

---

CALCIFICATION OF THE INTRACRANIAL CAROTID ARTERY AND  
ITS RELATION TO THE CLINICAL AND ANGIOGRAPHIC PICTURE

AN ANGIOGRAPHIC CLASSIFICATION OF ARTERIOSCLEROSIS CEREBRI

VALTER SEIXAS

To our knowledge there have been no previous attempts to correlate the angiographic findings with the presence of intracranial carotid calcifications in cases of arteriosclerosis cerebri. Furthermore, there is no satisfactory classification of the angiographic findings in cases of cerebral arteriosclerosis. The purpose of this study is to provide information on the following questions: (1) what kind of angiographic changes can be seen most often in patients with intracranial carotid calcifications?; (2) is there any possibility to classify the angiographic changes observed in arteriosclerosis cerebri?; (3) if this possibility exists, what are the relations between angiographic findings, age, sex, clinical history and neurological symptoms?

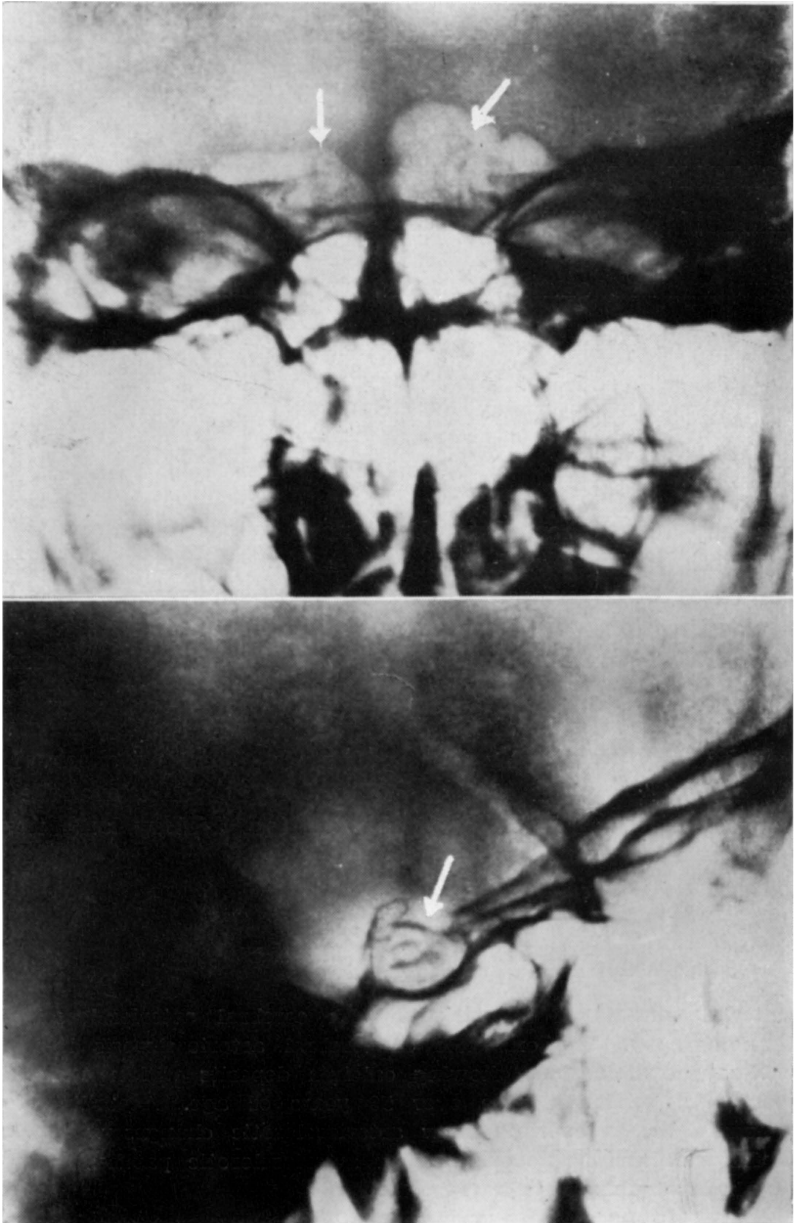
MATERIAL AND METHOD

Our material consists of 56 patients with cerebral arteriosclerosis submitted to carotid angiography. The existence of cerebral arteriosclerosis has been established by X-rays examinations showing calcium deposits within the wall of the carotid artery. All patients were over 50 years of age. According to Wolkoff (1933) all human beings over 40 show arteriosclerotic changes within the layers of the arterial wall and the occurrence of arteriosclerotic patches is supposed to be the last phase of this process (Fig. 1).

