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Subarachnoid Hemorrhage; An Angiographic Evaluation in Iran

Background/Objectives: The evaluation of different aspects of subarachnoid hemorrhage (SAH) can effectively improve the outcomes of this fatal disease.

This article presents some information about angiographic and epidemiologic findings in 580 cases of SAH in Iran.

Materials and Methods: We reviewed the records of 580 SAH patients in whom the disease was proved by brain CT scan and/or lumbar puncture. In all of the patients, a standard subtraction brain angiography was done.

Results: Sixty percent of all patients were male and about sixty percent of patients were aged 30-60years. The angiogram showed: aneurysm in 23.4%, arteriovenous malformation in 14.1%, and miscellaneous problems in 6.3%. The angiogram was normal in the remained 56%. The mean age of aneurysm patients was 46 years, and 59% of them were male. 33.6% of aneurysms resided in A.C.A, 31% in I.C.A (14.1% of total aneurysms located in P.Comm.A), 24.8% in MCA and 10.7% of aneurysm were located in posterior circulation.

Conclusion: The high prevalence of the disease in men could be due to the relatively high exposure of men to certain risk factors, such as smoking, or the ethnic factors may play a role. The lower mean age could be due to high percentage of men. Low prevalence of P.Comm.A aneurysms could be due to ethnic factors.

Keywords: subarachnoid hemorrhage, cerebral aneurysms, angiography, epidemiologic characteristics

Introduction

Of all the cerebrovascular accidents, 3% are due to subarachnoid hemorrhage, However ,brain infarctions subsequent to subarachnoid hemorrhage is responsible for 5% of the deaths due to brain infarctions.[1] The mortality rate (including the deaths before admission to hospital) may exceed 50%,[1] Some studies show that 12% of patients die before they reach hospital and the one-year survival has been estimated 45-57%.[2] Half of the survivors will suffer neurological deficits because of the primary hemorrhage and/or its complications such as rupture, hydrocephalus, and vasospasm. The annual incidence of subarachnoid hemorrhage differs from 6 to 26 in one hundred thousand.[3] The etiologies are divided into traumatic (most common) and non-traumatic (spontaneous).[1-3]Intracranial aneurysms are the most common cause of non-traumatic subarachnoid hemorrhage, being responsible for 60-85% of cases;[1-4] arteriovenous malformations rank second (5-10%).[2,5] A group of other causes such as mycotic aneurysms and tumoral causes come as the third. Intracranial aneurysms usually arise from the circle of Willis and its branches.[3,5] The location of an aneurysm not only is important for the patient management but also affects the clinical presentation. Some avoidable factors such as hypertension, cigarette smoking and alcohol consumption can be probable causes of aneurysm formation or hemorrhage.[1,7] According to the aforementioned points, the main goals of our study, that was done for the first time in Iran and comprises 580 cases, were as follows:

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1- Finding some epidemiologic characteristics in 580 cases of subarachnoid hemorrhage in Iran 2- Evaluating the etiologies and their angiographic presentations. 3- Discerning the anatomical distribution of cerebral aneurysms.

Materials and Methods

We reviewed records of patients with a definite diagnosis of subarachnoid hemorrhage based on their CT-Scan images or lumbar puncture findings. Brain four-vessel angiography was done in Medical Imaging Center, affiliated to Tehran University of Medical Sciences. Excluding incomplete reports, we finally reviewed 580 cases of subarachnoid hemorrhage. Brain digital subtraction angiography was carried out in all cases by bilateral catheterization of both common carotids placing the catheter an inch before the bifurcation and uni/bilateral catheterization of vertebral arteries. If unilateral injection of vertebral artery couldn't enhance the distal part of contralateral vertebral artery and PICA, we used bilateral injection method. Both of the common carotid arteries were injected in the lateral, oblique and AP positions. The lateral and frontal views of vertebrobasilar arteries were taken. According to the angiographic findings and radiologist's recommendation, extra views were taken (transorbital, basal and reverse oblique). The angiography device was a GE-DEX DSA with 1200 MA and 140 KVP. We used catheters 4-7 French and their type were Multipurpose, Simmon, Head hunter or Mani catheters. SPSS 10 was used for data analysis. The confidence interval and the statistical error type I were 95% and 5%, respectively.

