SPONTANEOUS SUBARACHNOID HÆMORRHAGE WITH RECOVERY

Remarks on the ætiology of such cases in the absence of any obvious renal or vascular disease and without any known infection or general tendency to hæmorrhages of any kind.*

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INTRODUCTION.

IN recent times the use of lumbar puncture for diagnosis and treatment has revealed many cases of spontaneous diffuse subarachnoid hæmorrhage—terminating in recovery—of unknown causation in apparently otherwise healthy persons. In some of these cases recovery has doubtless been favoured by the relief of pressure on the brain and spinal cord afforded by the lumbar puncture, repeated if necessary. Reports of cases of this class are becoming more frequent in Great Britain, the Continent and America. The question of the probable ætiology of such cases is intimately allied to that of the ætiology of spontaneous cerebral or cerebellar hæmorrhage occurring in otherwise apparently healthy subjects (C. O. Hawthorne and others). By *spontaneous* we mean *non-traumatic*; and we shall not discuss hæmorrhages secondary to tumours or due to renal and vascular diseases, or known infections, or general tendency to hæmorrhages of any kind. This excludes the consideration of hæmorrhage secondary to meningitis of any sort or connected with syphilis, tuberculosis or malignant endocarditis, with or without the intermediate formation of a mycotic aneurysm, leukæmia (notably, myeloid leukæmia), purpura (various classes), and hæmophilia.

In some cases (especially fatal ones), owing to their sudden onset and severity, the symptoms may resemble those of general intracranial pressure from hæmorrhage into the ventricles. In other cases (especially after the first onset) the symptoms may be chiefly those of meningeal irritation, including cervical rigidity and Kernig's sign (C. P. Symonds and others), and owing to that and because of the usual moderate pyrexia of subarachnoid hæmorrhage, a clinical diagnosis of *meningitis* or, after a post-mortem examination, of *meningitis hæmorrhagica*, has formerly sometimes been made. In the present case and in various recorded cases (Rathery and Bonnard, Fiessinger and Janet, Otero) the lethargy and somnolence have resembled that of encephalitis lethargica. In some cases there have been localised symptoms, probably due

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to slight superficial laceration of nervous tissue ; but with the cases in which the subarachnoid hæmorrhage is secondary to a definite cerebral or cerebellar hæmorrhage we are not concerned here—any more than we are with cases in which the subarachnoid hæmorrhage is due to conditions or injuries acting from outside. In one case (Simon and Michon), in a youth who recovered, it was suggested that the starting-point of the hæmorrhage was spinal instead of in the supposed usual position, that is to say, at the base of the brain. In some cases (Riddoch and Goulden, J. A. Conway) ocular symptoms (retinal, vitreous or subhyaloid hæmorrhages) have been present, and a rare complication is the occurrence of herpes (W. J. Adie).

PERSONAL CASE.

The patient, Mrs. C. L. G., age 54 years, a rather thin-looking Englishwoman, was sent to hospital on January 30, 1926, in a deeply somnolent condition, as a probable case of encephalitis lethargica. On admission the temperature was normal; pulse, 60; respiration, 24 per minute. She could easily be roused from her somnolence to answer questions, but when left undisturbed she would quickly relapse into an apparently ordinary sleep. In that respect her condition suggested encephalitis lethargica. When roused up and questioned she did not complain of any headache or other pain but only of a feeling of tiredness and sleepiness. There was very slight cervical rigidity, inasmuch as she could not bend her head forward, but there was no definite Kernig's sign. The left pupil was slightly smaller than the right, but both reacted normally to light; later on it was thought that the left pupil reacted slightly more slowly than the right, and the left palpebral fissure was often smaller than the right. There was no diplopia. No paralysis or anæsthesia was found anywhere. No disorder of the deep or superficial reflexes was detected, excepting that the superficial abdominal reflexes could not be obtained. No other nervous symptoms of any kind were present. By ophthalmoscopic examination the fundi appeared normal. No evidence of visceral disease in the thorax or abdomen was obtained on admission or later on. The brachial blood-pressure taken later on was 120 mm. Hg. (systolic) and 180 mm. Hg. (diastolic).

