Original Research Article

Role of computed tomographic (CT) angiography in evaluation of acute non-traumatic subarachnoid haemorrhage (SAH) in tertiary care centre

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Abstract

Background: The annual incidence of non-traumatic sub arachnoid haemorrhage (SAH) is believed to be ranged from approximately 11 to 25 per 100000 population. Aneurysm is the important aetiology for non-traumatic SAH.CT angiography is useful diagnostic tool for detection depending on the size and location of an aneurysm. **Aim:** To study role of CT angiography in evaluation of acute non-traumatic SAH. **Material and Methods:** An observational descriptive hospital-based study was conducted in radiology department of tertiary care centre for two years which included 40 cases of acute non-traumatic SAH admitted in emergency department. **Results:** Mean age was 49.56 years and age ranging from 7 years to 70 years. Male to female ratio was 1:1. Out of total cases 60% patients had aneurysm, 30% cases had arteriovenous malformations (AVM). CT angiography (CTA) correctly diagnosed aneurysm in 97% cases. Common sites for aneurysm were bifurcation of internal carotid artery and posterior carotid artery (33.3%), anterior communicating artery (29.2%) and middle carotid artery (25%). **Conclusion:** CT angiography is a useful method for both diagnosis and management if intracranial aneurysm and arteriovenous malformations. Negative CT angiographic findings in patients with SAH must be assessed with digital subtraction angiography (DSA).
Key Word: DSA, Aneurysm, ICH, MRI.

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Received Date: 09/06/2019 Revised Date: 02/07/2019 Accepted Date: 28/08/2019
DOI: https://doi.org/10.26611/10081131

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 01 September 2019

INTRODUCTION

Patients with throbbing headache accounts for 1% to 2% of visits to the emergency department (ED).[1,2] The annual incidence of non-traumatic sub arachnoid haemorrhage (SAH) is believed to be ranged from approximately 11 to 25 per 100000 population.[3,4] Early detection is critical because about 25% patients may die within 24 hours and without definitive treatment three month mortality is as high as 50%.[5] The current standard of care in ED evaluation of patients present with thunderclap headache is to rule out SAH which begins with non-contrast CT of head. Once SAH is confirmed, it is paramount to detect the source of bleeding in order to initiate therapy. Aneurysm is the important aetiology for non-traumatic SAH. The reported sensitivity of CT angiography lies in the range of 80 to 97% depending on the size and location of an aneurysm[6,7]. Same CT angiography data may lead to varying detection rates when different visualization strategies, computer platform and graphic hardware are used.[8,9] Our aim of study to use CT angiographic data and

How to cite this article: Sushant H Bhadane, Sapana S Bhadane. Role of computed tomographic (CT) angiography in evaluation of acute non-traumatic subarachnoid haemorrhage (SAH) in tertiary care centre. *MedPulse – International Journal of Radiology.* September 2019; 11(3): 97-101. http://www.medpulse.in/Radio%20Diagnosis/

various 2D and 3D post processing techniques for detection of aetiology of non-traumatic SAH in acute emergency settings and direct patients for intervention or other diagnostic imaging modality in cases of negative CT angiography and thus set up a protocol for evaluation of patients of non-traumatic SAH in acute settings.

MATERIAL AND METHODS

An observational descriptive hospital-based study was conducted in radiology department of tertiary care centre from August 2005 to August 2007. Institutional Ethical Committee (IEC) permission was sought before data collection. Patients coming to Emergency Department (ED) with one of the mentioned complaints like sudden onset of severe headache over 60 seconds or less of different in quality and intensity from previous headaches, associated with altered mental status, loss of consciousness with or without neurological deficits and detected SAH on plain non-contrast enhanced CT scans were included. Also patients with known SAH presenting acutely with sudden deterioration of neurological status were included. Patients having history of an allergic reaction to contrast dye or iodine allergy, evidence of renal insufficiency as determined by a measured serum creatinine level >2.0 mg/dl and pregnant females were excluded. Valid informed consent and ascent were taken from patients before data collection. Data about sociodemographic parameters was collected through interview. Thorough general and systemic clinical examination was performed. After that radiological diagnostic imaging was performed. Standard operating protocol and definitions were set up before commencement of study and followed till end.

