A COMPARATIVE ANALYSIS OF ANUERYSMAL SUBARACHNOID HEMORRHAGE BY COMPUTED TOMOGRAPHIC ANGIOGRAPHY (CTA) VERSUS DIGITAL SUBTRACTION ANGIOGRAPHY (DSA)

Atif Mehmood[1], Kashif Mehmood[2]

[1]Lecturer Radiology, Khyber Medical University Peshawar
[2]Post Graduate Trainee, Jinnah Hospital Lahore

Address for Correspondence:
Atif Mehmood
[1]Lecturer Radiology, Khyber Medical University Peshawar
Email: atifmehmood.ipms@kmu.edu.pk

Abstract: Rupture of intracranial aneurysms and distortions are the real reasons for unconstrained subarachnoid hemorrhage (SAH). Keeping in mind the end goal to announce the preoperative symptomatic estimation of intracranial aneurysms, two imaging modalities, figured computed tomographic angiography (CTA) and intra-arterial digital subtraction angiography (IA-DSA) were contrasted to recognize such anomalies and to assess cerebrovascular structures with an aim to treat them.

Objective: This study aims to figure out the demonstrative estimation of Computed Tomographic Angiography (CTA) for the uncovering of cerebral aneurysms in patients introducing the non-traumatic Subarachnoid Hemorrhage (SAH) in correlation with intra-blood vessel DSA.

Methods: In this cross sectional diagnostic relative study, DSA and the demonstrative estimation of CTA were compared. Sensitivity and specificity were computed and thought about between the two modalities. From crude information, three dimensional volume rendered recreation and two dimensional greatest power projection (MIP) perspectives were finished. The morphologic Information of aneurysm on CTA was contrasted with DSA, which is considered the best quality level imaging technique.

Results: Out of 70 patients, cerebral CTA analyzed intracranial aneurysms in 67 patients. Study of DSA affirmed the vicinity of intracranial aneurysms in 63 patients resulting in aggregate of about 90%. While diagnosing cerebral aneurysms, The study discovered that the sensitivity of Computed Tomographic Angiography (CTA) was 97% and the specificity was found out to be 100%.

Conclusions: According to our study, cerebral CTA is more sensitive, non invasive and quick imaging strategy than DSA in the evaluation of cerebral aneurysms in patients having SAH.

Key Words: Intra-Arterial Digital subtraction angiography (IA-DSA), CT Angiography (CTA), subarachnoid hemorrhage, cerebral aneurysms.

INTRODUCTION

Subarachnoid Hemorrhage (SAH) is associated with high morbidity and mortality. Particularly in women, the commonest reasons for non-traumatic SAH are burst cerebral aneurysms [1], and the ratio of non-traumatic SAH is 1.6 times higher in women than in men [2]. As a rule populace the commonness of the intracranial aneurysms (ICA) is 0.2 – 8% [3] and they are typically found when burst in 90% of cases, bringing on subarachnoid hemorrhages [4].

Due to hemorrhage and its primary complications, 25-50% of the suffered patients die, in spite of rational diagnosis and treatment of these events [5]. The Intra-Arterial Digital Subtraction Angiography (IA-DSA) is the best quality level practice for discovering the presence of intracranial aneurysms [6] and for postoperative patient assessment after surgical cut-out of the aneurysm[7]. In any case, in the assessment of SAH and cerebral aneurysms DSA is an expensive and invasive indicative strategy in which lasting neurologic shortfalls are accounted for a rate of 0.07% [8]. For the examination of intracranial aneurysms and outlining the treatment of the procedure, Digital Subtraction Angiography (DSA) has been acknowledged as a satisfactory and elective system before surgery among those patients with above issue and the outcomes picked up from this demonstrative strategy were urgent, yet in patients with subarachnoid drain we ought to say that 12-20% of results picked up from this technique have been negative [9-10]. An option of non-invasive and economical imaging methodology is Computed tomography angiography (CTA) with the upside of it being performed quickly after crisis unenhanced mind registered tomography in patients with SAH [11]. Fast appraisal of ICA has changed demonstrative way to deal with ICA assessment by negligibly invasive cross sectional imaging and in fact propelled practices, for example, Magnetic Resonance Angiography (MRA) and Multidetector Computed Tomographic Angiography (MDCTA) [12]. CTA has sensitivity of 97% and specificity of 100%. In analysis and follow up of ICA, DSA is continuously being replaced by MDCTA and MRA because of the present improvement of the cross sectional imaging and for remedial arranging without performing an extra analytic DSA, in intense setting of subarachnoid hemorrhage[13-14]. For the analysis of intracranial aneurysm in patients with SAH, CTA is the decision of imaging methodology at a few healing centers [15] and DSA has been replaced by CTA in preoperative setting and for