A lumbar puncture made on February 1 proved the case to be one of subarachnoid hæmorrhage. It yielded cerebrospinal fluid (only 15 c.c. withdrawn) uniformly mixed with blood; when the blood-corpuscles were separated by centrifugalisation the clear supernatant fluid was yellow (4 by Meulengracht's scale) and gave a positive indirect Hijmans van den Bergh reaction for bilirubin. With this the patient's blood-plasma was compared; it was likewise yellow (8 by Meulengracht's scale) and gave a not very strong positive indirect Hijmans van den Bergh reaction. The condition of the cerebrospinal fluid was the same on the morning of February 2, when 15 c.c. were again withdrawn; the clear yellow fluid, from which the blood-corpuscles had been separated, gave a positive reaction for hæmoglobin as well as a positive indirect Hijmans van den Bergh reaction for bilirubin.

The *history* previous to admission was that on January 28 the patient had suddenly complained of severe pains in her head, after which she fell into the condition of somnolence in which she was admitted. Previously to this attack she had apparently enjoyed good health, excepting that for over thirty years (since her sixteenth year) she had suffered from attacks of headache—chiefly on the left side—and vomiting, lasting two or three days, and recurring about every six weeks. The only method of treatment for these migraine-like attacks, which she thought had done her any good, was to rest on her back in a quiet room and to abstain from any food or drink. Even after taking a little tea during these attacks she would sometimes vomit. She had had only one child (a girl, age 12 years, living and healthy), and no miscarriages.

In regard to the causation of the subarachnoid hæmorrhage there was no history or evidence pointing to traumatism, syphilis, tuberculosis or any infection, cardiac, vascular or renal disease, or any hæmorrhagic tendency. The patient's blood-serum and cerebrospinal fluid both gave a negative Wassermann reaction. The blood-coagulability and the bleeding-time were apparently normal. A blood-count gave: hæmoglobin, 97 per cent.; erythrocytes, 5,100,000, and white cells, 10,000, per c.mm. of blood. The differential count of the white cells gave: polymorphonuclear leucocytes, 62 per cent.; lymphocytes, 27 per cent.; monocytes (transitionals and large mononuclears), 9 per cent.; eosinophiles, 2 per cent. There was apparently no diminution of blood-platelets. The slight leucocytosis noted may have been post-hæmorrhagic.

The diagnosis of subarachnoid hæmorrhage was confirmed by the patient becoming suddenly unconscious on the afternoon of February 2, evidently owing to fresh subarachnoid hæmorrhage. This attack commenced with a spastic condition in the upper limbs and there was Cheyne-Stokes respiration for about three-quarters of an hour; the pupils were large; the pulse was unaltered. An intravenous injection of gr. 1/20 'lobelin' seemed to have a favourable effect. Anyhow, this attack passed off in about two-and-a-half hours, and the previous condition of somnolence (as on admission) returned.*

After that the condition remained unaltered for some time. We failed to obtain any cerebrospinal fluid by lumbar puncture on February 6, and no further attempts were made to obtain any, especially as the above-mentioned exacerbation of the symptoms had followed a few hours after the second lumbar puncture. For about 12 days there was moderate pyrexia (*see figure*), as is usual in cases of subarachnoid hæmorrhage. During the first two days in the hospital the pulse was only about 60 a minute, but afterwards, with the pyrexia, it became somewhat more frequent. On February 11, when the fever ceased, the patient seemed to pay more attention to what was going on near her, and made a few sensible remarks. On the following day she talked a little spontaneously and said that she did not feel sleepy. From this time she continued gradually to improve. From February 20 she could use a knife and fork with her meal and soon afterwards she was able to get out of bed to sit up a little. On March 13 she could walk about quite well and was very cheerful; there was no cervical rigidity. She told us that she could not remember anything of her illness except that, when recovering, she felt very sleepy. The eyes had occasionally been ophthalmoscopically examined for anything abnormal, but always with negative result. She left the hospital on April 3.