---

Summary of a doctoral dissertation presented to the Johannes Gutenberg University, Mainz, Germany (Neurosurgical Clinic: Prof. Dr. K. Schürmann). Paper presented at the Third European Congress of Neurosurgery (Madrid, April 23-26, 1967).

*Author's note* — We wish to express our thanks to Prof. Dr. K. Schürmann for the access to the clinical records of the Neurochirurgische Universitätsklinik (Mainz), for the technical assistance and for his very helpful criticism and advice.



*Fig. 1 — Calcification of the intracranial carotid artery at the syphon.*

## RESULTS

In our material there was a predominance of males (71%) against females (29%).

Age	Sex		Total
	M	F	
50-54	9	2	11
55-59	11	4	15
60-64	14	7	21
65-69	5	3	8
Older than 70	1	—	1
	40 (71%)	16 (29%)	

Table 1 — Age and sex of 56 patients with cerebral arteriosclerosis.

Anamnestic data show a great variability of the first symptoms, some cases presenting an initial apoplectiform crisis, others a progressive course. Only the psychic disturbances and the episodes of dizziness usually showed a slow progression upon the initially mild symptoms (table 2).

First symptom	Acute evolution	Progressive evolution	Total
Motor disturbances	12	13	25
Speech disturbances	4	3	7
Headache	3	4	7
Convulsions	7	—	7
Mental disturbances	1	4	5
Ictus	3	—	3
Visual disturbances	—	1	1
Sensibility disturbances	—	1	1
Dizziness	1	6	7

Table 2 — First symptom reported by 56 patients with cerebral arteriosclerosis.

Two main groups of symptoms led the patients to search for medical care: (1) motor deficiencies such as hemiparesis, weakness and monoparesis; (2) psychic disturbances such as forgetfulness, slowness and hallucinations. Other symptoms such as headache, dizziness, defective vision, speech disorders and asynchronisms were generally considered as secondary.

Angiographic analysis of intracranial arteries in our cases revealed a series of signs which have to be considered as typical of arteriosclerosis because of their frequency and their presence simultaneously to other characteristic signs. The cervical arteries were visualized angiographically in 10 of our 56 patients. All showed total or partial block, more often affecting the arteria carotis interna. The arteria carotis communis was totally blocked in one case. We found 8 total blocks in the cervical part of the internal carotid artery. No block was seen in the external carotid artery.

The angiographic analysis in the remaining 46 cases revealed a different picture since it was possible to find a series of changes which took place in these arteries. The study was made with regard to the existence of total or partial blocks as well as irregularities in caliber, including aneurysmal formations.

It was seen in all cases that the syphon was the most often affected segment, being completely obstructed in two cases. Total occlusion of the arteria cerebri anterior was observed in 5 cases. A total block in the arteria cerebri media was seen in 2 cases. Small peripheral arteries were occluded in three cases. A total of 20 out of 56 patients (36%) had intracranial vascular occlusions of any kind.

Irregularities of the caliber and of the wall, partial block and aneurysms predominated at the syphon. Partial block at this site with lumen reduction of more than 50 per cent was seen in 7 cases; wall-irregularities with lumen reduction of less than 50 per cent were observed in 11 cases and aneurismal formations in 5 cases.

Other partial blocks were found: 9 times in anterior cerebral artery and once in the arteria cerebri media. This group presenting partial vessel occlusion which still shows some blood flow consisted of 21 patients.

