



CT Angiography detection of ruptured intracranial aneurysms with subarachnoid hemorrhage in a hospital-based population

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Abstract

Background: Rupture of an intracranial aneurysm presents as subarachnoid hemorrhage (SAH). SAH is a catastrophic event with an overall mortality rate varying from 32-37%. It may be commonly associated with intraparenchymal hemorrhage (IPH), intraventricular hemorrhage (IVH), subdural hemorrhage (SDH).

Objectives: To know the frequency, most common site of aneurysms and associated anatomical variants in patients with ruptured intracranial aneurysms.

Material and Methods: The study includes 150 patients who have undergone CT Angiography at with symptoms like headache, neck stiffness, and clinically diagnosed SAH. The required data were collected on a retrospective basis from the database available at Great eastern medical school and hospital from January 2017 to March 2019. From the obtained data, the prevalence, common site of intracranial aneurysms and anatomical variants (if any) were evaluated.

Results: A total of 150 patients have undergone non-contrast CT and further angiographic imaging at Great eastern medical school and hospital from January 2017 to March 2019, of which 20 patients were documented with ruptured intracranial aneurysms. Of these patients, the mean age was 51 years with equal incidence in males and females. 65% of the aneurysms were seen on the left and 35% on the right side. 84% of the aneurysms were in the anterior circulation and 16% in the posterior circulation. Isolated aneurysms were seen in 70% and synchronous aneurysms in 30% of the study population. The most common site of aneurysms was in the supraclinoid ICA corresponding to 34.6%. The other sites were 30.7% in MCA, 11.5 % in Acom, 11.5% in PCA, 3.8% in Pcom, 3.8% in ACA and 3.8% in Vertebral arteries respectively. Anatomical variants were seen with 25% of the study population, predominantly in the posterior circulation.

Conclusion: Any CT scan showing an intraparenchymal hemorrhage in the temporal lobe, with or without a frontal, parietal and intraventricular extension should be looked in for any ruptured aneurysms even in the absence of SAH.

Keywords: Subarachnoid hemorrhage, Aneurysm, CT Angiography.

Introduction

Rupture of an intracranial aneurysm presents as subarachnoid hemorrhage (SAH) due to the flow

of blood into the subarachnoid space. The variations in the major intracranial vasculature increase the hemodynamic stress and lead to

developing an aneurysm, arteriovenous malformation, or cerebrovascular disease. SAH is a catastrophic event with an overall mortality rate varying from 32-37%. It may be commonly be associated with intraparenchymal hemorrhage (IPH), intraventricular hemorrhage (IVH), subdural hemorrhage (SDH) in up to 34, 17, and 35% cases, respectively¹.

Material and Methods

The study includes 150 patients who have undergone CT Angiography at GEMS as directed by the clinician presenting with symptoms like headache, neck stiffness, and clinically diagnosed SAH. The required data were collected on a retrospective basis from the database available at Great eastern medical school and hospital from January 2017 to March 2019. The database was searched for patients with ruptured intracranial aneurysms, intraventricular and subarachnoid hemorrhages on non-contrast CT and CT angiography imaging. Those patients with angiographically documented aneurysms were reviewed with non-contrast CT and CT angiography images. From the obtained data, the prevalence, common site of intracranial aneurysms and anatomical variants (if any) were evaluated.

Results

There were a total of 150 patients who have undergone non-contrast CT and further angiographic imaging at Great eastern medical school and hospital from January 2017 to March 2019, of which 20 patients were documented with ruptured intracranial aneurysms. Of these patients, the mean age was 51 years with equal incidence in males and females. 65% of the aneurysms were seen on the left and 35% on the right side. 84% of the aneurysms were in the anterior circulation and 16% in the posterior circulation (Figure 1). Isolated aneurysms were seen in 70% and synchronous aneurysms in 30% of the study population. The most common site of aneurysms was in the supraclinoid ICA corresponding to

34.6%. The other sites were 30.7% in MCA, 11.5% in Acom, 11.5% in PCA, 3.8% in Pcom, 3.8% in ACA and 3.8% in Vertebral arteries respectively (Figure 2). Anatomical variants were seen with 25% of the study population, predominantly in the posterior circulation.

PERCENTAGE OF ANEURYSMS IN ANTERIOR AND POSTERIOR CIRCULATION

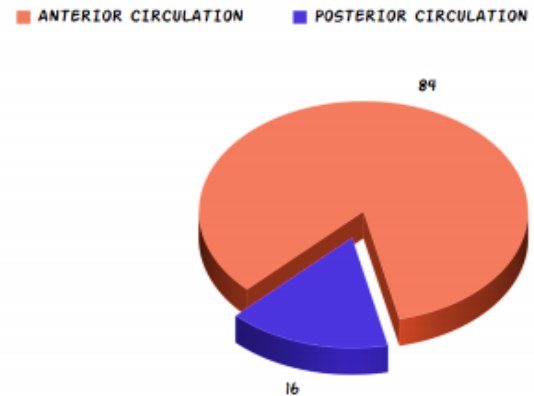


Fig.1: Percentage of aneurysms in the anterior and posterior circulation.