On May 19 we had an opportunity of seeing her again. She looked well, but her husband thought there was some diminution in her energy and memory since the illness. As before, we could obtain no superficial abdominal reflexes; there was also slight right lower facial paresis. Since her illness she had had none of her habitually recurrent migraine-like attacks.

We should like to thank Dr. F. E. Loewy, one of the resident medical officers at the German Hospital, for kind assistance in the examination of the case.

* We may, however, remark that a favourable action has been claimed for lobelin in cases of respiratory disturbance due to increased intracranial pressure.

SUMMARY OF THE CASE.

The patient was a married English woman, age 54 years, who was sent into the hospital as a case of suspected lethargic encephalitis. Examination of the cerebrospinal fluid, however, showed it to be one of subarachnoid hæmorrhage. This diagnosis was further confirmed six days after the commencement of the illness by the patient suddenly becoming temporarily comatose, evidently owing to further hæmorrhage. The usual moderate pyrexia, as noted in other cases, was present.

The Wassermann reaction was negative in her blood-serum and cerebrospinal fluid, and there was no evidence of any tuberculosis. Previously to the illness she had been apparently healthy, excepting that, since her sixteenth year, she had suffered from attacks of headache (chiefly left-sided) and vomiting, lasting two or three days, and recurring about every six weeks. She gradually recovered from the subarachnoid hæmorrhage without there being any *definite* localising symptoms, but very slight right lower facial paresis was observed after her recovery, and her husband noticed some impairment of her memory and energy. Since her illness (about three months) she has had none of her habitually recurrent migraine-like attacks.

DISCUSSION.

In regard to the diagnostic importance of the examination of the cerebrospinal fluid in these cases (*see* Froin, C. P. Symonds, and others) we will say nothing, excepting that, after separation of the erythrocytes, the yellow colouration (xanthochromia) and the positive Hijmans van den Bergh indirect reaction for bilirubin should be compared with those of the patient's blood-plasma. If the patient happened to be jaundiced or, though not actually jaundiced, for some reason to have bilirubin in the blood-plasma somewhat in excess of the normal limit, one could understand that the cerebrospinal fluid freshly mixed with blood either at the time of the lumbar puncture (owing to a minute vessel being wounded by the puncture) or just previously, would give a positive Hijmans van den Bergh reaction for bilirubin, but of *very much less degree* than that given by the blood-plasma itself. On the other hand, in cases of the kind (as is well recognised) the uniform admixture of blood—the same in every specimen withdrawn—proves that the blood was mixed with the cerebrospinal fluid before the lumbar puncture was made, and a sufficiently marked positive Hijmans van den Bergh (indirect) reaction proves that before the lumbar puncture was made some of the hæmoglobin had been transformed into blood-bilirubin. This shows that subarachnoid hæmorrhage had occurred, or at all events that there had been leakage of blood into the subarachnoid space, *some time before* the lumbar puncture was made.

In discussing the *possible causes of the hæmorrhage* in cases like the present one we will shortly refer to the most probable explanations of non-traumatic hæmorrhage into the brain or meninges—"spontaneous" cerebral, cerebellar and leptomeningeal or subarachnoid hæmorrhage—in otherwise apparently

healthy (often youthful) individuals, that is to say, in the absence of any tumour or any obvious renal or vascular disease and without any known infection or general tendency to hæmorrhage (hæmophilia, purpura, leukæmia).