patient subsequent [16-17]. The point of our study is to focus the part of Computed Tomographic Angiography (CTA) in discovering and assessment of intracranial-aneurysms (ICA) in patients with Subarachnoid Hemorrhage (SAH) in Pakistani settings and specialized ability. CTA, being quicker, more secure and less obtrusive methodology when contrasted with IA-DSA, will serve to diminish the danger of mortality and morbidity in patients' as of now in grave threat and will prompt early treatment planning.

METHODOLOGY

The study is a Cross sectional Diagnostic comparative study. The study commenced from October 2011 to May 2012 at Nishtar Medical College & Hospital Multan and Jinnah Hospital Lahore hence comprising eight months. The sampling technique was selected to be non- probability, purposive sampling after being approved by institutional review committee of the institute. The inclusion criterion was limited for both male and female subjects. Patients who were of age between 20 to 75 years, who were diagnosed as cases of anuerysmal SAH on CT brain (plain) and cerebral CTA were included and patients presenting with history of trauma, previous history of neurosurgical intervention, pregnant ladies and the patients with history of adverse contrast effects were excluded. The figured sample size with 95% certainty interim and predominance i.e.72.5%, with 96.25% sensitivity, 95% specificity and 10% accuracy of the procedure, incorporates more or less 70 patients in this study.

After approval from ethical committee, 70 cases satisfying the inclusion criteria, conceded in Neurosurgical office through Accident & Emergency division, answering to radiology office and asked for cerebral CTA were enrolled for the study. Informed consent and a brief history were taken from patients/specialists. Understanding demographic profile was recorded on exceptional composed Performa. Cerebral CTA information was achieved utilizing 16-slice Spiral CT output (Model: TOSHIBA, AQUILION). Patients were submitted to CTA with

taking after specialized parameters: Scan volume: Base of skull to vertex, Scan plane: Parallel to Orbito-meatal line. Pivot: 0.4 to 0.5 sec, Table speed: 6.6mm/revolution, Reconstruction Interval: 0.4-0.5mm, collimation: 0.6mm, , 120 kvp, 150 mAs, Field of view(FOV): 250mm, output volume: 110-120mm, 75-100ml of non-ionic difference media(350-370 md L/ml) by means of antecubital vein was infused at a rate of 3-4 ml/s by a force injector at 300 PSI with Sure Start strategy. The pictures were prepared applying Multi planner Reformatting (MPR) on VITRERA-3D workstation utilizing Maximum Intensity Projection (MIP), Shaded Surface Display (SSD) and Volume Rendering Technique (VRT). Discoveries were assessed by radiologist on printed copies and additionally on work station and CTA discoveries will be noted for number, size and neck size of aneurysm and conduit of beginning. Every one of the patients will get surgery and agent discoveries will be noted for the same aneurismal qualities which will be taken as the Gold Standard.

The gathered data was then entered and analyzed in SPSS v 20.00. The variables incorporate age (20-75 years) and sex (male/female). CTA and agent discoveries (number, supply route of root, size and neck size of aneurysm). Frequency and rates were ascertained for the result variables like number, vein of inception, size and neck size of the aneurysms. Mean and standard deviation was ascertained for age. Stratification was done for age and sexual orientation to see the impact of these on result variables. Part of CTA was dictated by ascertaining sensitivity, specificity and indicative precision. Agent discoveries will be taken as best quality level.

RESULTS

In 70 patients present in this study, the picture obtaining and estimation of MDCT Angiograms were appraised as extraordinary. An aggregate of 63 aneurysms were available at DSA in all patients included in this revise. Of the 63 aneurysms, 27 (42.8%) aneurysms were to be found at the anterior communicating artery (ACoA), 14

(22.2%) were present at the posterior communicating artery (PCoA), 7 (11.1%) were at the middle cerebral artery (MCA) (bi-/trifurcation), 8 (12.7%) at the posterior circulation (3 of the tip of basilar artery, 3 of the posterior inferior cerebellar artery, 1 of the superior cerebellar artery, 1 of the posterior cerebral artery), 5 (7.93%) at the Internal Carotid Artery (ICA) and 2 (3.17%) at the ACA (Table.1). At DSA, there were 4 false-negative discoveries in 4 patients. The Multidetector Computed Tomographic Angiography (MDCTA) demonstrates the general sensitivity, specificity, and precision of 93.5%, 94.2%, and 91.5%, contrasted with DSA respectively.

However on every patient premise for finding of the aneurysms with MDCTA, the sensitivity, specificity, and precision rate of 100% can be expert. The sensitivity, specificity, diagnostic accuracy, positive and negative perceptive number of aneurysms identified and character were likewise figured by size of the aneurysm. For aneurysms 2 mm, the sensitivity of MDCTA was 77.8%, for 3 mm or more it was 100%. MDCTA was exact when numeral anuerysmal projections present and the relationship of the aneurysm with the connecting blood vessel branches were outlined. For aneurysm lobularity and nearby branch for 2mm and 3mm, the precision of MDCTA was 97% and 100% respectively. In this study, for the data analysis of 44 aneurysms in 40 patients, MDCTA image reconstruction was done by using automated segmentation algorithms with the combinations of VRT. Without erasing the blood vessel portion or picture of the aneurysm in each patient, the bony part could be separated from every one of these pictures successfully. After automated segmentation, it was judged that VRT pictures gave significant additional data in 8 (20.1%) and 10 (25.1%) of 40 patients, respectively. In any case, in the persevering patients the automated segmentation algorithm did not offer any additional data. At the base of the skull, better depiction of little aneurysms from bone and better representation of an aneurysm anticipating poorly were the extra data that is given by the automated segmentation algorithm.

TABLE I: NUMBER OF ANEURYSMS DETECTED ON CTA AND DSA

Aneurysm	CTA	DSA
ACoA	29	27
PCoA	16	14
MCA	07	07
Posterior circulation	08	08
ICA	05	05
ACA	02	02
Total	**67**	**63**

DISCUSSION

Nowadays, invasive and non-invasive diagnostic angiographic systems have been utilized for the analysis of cracked intracranial aneurysms in those patients giving SAH. DSA has completely replaced by CTA in patients with SAH in a few centers[18]. It is accounted for in the late studies that in diagnosing intracranial aneurysms, the sensitivity of MDCTA went from 85% to 96% and specificity from 83% to 97% with 4-channel MDCT scanners [19-23]. In examination with the previous single-detector row CTA studies, these studies likewise reported more prominence for the finding of little aneurysms. Still so, it was additionally said in these studies that even by MDCT, various little aneurysms could be missed. In the investigation of Dammert et al [19], it is accounted for that in 50 patients, 83% discovering rate is accomplished by MDCTA. By utilizing MDCTA, Teksam et al [20] uncovered 113 aneurysms in 100 patients and expressed 84% sensitivity rate for aneurysms of <4 mm. In a survey of 178 aneurysms portrayed by Kangasniemi et al, both DSA and MDCTA identified just 4 out of 11 cerebral aneurysms of <2 mm in width [21]. As of late the activity of 16-channel MDCTA by Tipper et al is accounted for the finding of intracranial aneurysms [24]. With all in all sensitivity of 96% and specificity of 100%, they recognized 51 of 53 aneurysms after the examination of 57 patients with assumed intracranial aneurysms. The discoveries of most past MDCTA studies were as per the sensitivity rate of our study. Be that as it may, the discoveries of this report with a nearly substantial number of aneurysms and patients are not comparable to than those specified in an advanced learning in which 16-channel MDCT is utilized [24]. On the further

