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FUNDAL HAEMORRHAGES IN RUPTURED INTRACRANIAL ANEURYSMS

I. Material, Frequency and Morphology

BY

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Among 195 patients with intracranial aneurysms, 79 had fundal haemorrhages (FH), an incidence of 40.5 % (99 % confidence limits 31–50). FH occurred alone in 26.7 % and were associated with papilloedema in 13.8 % of the cases. The total incidence was found to be higher than the frequencies found by similar studies, and the reasons are discussed. Among the 79 patients, 33 had mild retinal haemorrhages (grade I), in 25 the haemorrhage was more severe (grade II), and 21 had preretinal or vitreous haemorrhages (grade III). Aneurysms on the anterior communicating artery, with the tendency, upon rupture, to large haemorrhages, were responsible for the greater, part of FH as well as for the most severe cases (grade III), indicating a positive correlation between the amount of bleeding which suddenly occurs in the subarachnoid space and the incidence and severity of FH. No correlation could be demonstrated between the shape and site of FH and the aneurysmal site, or between the laterality of FH and the hemispheric site of the aneurysm.

Key words: intracranial aneurysms – subarachnoid haemorrhage – fundal haemorrhage – retinal haemorrhage – preretinal haemorrhage – vitreous haemorrhage – frequency.

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A preliminary report (Fahmy 1972a) established the incidence of fundal haemorrhages (FH) in ruptured intracranial aneurysms as 32.4 %. In the present study, which may be regarded as a continuation of earlier publications (Fahmy et al. 1969, Fahmy 1972a, b, c), the incidence was reexamined and found to correspond to 40.5 %. Comparing these figures with other frequencies (20 %, Biemond & Ter Braak (1933); 11 %, Richardson & Hyland (1941); 15.6 %, Dandy (1944); 10 %, Hamby (1952); 28.9 % Henderson (1955)), the present study seems to show the highest incidence. One of the objects of the present investigation was therefore to find an explanation for this finding, and furthermore, to establish the incidence of FH in respect to the aneurysmal topographic location, sex and age. Moreover, it was necessary to redescribe the morphology of FH in detail, and examine its relationship to the hemispheric site of the aneurysm.

Material

The material comprises 195 successive patients with ruptured intracranial aneurysms admitted to the Department of Neurosurgery S, Municipal Hospital Aarhus, during the period 1.4.1959 to 31.3.1970 (11 years).

Table I.
Incidence of fundal haemorrhages in ruptured intracranial aneurysm as reported by the various authors.

Authors	Intracranial aneurysms	Retinal haemorrhages		Total %
		Alone %	Associated with papilloedema %	
Biemond & Ter Braak (1933)	40	15	5	20
Richardson & Hyland (1941	118	5.1	5, 9	11
Dandy (1944)	108	4.6	11	15.6
Hamby (1952)	130			10
Timberlake & Kubik (1952)	280	23.6		
Holmes (1954)	106	8.5		
Manschot (1954)	225	20		
Henderson (1955)	114	12.3	16.6	28.9
Krayenbühl & Yasargil (1959)	136	14.7		
Riise (1969)	92	20.6		
Present cases	195	26.7	13.8	40.5

In contrast to the material examined previously (Fahmy et al. (1969), Fahmy 1972 a, b)), only anatomicaly verified cases are included in the present study. The diagnosis was established either at operation (144 cases), or autopsy (51), or both (26 cases). Out of the original series of 221 patients the following 26 were excluded: 13 patients were neither operated nor autopsied. Six patients had co-existing angioma. Two had meningioma and one had cerebral metastasis. In three patients with a history of trauma it could not be decided with certainly whether the aneurysm was congenital or traumatic. One patient with a positive angiographic finding underwent operation without any aneurysm being found.

Among the 195 patients, 18 (9 %) had more than one aneurysm. These patients were listed according to the ruptured aneurysms. From Fig. 1 it may be seen that 13 patients had aneurysms on the anterior cerebral artery, 61 on the anterior communicating artery, 63 on the internal carotid artery, 52 on the middle cerebral artery, 3 on the basilar artery, 2 on the ophthalmic artery and 1 on the primitive trigeminal artery.