#### COMMENTS

The above mentioned angiographic abnormalities, described by many authors and present in 41 of our cases (73%) with calcified syphon, should be considered as signs of arteriosclerosis. Figure 2 illustrates the fre-

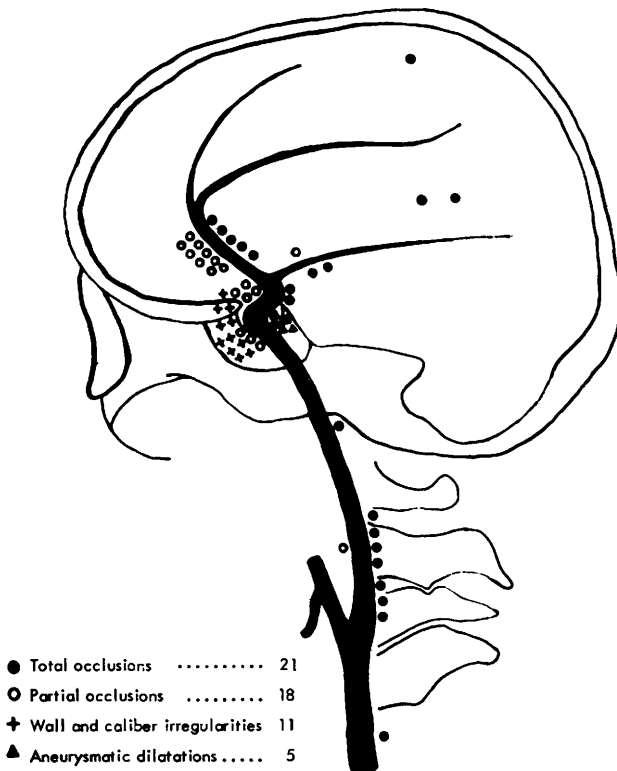


Fig. 2 — Site and number of angiographic alterations in patients presenting calcifications in the carotid artery.

quency and the localisation of the angiographic changes in cervical and intracranial vessels in these patients with calcifications of the carotid artery.

It is interesting to point out that in 15 of our patients (27%) there were neither block nor caliber-irregularities at all despite the calcification of the carotid arteries. This would mean that there may be arteriosclerotic changes in the vessel walls without reduction of the arterial lumen.

We have tried to identify other angiographic signs of cerebral arteriosclerosis and their frequency. Most frequently in 13 of 15 patients a wavy course of the vessels could be observed; 10 cases showed a very striking vessel-poverty in the periphery and in 13 cases the presence of small knots denoted a kinking of the vessels.

A prolonged circulation time was noticed in 6 cases. The course of the arteria cerebri anterior had an angular form instead of the normal rounded one. The sign considered by Moniz as typical for arteriosclerosis — rectilinear course plus vascular dilatation — has been found only in one of our cases.

This study permits the classification of the angiographic abnormalities due to arteriosclerosis in 3 grades:

*Grade I* — Wavy course of the cerebral vessels and small number of peripheral vessels; formation of small knots; prolonged circulation time; angular form of the arteria cerebri anterior (in lateral picture), its course following a straight line and its caliber being broad;

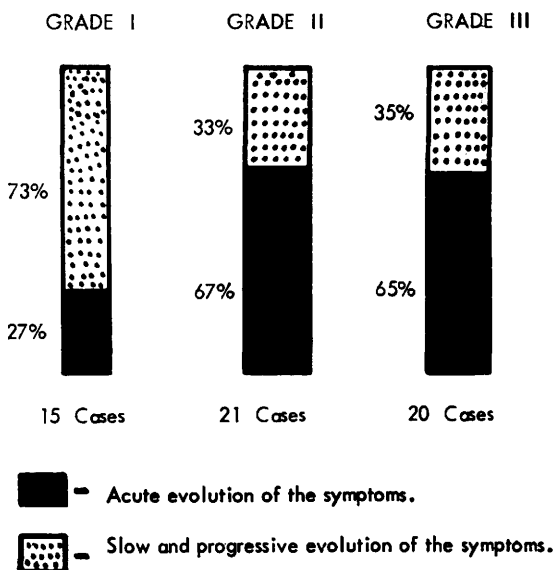


Fig. 3 — Relation between angiographic alterations and clinical evolution in the three grade-groups of cases.

*Grade II* — Partial block (stenosis); irregularities of all and caliber as well as aneurysmal formation (these changes still allow the blood to flow into the brain);

*Grade III* — Total block of some vessels of the carotid system causing a generalized or localized interruption of blood supply to the brain.

The relations among these 3 different grades have been statistically controlled (Fig. 3). In 73% of the 15 patients presenting angiographic changes of grade I the illness had a slowly progressive installation. Among 21 cases in which angiographic changes of grade II were found the disease had an acute apoplectiform course in 14 (67%) and a slowly progressive evolution in 7 (33%) cases.