Results

Of 580 patients in this study 344 were male (59.9%). (Figure 1) One hundred and seventeen patient (20.1%) were in their fifth decade of life (40-50), 107 were in their sixth (18.4%) and 108 ones were in their fourth (18.6%). (Figure 2) The mean age was in the fifth decade of life (40-50 years old) and sixty eight percent of the patients falling between 30-70 years of age. On the whole, there were 136 cases of aneurysm (23.4%), 82 cases of arteriovenous malformations (14.2%), 325 cases with normal angiograms (56%) and 37 cases with other pathologies (6.4%). (Figure 3)

Among 255 (43.9%) patients with distinct diagnosis in their brain angiography, 53.9% had aneurysm and 32.1% had arteriovenous malformations. Headache as the most common symptom was noted in 63% of patients with aneurysm and 28% of patients with normal angiograms (p<0.0001).

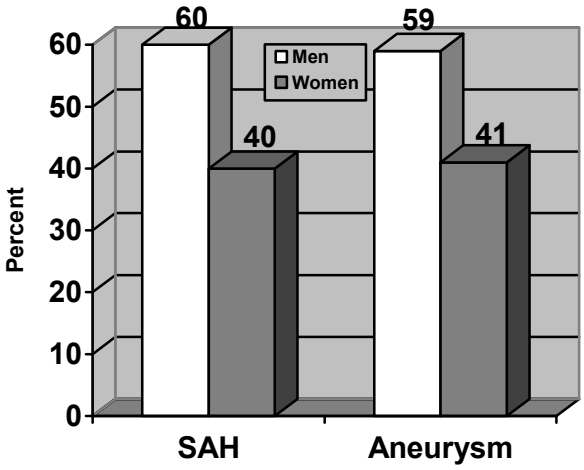

Figure 1: Sex distribution of subarachnoid hemorrhage and aneurysm patients

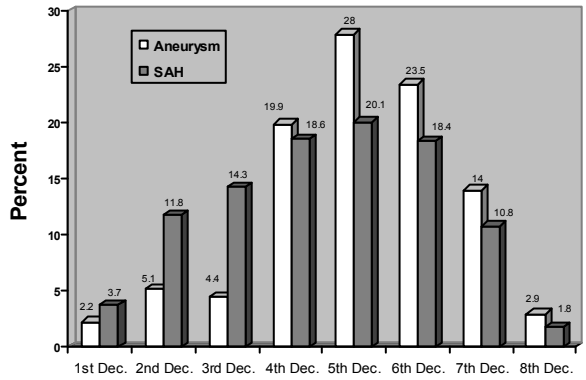

Figure 2: Age distribution of SAH and Aneurysm patients

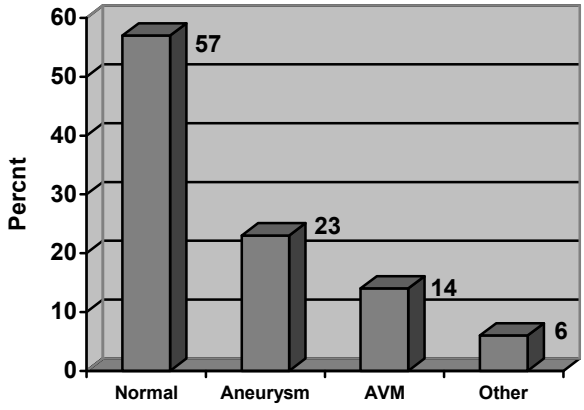

Figure 3: Angiographic findings in all the patients

Reduced consciousness was present in 25% of aneurysm patients and in 9.5% of those with normal angiograms (p<0/0001). Vomiting was seen in 30% of

aneurysm patients and 12% of patients with normal angiograms (p<0/0001).

Of the 136 cases of aneurysms, 79 (58%) were male with a male-female ratio of 1.4. The mean age was 46 and the largest age group fell in the fifth decade. Twelve percent of the patients were under 30 years old, 17% over 68. Seventy one percent of aneurysms were seen in the fourth to sixth decades. While seventy-two percent of all arteriovenous malformations occurred under 30 years of age. Multiple aneurysms were seen in 13 patients (all with two aneurysms). Hence, the total number of intracerebral aneurysms was 149. The rate of multiple aneurysms was 9.56%. Sixty-one per cent of multiple aneurysms were detected in the ipsilateral hemisphere and 23% located in the contralateral homonymous artery. Fusiform aneurysms were seen in 4 (2.9%) and giant aneurysms in 8 patients (5.9%). In two cases, aneurysms were accompanied by arteriovenous malformations. Anatomically, we had 16 aneurysms (10.7% of all) in the posterior circulation and the remaining (133 aneurysms/89.3%) were in the anterior circulation. More detailed anatomical distribution is presented in the table1.