Results

Frequency

Among the 195 patients, 79 had FH (40.5 % – 99 % confidence limits 31–50). In 52 instances the FH occurred alone (26.7 % – 99 % confidence limits 19–36) and in 27 cases it was associated with papilloedema (13.8 % – 99 % confidence limits 8–22). Fig. 1 shows that FH was significantly most common in aneurysms located on the anterior communicating artery ($\chi^2 = 8.264$, f = 3, $P < 0.01$). Out of the 195 patients, 100 were women and of these 37 % had FH. Among the 95 males, 42 (44.2 %) had FH (Fig. 2); the difference is not significant ($\chi^2 = 1.041$, f = 1, $P > 0.3$). Fig. 3 gives the distribution of FH by age, but the variation in the different groups is not significant ($\chi^2 = 2.742$, f = 5, $P > 0.8$).

Morphology

Fundal haemorrhages may be described in respect to *severity* (Fahmy 1972a), *shape* and *site*.

Among the 79 patients with FH, 33 had mild retinal haemorrhage (grade I), 25 had more severe heamorrhage (grade II) and 21 had large preretinal or vitreous haemorrhage (grade III).

Figs. 1, 2, and 3 show the distribution of FH according to severity in respect to the aneurysmal site, sex and age.

Aneurysm on the anterior communicating artery was responsible for 11 cases out of the 21 with FH grade III, an incidence which was significant as compared to the other groups ($\chi^2 = 3.805$, f = 1, $P < 0.05$). The same was true as to the 10 patients with *vitreous haemorrhage* (VH); 7 had aneurysm of the same

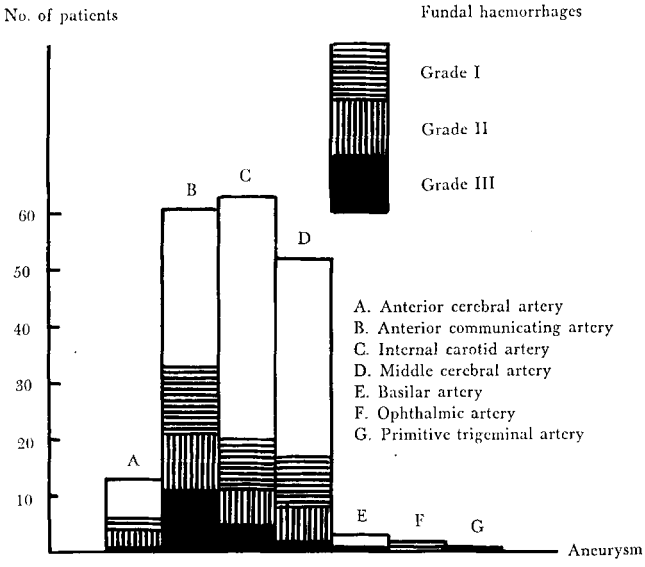

Fig. 1.
Incidence of fundal haemorrhages with respect to the site of the aneurysm.

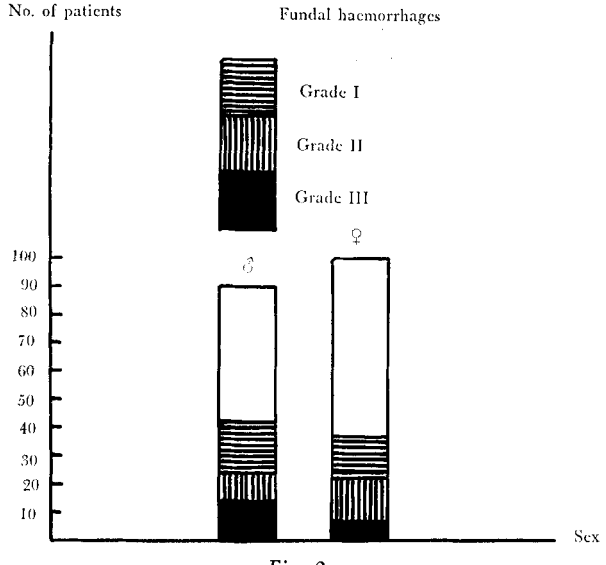

Fig. 2.
Incidence of fundal haemorrhages with respect to sex.

