Neuroradiology (1989) 31: 232-236

Neuro radiology


# Multiple cerebral aneurysms - a reappraisal

F. M. A. Wilson, T. Jaspan, and I. M. Holland

Neuroradiology Department, University Hospital, Nottingham, England

**Summary.** 254 consecutive cases of angiographically demonstrated intracranial cerebral aneurysms occuring over a three year period were reviewed with specific reference to aneurysm multiplicity, site, patient age and the presence of infundibular abnormalities. The overall incidence of multiple aneurysms was 44.9%. Female patients accounted for 66.5% of all aneurysm cases. The incidence of multiplicity was higher in women (51.5%) than men (31.7%) and overall was higher in patients over 40 years of age (52.8%) compared to those under this age (26.3%). Infundibula occured in 27.2% of all patients and 9.45% of all patients demonstrated infundibular dilatation of the origin of the posterior communicating artery.

**Key words:** Angiography - Intracranial aneurysms - Multiplicity - Infundibular abnormalities

There have been numerous studies of the incidence and radiological features of cerebral aneurysms over the past 30 years, the incidence of multiplicity being variably assessed at between 5 to 33% for large series [1-6]. We undertook this study following a subjective impression of a higher incidence of multiplicity in our subject population. In addition the age/sex pattern and relationship to posterior communicating artery infundibular abnormalities were assessed and the attendent implications discussed.

## Patients and methods

During the period from January 1985 to March 1988 inclusive all patients admitted to the neurosciences unit following a suspected subarachnoid haemorrhage underwent lumbar puncture cranial computerized tomography (CT) examination on a Picker 1200SX scanner. Cerebral angiography was undertaken on a Siemens Angioscope unit by transfemoral selective catheterization. The examinations were performed under general anaesthesia with close $pCO_2$ monitoring throughout the procedure, the $pCO_2$ being kept between 3.2 and 3.8 KPa. Four vessel studies were performed in most cases although in 21 patients (8.26% of all cases) vertebral injections were not made due to the presence of atherosclerotic disease at the origins of the vertebral arteries. Internal carotid artery injections were performed in those patients under 50 years of age and without radiological evidence of atherosclerotic disease at the common carotid bifurcation. Common carotid injections were