PERCENTAGE OF ANEURYSMS IN INTRACRANIAL VESSELS

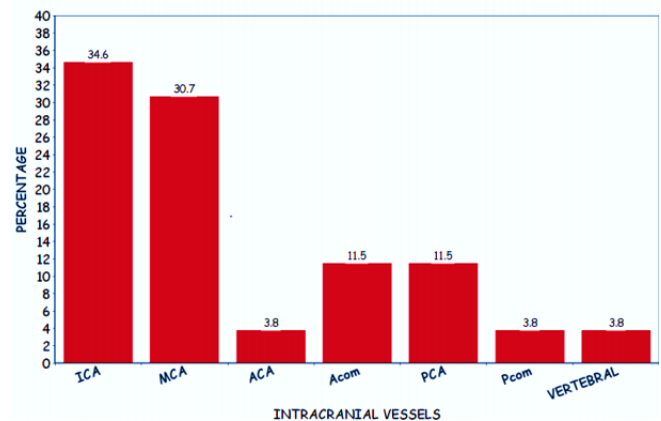


Fig.2: Percentage of aneurysms in intracranial circulation.



Fig.3: Volume rendering and axial CT angiography images of brain showing images of cerebral vessels with aneurysm involving the right PCA with aplastic left A1

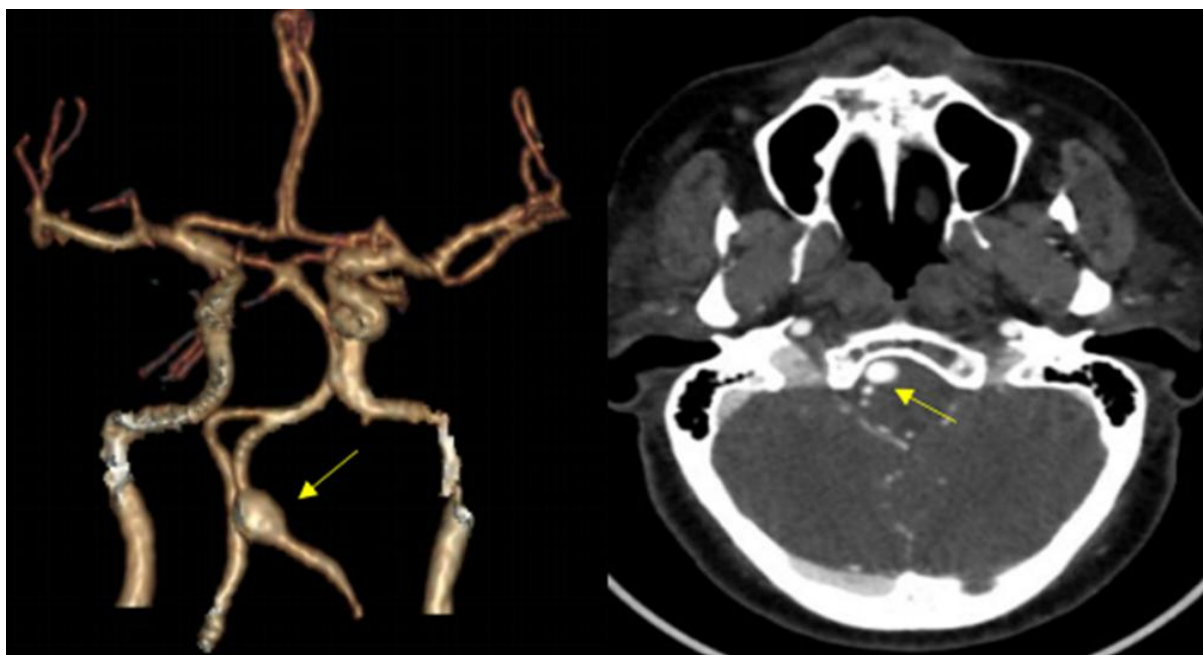


Fig. 4: Volume rendering and axial CT angiography images of the brain showing images of cerebral vessels with aneurysm involving the left vertebral artery

Discussion

Subarachnoid hemorrhage is most commonly caused due to the rupture of an intracranial aneurysm, head injury, cerebral arteriovenous malformation, arteriovenous fistula, etc. Aneurysmal rupture may also present with intraparenchymal hemorrhage (IPH), intraventricular hemorrhage (IVH), or subdural

hemorrhage in 34%, 17% and 35% of cases, respectively¹. Aneurysmal SAH is considered to be a medical emergency leading to death and permanent disability in nearly 50% of the survivors. It has a mortality rate ranging from 32-67%². Risk factors for the development of intracranial aneurysms include both inherited and acquired causes [Table 1a,1b]³.