control, every missing aneurysm in occurrence by DSA pictures could be perceived in our study at review survey. This appraisal began instantly at our doctor's facility after the establishment of MDCT. Consequently, we anticipated to diminish the delicate mistake in the clarification of reports of MDCTA for cerebral aneurysms, by developing viewer ability. In these 4 false-negative results, 2 were identified with the ACoA while 2 were with the PCoA. For finding of back imparting blood vessel aneurysms, this conclusion is in accordance with the prior studies that had comparatively unfortunate sensitivities and specificities [25, 27]. That was principally because of the similar morphologic elements of their little size (<3 mm), with infundibular expansions which arranged their inclination difficult. Henceforth, we think about that critical concern which is essential in the clarification of modest aneurysms (<3mm) at MDCTA beginning from the front and back imparting vein, principally if viewer certification is not all that reasonable.

On the off chance that discoveries on MDCTA are indistinct, we think that a correlative DSA ought to be considered, while the likelihood of part from minor aneurysm is thought to be wicked good [28]. In this study, as the amplification element was not expected, exact degree of aneurysm measurement was not encouraging at DSA. Be that as it may, MDCTA made conceivable computerized parameters of anuerysmal degree in each chosen plane with help of Computed Tomography delicate products. Therefore, as a substitute of aneurysm arch and neck measurements, the N/D proportion of aneurysms with DSA and also MDCTA is put next to each other. These results are in similarity

by a former interpretation of Winter imprint et al [23]. Because of its impact on the decision of the treatment alternatives, N/D proportion of aneurysm is critical [29]. Our outcomes likewise recommend that supportive data can be offered by MDCTA in regards to the lobularity and the connection with adjacent branches. The spatial resolution of MDCTA is not as to an expansive degree as DSA, on the grounds that in a couple of patients in our grouping, the representation of the distal piece of the neighboring branches was not clear. Yet, in each patient the source of adjacent branches was all around affirmed. These possibilities of MDCTA for exact aneurysm depiction (i.e. lobularity, N/D proportion, and presence of connecting blood vessel branches) were viewed as steady in building a gainful decision with respect to whether practice endovascular treatment or the surgical section. The interest and utilization of vascular applications have been enhanced with the presentation of MDCT scanners [30]. More noteworthy greater volumetric coverage, significantly faster scanning speed and the higher longitudinal spatial resolution were the crucial theoretic focal points of MDCT that all were impractical with the single-detector row CT scanners [31]. In many patients of this arrangement, the standardized VRT pictures were produced by experienced technologists in most limited conceivable time which is under 7 minutes that depicted in earlier reports. The outcomes of this review recommend that both MDCTA and DSA have equal role and capable of revealing the intracranial aneurysms of <3 mm. In addition it indicates right around 100% presentation rate for these cracked aneurysms. We additionally evaluated the capacity of exactness of MDCTA in the aneurysm order and that handling and picture securing should be possible quickly. As a result of quick assessment, MDCTA has a reasonable position in patients with intense subarachnoid hemorrhage. We bargain a few breaking points of our study. A principle weigh in our reexamine populace was the moderately high recurrence of aneurysm (84%), which may have built up viewer expectation inclination. At long last, the DSA was our standard of introduction for the representation of intracranial aneurysms. Small aneurysms still, with

this methodology couldn't be portrayed. 3D rotational DSA has been presented nowadays and practiced clinically, aside from its high cost put off it from being utilized widely as a part of different setups [32-33]. To gain the exact data about the intracranial aneurysms and its adjacent branches, 3D rotational DSA assumes a noteworthy part; given that disclosure of them from exceptional discernment without vessel overlie [34].