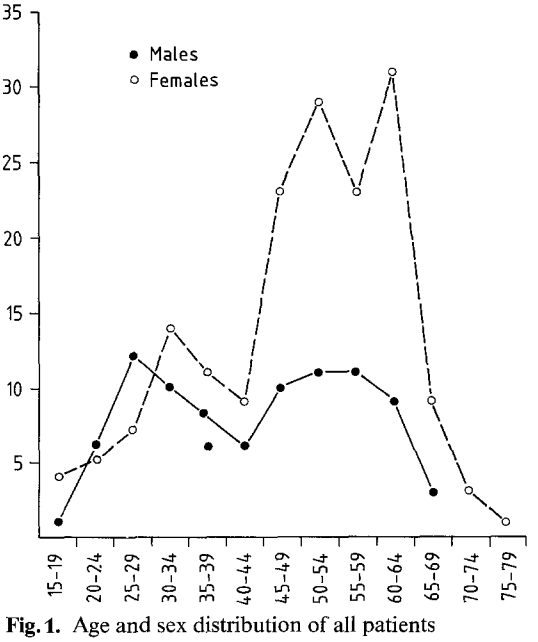


**Fig. 1.** Age and sex distribution of all patients

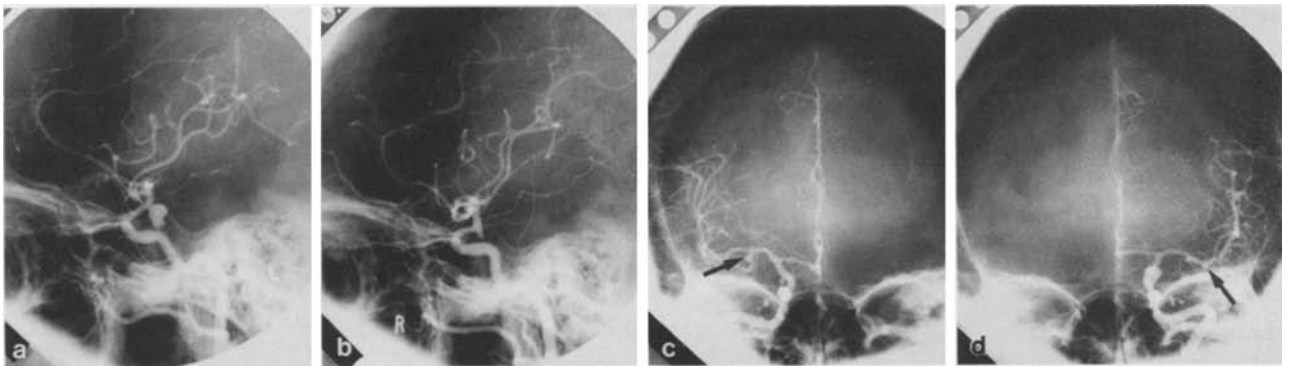

**Fig. 2.** Large multilocular left (**a**) and small unilocular right (**b**) aneurysms at the origin of the posterior communicating arteries. **c, d** Small unilocular aneurysms at the primary division of both middle cerebral arteries *(arrows)*

performed in the remainder. Standard projections for the carotid arteries (PA, PA 20°, PA oblique and lateral) and vertebral arteries (Townes and lateral) were used in all patients with appropriate modifications where felt necessary. All angiograms were performed within 2 weeks of the subarachnoid haemorrhage, and were assessed independently (IMH and TJ).

## Results

### *Age and sex*

Of the 254 patients examined 169 were females (66.5%) with an age range of 15 to 76 years and a mean age of 49.1 years. There were 85 males (33.5%) with an age range of 19 to 67 years and a mean age of 43.5 years. The mean age for the combined group was 47.2 years. Figure 1 shows the age and sex distribution of all the patients and demonstrates an increasing frequency of aneurysms with advancing age, maximal in the fourth to sixth decades.

The average age of females with a single aneurysm was 46.8 years rising to 50.9 years for patients with two aneurysms, 51.7 years for three aneurysms and 53.6 years for those with four or more lesions. The overall average age for females with multiple aneurysms was 51.2 years. For the men the average age for single aneurysms was 41.8 years and for multiple aneurysms 47.1 years. For the whole group the average age of patients with a single aneurysm was 44.7 years and for those with multiple aneurysms 50.2 years. The incidence of multiplicity in patients over 40 years of age was 52.8% compared to 26.3% in patients aged under 40 years.

### *Site of aneurysm*

The sites of aneurysm formation are shown in Table 1.

The most frequent sites were the middle cerebral artery (24.1%), the posterior communicating (22.5%) and anterior communicating artery (18.6%) origins. A total of 414 aneurysms were demonstrated in the 254 patients examined. Of these, 43 aneurysms (10.4%) were in the vertebrobasilar territory. Posterior circulation aneurysms occured in 28/169 (16.6%) of the female and 12/85 (14.1%) of the male patients, the incidence for the combined group being 40/254 (15.7%). In those patients with a single aneurysm 11/140 (7.9%) had a posterior circulation aneurysm whereas they occured in 29/114 (25.4%) of those patients with multiple aneurysms. Mirror aneurysms (at an equivalent site on the contralateral side) occurred in 4/27 (14.8%) of the men and 28/87 (32.2%) of the females with multiple lesions giving a total incidence of 32/114 (28%). Figure 2 displays the angiogram of a 50 year old woman which illustrates symmetrically distributed posterior communicating artery and middle cerebral artery primary division aneurysms. Multiple aneurysms occured on the same side in 13/27 (48.15%) of the males and 45/87 (51.7%) of the female patients, with a total incidence 58/114 (50.9%) in all the cases.

### *Multiplicity*

One hundred and fourteen out of the 254 (44.9%) patients studied were shown to have multiple aneurysms of which 87 were females (76.3%) and 27 were males (23.7%). 78 (68.4%) of these multiple cases had two aneurysms, 27 (23.7%) had three aneurysms, 8 (7.8%) had four aneurysms and one case had five aneurysms. Figure 3 shows the age distribution of patients with multiple aneurysms alongside the distribution for all patients. The graph shows an increasing incidence with advanc-

ing age, with a peak in the 45-65 year age group. 17.5% (20/114) of all multiple aneurysm cases occured in patients under the age of 40 years compared with 82.5% (94/114) of patients over the age of forty. In those patients under the age of 40 years, 20/76 (26.3%) had multiple aneurysms whereas 94/178 (52.8%) of cases over the age of 40 years harboured multiple lesions.