The same relation was seen in the 20 cases with angiographic changes of grade III, the onset of disease being predominantly acute, assuming the form of an ictus (65%).

It was not possible to establish a correlation between the grade of psychical and neurological disturbances at the course of the disease and the angiographic findings.

#### SUMMARY AND CONCLUDING REMARKS

Fifty six patients with arteriosclerosis cerebri confirmed by X-rays examinations were clinically and angiographically studied. Calcifications of the carotid artery were found predominantly in human beings between the ages of 55 and 65 and more often among men than among women, the proportion being 2.5 to 1. Nearly all arteriosclerotic patients with calcium deposits in the carotid artery showed several neurological and mental deficits, the most frequent initial symptoms being motor disturbances. Angiographic anomalies found in these patients can be classed into 3 groups: (a) *grade I* — wavy course of the cerebral vessels, small number of peripheral brain vessels, formation of small knots, prolonged circulation time, arteria cerebri anterior with angular form, straight course and broad caliber; (b) *grade II* — partial block, irregularities of wall and caliber, aneurysmal formations; (c) *grade III* — total block of some vessels of the carotid system preventing a generalized or localized cerebral blood supply. Grades II and III angiographic abnormalities were most often seen at the syphon and at the carotid bifurcation in the neck (site of predilection). Most patients with a progressive clinical course belonged to the I group. The course of the disease did not differ in patients with grades II and III angiographic changes since usually the illness had an apoplectiform onset. Arteriosclerotic degenerative irregularities within the layers of the arteries (up to atheromatous patches) may occur without reducing the arterial lumen. In such cases the patients may remain asymptomatic until there is a decompensation in the brain circulation due to many causes.

## RESUMO E CONCLUSÕES

Foram estudados, clínica e angiograficamente, 56 pacientes com arteriosclerose cerebral comprovada mediante visibilização radiológica de calcificações localizadas na porção intracraniana da artéria carótida interna. Calcificações da artéria carótida interna ocorrem com mais freqüência em indivíduos com idade entre 55 e 65 anos. Os homens são mais afetados do que as mulheres na proporção de 2,5:1. Os sintomas iniciam-se preferentemente com distúrbios motores. Posteriormente foram verificados, ao mesmo tempo e no mesmo paciente, vários distúrbios neurológicos e psíquicos. Nesses pacientes as alterações angiográficas do sistema carotídeo podem ser classificadas em 3 grupos: a) 1.<sup>o</sup> grau — percurso ondulado das artérias cerebrais, pobreza vascular na periferia, formação de acotovelamentos das artérias, aumento do tempo de circulação, artéria cerebral anterior com forma angulada; b) 2.<sup>o</sup> grau — oclusões parciais, irregularidades das paredes e do calibre das artérias e formações aneurismáticas; c) 3.<sup>o</sup> grau — oclusões totais de artérias do sistema carotídeo. As alterações de 2.<sup>o</sup> e 3.<sup>o</sup> grau foram observadas com maior freqüência nas proximidades do sifão carotídeo e junto à origem da carótida interna (zonas de predileção). Na maioria dos casos cuja sintomatologia evoluiu lenta e progressivamente foram encontradas alterações de 1.<sup>o</sup> grau. Entre os dois grupos de pacientes com oclusões parciais ou totais (2.<sup>o</sup> e 3.<sup>o</sup> grau) não foi verificada qualquer diferença na evolução clínica pois na maioria dos casos destes dois grupos, a sintomatologia começou de maneira abrupta. Podem ser encontradas degenerações arterioscleróticas (até placas ateromatosas) nas paredes arteriais, sem que ocorra diminuição da luz do vaso. Os doentes podem permanecer assintomáticos até que, por uma causa eventual, a circulação cerebral se descompense.

## REFERENCES

1. ARING, C. D. & MERRITT, H. H. — Arch. Int. Med. 56:435-456, 1935.
2. BADT, B. — Neurol. Zbl. 138:610-656, 1932.
3. BERGERHOFF, W. — In Handbuch der medizinischen Radiologie. Springer Verlag, Berlin-Göttingen-Heidelberg, 1963.
4. BONNET, P. & BRET, P. — