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Scientific Research

Computed Tomography Angiography Compared to Catheter Based Angiography in Evaluation of Cerebral Arterial Aneurysm and Arteriovenous Malformation

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Abstract

Both cerebral arterial aneurysm and arteriovenous malformation are cerebrovascular disease, which required immediate diagnosis and urgent treatment. Since the introduction of multislice CT scanners, CT angiography (CTA) has become a powerful tool for imaging the vascular system. The goal of this study is to compare catheter based angiography and CTA in the evaluation of cerebral arterial aneurysm and arteriovenous malformation AVM. A retrospective analysis of 50 patients for exploring the record of patient who underwent both multislice CT angiography (MSCTA) and catheter based angiography before treatment is presented during last one year in the department of Radiology, King Fahd Hospital-Jeddah, Kingdom of Saudi Arabia. The sensitivity of CTA for picking up aneurysm is 86% and the sensitivity of catheter based angiography for picking up aneurysm is 97%. The specificity of CTA for picking up aneurysm is (76%), the false positive cases are (3%) and the false negative cases are 10%. The sensitivity of both CTA and catheter based angiography for picking up arteriovenous malformation is (90%). The specificity of CTA for picking up AVM is (76%), the false positive cases are (10%) and no false negative cases in CTA are found. The sensitivity and specificity of catheter based angiography is 100% in diagnosis and detection of cerebral arterial aneurysm and AVM. The present study concluded that CTA has high sensitivity and specificity in detecting aneurysm and AVM enough to be chosen as the first step. Catheter based angiography, still a gold standard for radiology examination, is the most accurate, sensitive and specific method in diagnosis and detection of cerebral arterial aneurysm and arteriovenous

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malformation, which can be done as the second step. In addition, catheter based angiography is done for treatment planning, treatment with interventional procedure and for prognosis after treatment.

Keywords

CTA, CCA, Cerebral Arterial Aneurysm and Arteriovenous Malformation

1. Introduction

Both cerebral arterial aneurysm and arteriovenous malformation are cerebrovascular disease, which required immediate diagnosis and urgent treatment [1].

Subarachnoid hemorrhage occurred spontaneously from a ruptured cerebral aneurysm, or may result from head injury. In general, the diagnosis is confirmed with a CT scan of the head, or occasionally by lumbar puncture. CT scan without contrast, of the brain which identifies over 95 percent of cases especially is the modality of choice on the first day after the onset of bleeding. MRI may be more sensitive than CT after several days [2]. Within six hours of the onset of symptoms a single study has reported that CT is 100 percent sensitive.

The CT angiography has advantages *i.e.* enhanced imaging of the aneurysm neck, detection of aneurysms up to 1.7 mm and superior delineation of surgical anatomy. On the other hand, some disadvantages of CT angiography are worth mentioning such as inefficient detection and delineation of cavernous sinus and posterior inferior cerebellar artery and radiation risks [3] [4].

During the treatment of patients having intracranial aneurysms and specifically in the evaluation of patients suffering from painful partial cranial nerve III palsy to rule out posterior communicating artery aneurysms [5]. Moreover, other studies have proven that a 7-mm posterior communicating artery aneurysm can be missed by MR imaging of the brain similarly in case of MR angiography, but could be observed by CT angiography [6] [7]. Furthermore, it has been shown that CT angiography was better in detecting traumatic aneurysms in patients with skull base fractures [8]. It seems that newer machines have increased in resolution enough to reliably detect aneurysms as small as 3 mm.

The goal of this study is to compare catheter based angiography and CTA in the evaluation of cerebral arterial aneurysm and arteriovenous malformation.

2. Material and Method

This is a retrospective study for exploring the record of patients who have underwent both CTA and catheter based angiography during last one year in the Radiology Department; King Fahd Hospital-Jeddah, Kingdom of Saudi Arabia. The cases included in study have been imaged with both modalities for the diagnosis of cerebral arterial aneurysm and AVM.

In our study, 50 patients (32 male and 18 female), aged (12 - 65 year) with subarachnoid hemorrhage (SAH), intracerebral hemorrhage (ICH) or intraventricular hemorrhage (IVH) detected by non-enhanced cranial CT with suspected arterial aneurysm and AVM who have been imaged first in CTA with MSCT scanner speed light Volume CT (VCT-64 slice, General Electric Company Healthcare), Then in catheter based angiography with DSA artis zee biplane system, Siemens Company. A standardized evaluation was performed by experienced radiologists in both CTA and catheter based angiography.

Demographic data: The details of patients involved in my research are listed in **Table 1**, **Table 2**.

3. Results

Fifty patient with subarachnoid hemorrhage SAH, ICH or IVH detected by non-enhanced cranial CT, 29 (58%) of cases have intracerebral arterial aneurysm and 21 (42%) have AVM. The (58%) 29 patients with cerebral arterial aneurysm out of which (20%) 10 female and (38%) 19 male came with different ages from 3rd to 7th decade, which mean that the aneurysm develops in all ages and the majority in adult between 30 to 60 years. The (42%) 21 patients with arteriovenous malformation out of which (14%) 7 female and (28%) 14 male came with ages from 2nd to 5th decade, as a result the AVM appear more in younger patients between 10 to 30 years (**Figure 1**, **Figure 2**).

Table 1. Represented details of 29 out of 50 patients with SAH, IVH or ICH and suspected aneurysm underwent CTA and catheter based angiography.

Patient	Age	Gender	Diagnosis	In CTA	In Angio1	In Angio2
1	53	M	SAH	N	Very small	
2	54	M	SAH-IVH	Y	Y	
3	56	F	SAH	Y	Coiling	
4	32	F	SAH	Y	Y	Coiling
5	54	F	SAH-ICH	Y	Y	Coiling
6	35	F	SAH	N	Very small	f/u-clip
7	37	M	SAH	Y	Coiling	
8	55	M	SAH	N	Very small	
9	65	M	SAH	Y	Y	Coiling
10	42	F	SAH	Suspicion	Y	f/u-clip
11	42	M	SAH-IVH	Suspicion	Y	
12	40	M	SAH	Y	Coiling	
13	50	M	SAH	Y	Y	Coiling
14	38	F	SAH	Suspicion	N	
15	51	M	SAH	Y	Y	Coiling
16	45	M	SAH	Y	Y	Coiling
17	55	M	SAH	Y	Y	Coiling
18	58	M	SAH-ICH	Y	Coiling	
19	31	M	SAH	Y	Y	
20	60	F	SAH	Y	Coiling	
21	40	F	SAH-IVH	Suspicion	Y	f/u-clip
22	49	M	SAH	Y	Y	
23	50	F	SAH	Y	Y	Coiling
24	33	M	SAH	Y	Coiling	
25	28	M	SAH	Y	Y	
26	35	M	SAH	Y	Y	Coiling
27	30	F	SAH	Y	Y	Coiling
28	25	M	SAH	Y	Coiling	
29	40	M	SAH	Y	Y	Coiling

Table 2. Represented details of 21 out of 50 patients with SAH, IVH or ICH and suspected arteriovenous malformation underwent CTA and catheter based angiography.

Patient	Age	Gender	Diagnosis	In CTA	In Angio1	In Angio2
1	22	M	IVH-ICH	Suspicion	Y	Embolization
2	28	M	ICH	Suspicion	Y	Embolization
3	29	F	SAH	Y	Y	Embolization
4	38	M	SAH-ICH	Y	Embolization	F\U
5	25	M	SAH	Suspicion	N	
6	30	M	SAH	Y	Embolization	
7	14	F	ICH	Y	Embolization	F\U
8	38	M	SAH-ICH	Suspicion	Y	Embolization
9	23	M	ICH	Y	Y	
10	18	F	SAH	Y	Y	Embolization
11	20	M	SAH	Y	Embolization	
12	28	M	SAH	Y	Embolization	
13	35	M	SAH	Y	Y	Embolization
14	19	F	SAH	Y	Y	Embolization
15	19	M	SAH	Y	Embolization	F\U
16	12	M	SAH	Y	Embolization	
17	15	M	SAH	Y	Embolization	F\U
18	19	M	SAH	Y	Y	Embolization
19	23	F	SAH	Y	Y	Embolization
20	14	F	SAH-IVH	Suspicion	N	
21	16	F	SAH	Y	Y	Embolization

Figure 1. Female patient 35y old with SAH in CTA there is no definite vascular focal out pouching/aneurysm or malformation identified. In catheter based angiography Evidence of very small aneurysm at the A1 segment of the right anterior cerebral artery adjacent to its origin from the carotid bifurcation which protruded superiorly and mildly posteriorly.

The patient with intracerebral arterial aneurysm came with different ages from 3rd to 7th decade and patient with AVM most of them from 2nd to 4th decade (**Figure 3**). In CTA 76% of patient with suspected aneurysm was proved that they have cerebral aneurysm, 14% suspicion and 10% with no aneurysm—catheter based angiography is recommended for accurate assessment. In catheter based angiography 97% was proved that they have cerebral aneurysm and 3% was proved that they do not have aneurysm (**Figure 4**). In CTA 76% of patient with suspected AVM was proved that they have arteriovenous malformation, 24% suspicion—catheter based angiography is recommended for accurate assessment.

In catheter based angiography 90% was proved that they have arteriovenous malformation and 10% was proved that they do not have AVM (**Figure 5**), the sensitivity of CTA for picking up aneurysm is 86% and in AVM is 90%. The sensitivity of catheter based angiography for picking up aneurysm and AVM is 100% (**Figure 6**).

The specificity of CTA for picking up both aneurysm and AVM is 76% and the specificity of catheter based angiography for picking up aneurysm and AVM is 100% (**Figure 7**), in CTA the false positive cases in aneurysm was 3% and in AVM was 10%. The false negative cases in aneurysm was 10% and in AVM 0% (**Figure 8**).

Figure 2. Male patient 21y old with intracerebral hemorrhage and intraventricular hemorrhage, complaining of severe headache. In CTA, enlarged AVM in right posterior cerebral artery and drained in the superior sagittal sinus which conformed by diagnostic catheter based angiography.