*Infundibula*

Infundibula were present in 69/254 (27.2%) of patients with a total of 81 infundibula in all patients, 12 patients having two infundibula. 75 (92.6%) of the infundibula were present at the origin of the posterior communicating artery from the internal carotid artery, three at the origin of a lenticulostriate artery, two at the anterior choroidal artery origins and one at an ophthalmic artery origin. The average age of the 50 female patients with an infundibulum was 50.2 years and for the 19 men 48.9 years, an overall average of 49.8 years. In 32 out of the 69 patients (46.4%) with infundibula there were coexisting multiple aneurysms. A contralateral posterior communicating artery aneurysm was found in 17/75 (22.7%) of cases with a posterior communicating artery infundibulum. 46 (56.8%) of the infundibula were found on the left side and 35 (43.2%) on the right. The infundibula were all of the rounded shape as described by Ebina et al. [7] and all less than 3 mm in diameter. However, unlike their series, the discrete infundibula were usually associated with a non dominant thread-like posterior communicating artery (Fig. 4).

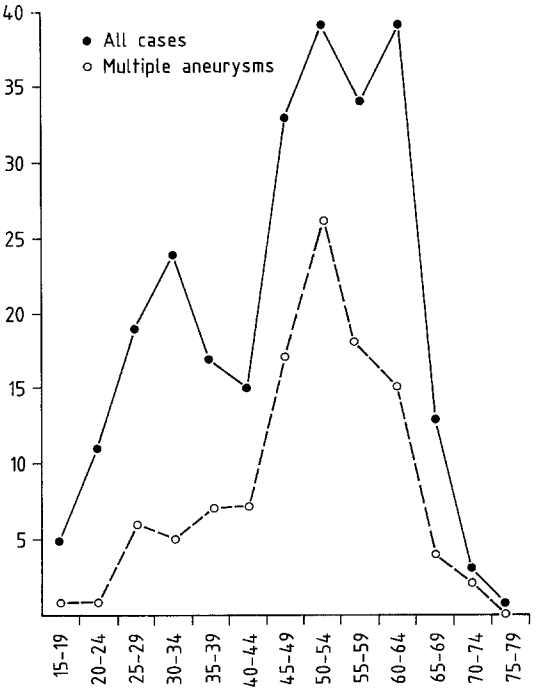


**Fig. 3.** Age distribution of all patients compared to those with multiple aneurysms

*Infundibular widening*

In contradistinction to discrete infundibula, 24 patients (9.45%) showed evidence of infundibular dilatation of the posterior communicating artery origin. The vessel origin was triangular in shape and in most cases led on to a dominant or wide posterior communicating artery (Fig. 5). The average age of the 17 females and 7 males in this group was 48.4 years. In

**Table 1.** The site of the 414 aneurysms in 254 cases

| Site of aneurysm | No of cases | Percentage | Average age of males (years) | Average age of females (years) | Average age (years) | % of males | % of females | % on right | % on left | |
|---|---|---|---|---|---|---|---|---|---|---|
| Middle cerebral artery | 100 | 24.1 | 47.1 | 51.7 | 50.2 | 33 | 67 | 49 | 51 | |
| Posterior communicating artery | 93 | 22.5 | 46.9 | 47.9 | 47.8 | 17.2 | 82.8 | 53.7 | 43.3 | |
| Internal carotid artery | 86 | 20.8 | 42.6 | 48.5 | 47.1 | 24.4 | 75.6 | 43 | 57 | |
| Anterior communicating artery | 77 | 18.6 | 41.0 | 53.3 | 47.7 | 45.4 | 54.6 | 53.2 | 46.8 | |
| Vertebrobasilar circulation | 43 | 10.4 | 44.5 | 47.6 | 46.6 | 30.2 | 69.8 | 20.9 | 30.2 | (48.9% at basilar tip) |
| Anterior cerebral artery | 15 | 3.6 | 51.4 | 53.5 | 52.5 | 46.7 | 53.3 | 73.3 | 26.7 | |