One of the most probable explanations is the rupture of a small aneurysm—usually at the base of the brain near the circle of Willis—such as has been described by E. G. Fearnside, H. M. Turnbull, C. P. Symonds and others, and has been occasionally observed in otherwise healthy young subjects. These aneurysms—more than one of which may even be present in the same person—are presumably dependent on some local developmental defect in the vessel-wall, so that they have been termed *congenital aneurysms* by some writers. According to Fearnside, intracranial aneurysms may occasionally be due to an inherent, inborn, weakness. In his paper of 1916 (p. 281) he writes: “In the non-inflammatory group a congenital weakness of the arterial wall at junctional points (points of junction and bifurcation) is an important factor in their formation.” Turnbull has suggested that a breach in the media—due to an inborn defect—may be the cause of the trouble. A. Duguid’s case of ruptured aneurysm of the basilar artery in a youth, age 17 years, may be instanced in evidence that aneurysms may be formed by a pouching of a fibrosed intima through a deficient or severed media. In this connection Dr. Weber suggests that certain cases of non-syphilitic aneurysms, apparently of non-inflammatory origin, and occurring in hypoplastic aortas, might be remembered. He (Dr. Weber) would also point out that aneurysms analogous to the so-called ‘congenital aneurysms’ of the brain ought to be carefully searched for in other organs, to account for (supposed inexplicable) hæmorrhages, for instance, spontaneous hæmatomata in the spleen (one probable cause of splenic cysts).

Another possibility is that a defective blood-vessel (artery) sometimes ruptures without there being any aneurysm. In many fatal cases of spontaneous hæmorrhage into the brain or meninges in spite of search at the necropsy no aneurysm of any kind has been found. It is certain that in some cases very careful searching at the necropsy is required to detect the presence of a ruptured aneurysm and even careful pathologists have been known to have overlooked an aneurysm that was subsequently detected. *Nevertheless, rupture of a defective artery without the preliminary formation of an aneurysm must be admitted as a possible alternative explanation.* In this connection we would refer to some work of O. P. Reuterwall in regard to slighter forms of disease in the cerebral arteries. His work throws light on the occasional occurrence of spontaneous hæmorrhage in the brain or meninges of young and apparently healthy individuals apart from syphilis and local active inflammation. He has recorded his careful examination of the basilar artery in 87 post-mortem examinations; in seven of these he found transverse ‘rents’ in the internal elastic lamina which during life had undergone connective-tissue repair. Similar conditions would probably have been found in other arteries of the brain and meninges, had they been examined in the same careful way. As these ‘rents’ tended to be multiple, the internal elastic lamina

was probably peculiarly 'fragile' in such cases. The ages in the seven positive cases varied between 38 and 70 years, and, though in all of them there were arterial atheromatous changes present, the 'rents' had occurred at almost healthy or only slightly diseased sites. The same causes (perhaps blood-pressure strain, slight local disease and the unexplained condition of 'fragility' in question) which produced the 'rents' in the internal elastic lamina might probably, in some exceptional cases, give rise to complete rupture and hæmorrhage or to the formation of an aneurysm.

S. Goldflam has suggested that the cause of so-called 'spontaneous' subarachnoid hæmorrhage may in some cases be a *functional vasomotor disturbance* analogous to what is supposed to occur in *migraine* and Raynaud's symptom-complex. According to the theory in question capillary oozing may take place during the stage of active hyperæmia, which follows that of vasoconstriction. A similar theory has been suggested to account for certain attacks of intra-ocular hæmorrhage, and in this connection one of us (F. P. W.) remembers the case of a man, age 33 years, subject to attacks of migraine and transient blindness, who had an intra-ocular hæmorrhage (into the vitreous of the right eye), which, it was suggested, might have been due to extreme hyperæmia during a period of vascular relaxation following preliminary migrainous angiospasm. In another subject of recurrent migraine-like attacks (a woman, age 52 years) detachment of the retina had occurred in the right eye. Cases of intra-ocular hæmorrhage in women supposed to correspond to "vicarious (supplementary) menstruation" are probably due to extreme vascular "flushing."

In this connection we should also allude to the theory that in cases of spontaneous subarachnoid hæmorrhage the hæmorrhage may be due to a *diffused oozing*, analogous to the hæmorrhage in some cases of gastrostaxis and epistaxis and in some rare cases of hæmaturia. K. Meylahn even goes so far as to suggest that the hæmorrhage is due to *diapedesis of blood-cells* owing to functional vasomotor disturbance.

