Evaluation of Subarachnoid Hemorrhage: A Role of Catheter Angiography

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ABSTRACT

INTRODUCTION: Computer tomography (CT) scan is the gold standard for detecting subarachnoid haemorrhage and angiography for visualizing the vascular pathology.

METHODS: A prospective hospital based study with a primary aim to study role of CT with Catheter Angiography for evaluation of subarachnoid hemorrhage (SAH). Forty consecutive patients with diagnosis of SAH either from emergency department or ward attending the Radiology Department, Bir Hospital were enrolled into the study. CT Scanning and Catheter Angiography were carried out by the experienced radiologists

RESULTS: Among 40 CT positive SAH patients, aneurysm was found in 85% of the total patient by catheter angiography. Most common age group of patients both in CT positive SAH as well as catheter angiography positive SAH was 51-65 years age group, least common age group being >65 years of age. 34 cases were angi positive (Aneurysmal SAH) which comprised 85%. Among total number of cases of aneurysmal SAH, 31 out of 40 patients(77.5%) were with single aneurysm followed by 3 out of 40 patients(7.5% ) with multiple aneurysm and 6 out of 40 (15%) were without aneurysm.

CONCLUSION: CT scan with catheter angiography is very good tool to detect vascular pathology in patients with subarachnoid hemorrhage

KEY WORDS: Angiography, MCA, PCoA, Subarachnoid Hemorrhage, CT scan

INTRODUCTION

Subarachnoid hemorrhage (SAH) is defined as bleeding into the subarachnoid space (the area between the arachnoid membrane and the piamater surrounding the brain) 1.

If SAH is suspected, CT scanning is the first line of investigation because of the characteristically hyperdense appearance of extravasated blood in the basal cisterns. A false-positive diagnosis of SAH on CT is possible in the presence of generalized brain edema, which causes venous congestion in the subarachnoid space. Brain CT may also help in distinguishing primary SAH from traumatic brain injury. If trauma is the cause of SAH, the blood is usually confined to the superficial sulci at the convexity of the brain, adjacent to a fracture or to an intracerebral contusion. 2

Magnetic resonance imaging (MRI scan) may be more sensitive after several days, compared to CT Scanning. MRI with FLAIR (fluid attenuated inversion recovery) techniques demonstrates SAH in the acute phase as reliably as CT. MRI is increasingly superior to CT in detecting extravasated blood. This makes MRI a unique method for identifying the site of the hemorrhage in patients with a negative CT scan but a positive lumbar puncture. After a subarachnoid hemorrhage
is confirmed, its origin needs to be determined. The gold standard for detecting aneurysms is catheter angiography. Other imaging modalities are MR angiography (MRA) and CT angiography (CTA). CT is the “gold standard” for detecting SAH and angiography for visualising the vascular pathology. Angiography is an X-ray examination of blood vessels when they are filled with a contrast medium. This type of study in our setting will help us to establish the primary cause of SAH and site of the hemorrhage in patients with a positive CT scan, so will be easier to institute the definitive treatment of SAH.

SAH may occur spontaneously, usually from a cerebral aneurysm, or may result from trauma. Symptoms include an intense headache, vomiting, an altered level of consciousness and signs of meningeal irritation. Risk factors for SAH are smoking, hypertension, excessive alcohol intake, genetic, sympathomimetic drugs. Some protection of uncertain significance is conferred by Caucasian ethnicity, hormone replacement therapy, and high cholesterol level and diabetes mellitus. SAH is associated with a high mortality rate.

Improved diagnostic accuracy over time, including exclusion of SAH mimics, may also be playing a role. If SAH is suspected, CT Scanning is the first line of investigation because of the characteristically hyper dense appearance of extravasated blood in the basal cisterns. Brain CT may also help in distinguishing primary SAH from traumatic brain injury. If trauma is the cause of SAH, the blood is usually confined to the superficial sulci at the convexity of the brain, adjacent to a fracture or to an intracerebral contusion. SAH is often a devastating event. Level of consciousness on admission, patient age, and the amount of blood on initial head computed tomography (CT) scan are the most important prognostic factors for SAH at presentation. Magnetic resonance imaging (MRI scan) may be more sensitive after several days, compared to CT Scanning.

MRI with FLAIR (fluid attenuated inversion recovery) techniques demonstrates SAH in the acute phase as reliably as CT. The gold standard for detecting aneurysms is catheter angiography. This type of study in our setting will help us to establish the primary cause of SAH and site of the hemorrhage in patients with a positive CT scan, so will be easier to institute the definitive treatment of SAH.

MATERIALS AND METHODS

40 consecutive patients fulfilling the inclusion criterion with diagnosis of SAH, either from emergency department or ward attending the Radiology Department, Bir Hospital over a period of one year were enrolled in the study.

INCLUSION CRITERIA:

Patients with SAH who accept to undergo both CT scan and Catheter Angiography.

EXCLUSION CRITERIA:

Patients who accept only one imaging modality and Patient or guardian not giving the consent.

History and clinical findings were recorded from the relatives of the patient in a pre designed Data collection form. CT Scanning and Catheter Angiography were carried out by the experienced radiologists or by trainee under supervision. Each lesion was assessed by at least two experienced radiologists involved. For angiography, catheter was introduced into femoral, axillary or carotid artery by seldinger needle with trocar and cannula, the dye was injected through the cannula confirmed by image intensifier fluoroscopy which showed the involved pathology. Strong asepsis was maintained during the procedure. Collected data was analyzed using SPSS program and Microsoft Excel Software.

RESULTS:

![Figure 1. Catheter Angiography finding (AVM, AVM with aneurysm and aneurysm)](image)

In the present study 34 cases were positive (Aneurysmal SAH which comprises 85% and 6 cases were negative (Non Aneurysmal SAH) which comprises 15% among the total 40 cases.
The study had shown that 31 patients with single aneurysm which comprises 77.5%, 3 patients had multiple aneurysm which comprises 7.5% and others 6 (15%) were of no aneurysm in the total number of cases.

### Table no. 1 Correlation between CT and angiography findings of SAH

<table>
<thead>
<tr>
<th>Age</th>
<th>CT Findings (%)</th>
<th>Angiography +ve Aneurysm (%)</th>
<th>Angio-ve Non-aneurysm (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-50</td>
<td>9 (22.5)</td>
<td>8 (20)</td>
<td>1 (2.5)</td>
</tr>
<tr>
<td>51-65</td>
<td>24 (60)</td>
<td>21 (52.5)</td>
<td>3 (7.5)</td>
</tr>
<tr>
<td>&gt;65</td>
<td>7 (17.5)</td>
<td>5 (12.5)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Total</td>
<td>40 (100)</td>
<td>34 (85)</td>
<td>6 (15)</td>
</tr>
</tbody>
</table>

In the study all 40 patient were CT positive SAH whereas when angiography was done it was only 85% of the total patient. Most common age group for CT as well as angiography were 51-65 years age group, least common age group being >65 years age group followed by 36-50 age group.

### Table no. 2 Catheter Angiography finding (AVM, AVM with aneurysm and aneurysm)

<table>
<thead>
<tr>
<th>Angiographic Findings</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACoA</td>
<td>14</td>
<td>35.0</td>
</tr>
<tr>
<td>MCA</td>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td>PCoA</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>No findings</td>
<td>6</td>
<td>15.0</td>
</tr>
<tr>
<td>ACA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>ACA WITH MCA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>AVM</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>AVM With ACA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>BA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>BILATERAL ACA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>BILATERAL MCA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>ICA</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Among the 40 cases enrolled in the study 14 (35%) were found to be aneurysm of ACoA followed by 7 (17.5%) of MCA, 5 (12.5%) PCoA, 1 (2.5%) ACA, 1 (2.5%) B/L ACA, 1 (2.5%) ACA with MCA, 1 (2.5%) B/L MCA, 1 (2.5%) ICA, 1 (2.5%) BA, 1 (2.5%) AVM with ACA and the others 1 (2.5%) AVM and 6 (15%) were found to be of no finding.

### DISCUSSION

In this study, Out of 40 in one third of patients CT was done 2 days of onset of symptom and in remaining two third it was done 3 days after onset of symptoms respectively. Delayed scan is probably due to lack of health education, availability of CT scan in nearby health centre.

The cornerstone of SAH diagnosis is the noncontrast head CT scan. Clot is demonstrated in the subarachnoid space in 92 percent of cases if the scan is performed within 24 hours of the bleed. Intracerebral extension is present in 20 to 40 percent of patients and intraventricular and subdural blood may be seen in 15 to 35 and 2 to 5 percent, respectively. The head CT scan should be performed with thin cuts through the base of the brain to increase the sensitivity to small amounts of blood.\(^8\)

The sensitivity of head CT for detecting SAH is highest in the first 12 hours after SAH (nearly 100 percent) and then progressively declines over time to about 58 percent at day five. The sensitivity of head CT is also reduced with more minor bleeds. In one study, for example, a minor SAH was not diagnosed by CT scan in 55 percent of patients; lumbar puncture was positive in all cases.\(^9\) Among 40 patients, 8 (20%) angiography was done 10 days after the CT scan and 8 (20%), 4 (10%), 3 (7.5%), 5 (12.5%), 5 (12.5%), 3 (7.5%), 3 (7.5%), 1 (2.5%) angiography were done on 11,12,13,14,15,16,17 and 18 days respectively after the CT scan.