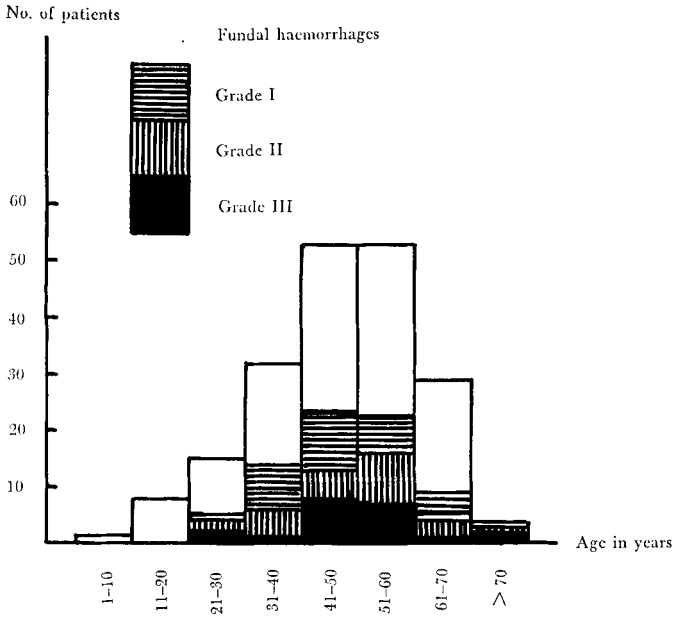

Fig. 3.
Incidence of fundal haemorrhages with respect to age.

location. The incidence is significant ($\chi^2 = 5.233$, f = 1, $P < 0.025$). Additional significance could be proved in respect to sex; 9 of the 10 patients with VH were males ($\chi^2 = 5.583$, f = 1, $P < 0.025$). Vitreous haemorrhages were bilateral in 6 cases and unilateral in 4. As to severity, VH was massive in 6 instances, moderate in 2 and slight in 2. Seven patients died, 2 could be followed up, an ophthalmic examination 9 and 16 months later revealed a permanent visual impairment due to persisting opacities in the vitreous.

A common feature of the 10 patients was the fact that VH had arisen from a large preretinal haemorrhage which invaded the vitreous in the second week after the attack (mean time 11 days). Another feature of these patients was the tendency to large cerebral haematomas and elevated intracranial pressure, as observed in 7 cases.

As to the *shape* of FH, retinal haemorrhages (grade I + II) were mostly linear or streaked in 32 cases, mainly round or flame-shaped in 19 and combined in 7 instances. Preretinal haemorrhages (grade III) had a typical appearance, being more pronounced and dark. No correlation could be found between the shape of the haemorrhages and the aneurysmal site (Table II).

Table II.

The shape of fundal haemorrhages in 195 patients with ruptured aneurysms (figures in brackets indicate the number of patients).

Aneurysms	Retinal haemorrhage			Preretinal haemorrhage	Vitreous haemorrhage	Total
	Linear-Streaked formed	Round-Flame formed	Both			
Anterior cerebral artery (13)	1	4	–	1	–	6
Anterior communicating art. (61)	12	7	3	4	7	33
Internal carotid artery (63)	7	6	2	5	–	20
Middle cerebral artery (52)	11	2	2	1	1	17
Basilar artery (3)	–	–	–	–	1	1
Ophthalmic artery (2)	1	–	–	–	–	1
Primitive artery (1)	–	–	–	–	1	1
Total	32	19	7	11	10	79

Table III.

The site of fundal haemorrhages in 195 patients with ruptured aneurysms (figures in brackets indicate the number of patients).

Aneurysms	Retinal-preretinal haemorrhage				Vitreous haemorrhage	Total
	Papillar	Peripapillar	Peripher	Diffuse		
Anterior cerebral artery (13)	3	1	–	2	–	6
Anterior communicating artery (61)	–	8	13	5	7	33
Internal carotid artery (63)	1	5	6	9	–	20
Middle cerebral artery (52)	1	9	5	1	1	17
Basilar artery (3)	–	–	–	–	1	1
Ophthalmic artery (2)	–	–	1	–	–	1
Primitive trigeminal artery (1)	–	–	–	–	1	1
Total (195)	4	23	25	17	10	79

According to a rough classification, the *site* of the retinal and preretinal haemorrhages was predominantly papillary in 4 cases, mostly peripapillary in 25 and diffuse in 17. Table III shows that no correlation exists between the site of the haemorrhages in the fundus and the topographic site of the aneurysms.

Relationship to the hemispheric site of the aneurysm

The material was divided into three groups: 62 patients had aneurysms in the right cerebral hemisphere, 69 in the left, and 64 patients on the midline. Nineteen patients (30.65 %) of the first group, 26 (37.38 %) of the second and 34 (53.12 %) of the last group had fundal haemorrhages. The difference is significant ($\chi^2 = 6.899$, f = 2, $P < 0.05$). As may be seen from Fig. 4, no correlation could be found between the hemispheric site of the aneurysm and the laterality of FH.

