inclusion in the study required both CTA and DSA studies. Thirty four patients had to undergo surgery and 10 patients had to undergo endovascular embolization.

DSA and CTA images were evaluated by two radiologists retrospectively. Maximum diameter of the aneurysm was measured at CTA. Diameter of aneurysm was estimated by comparing with diameter of cateheter at DSA. Presence, number, diameter and localization of the aneurysms were detected and used for comparing CTA and DSA.

The CTAs were performed in a 64-detector Aquillon (Toshiba Medical Systems, Tokyo, Japan). A lateral scout was necessary to plan the scanning area, which included the area between foramen magnum and 1 cm over the lateral ventricules. The field of view (FOV) was carefully placed to surround major branches of the circle of Willis (FOV : 18 cm). A total volume of 120 ml nonionic contrast medium was injected automatically at a rate of 4-6 ml/s through a 20-gauge needle inserted in the antecubital vein. Automatic bolus-tracking programme was used (Sure-start, Toshiba Medical Systems, Tokyo, Japan). No contrast media complications were remarked in any patients. The scanning parameters were 120 KVp; 300 mA; with 0,5 mm collimated slices on a 0,83 pitch. The reconstruction increment was set to 0.5 mm with a soft reconstruction kernel in order to improve the longitudinal resolution on a 512×512 matrix. Acquired data were transferred to our DICOM server through a high performance local area network. The diagnosis was made in the workstations, where we could do all the image post-processing needed. Source images were used for interpretation. Volume rendering or maximum intensity projection protocols were used when needed.

DSAs were carried out on a Siemens unit (Multistar Plus/T.O.P., Forchheim, Germany) by two experienced interventional radiologists. A selective four-vessel angiography via femoral artery catheterization was performed in 65 patients. Anteroposterior, lateral, oblique and -if necessary- additional views of each vessel were obtained by the manual injection of 6 ml nonionic contrast media at a rate of 4-7 ml/second. The FOV for cerebral angiography was usually 20 cm and the matrix size was 024×1024.

RESULTS

All of the 65 patients underwent CTA and DSA. They were 35 women (57%) and 30 men (43%), aged 14–80 years (mean age 52 years). According to the plain CT, 55 patients (84%) suffered from acute SAH, 7 patients had intracerebral hemorrhage and 1 patient had subdural hematoma. Two patients did not have intra- or extra-axial hematoma. Thus, our study group consisted of 50 patients positive for the presence of aneurysm(s) (total number of aneurysms were: 67), according to CTA and DSA. There was only a single aneurysm in 36 patients (72%), 2 aneurysms in 13 patients (26%) and 5 aneurysms in 1 patient (2%). Overall, according to CTA measurements, 1% of the aneurysms were ≤3 mm, 27% 4–5 mm, 39% 6-10 mm and 33% of them were >10 mm, while the maximum diameter of the sac ranged between 3 and 29 mm and the mean size was 9,19 mm. Considering the diameters of the aneurysms, there was no difference

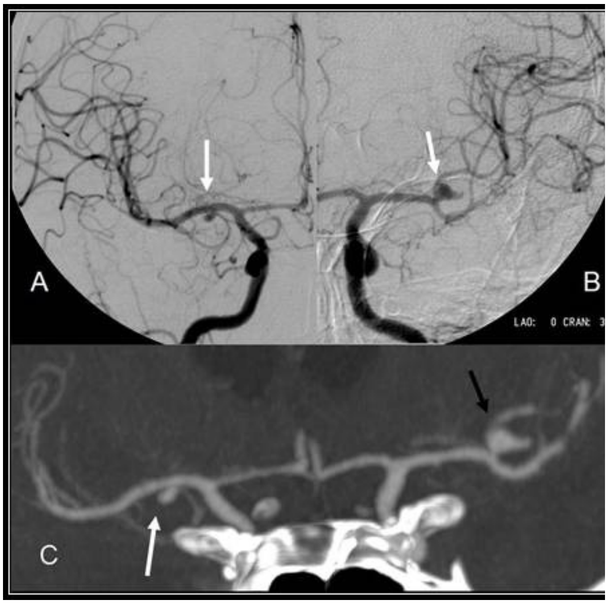

Figure 1. A, B: Saccular aneuryms located at bilateral middle cerebral artery M1 segments at digital subtraction angiography (arrows). C: After left carotid arter injection an aneurysm located at middle cerebral artery M1 segment (arrow)

greater than 2 mms between DSA and MDCTA. Of the 67 aneurysms found at DSA, 2 (3%) were located at internal carotid artery (ICA) cavernosal segment; 8 (%12) were at ICA ophtalmic segment, 2 (3%) at ICA communicating segment, 24 (37%) at middle cerebral artery (MCA) M1 segment; 1 (1%) at MCA M2 segment; 14 (21%) at anterior communicating artery (AcoA); 1 (1%) at anterior cerebral artery (ACA) A1 segment; 2 (3%) at ACA A2 segment; 1 (1%) at superior cerebellar artery; 4 (6%) at basilary artery; 6 (9%) at posterior communicating artery (PcoA) and 2 (3%) at posterior cerebral artery (PCA) P2 segment (Figure 1). CTA have detected all of the aneurysms but location of two aneurysms were interpreted different with DSA than with MDCTA. They were misinterpreted as located at cavernosal segment of ICA, but found to be located at PcoA at DSA (Figure 2). One of them was not operated. But the other one was treated with endovascular treatment. It was confirmed that it is located at PcoA with selective catheterisation. One of these aneurysms was 5 mm and the other one was 10 mm. 44 of all aneurysms were treated by surgery and/or endovascular embolization. Surgical treatment was performed in 34 aneurysms. Endovascular treatment with Guglielmi detachable coils (GDC) was performed in 10 aneurysms.