It must be admitted that in the present case (Mrs. C. L. G.) a history of recurrent migraine-like attacks constituted the most prominent feature of the previous medical history and that migraine-like symptoms have been attributed to an intracranial aneurysm in certain cases in which the presence of such an aneurysm was proved. Nevertheless, though rupture of an aneurysm is perhaps the most likely explanation of the subarachnoid hæmorrhage in Mrs. C. L. G., we cannot believe that, in the absence of any localising symptoms, any aneurysm of the kind could have been the cause of the severe recurrent migraine-like attacks to which the patient (otherwise apparently healthy) was subject for over thirty years before the occurrence of the subarachnoid hæmorrhage. That there may be some indirect ætiological connection between recurrent migraine-like attacks and ultimate subarachnoid hæmorrhage seems probable. Dr. Weber has heard of the case of a middle-aged lady who had been subject to recurrent migraine-like attacks with sickness and who died of

what was probably acute subarachnoid hæmorrhage. (The term "leptomeningeal" was apparently used but we only know that a post-mortem examination was made abroad.)

Spontaneous hæmorrhage in the brain or meninges might conceivably be occasionally connected with congenital *angiomaticous or telangiectatic nævi* or so-called 'congenital varicose veins' of the meninges; for, indeed, hæmorrhage is notoriously more liable to occur in connection with abnormal vascular structures than in connection with normal tissues. Such cases must, however, be of extreme rarity (cf. Anders and E. Herman).

Finally, we must still allude to the possible though improbable occurrence in an apparently healthy individual of local inflammation of an artery leading to 'spontaneous' hæmorrhage in the brain or meninges. Though we have never met with such a case, Parkes Weber has recorded *local arteritis* of the right middle cerebral artery in a previously apparently healthy man, age 43 years, which might conceivably have given rise to hæmorrhage, but which actually gave rise to fatal thrombosis.

BIBLIOGRAPHY.

- ADIE, W. J., "Herpes in spontaneous subarachnoid hæmorrhage," *Lancet*, 1926, i, 124.
- ANDERS, "Ueber einen Fall von ausgedehnter zerebraler Varicenbildung mit tödlicher Blutung in Verbindung mit Sinus pericranii," *Beiträge z. path. Anat. u. z. allg. Path.*, 1918, lvix, 540. (References to the literature).
- BANKS A. G., and PRINGLE, A. M. N., "Toxic (subdural) meningeal hæmorrhage," *Lancet*, 1926, i, 975. (The meningeal hæmorrhage in at least two of the three cases seems to have been subarachnoid. See C. P. Symonds's letter on the subject, *Lancet*, 1926, i, 1119).
- BEADLES, C.F., "Aneurysms of the larger cerebral arteries," *Brain*, 1907, xxx, 285. (He gives references to much previous literature, including Rivington, *Med. Chir. Trans.*, 1875, lviii, 183).
- BITTORF, A., "Ueber Leptomenigitis hæmorrhagica acuta," *Deut. Zeits. f. Nervenheilk.*, 1916, liv, 375.
- CONWAY, J. A., "Two cases of cerebral aneurysm causing ocular symptoms, with notes of other cases," *Brit. Journ. Ophthalm.*, 1926, x, 78 (with references to earlier English literature on the subject).
- CUSHING, HARVEY, "Contributions to the clinical study of intracranial aneurysms," *Guy's Hosp. Rep.*, 1923, lxxiii, 159.
- DEBRE, R., and LAMY, "Deux cas d'hémorrhagie méningée liée à une septicémie pneumobacillaire," *Presse méd.*, 1926, xxxiv, 263.
- DUGUID, A., "A ruptured aneurysm of the basilar artery at the age of 17 years," *Journ. Path. Bact.*, 1925, xxviii, 389.
- FEARNSIDES, E. G., "Intracranial aneurysms," *Brain*, 1916, xxxix, 224.
- FIESSINGER, N., and JANET, H., "Erreurs de diagnostic avec l'encéphalite léthargique : hémorragie méningée," *Bull. Soc. méd. des hôp. de Paris*, 3rd series, 1920, xlv, 1230.
- FITZ, R., "A case of intracranial aneurysm," *Boston Med. Surg. Journ.*, 1924, cxc, 521.
- FRON, "Les hémorrhagies sous-arachnoidiennes et le mécanisme de l'hématolyse en général," *Thèse de Paris*, 1904; quoted by Symonds, *loc. cit.*
- GOLDFLAM, S., "Beitrag zur Aetiologie und Symptomatologie der spontanen subarachnoidalen Blutungen," *Deut. Zeits. f. Nervenheilk.*, 1923, lxxvi, 158.
- HAWTHORNE, C. O., "Cerebral and cerebellar hæmorrhages in apparently healthy adolescents and children," *Practitioner*, 1922, cix, 425.