The aneurysms of the anterior cerebral artery (ACA) were dominantly in the anterior communicating artery (84% of ACA aneurysms; 28.1% of all the aneurysms) while the rest were located distal to the anterior communicating artery, in pericallosal or callosomarginal branches.

Of all the 46 aneurysms in the internal carotid artery (ICA), 45.6% occurred in the posterior communicating artery, nearly 30.4% at the bifurcation, 8.6% in the intracavernous segment of ICA, and 6.5% at the origin of the ophthalmic artery.

Aneurysms of the middle cerebral artery (MCA) constituted 24.8% of the whole total aneurysms, most of which (81%) occurring at the bifurcation and the remaining were found more proximally in M1 segment.

The basilar artery bore 6.7% of all the aneurysm in this study. The majority (8, 80%) were observed in the basilar tip. The remaining 2 aneurysms were in the arterial trunk and appeared fusiform.

Two posterior cerebral arteries (PCA) were in association with the arteriovenous malformations.

Table 1: Anatomical distribution of aneurysms

	Main territory	Total number & percent in this Territory	Anatomical Loc.	Total number in this Anat. Loc.	% among all aneurysms	% in this vascular distribution
Anterior Circulation 133 (89.3% of all)	ACA[1]	50(33.6%)	ACommA[5]	42	28.2	84
			Horizontal Portion of ACA	8	5.4	16
	ICA[2]	46(30.9%)	I.C.A Bifurcation	14	9.4	30.4
			PCommA[6]	21	14.1	45.6
			Intracavernous segment	4	2.7	8.6
			Ophthalmic A. Origin	3	2	6.5
			Supra clinoid portion	4	2.7	8.6
	MCA[3]	37(24.8%)	MCA Bifurcation	30	20.1	81
			Horizontal Portion of MCA	7	4.7	19
Posterior Circulation 16(10.7%)	Basilar A.	10(6.7%)	Basilar Tip	8	5.4	80
			Basilar Trunk	2	1.3	20
	Vertebral A.	4(2.7%)	PICA origin	4	2.7	
	PCA[4]	2(1.3%)		2	1.3	

1-Anterior Cerebral Artery//2- Internal Carotid Artery//3- Middle Cerebral Artery//4-Posterior cerebral Artery//5- Anterior Communicating Artery//6-Posterior Communicating Artery

Discussion

In our study, most patients aged 40-50 years (the mean age at the 5th decade of life) as reported by some SAH studies,[3] while it has been 50-60 years in some others.[1] Aneurysms and arteriovenous (AV) malformations are the major causes for SAH.[3] Aneurysms are more common and therefore dominate the epidemiological pattern of SAH.[1,3] SAH due to AV malformations occur at a younger age than SAH due to aneurysms (before 30 years of age versus 50-60).[3, 8-12]

Most studies have reported a 15-20% negative angiography result in SAH.[2, 4, 5] We had a higher rate of negative angiography results in our study ($p<0.0001$).

Many experts believe that a missed aneurysm is the most likely diagnosis with the negative (i.e. normal) angiography in SAH cases.[8] Therefore, most of our negative angiography cases could have been missed aneurysms, and the real percentage of aneurysms could have been higher than that was observed.

Major aneurysm studies have shown that most of the patients are women at the sixth decade of life. (56%)[1,3,6,8,11,12] In men the incidence of SAH was slightly higher in the 5th decade than the 6th decade of life.[3,8]

Therefore, considering the high number of aneurysms, and the male preponderance in our SAH patients (more than many other studies), with regard to this fact that aneurysms affect men at a younger age (10 years earlier than women), we could suspect that the lower mean age in our patients is mainly due to the preponderance of men.

Regarding the gender pattern in SAH, most studies have reported a female-to-male ratio of around 1.6.[1-3] Since in females, the peak ages of both SAH and rupture of aneurysm fall within the sixth decade of life (the years of menopause), some experts blame the female sex hormones [3,8], while others believe that it must be due to the preponderance of women population at old age[8] but it is controversial.[3]

In spite of most reports, we observed a male predominance in both SAH and aneurysm .[1,3,6,8-12] Thus, considering the risk factors for aneurysmal rupture (such as hypertension, cigarette smoking and alcohol consumption),[1,3] we can say that the reverse gender ratio in the Iranian patients can be partly due to less frequent smoking and drinking habits among the Iranian women than their male peers. This could be due to their different cultural and social factors from those in the western countries. And finally, the ethnic reasons should not be missed out.