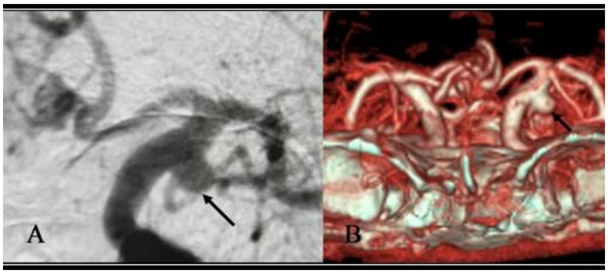

Figure 2. A: The aneurysm found to be located at posterior communicating artery at digital subtraction angiography (arrow). B: It was misinterpreted as located at cavernosal segment of internal carotid artery (arrow).

DISCUSSION

The ideal imaging modality for detection and characterisation of an aneurysm should be noninvasive, easy to perform, reproducible, readily available and accompanied by minimal complications. It should also should depict aneurysms with a high degree of accuracy (11). Use of imaging for the evaluation of patients with an intracranial aneurysm involves detection and the origin origin of the aneurysm; demonstration of the sac, neck and the surrounding vascular anatomy; orientation of the sac according to the bony structures of the skull base; morphological features of the sac; presence or absence of intraluminal thrombus or peripheral calcifications and accurate measurements of the sac, neck and aneurysm filling (1).

DSA has been considered the standard reference method for detection of intracranial aneurysms. DSA has some advantages like large field of view, high spatial resolution and temporal imaging capabilities; yet it is time consuming, invasive, and operator-dependent technique. It also has temporary or permament neurologic complication rates of 0.6% and 0.3% respectively (12). Information on mural calcifications, luminal thrombi, proximity to bony structures of the skull base and to the brain parenchyma, which cannot be obtained by DSA, are useful for the treatment planning (1). Superposition of kinking of vessels, tortuosity of vessels, small aneurysms and complex structure of the aneurysm may lead to misdiagnosis at DSA. To avoid these problems, DSA images should be taken at multiple plans. Therefore conventional angiography necessitates the use of the contrast medium at a high quantity (13) and a lot of time. These limitations reduce the diagnostic accuracy of DSA (1). But it can be improved with rotational angiography (14).

CTA is an easy to perform method, time saving and it is tolerated well by patients with acute SAH (1). CTA has proven to be an effective imaging method for detection of aneurysms (15). Immediately after the confirmation of SAH at CT, and in the absence of contraindications of contrast material, CTA can be performed, which provides a reliable early diagnosis when positive. If the result is negative, the patient can undergo DSA for further investigation. Both CTA and DSA use ionising radiation. The amount of radiation is lower in DSA (16). But it is important to know limitations of CTA. The sensitivity for detecting aneurysms <4 mm, 4 to 10 mm, and >10 mm on a per-aneurysm basis was 0.84, 0.97, and 1.00 respectively (17). In addition to small size, the main reason aneurysms <4 mm were missed was their close proximity to bone (17). This is thought to be due to lower spatial resolution of CTA compared to DSA. But with recent developments of CT technology, speed and spatial resolution have been increased. The other disadvantage of CTA is that it can't determine time-related characteristics of an aneurysm filling. This feature may be important especially in determining which ACA preferentially fills an AcomA aneurysm. Technical parameters are very important for CTA. Concentration and dose of contrast agent, injection rate, weight of the patient, hemodynamical factors and proper time of scanning, affect the quality of the imaging. In case of a technical fault MDCTA can't be repeated at once. Our study did not suffer from any technical problems, and all of our images were sufficient for diagnosis.

In this study CTA could detect all of the aneurysms located at MCA and AcoA regardless of their size. We can propound that the use of CTA alone would be sufficient in detection of aneurysms located at MCA or AcoA for preoperative assesment. But aneurysms located at PcoA can be overlooked with CTA because of their close relationship with bone and vascular structures. This finding is consistent with the literature (1,4,6). Karamessini et al. (1) also found poor detection rate in the PcoA aneurysms with CTA. They postulated that it is mainly due to their small size (<4 mm), lobulated shape and close proximity to the posterior clinoid process.

In our study, we did not find significant difference between CTA and DSA regarding determination of the size of the aneurysms. But in our opinion, more detailed measurements can be done with CTA than DSA.

We acknowledge that our study had limitations. All of our patients did not undergo surgery, so we could not correlate our findings with the surgery results in all of our patients. Also we could not reach the repeat examinations of the patients without aneurysm in initial examination.

As a result, CTA is an easily performed, non-invasive, easily available method for evaluation of aneurysms. CTA has excellent correlation with DSA for detection of localization of aneurysms other than the ones located at PcoA and ICA cavernosal segment. But for the aneurysms located at PcoA and ICA cavernosal segment, performance of CTA is lower (%75). When dealing with PcoA ve ICA cavernosal segment aneurysms, this disadvantage of MDCTA should be taken in consideration and these regions must be evaluated more carefully.

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