Specifications and scanning protocol: All patients were scanned on Siemens Somatom Volume Zoom Multislice Spiral CT scanner (Siemens Limited). Initially a plain scan was done to confirm SAH. CT angiography (CTA) can be defined as a fast thin-section volumetric spiral (helical) CT examination performed with a time-optimized bolus of contrast medium in order to enhance the cerebral arteries. In order to visualize the intracranial arteries, the examination included the region from the first vertebral body up to the vertex. It was important to include the atlas in the study to ensure incorporation of the posterior inferior cerebellar artery (PICA), which had an extra cranial origin from the vertebral arteries in about 18% of cases. For enhancement of intracranial arteries, 70 mL of contrast medium (lohexol 300 mg %w/v) was injected intravenously at a flow rate of 3-4 mL/sec by using power injector (pressure injector; Medrad). A bolus tracking method was used routinely to achieve optimal synchronization of contrast medium flow and scanning. Once the injection is started, the bolus tracking software measures attenuation values within one internal carotid artery (ICA), and the spiral scan automatically started as soon as a threshold of 80 HU is exceeded. On our four-row multisection scanner (Somatom 4 Volume Zoom, Siemens Medical Solutions). We used the following parameters: 120 kVp, 200 mAs, collimation of 4 × 1 mm, table feed of 2. 7 mm per rotation, and rotation time of 0. 5 seconds. Image reconstruction parameters were section thickness of 1. 00 mm, overlapping steps of 0. 8 mm, and field of view (FOV) of 120 mm^2. It is possible to perform reconstructions in steps of 0.23 mm to produce isotropic data thus yielding voxels of equal extent in all three dimensions. In our experience, this does not noticeably increase image quality while doubling the number of source images, thus leading to an extension of time spent on post processing of source data. The images of the patient were studied with the regular software of the workstation supplied with a Somatom Volume Zoom CT scanner (Syngo Wizard, Siemens Medical Solutions). The dVR images were created on a separate workstation (3D Virtuoso; Siemens Medical Solutions). Data was entered in Microsoft Excel 2007 and analysed with SPSS v.21. Descriptive statistics like mean, standard deviation, frequency and proportion were used. Table, graphs and figures were put at appropriate places to summarize results.

RESULTS

In this study, a total of 40 patients who were proven cases of Sub Arachnoid Haemorrhage (SAH) on non-enhanced CT scans were enrolled. All patients had presented with history of throbbing headache or unconsciousness at the time of diagnosis. All the patients underwent CT angiography. Table no. 1 highlights age and gender wise distribution of cases. Out of 40 cases, 20 were males and 20 were females. Among males, highest number of patients were of age group 41 to 50 years (30%) followed by 31 to 40 years (25%) and 11 to 20 years (15%). Among females, highest number of patients were of age group 41 to 50 years (30%) followed by 61 to 70 years (20%) and 11 to 20 years (20%). Overall, male to female ratio was 1:1. Among both sexes, highest number of patients were from age group of 41 to 50 followed by 31 to 40years and 11 to 20 years of age. Age range was 7 years to 70 years of age. Figure no.1 depicts aetiological factors present among cases. Out of 40 patients, 24 patients were found to have aneurysm, 12 patients were found to have arteriovenous malformations and in remaining 4 patients, no aetiology found on CT angiography. Out of 24 aneurysm detected on CT angiography, 1 was falsely diagnosed as aneurysm and was found to be infundibular dilatation of posterior communicating artery. Out of 36 patients in which

causative factor was detected on CT angiography, 16 were confirmed on neurosurgical examination and remaining twenty underwent digital subtraction angiography (DSA). Table no. 2 shows distribution of sites of aneurism in males and females. Overall bifurcation of internal carotid artery and posterior carotid artery was commonest site (33.3%) followed by anterior communicating artery (29.2%), middle carotid artery (25%). Aneurysm at basilar and posterior circulation arteries was less. Among males, anterior communicating artery and bifurcation of internal carotid artery and posterior carotid artery were common sites while in females, middle carotid artery and bifurcation of internal carotid artery and posterior carotid artery were common sites. Out of 24 aneurysm cases detected on CT angiography, 11 were males and 13 were females.

Table 1: Age and Gender wise distribution of study subjects (n=40).