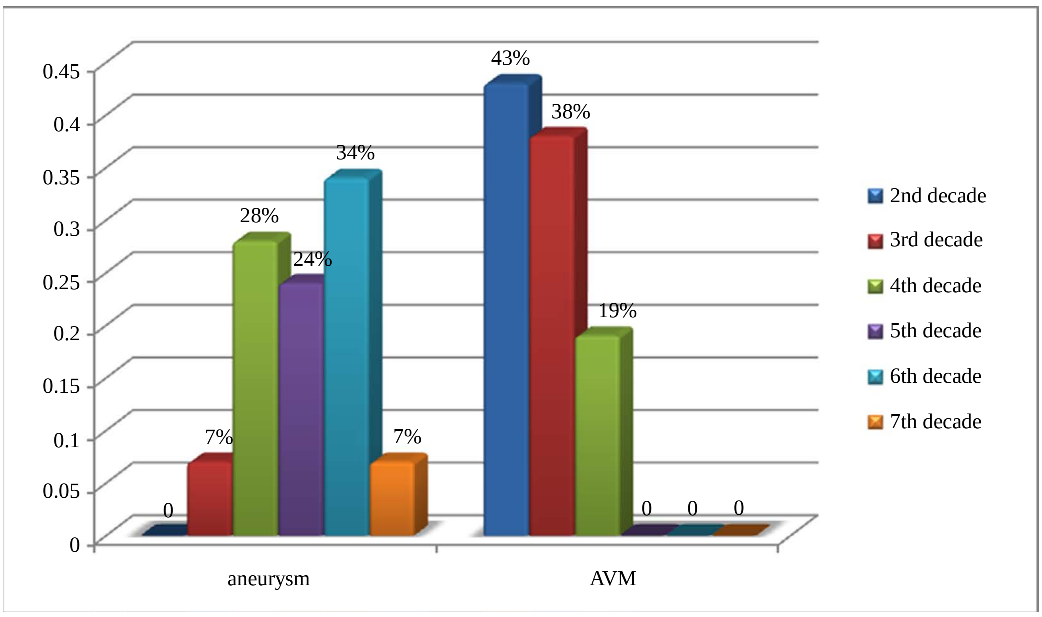

Figure 3. Age distribution of patient with aneurysm and AVM.

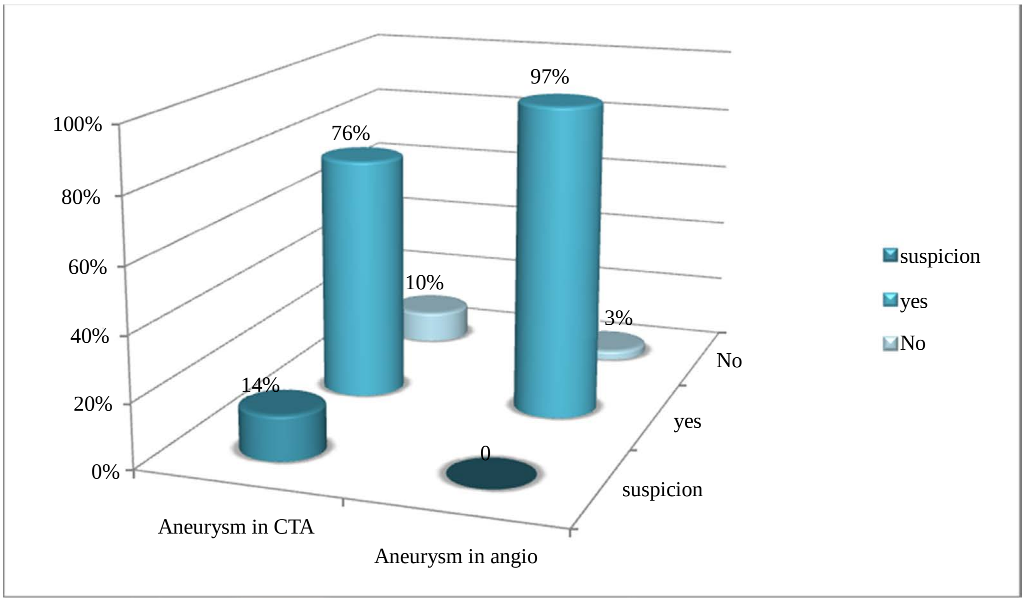

Figure 4. Comparison of the percentage distribution of cases with positive, negative and suspicion of aneurysm.