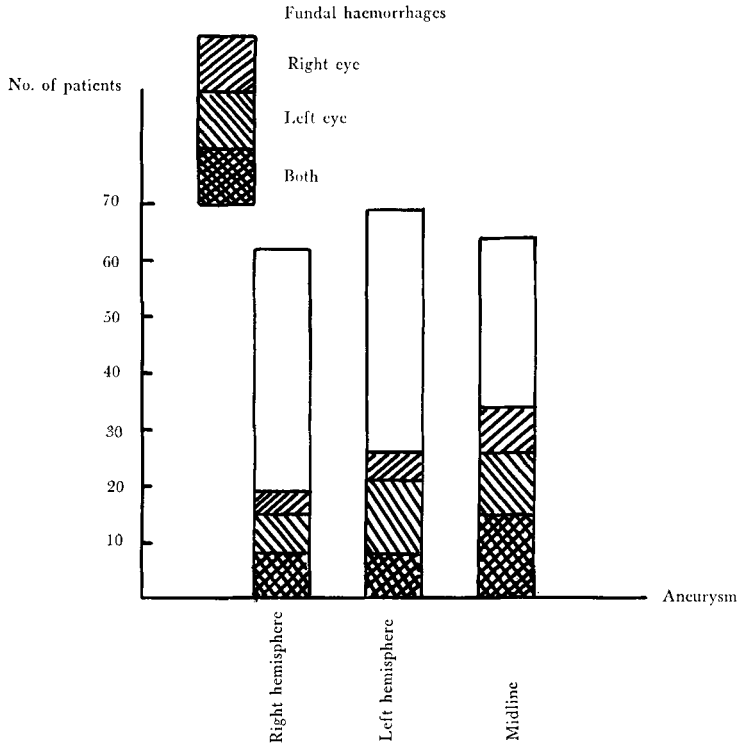

Fig. 4.
Correlation between hemispheric site of the aneurysm and laterality of fundal haemorrhages.

Discussion

There are several factors which may influence the establishment of the frequency of FH in ruptured intracranical aneurysms. In older literature subarachnoid haemorrhage was used synonymously with ruptured aneurysm, and many authors (Biemond & Ter Braak 1933, Richardson & Hyland 1941, Manschot 1944, 1954, Timberlake & Kubik 1952) selected their materials correspondingly, i.e. established the diagnosis partly by lumbal puncture. Others (Holmes 1954, Henderson 1955, Krayenbühl & Yasargil 1959, Riise 1969, Fahmy et al. 1969, 1972a,b) were content with positive angiographic findings. Elsewhere (Knudsen & Fahmy 1971) it was demonstrated that in some patients with a typical clinical course and positive angiographic findings, the subarachnoid haemorrhage may be due to cerebral disorders other than ruptured aneurysms. Further, as was shown (Fahmy et al. 1969), among 328 cases with subarachnoid haemorrhages, fundal haemorrhages were significantly the most common ($P < 0.001$) in patients with intracranical aneurysms as compared with other diagnostic groups, suspicion of aneurysms, plexiform angioma and haemorrhage apoplexy. Out of these facts it may be concluded that only anatomically verified materials of ruptured aneurysms would show such a high incidence of fundal haemorrhages as in the present investigation.

A different understanding of the FH may explain the variation in the reported incidence (Table I). While some authors (Biemond & Ter Braak 1933, Richardson & Hyland 1941, Dandy, Henderson 1955) state the total incidence of FH and the incidences of it occurring alone and as associated with papilloedema, others (Hamby 1952, Timberlake 1952, Manschot 1954, Krayenbühl & Yasargil 1959, Riise 1969) indicate the incidence only either totally or solely. Elsewhere (Fahmy 1972c) it was demonstrated that FH and papilloedema were two independent signs, and therefore a total indication of FH, including cases associated with papilloedema, may give the truest frequency.

The time elapsing from the rupture of the aneurysm until the ophthalmologic examination may play an important role in establishing the incidence of FH. Though FH in ruptured aneurysms are not absorbed as quickly as retinal haemorrhages in the newborn, an examination within days will still reveal the greater part of the cases. A sample from the present investigation including 32 patients with papilloedema was stdied (Fahmy 1972c), and showed that 26 were seen within two weeks. The same may be true for patients with FH.

The fact that aneurysms situated on the anterior communicating artery with the tendency upon rupture to large haemorrhages, were responsible for the greater part of FH on the one hand, and preretinal and vitreous haemorrhage, on the other hand, indicates a positive correlation between the amount

of bleeding which suddenly occurs in the subarachnoid space and the incidence and severity of FH.

According to the results of the present study, only classification of FH by severity as suggested earlier (Fahmy 1972a) would have any significance. Patients with fundal haemorrhages of the various grades have different clinical courses and prognoses. The second part of this investigation (Fahmy 1973c) should serve as a further documentation.

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