Incidence of Intracranial Aneurysms in India

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Since the use of safe percutaneous cerebral angiography has become widespread, the diagnosis of intracranial aneurysms causing subarachnoid hemorrhage has become easier and the incidence of this diagnosis in Western countries has increased during the past decade. Enough experience has now accumulated to justify a comparative analysis combining the experience of many Western centers.\(^{12,14,30,31}\)

In India and the Orient, on the contrary, the experience has been different. During the past 15 years in the East the growth of neurosurgery has been very rapid, and a large number of neurosurgical conditions like abscesses and tumors have been treated. Moreover, all varieties of neuroradiological diagnostic procedures including cerebral angiography have been widely adopted. But, peculiarly, the diagnosis of intracranial aneurysms is made much less frequently than in the countries of the Western world.

This paper seeks to determine whether subarachnoid hemorrhages are uncommon in India,\(^{34}\) and to discuss the possible avenues of future research. We are presenting the experience with aneurysms encountered at the General Hospital, Madras, correlated with figures obtained from various centers in India, the Middle East, and the Far East.

Clinical Survey

Madras General Hospital. The cases of subarachnoid hemorrhage admitted to the Madras General Hospital have been studied. This government hospital has a capacity for about 2000 inpatients, and in addition treats some 40,000 outpatients per month. Of 10,141 cases admitted to the department of neurology and neurosurgery from 1951–1967, 75 were found to be aneurysms and 49 arteriovenous malformations. Less than a dozen intracranial aneurysms are encountered per year. This department usually has 100 inpatients. In over 4000 cerebral angiograms done for various conditions other than subarachnoid hemorrhage, incidental discovery of the existence of aneurysms has been remarkably infrequent. During the period under consideration, the incidence of arteriovenous malformation has been almost the same as that of berry aneurysms.

Other Hospitals in India. A survey of the cases of aneurysms at other neurosurgical centers in India was made. A similar low incidence was found both in the older neurosurgical centers with experience of more than a decade and in the younger neurosurgical centers, despite aggressive neurosurgeons out to discover aneurysms. Singh\(^{35}\) found two subarachnoid hemorrhages in 3000 medical admissions in a general hospital. Chatterjee\(^4\) commented on his experience in Calcutta: "While analyzing 1000 angiograms, the aneurysms found were very few." Mathai\(^5\) had 47 cases of subarachnoid hemorrhage over 15 years. Mukerjee\(^21\) found six cases of subarachnoid hemorrhage out of 1398 admissions in a neurology department. Mathur\(^16\) saw only one or two cases of cerebral aneurysms per year and is certain that they are very uncommon; he did not encounter a single aneurysm in 480 consecutive unselected autopsies at Agra.

It is worthwhile to note that the experience has been similar in Iran and Japan. Sano\(^7\) treated 1800 brain tumors but encountered only 90 aneurysms. At the Middle East Neurosurgical Congress in Iran in 1963, a similar opinion regarding the incidence of aneurysm was expressed by Ameli\(^1\) and Samii.\(^22\)

The above survey reveals a low incidence of cerebral berry aneurysms. The most obvious explanation could be that aneurysms are not being diagnosed. The Madras General Hospital is the oldest and one of the biggest in India, and has been attached to a teaching medical college for over 130 years. As a teaching hospital, the clinical vigilance is high; many varieties of clinical emergencies are diagnosed, but not more than 40
intracranial hemorrhages are seen each year. Of these, about two thirds of the patients come in for cerebral angiography, and a dozen aneurysms may be demonstrated. The experience at Calcutta, Bombay, Vishakapatnam, Vellore, and Hyderabad has been similar. In all these cities, neurosurgical centers have been established for more than 15 years.

Thus although allowance can be made for missing some cases in overcrowded general hospitals, still the low incidence of subarachnoid hemorrhage and aneurysms seen in all centers seems significant. This problem has been raised periodically in neurological conferences in India and the East.39

To determine the causes for this low incidence, we have made a comparative study of the conditions in different countries that lead to the formation of aneurysms and eventually to their bursting. We are presenting a brief review of the present state of knowledge concerning the etiology of aneurysms followed by the possible reasons for the low incidence in India and the East.

**Etiology**

**Congenital Defects and Degenerative Changes.** The existence of developmental defects in the media of cerebral blood vessels suggested by Turnbull36 in 1918 as a cause of aneurysm formation was confirmed by Forbus9 in 1930 by autopsy studies. Schmidt44 in 1931 agreed with this observation but stressed the importance of degeneration in aneurysm formation.

Glynn7 in 1940 determined the frequency of defects in the media of the blood vessels of aneurysmal and non-aneurysmal brains and found that the majority of cerebral blood vessels showed medial defects whereas the frequency of aneurysms in autopsy studies was only 0.25% to 1.5%. He suggested that defect of the medial coat was not the cause of aneurysm since the thick internal elastica laminae was sufficient protection against intravascular pressure; he confirmed this by inflation experiments. Richardson and Hyland23 agreed with Glynn that the medial defect was not the essential element in aneurysm formation but suggested that it could be a predisposing factor, some additional factor being needed for actual aneurysm formation.

Carmichael9 in 1950 studied the histology of small aneurysms and also of the basal cerebral blood vessels in unselected cases and found that blood vessels with aneurysms showed evidence of atheroma. The aneurysmal sac itself showed degenerative hyperplasia of the intima. The age distribution and the constant presence of degeneration in the sac suggested degeneration as the cause. But he also found that a high proportion of the aneurysms occurred at the bifurcation where medial defects occur.