CONCLUSION

As indicated by our study, Cerebral CTA is more sensitive, fast and non-invasive imaging procedure than DSA for the evaluation of aneurysms in those patients giving subarachnoid discharge created by intracranial aneurysms and can be effectively embraced as a first decision imaging technique in the symptomatic calculation of non-traumatic SAH and capably lead the helpful methodology.

REFERENCES

1. 1. Van GIJN J, Rinkel GJ. Subarachnoid hemorrhage: diagnosis, causes and management. Brain 2001;124:249-278.

2. Keedy A. An overview of intracranial aneurysm. Mcgill J Med 2006;9:141-146.

3. Pechlivanis I, Schmied K, Scholz M, Konig M, Heuser L, Harders A. 3-Dimentional computed tomographic angiography for use of surgery planning in patients with intracranial aneurysms. ActaNeurochir (Wien). 2005 Oct; 147(10):1045-53; discussion 53.

4. Gasparotti R, Liserre R. intracranial aneurysms. EurRadiol. 2005 Mar; 15(3): 441-7.

5. Hop JW, Rinkel GJ, Algra A, van GJ. Case-fatality rates and functional outcome after subarachnoid hemorrhage: asystematic review. Stroke 1997; 28(3): 660-4.

6. Willinsky RA, Taylor SM, TerBrugge K, et al. Neurologic complications of cerebral angiography: prospective analysis of 2,899 procedures and review of the literature. Radiology 2003;227:522 528

7. Teskam M, McKinney A, Cakir B, Truwit CL. Multi-slice computed tomography angiography in the detection of residual of recurrent cerebral aneurysms after surgical clipping. ActaRadiol 2004;45:571-576

8. Cloft HJ, Joseph GJ, Dion JE. Risk of intracranial angiography in patients with subarachoid hemorrhage, cerebral aneurysm,andarteriovenous malformation: a meta-analysis. Stroke 1999;30:317-320

9. White PM, Teasdale EM, Wardlaw JM, Easton V. Intracranial aneurysms: CT angiography and MR angiography for detection prospective blinded comparison in a large patient cohort. Radiology 2001; 219(3): 739-49.

10. Pathirana N, Refsum SE, McKinstry CS, Bell KE. The value of repeat cerebral angiography in subarachnoid haemorrhage. Br J Neurosurg 1994; 8(2): 141-6.

11. Yoon DY, Lim KJ, Choi CS, et al. Detection and characterization of intracranial aneurysms with 16-channel multidetector row CT angiography: a prospective comparison of volume rendered images and digital subtraction angiography. AJNR 2007;28:787-794

12. Nael K, Villablanca JP, Mossaz L, Pope W, Juncosa A, Laub G, et al. 3-T contrast enhanced MR angiography in evaluation of suspected intracranial aneurysm: comparison with MDCT angiography AJR Am J Roentgenol. 2008 Feb; 190(2): 1497-502

13. Liang EY, Chan M, Hsiang JH, Walkden SB, Poon WS, Lam WW, et al. Detection and assessment of intracranial aneurysms: value of CT angiography with shaded –surface display. AJR Am J Roentgenol. 1995Dec; 165(6):1497-502

14. Papke K, Brassel F. Modern cross-sectional imaging in the diagnosis and follow-up of intracranial aneurysms. EurRadiol. 2006 Sep; 16(9):2051-66.

15. Agid R, Andersson T, Almqvist H, et al. Negative CT Angiography findings in patients with spontaneous subarachnoid hemorrhage:when is digital subtraction angiography still needed?AJNR 2010;31:696-705.