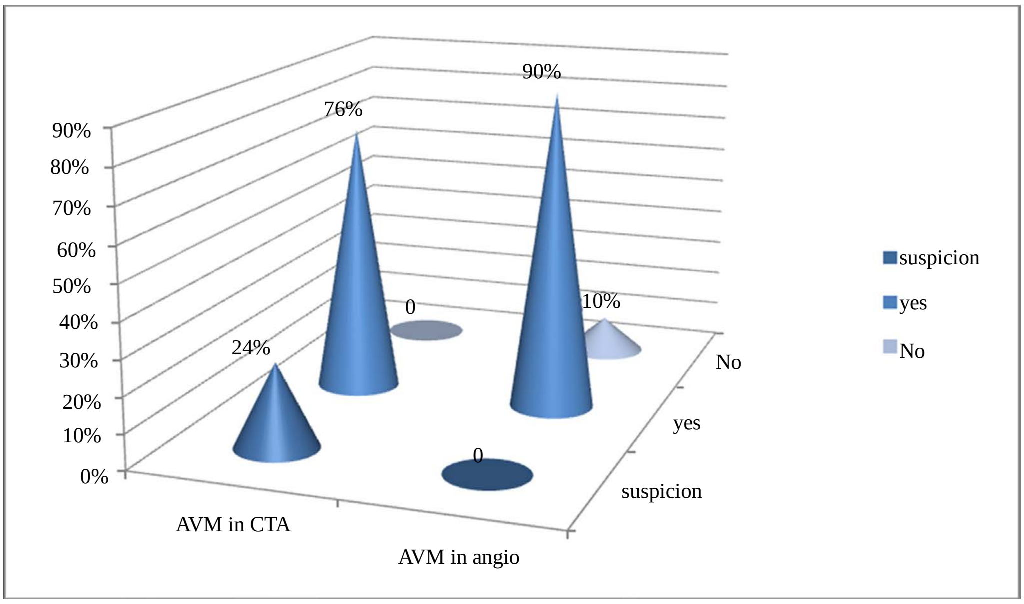

Figure 5. Comparison of the percentage distribution of cases with positive, negative and suspicion of AVM.

The distribution of further workup of cases underwent diagnostic catheter based angiography showed that out of 29 patients with aneurysm, 20 patients underwent catheter based angiography for diagnosis and treatment planning, and 17 patients underwent catheter based angiography for interventional procedure for treatment and 3 patients for follow up angiography after surgery. Out of 21 patients with AVM, 11 patients underwent catheter based angiography for diagnosis and treatment planning, 18 patients underwent catheter based angiography for interventional procedure for treatment and 4 patients for follow up angiography post Embolization.

4. Discussion

Most referred patients came with the diagnosis of AVM using conventional catheter angiography (CCA).

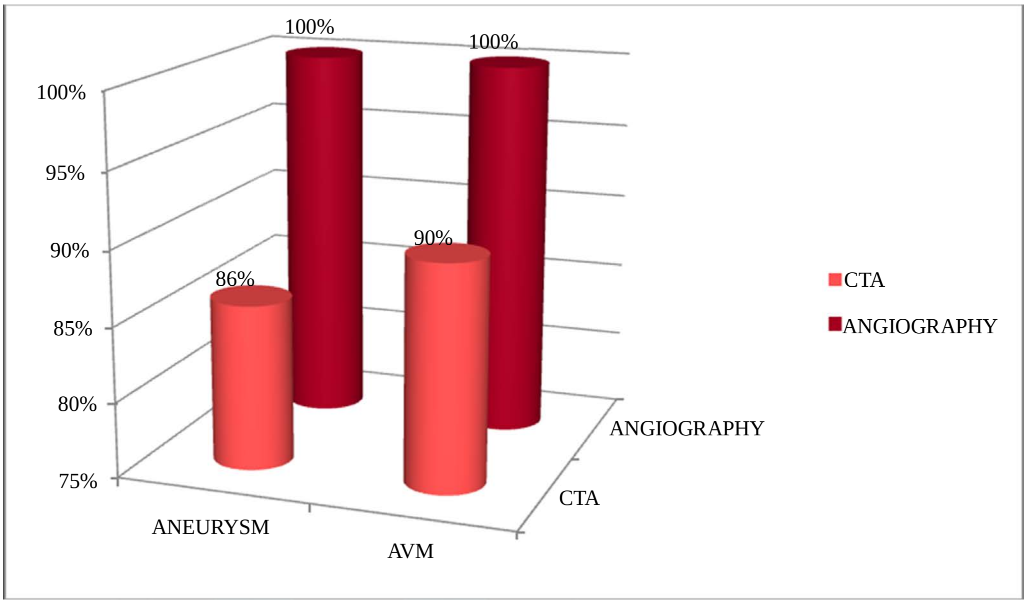

Figure 6. Percentage distribution of the sensitivity for picking up aneurysm and AVM.