Age group (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
<11	1	5	0	0	1	2.5
11 to 20	3	15	4	20	7	17.5
21 to 30	2	10	1	5	3	7.5
31 to 40	5	25	2	10	7	17.5
41 to 50	6	30	6	30	12	30
51 to 60	2	10	3	15	5	12.5
61 to 70	1	5	4	20	5	12.5
Total	20	50	20	50	40	100

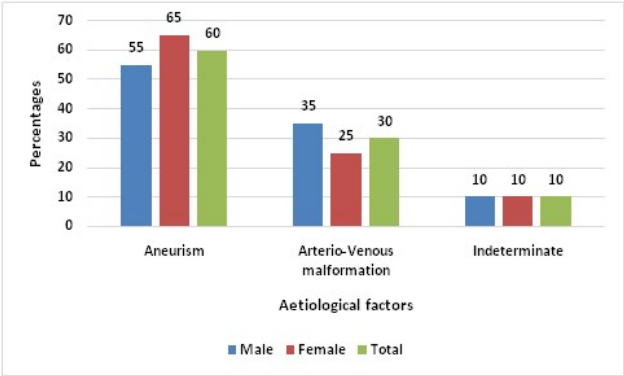

Figure 1: Aetiological factors among cases (n=40).

Table 2: Gender wise distribution of sites of aneurysm.

Site*	Male	Female	Total	%
ACOM	4	3	7	29.2
Bifurcation of ICA and PCA	4	4	8	33.3
MCA	2	4	6	25.0
Basilar	1	1	2	8.3
Posterior circulation arteries	0	1	1	4.2
Total	11	13	24	100.0

*ACOM- Anterior Communicating Artery; ICA- Internal Carotid Artery; PCA: Posterior Carotid Artery; MCA: Middle Carotid Artery.

DISCUSSION

The most reliable method for establishing the diagnosis of SAH is computerized tomography. It should be done as soon as possible as 98% CT scans are positive for SAH within 12 hours and 95% within 24 hours and pick up rate then decreases to 73% on day three.[10] CT Angiography (CTA) is a primary imaging and useful management utility in patients presenting with acute non-traumatic sub arachnoid haemorrhage (SAH) which reduces time required for diagnosis as well as medical costs.[11] In present study, all patients presenting with acute non-traumatic SAH underwent a CTA of the head. It identified an aneurysm as the cause of SAH in 97% of patients. In present study, mean age was 49.56 years and age ranging from 7 years to 70 years. Male to female ratio was 1:1. Study done by Heit *et al*[12] reported mean age of 54 years with age range from 19 to 92. In their study, male to female ratio was 1.05:1. Study done by Domitille *et al*[13] reported average of 54 years with age range from

27 years to 84 years of age and male to female ratio of 1:0.78. Aaron *et al*[14] reported throbbing headache was commonest symptoms. Similar finding was noted in present study. In present study, out of total cases 60% patients had aneurysm, 30% cases had arteriovenous malformations (AVM). CT angiography (CTA) correctly diagnosed aneurysm in 97% cases. Digital subtraction angiography identified aneurysms in approximately 3% of patients with CTA negative for sub arachnoid haemorrhage. Study done by Heit *et al*[12] reported vasculitis or vasculopathy(7%), aneurysm(5%), AVM(1%) and arteriovenous fistula. These findings are different from that noted in present study. Prior studies reported findings about aetiology and also noted down that DSA identified aneurysms in approximately 3%.[15,16] Kitkhuandee *et al*[17] reported 57.6% aneurysm, 4.2% arteriovenous malformation (AVM) and 0.8% Moyamoya disease. In present study common sites for aneurysm were bifurcation of internal carotid artery and posterior carotid artery (33.3%), anterior communicating artery (29.2%) and middle carotid artery (25%). In study done by Domitille *et al*[13] middle cerebral artery, anterior complex artery and internal carotid artery were common sites. Kitkhuandee *et al*[17] reported anterior communicating artery(35.5%), posterior communicating artery (17.1%), middle cerebral artery (15.7%), internal carotid artery (11.8%), basilar artery (2.6%),vertebra-basilar junction (1.3%) and 10.5% others as a sites of aneurysm. Heit *et al*[12] reported the distribution of SAH which was diffuse (40%), perimesencephalic (31%) and sulcal (16%). These findings are similar to the distribution found in present study. Similar findings were also reported by previous studies.[15,16,18] Aneurysm involving skull base did not show very well on 3D images. Analysis was more easily performed by using the sectional images. Intra-aneurysmal thrombosis or calcification of aneurysm wall were easily recognized on section images.

CONCLUSION

CT angiography is a useful method for both diagnosis and management if intracranial aneurysm and arteriovenous malformations. Resent technical developments such as multiscan CT and high resolution dVR provide CT angiographic images of better quality. Negative CT angiographic findings in a patient with sub arachnoid haemorrhage (SAH) must be assessed with digital subtraction angiography (DSA).

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Source of Support: None Declared
Conflict of Interest: None Declared