Zuccarello M et al.\(^{10}\) reported Fifty cases of subarachnoid haemorrhage from aneurysms in which CT gave direct evidence of aneurysm in 13 cases and indirect signs in 25 cases. In the remaining 12 cases the aneurysm could not be located. Apart from this they were able to demonstrate 16 intraventricular haemorrhages, 16 intracerebral haemorrhages, six cases of oedema of the brain, nine subarachnoid haemorrhages and, finally on 31 occasions enlargement of the ventricles.
Within the last decade, diagnostic and interventional angiography have been developed to a high degree of performance, due to the widespread use of DSA, the miniaturization of the puncture trauma and the introduction sets (catheters, sheaths), the development of high-tech materials (e.g., Nitinol guidewires) and the application of non-ionic, low osmolality contrast media. The specific risks of the procedure, thereby, have been significantly reduced, but could not be totally eliminated. To evaluate vascular diseases non-invasively, special attention was attributed to the progress of colour coded duplex, (spiral) CT-angiography and (CE) MR-angiography, based on the established imaging with US, CT and MRA.

Karttunen AI et al.11 had stated that the CT is the "gold standard" for detecting SAH and angiography for visualizing the vascular pathology.

Our study showed 34 cases were angio positive (Aneurysmal SAH) which comprises 85% and 6 cases were angio negative (Non Aneurysmal SAH) which comprises 15% among the total 40 cases. Among total 34 cases of aneurysmal SAH, 31 patients had single aneurysm which comprised 90.8% and 3 patients had multiple aneurysms which comprised 9.2 %. Among the types of aneurysm 27 (79.49%) were saccular type and 7 (20.51%) were fusiform type.

Massoud TF et al.12 studied and reported in North America 80-90% of non-traumatic cases caused by rupture of intracranial aneurysm. Another 15% is associated with bleeding from AVM and the remaining 5% is caused by various other lesions such as carotid artery dissection.

Among the 40 cases enrolled in the study 14 (35%) were found to be aneurysm of ACoA followed by 7 (17.5%) of MCA, 6 (15%) PCoA, 1 (2.5%) ACA, 1 (2.5%) B/L ACA, 1 (2.5%) ACA with MCA, 1 (2.5%) B/L MCA, 1 (2.5%) ICA, 1 (2.5%) BA, 1 (2.5%) AVM, 1 (2.5%) AVM with ACA.

The aneurysm which is located in the anterior circulation was 33 which comprise 97%, in the posterior circulation 1 comprising 3% among the 34 cases of aneurysms.

Osborn AG.13 had described the common locations are the anterior communicating artery 30-35%, the posterior communicating artery 30-35%, middle cerebral artery 20% and five percent arise from basilar artery, 5% arises from posterior fossa vessels.

We had 34 cases comprising 85% angiography positive cases which consisted of 21 (52.5%) female and 13 (32.5%) male from total 40 patients in the study. In the study all 40 patient were CT positive SAH whereas when angiography was done it was only 85% of the total patient. Most common age group for findings in CT as well as angiography were 51-65 years age group, least common age group being >65 years age group followed by 36-50 years age group.

Pinto AN et al.14 studied and revealed that angiography is usually recommended in perimesencephalic subarachnoid haemorrhage (PM SAH) to rule out a basilar artery aneurysm. However it is not known how often aneurysms are found among patients with a CT pattern of PM haemorrhage or the frequency of this CT pattern after rupture of posterior circulation aneurysms. CTs of all SAH caused by posterior circulation aneurysms admitted from 1/85 to 12/92 where reviewed by two examiners. Late (> 72h) examinations were excluded. The remaining CTs were classified in perimesencephalic (PM) or non PM. Total 81 posterior circulation aneurysms were collected. Only one PM-like CT pattern was found, due to ruptured posterior communicating artery aneurysm. During the same period 37 PM SAH with negative angiographic results were admitted. The likelihood of finding an aneurysm in a patient with an early CT showing a PM distribution of haematic densities was 2.7%. Although the probability of finding an aneurysm in a SAH patient with a PM CT pattern is low, a complete 4-vessel angiogram must be obtained.

**CONCLUSION:**

The present study showed that the catheter angiography is very good diagnostic tool in the setup like ours where ancillary diagnostic modalities are out of reach of the majority of our population. Subsequent use of these diagnostic modalities is very helpful in identifying the site of the bleed and localization of the cerebral aneurysm.

**REFERENCES**