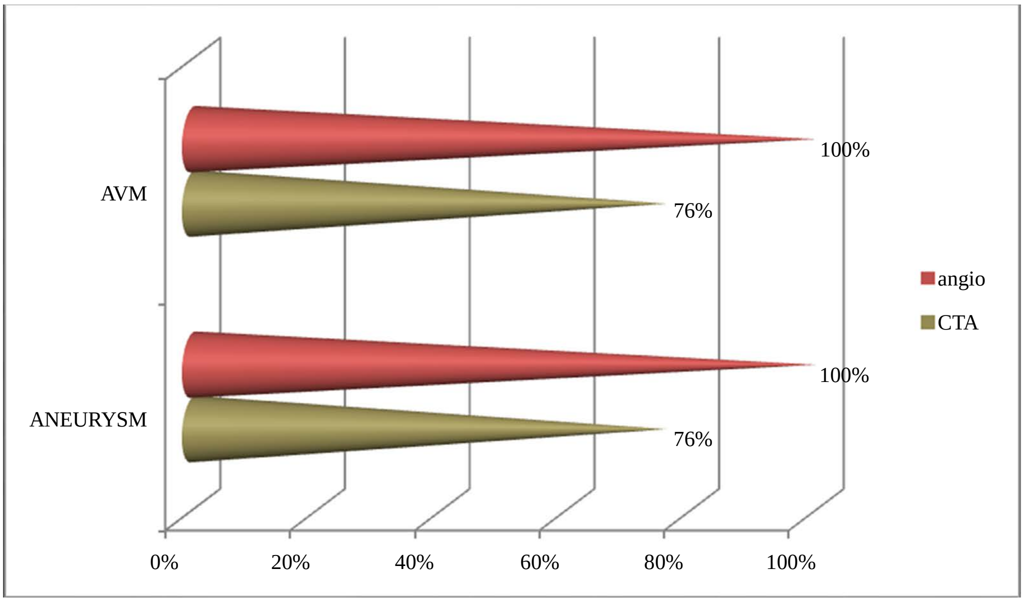

Figure 7. The specificity of CTA for picking up aneurysm and AVM.

Even with limited risk of cerebral angiography in patients with AVMs, the diagnostic accuracy of noninvasive imaging techniques, such as MR angiography and CT angiography, must be comparable to that of CCA if they are to be used as a substitute for CCA [9]. MR angiography can be performed together with CCA, but could not replace it. It was reported that when used to image brain AVMs, it could not show small vessels and regions of slow blood flow with the same degree [10].

Both modalities catheter based angiography and Computed tomographic angiography are used in diagnosis of cerebral arterial aneurysm and arteriovenous malformation. The (58%) 29 patients with cerebral arterial aneurysm out of which (20%) 10 female and (38%) 19 male came with different ages from 3rd to 7th decade, which mean that the aneurysm develops in all ages and the majority in adult between 30 to 60 years. The (42%) 21 patients with arteriovenous malformation out of which (14%) 7 female and (28%) 14 male came with ages from 2nd to 5th decade, as a result the AVM appear more in younger patients between 10 to 30 years [9].