16. Chen CY, HsiehSC, Choi WM, et al. Computed tomography angiography in detection and characterization of ruptured anterior cerebral artery aneurysms at uncommon location for emergent surgical clipping. Clin Imaging 2006;30:87-93.

17. Sagara Y, Kiyosue H, Hori Y, et al. Limitations of three dimensionalreconstructed computerized tomography angiographyafter clip placement for intracranial aneurysms. *J Neurosurg*2005;103:656-661.

18. Young N, Dorsch NW, Kingston RJ, Markson G, McMahon J. Intracranial aneurysms: evaluation in 200 patients with spiral CT angiography. *EurRadiol*2001;11:123-130.

19. Dammert S, Krings T, Moller-Hartmann W, et al. Detection of intracranial aneurysms with multislice CT: comparison with conventional angiography. Neuroradiology 2004;46:427–34

20. Teksam M, McKinney A, Casey S, et al. Multi-section CT angiography fordetection of cerebral aneurysms. *AJNR Am J Neuroradiol*2004;25:1485–92

21. Kangasniemi M, Makela T, Koskinen S, et al. Detection of intracranial aneurysms with two-dimensional and three-dimensional multislice helical computedtomographic angiography. *Neurosurgery* 2004;54:336–40

22. Jayaraman MV, Mayo-Smith WW, Tung GA, et al. Detection of intracranial aneurysms: multi-detector row CT angiography compared with DSA. *Radiology* 2004;230:510–18

23. Wintermark M, Uske A, Chalaron M, et al. Multislice computerized tomography angiography in the evaluation of intracranial aneurysms: a comparison with intraarterial

digital subtraction angiography. J Neurosurg 2003;98:828–36

24. Tipper G, U-King-Im JM, Price SJ, et al. Detection and evaluation of intracranial aneurysms with 16-row multislice CT angiography. *ClinRadiol*2005;60: 565–72.

25. Anderson GB, Steinke DE, Petruk KC, et al. Computed tomographic angiography versus digital subtraction angiography for the diagnosis and early treatmentof ruptured intracranial aneurysms. *Neurosurgery* 1999;45:1315–20

26. Korogi Y, Takahashi M, Katada K, et al. Intracranial aneurysms: detection with three-dimensional CT angiography with volume rendering—comparison with conventional angiographic and surgical findings. *Radiology* 1999;211:497–506

27. Velthuis BK, Van Leeuwen MS, Witkamp TD, et al. Computerized tomography angiography in patients with subarachnoid hemorrhage: from aneurysm detection to treatment without conventional angiography. *J Neurosurg*1999;91:761–67

28. Cromptom M. Mechanisms of growth and rupture in cerebral berry aneurysms.*BMJ* 1996;1:1138–42

29. FernadezZubillaga A, Guglielmi G, Vinuela F, et al. Endovascular occlusion of intracranial aneurysms with electrically detachable coils: correlation of aneurysmneck size and treatment results. *AJNR Am J Neuroradiol*1994;15:815–20

30. Rubin GD, Shiau MC, Leung AN, et al. Aorta and iliac arteries: single versusmultiple detector-row helical CT angiography. *Radiology* 2000;215:670–76

31. Kato Y, Nair S, Sano H, et al. Multi-slice 3D-CTA: an improvement over single slice helical CTA for cerebral aneurysms. *ActaNeurochir (Wien)* 2002;144:715–22

32. Sugahara T, Korogi Y, Nakashima K, et al. Comparison of 2D and 3D digitalsubtraction angiography in evaluation of intracranial aneurysms.

*AJNR Am J Neuroradiol*2002;23:1545–52

33. Bidaut LM, Laurent C, Piotin M, et al. Second-generation three-dimensional reconstruction for rotational three-dimensional angiography. *AcadRadiol* 1998;5:836–49

34. Tanoue S, Kiyosue H, Kenai H, et al. Three-dimensional reconstructed images after rotational angiography in the evaluation of intracranial aneurysms: surgical correlation. *Neurosurgery* 2000;47:866–71