With negative angiography results in SAH, the most common cause is believed to be technical errors[4] such as incomplete angiographic views.[1] Some other factors to be considered are as follows:

Most of the time, vasospasm is seen 3-7 days after SAH in up to 70% of cases.[3] It means that an untimely angiography will miss out some of the aneurysms because of the vasospasm.[1] Also it is likely to happen if the aneurysm is too small to be detected. Sometimes aneurysms are not seen because of mass effect due to focal parenchymal hematoma (most seen in the anterior communicating artery aneurysms) or due to thrombosis in the neck of the aneurysm or in its entire sac.[1]

In this study, we had normal angiogram in 57% of our SAH patients that is much higher than most studies.[2,4] The reasons we assume could be as follows: inadequate complementary projections, performing angiographies in an inappropriate time and when there was a possibility of vasospasm, injecting hyperosmollar contrast media (in the first 1.5 years of the project) which could have caused vasospasm.

It must be noticed that aneurysms can present with hemorrhage at any size, but the risk of rupture significantly increases with size.[13] There are reports that aneurysms of less than 5 mm are less prone to hemorrhage,[6] while 5-15 mm ones bleed more.[14]Some others mention a cut-off size of 10 mm for an increased risk of hemorrhage.[6,10] Naturally, hemorrhagic aneurysms of smaller size are hard to visualize. The size of hemorrhagic aneurysms in Iranian patients is not clear. Some symptoms such as headache and low-consciousness were more prevalent with proved aneurysm than in patients with normal angiography. This may suggest some difference between these two groups. (accepting that many normal angiograms are actually missed aneurysms, which could have smaller size in comparison to visualized aneurysms).

Our findings on anatomical distribution of the aneurysms in the anterior and posterior circulations (about 90% and 10%, respectively) reproduced those in other studies.[3,4]

Additionally, we investigated the distribution of aneurysms in the branches of Willis circle. The anterior cerebral artery aneurysms constitute 33.6% of our cases (most of them in the anterior communicating artery) similar to other reports (without significant clinical difference).[3-6,15-19]

Thirty-one percent of all our patients had aneurysm of the internal carotid artery, as in most reports[3,6] but some have stated it to be up to 50% of all the cerebral aneurysms.[19] However, the anatomical distribution was different along the internal carotid artery branches; posterior communicating artery aneurysms was 14% in the present study that is significantly lower than the 25-30% by most others ($p\leq0.010$). [3,4,6] There are reports that posterior communicating

artery aneurysms constitute 50% of all internal carotid aneurysms.[19] With the posterior communicating aneurysms it must be noted that they have a higher risk of hemorrhage (along with aneurysms of posterior circulation and anterior communicating artery)[19] so that they are more frequent in SAH, and also they occur more in women.[19] The less number of women in our study may partly justify the lower prevalence of posterior communicating artery aneurysm in our results. Also we found more carotid bifurcation aneurysms without obvious reason for this finding.

We came across 24.8% of all the aneurysms in the middle cerebral artery, as compared to 20% in other studies.[3,6,15-18] The middle cerebral artery bifurcation is particularly important since most of the middle cerebral artery aneurysms occur in this region. The rate of aneurysms at the bifurcation is 13-20% in the literature, lower than our 20%. The incidence of the basilar aneurysms in the current survey (less than 7%) matched with most other studies.[3,4,6]

The multiple aneurysms have been reported to be 5-15% and even up to 30% in the centers with expert staff.[4-8,10,19] In our study, less than 10% of patients had multiple aneurysms that was different from most other reports. The number of aneurysms is very important in SAH patients because the neurosurgeon must exactly know the aneurysm which is responsible for the bleeding before the operation. Obviously the risk of hemorrhage increases with multiple aneurysms.[19] Some studies showed that multiple aneurysms occurred bilaterally whereas in our study we observed that most of the cases (61%) were ipsilateral.[8]

Nine percent of the aneurysms have been stated to coincide with arteriovenous malformations, but 1.4% which resulted in our study is much lower.

Conclusion

High prevalence of subarachnoid hemorrhage in the Iranian men could be due to their relatively high exposure to certain risk factors such as smoking, or could be due to ethnic factors. We believe that these findings could be very helpful in preventing this fatal disease that involves men in their active years of life. The lower mean age of our patients as compared to other studies can be attributed to the relatively higher percentage of men in this study. The lower rate of posterior communicating artery aneurysms is an interesting finding that can shed light on the pathophysiologic mechanisms of disease and help us with the diagnosis and management of patients.

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