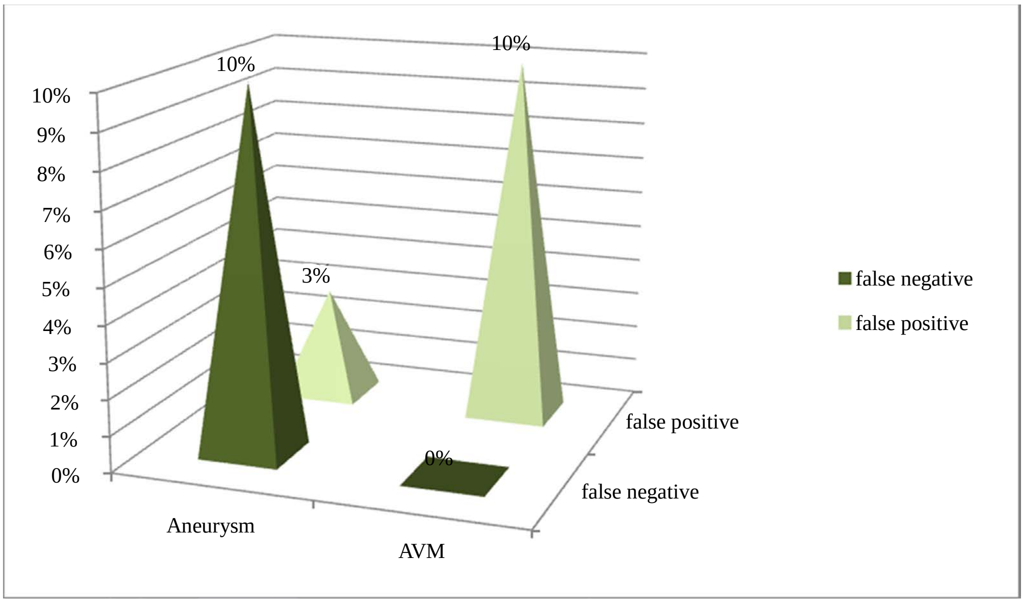

Figure 8. Percentage of false positive and negative in CTA.

Despite advances in noninvasive diagnostic neuroimaging, diagnostic cervicocerebral angiography remains the criterion standard for the evaluation of patients.

In catheter based angiography (97%) 28 patients proved that they have cerebral aneurysm and (3%) 1 patient was proved that he do not has aneurysm. In addition, 3 patients out of 4 with suspected aneurysm in CTA was proved by catheter based angiography that they have aneurysm and one with no aneurysm. Also 3 patients with no aneurysm in CTA were proved by catheter based angiography that they have a very small aneurysm less than 3 mm [9] [11].

As a result, the sensitivity of CTA for picking up aneurysm is (86%) 25 patients out of 29 and the specificity of CTA for picking up aneurysm is (76%) 22 patients out of 29. The false positive cases were (3%) one patient with suspected aneurysm in CTA and no aneurysm in catheter based angiography [12].

The false negative cases were (10%) 3 patients with no aneurysm in CTA and proved by catheter based angiography that they have a very small aneurysm less than 3 mm. The sensitivity and specificity of catheter based angiography for picking up aneurysm is (100%) [3] [4].

In CTA (76%) 16 of patients with suspected AVM was proved that they have arteriovenous malformation, (24%) 5 patient with suspicion AVM and catheter based angiography is recommended for accurate assessment. In catheter based angiography (90%) 19 patients was proved that they have AVM [12]. In addition, 3 patients out of 5 with suspected AVM in CTA was proved by catheter based angiography. The specificity of CTA for picking up AVM is (76%) 16 patients out of 21. The false positive cases were (10%) two patients with suspected AVM in CTA and no AVM in catheter based angiography. No false negative cases in CTA. The sensitivity and specificity of catheter based angiography for picking up AVM is (100%) [4].

Previous study revealed that the accuracy, sensitivity, positive predictive accuracy and negative predictive accuracy for CTA was 98%, 97.9%, 100% and 94.3% and for DSA was 99%, 99.3%, 100% and 98%, respectively. CTA is a reliable alternative to DSA in detecting intracranial aneurysms. The role of CTA in demonstrating AVMs can be considered complementary to that of DSA [13]. While the present study revealed that the specificity of CTA is 76% in diagnosis and detection of cerebral arterial aneurysm and arteriovenous malformation are 86% and 90% respectively, while the sensitivity and specificity of catheter based angiography is 100%. However, in another earlier study, MDCTA sensitivity, specificity, and accuracy were 92.5%, 93.3%, and 92.6%, respectively [14].

5. Conclusion

The present study concluded that CTA has high sensitivity and specificity in detecting aneurysm and AVM enough to be chosen as the first step. Catheter based angiography, still a gold standard radiology examination, is the most accurate, sensitive and specific method in diagnosis and detection of cerebral arterial aneurysm and arteriovenous malformation, which can be done as the second step. In addition, catheter based angiography is done for treatment planning, treatment with interventional procedure and for prognosis after treatment.

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