- HARVEY, W. H., "Congenital aneurysm in a young rabbit," *Journ. Path. Bact.*, 1914, xviii, 343.
- HERMAN, E., "Cavernoma cerebri: hæmorrhagia spinalis meningealis epi-, intra- et subduralis," *Deut. Zeits. f. Nervenheilk.*, 1923, lxxxix, 34. (With elaborate bibliography of the subject).
- MEYLAHN, K., "Ueber spontane diffuse Meningealblütungen," *Deut. Zeits. f. Nervenheilk.*, 1923, lxxviii, 78. (With references to previous, notably German, literature).
- NEAL, JOSEPHINE B., "Spontaneous meningeal hæmorrhage," *Journ. Amer. Med. Assoc.*, 1926, lxxxvi, 6. (Many references to the literature of the subject).
- OTERO, Quoted by Banks and Pringle, *loc. cit.*
- RATHERY, F., and BONNARD, "Hémorragie méningée simulant cliniquement l'encéphalite léthargique," *Bull. et Mém. Soc. méd. des hôp. de Paris*, 3rd series, 1920, xlv, 300.
- REUTERWALL, O. P., *Ueber bindegewebig-geheilte Risse der Elastica interna der Arteria basilaris*, Stockholm, 1923.
- RIDDOCH, G., and GOULDEN, C., "On the relationship between subarachnoid and intra-ocular hæmorrhage," *Proc. Roy. Soc. Med., Section of Ophthalmology*, 1924-1925, xviii, 3. (The full paper was published in *Brit. Journ. Ophthalm.*, 1925, ix, 209).
- SHENNAN, THEODORE, "Miliary aneurysms, in relation to cerebral hæmorrhage," *Edin. Med Journ.*, 1915, xv, 245.
- SIMON and MICHON, P., "Hémorragie méningée sous-arachnoidienne spontanée, pure et curable, chez un jeune sujet: point de départ spinal probable," *Presse méd.*, 1926, xxxiv, 154.
- SYMONDS, C. P., "Spontaneous subarachnoid hæmorrhage," *Proc. Roy. Soc. Med., Section of Neurology*, 1924, xvii, 39.
- "Spontaneous subarachnoid hæmorrhage," *Quart. Journ. Med.*, 1924, xviii, 93. (With an excellent bibliography of the subject).
- Clin. Journ.*, 1926, iv, 217.
- "Contributions to the clinical study of intracranial aneurysms," *Guy's Hosp. Rep.*, 1923, lxxiii, 139.
- TURNBULL, H. M., "Alterations in arterial structure, and their relation to syphilis," *Quart. Journ. Med.*, 1915, viii, 201.
- "Intracranial aneurysms," *Brain*, 1918, xli, 50.
- WEBER, F. PARKES, "Fatal thrombo-arteritis of the right middle cerebral artery of uncertain causation," *Brit. Med. Journ.*, 1923, i, 324.