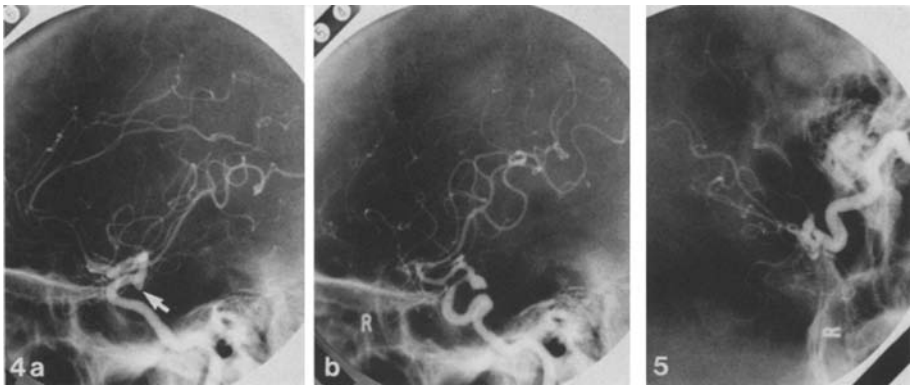


**Fig. 4.** **a** Large discrete left posterior communicating artery infundibulum. **b** Contralateral right posterior communicating artery aneurysm

**Fig. 5.** Infundibular widening of the right posterior communicating artery, the vessel distally being widely patent

13 out of the 24 cases (54.2%) there were coexisting multiple intracranial aneurysms. Six patients had contralateral posterior communicating artery aneurysms and 2 had a contralateral posterior communicating artery infundibulum. 3 cases had infundibular widening of both communicating arteries. Infundibular widening occured on the right in 64.3% and on the left in 35.7%.

## Discussion

The incidence of multiplicity of intracranial artery aneurysms has been variably assessed at between 5.3% to 33.3% [1-6]. The significance of establishing the presence of a further aneurysm(s) is that there is a higher associated mortality in patients with multiple lesions [2, 8]. Although rebleeding most often occurs from the original offending aneurysm, the risk of this happening is higher and occurs earlier in patients with multiple aneurysms [2]. In our study the incidence of multiplicity is higher than that found in the previous studies. The reason for this is not immediately apparent, however most of the previous studies did not employ routine full four vessel angiography.

Furthermore the use of selective internal carotid artery injections, standard multiple projections in all patients and routine general anaesthesia with optimal control of the arterial pCO2 may well maximize the sensitivity of the examination.

As in Ostergaard and Hog's study [5] we were able to confirm a higher overall incidence of aneurysms in female patients (66.5%) compared to men (33.5%) as well as a higher incidence of aneurysm multiplicity in women (51.5% of all female cases) than men (31.7% of all male cases). However, unlike their study, a definite increase both in the incidence of single and of multiple aneurysms was seen with advancing age with 20/76 (26.3%) of patients under the age of 40 years having multiple aneurysms, rising to 94/178 (52.8%) of all cases in patients over 40 years of age.

This increasing incidence of multiplicity with advancing age presents somewhat of a therapeutic dilemma in so much as that although the risks of rebleeding in patients with multiple aneurysms is higher, so the associated risks of surgery rise with increasing age [9, 10]. Opinions remain divided as to the relative risks and benefits of clipping any additional aneurysms found [11, 12] and will to a large extent be dependent on the surgical philosophy of the local neurosurgeon.

The site and distribution of aneurysms bore a similar relationship to previous studies [3, 11, 14, 15] with a similar proportion of cases demonstrating mirror aneurysms [2, 3]. Of note however is the relatively high incidence (25.4%) of posterior circulation aneurysms in patients with multiple aneurysms as compared to the incidence of 7.9% in those patients with only a single aneurysm, further emphasising the need for complete angiography.