Nystrom31 has studied the cerebral blood vessels and aneurysms using electron microscopy. The electron microscope confirms the findings seen through the ordinary microscope, but throws more light on the changes in the elastica and collagen near the aneurysm sites. Nystrom feels that defective collagen and elastic tissue are the starting point of aneurysms. The collagen resembles the embryonic collagen present in the walls of the cerebral blood vessels during development. This defective collagen allows the blood pressure, acting over the years, to enlarge the Eversen fenestration, which becomes the starting point of an aneurysm. Once this occurs, this area of the blood vessel becomes a locus of lowered resistance, and degenerative changes are secondary to an enlarging defect caused by defective elastic tissue and collagen.

The occurrence of aneurysms at the sites of bifurcation of arteries where medial defects are common clearly establishes the relationship between medial defects and aneurysms. The presence of many medial defects without aneurysms and the association of atherosclerotic degenerative changes at the site of aneurysms favor degeneration as the etiology.

The combined evidence for both these points of view suggests that the simultaneous occurrence of medial defects as well as degenerative changes would favor the formation of cerebral aneurysms.

Crawford9 in 1959 suggested three main factors that determine the age at which aneurysms develop: congenital defects, atherosclerosis, and hypertension. Any one of these factors may be significant in analyzing the low incidence of aneurysms in Indian subjects.

It would be worthwhile to investigate
whether there are racial differences in the occurrence of congenital defects in the media of cerebral blood vessels in various parts of the world, and to compare the incidence of aneurysms and medial defects in the Mongoloid and Negroid races with that in India and in Europe. Although for many centuries there has been real racial mixture in India, the features and other characteristics of most Indians are more Caucasian than Negroid or Mongoloid except in some part of South India and Northeast India. Hence it may well be that Indian brains may show the same incidence of congenital defects in the cerebral blood vessels as in the West.

In this context, it is significant that the incidence of arteriovenous malformation is comparable to that of aneurysms in the Indian series. In discussing the etiology of arteriovenous malformation and aneurysms, Nystrom\textsuperscript{23} has shown that the same collagen defect is present in both aneurysms and malformations.

Thus, it seems unlikely that a lower incidence of congenital defects is the cause of the lower incidence of aneurysms.

\textit{Atherosclerosis in Different Geographical Areas.} Extensive study of atherosclerosis in blood vessels in various parts of the world has been undertaken by many workers. Gore, \textit{et al.},\textsuperscript{8} conducted a comparative study of the occurrence of aortic and coronary atherosclerosis in different parts of the world, namely, Japan, the United States, India, and Jamaica. They found that the incidence of atherosclerosis in Indians was far less than that found in the United States. This was supported by Padmavathi\textsuperscript{24} and others.\textsuperscript{20,22,27} Holman, \textit{et al.},\textsuperscript{11} have noted significant differences in the evolution of atherosclerosis among Negroes as compared to the white population. The incidence of atherosclerosis was found to be less in the cerebral blood vessels than in the coronary vessels in all geographic divisions.\textsuperscript{8,20,27,29}

In a study of Indian subjects, Gupt\textit{ha,}\textsuperscript{9,10} discussing the pathology of cerebral arteriosclerosis, found that the atherosclerosis or atheroma of cerebral arteries was a rarity even at old age. Mathur and Kashyap\textsuperscript{17} reporting on atherosclerosis from India found that cerebral atherosclerosis was not seen below the age of 30 whereas coronary atherosclerosis started by the first decade and aortic changes even earlier. These findings are in accordance with the findings of other workers, referred to above. Mathur \textit{et al.},\textsuperscript{18,19} also found that the atherosclerotic changes in the cerebral blood vessels were much less severe than in blood vessels in other parts of the body, and that the complicated lesions of atherosclerosis, like ulceration and calcification, were much less in the cerebral blood vessels. They concluded that the factors that initiate atherogenesis are different from those that later cause more advanced lesions, and that there are important geographic differences in the prevalence of these latter factors.

In the Indian subcontinent, there seems to be a difference in the incidence of atherosclerosis between the north and the south. There is less of atherosclerosis in Madras than in North India, West Pakistan reports a greater incidence than Madras.\textsuperscript{8} It should be noted that Kulangara and Subramanian\textsuperscript{12} reported an incidence of atherosclerosis in South India as high as that in the United States.

Tissue calcification is less intense in India than in other parts of the world. Even normal intracranial calcification is seen much less frequently here.\textsuperscript{27} There is much less consumption of fats and proteins in India than elsewhere, and the lower incidence of degenerative changes with calcification in cerebral blood vessels is probably attributable to the dietary habits of the people.

Thus, it seems likely that atherosclerosis of blood vessels is less common in India than in the United States and that these changes occur less frequently in the cerebral blood vessels than in other parts of the body.

\textbf{Summary}

Subarachnoid hemorrhage and intracranial berry aneurysms occur much less commonly in India and the Eastern countries than in the West. We have suggested that the incidence of congenital defects in the media of the cerebral vessels may differ with various racial groups.

Both generalized and cerebral atherosclerosis is much less prevalent in the underdeveloped countries. There is also a significant difference in the incidence of atherosclerosis in various parts of the Indian subcontinent consistent with differences in diet. If atherosclerosis is one of the essential factors in the
development and eventual rupture of aneurysms, the low incidence of atherosclerosis and subarachnoid hemorrhage in the underdeveloped countries may be related. We suggest that extensive collaborative studies between the developed and the underdeveloped countries regarding the cause and incidence of cerebral aneurysms might be valuable.

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