Table 1a. Genetic conditions predisposing to aneurysm formation and subarachnoid hemorrhage

Adult polycystic kidney disease
 Coarctation of aorta
 Marfan's syndrome
 Hereditary hemorrhagic telangiectasia
 Ehlers-Danlos syndrome
 α 1 antitrypsin deficiency

Table 1b. Acquired risk factors for intracranial aneurysms [2]

Increasing age
 Hypertension
 Smoking
 Alcohol abuse
 Estrogen deficiency
 Hypercholesterolemia
 Carotid artery stenosis

Jianfeng Liu et al. analyzed the relationship between demographic factors, medical history, aneurysmal features, and Fischer grades as a measure of hemorrhagic volume⁴. Patients with ruptured intracranial aneurysms present with the characteristic symptoms of "worst headache of life," nausea, vomiting, loss of consciousness, seizures, and neck stiffness^{5,6}. The most crucial aspect that influences the volume of SAH is the site of the aneurysm, which predisposes them to hemorrhage directly into the parenchyma or ventricular system. CT Angiography, MR Angiography, and transcranial color-coded ultrasonography (TCCD) are the noninvasive techniques used in cases of ruptures intracranial aneurysms presenting with SAH. However, digital subtraction angiography remains the gold standard for the identification of the source of the bleed. High resolution multidetector computed tomography (CT) head scan is widely available and is considered as the primary investigation in patients with suspected SAH with a sensitivity of 95% on the day of hemorrhage⁷. It can demonstrate the source of the bleed and space-occupying lesions, causing mass effect such as obstructive hydrocephalus. Van Gijn J et al. stated that the sensitivity of the CT scanner to

detect a SAH continues to decrease and is 50% sensitive after one week and 30% after two weeks of hemorrhage⁸. Intracranial aneurysms are saccular, dissecting, fusiform, serpentine, blood blister type, traumatic, mycotic, atheromatous, etc. of which, saccular noted to be the most common type. Based on the size, they were categorized as small(<15mm), large(15-25mm), giant (25-50mm) and supergiant(>50mm). Most of the intracranial aneurysms encountered were small and subcategorized as small(<5mm) and medium (5-15mm)⁹. CT Angiography is a quick and noninvasive procedure that helps in the delineation of aneurysms and vascular spasm. It can depict the ruptured intracranial aneurysms with a pooled sensitivity and specificity of 98 and 100% respectively. Small aneurysms located near the skull base may be missed on a CT scan, which can be reduced by subtraction methods from enhanced to unenhanced data and selective bone removal, or "matched mask bone elimination." Brian JL et al. stated that 85% of the aneurysms were located around the anterior communicating artery (30-35%), the posterior communicating artery (30-35%), the middle cerebral artery bifurcation (20%), the basilar artery (5%) and the internal carotid artery (ICA

)terminus or posterior wall¹⁰. This study comprises a total of 150 patients who have undergone NCCT for headache, seizures and suspected SAH at Great Eastern Medical School and Hospital from November 2016 to December 2018, of whom 20 patients were documented with ruptured intracranial aneurysms. Further imaging was done with computed tomography angiography (CTA). In this study, there is an equal incidence of SAH in males and females. The mean age of presentation was 51 years, with saccular being the most common type of aneurysm comprising of about 53.57%. In our series, eight ICA and seven MCA aneurysms led to intraparenchymal hemorrhage into the adjacent temporal lobe. As the dome, which is the weakest portion of the aneurysm points laterally, it bled into the temporal lobe. Multiple aneurysms accounted for 25% in our study, predominantly on the left side and were associated with higher bleeding volumes. Specific aneurysmal sites are seen related to anatomical variations in the major intracranial vessels. Krzyzewski RM et al. stated aplasia/hypoplasia of the A1 segment of ACA is most commonly associated with aneurysm formation, comprising up to 36%. According to Orakdogan M et al., arterial hypoplasia/aplasia were the most common vascular variants associated with aneurysms. Thorough knowledge of these variants is essential for proper treatment and to increase the success rate in the management of the patient. Endovascular coiling and surgical clipping are useful to treat large and symptomatic aneurysms. Small aneurysms <7mm are unlikely to rupture, but if rupture occurs, it leads to devastating consequences.

Conclusion

Any CT scan showing an intraparenchymal hemorrhage in the temporal lobe, with or without a frontal, parietal and intraventricular extension, should be looked in for any ruptured aneurysms even in the absence of SAH. Our study showed ruptured intracranial aneurysms with subarachnoid hemorrhage in 13% of the study

population with no gender predilection. Left supraclinoid ICA was the most common vessel involved, and fetal PCA was the common anatomical variant associated with ruptured intracranial aneurysms.

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