Infundibula to the posterior communicating artery have been discussed since the early days of carotid angiography for example [12]. As in Ebina et al's study [7], infundibula could be divided into two groups with either a rounded or triangular configuration of the vessel origin. Unlike their study we found that the 81 lesions with a rounded shape, which we have designated as discrete infundibula, were associated with a rather thread like posterior communicating artery and were more easily confused with a small aneurysm. In contrast, in the 24 cases with a triangular shaped dilatation of the origin of the posterior communicating artery (designated infundibular widening) the emerging vessel was widely patent. In both categories of infundibular abnormalities there was a high incidence of multiple aneurysms (46.4% for infundibula and 54.2% for infundibular widening) and of associated contralateral posterior communicating artery aneu-

rysms (22.7% and 27.3% respectively). Whatever the significance of the angiographic differences in the appearance of these infundibular abnormalities it can be seen that there is a high incidence of them in patients with an intracranial aneurysm, occuring in 89 out of the 254 cases (35%) in our study. In addition 45/89 (50.5%) of patients showing such an abnormality harboured coexisting multiple aneurysms. The finding of a 23.7% incidence of an aneurysm of the contralateral posterior communicating artery lends further circumstantial radiological evidence of the close relationship between infundibular abnormalities and saccular intracranial aneurysms already alluded to in several previous studies [7, 16, 17]. This especially high associated incidence of multiple aneurysms might therefore arguably indicate the need for continued follow up of patients who have previously undergone aneurysm surgery with a known coexisting infundibular abnormality.

In summary, our study has shown a higher incidence of multiplicity of intracranial aneurysms and of posterior communicating artery infundibular abnormalities than reported in previous studies, although with a similar pattern of site and distribution of these lesions. The need for a complete radiological assessment of patients presenting with a subarachnoid haemorrhage, who are felt to be fit enough to undergo the appropriate angiography, is stressed.

## References


1. Hamby WB (1959) Multiple intracranial aneurysms. Aspects of treatment. J Neurosurg 16: 558–563
2. McKissock W, Richardson A, Walsh L, Owen E (1964) Multiple intracranial aneurysms. Lancet I: 623–626
3. Heiskanen O (1965) Multiple intracranial arterial aneurysms. Acta Neurol Scand 41: 356–362
4. King G, Slade HW, Campoy F (1954) Bilateral intracranial aneurysms. Arch Neurol Psychiaty 71: 326–336
5. Ostergaard JR, Hog E (1985) Incidence of multiple intracranial aneurysms, influence of arterial hypertension and gender. J Neurosurg 63: 49–55
6. Sengupta RP, McAllister VL (1986) Subarachnoid haemorrhage. Springer, Berlin Heidelberg New York, p 143
7. Ebina K, Ohkuma H, Iwabuchi T (1986) An angiographic study of incidence and morphology of infundibular dilatation of the posterior communicating artery. Neuradiology 28: 23–29
8. Paterson A, Bond MR (1973) Treatment of multiple intracranial arterial aneurysms. Lancet I: 1302–1304
9. Artiola i Fortuny IL, Adams CBT, Briggs M (1980) Surgical mortality in an aneurysm population: effects of age, blood pressure and preoperative neurological state. J Neurol Neurosurg Psychiaty 43: 879–882
10. Yoshimoto T, Uchida K, Kaneko U, Kayama T, Suzuki J (1979) An analysis of follow up results of 1000 intracranial saccular aneurysms with definitive surgical treatment. J Neurosurg 50: 152–157
11. Poppen JL, Fager CA (1959) Multiple intracranial aneurysms. J Neurosurg 16: 581–589
12. Saltzman GFR (1959) Infundibular widening of the posterior communicating artery. Acta Radiol 51: 415–421
13. Sengupta RP, McAllister VL (1986) Subarachnoid haemorrhage. Springer, Berlin Heidelberg New York, p 195
14. Kayembe KNT, Sasahara M, Hazama F (1984) Cerebral aneurysms and variations in the circle of Willis. Stroke 15: 846–850
15. Sengupta RP, McAllister VL (1986) Subarachnoid haemorrhage. Springer, Berlin Heidelberg New York, p 120
16. Stunz JT, Ojemann GA, Alvord EC (1970) Radiographic and histologic demonstration of an aneurysm developing on the infundibulum of the posterior communicating artery. J Neurosurg 33: 591–595
17. Fox JL, Baiz TC, Jakoby RK (1964) Differentiation of aneurysm from infundibulum of the posterior communicating artery. J Neurosurg 21: 135–138


Received: 7 December 1988

Dr. F. M. A. Wilson, FRCR
Neuradiology Division
Department of Radiology
University Hospital
Nottingham NG7 2UH
England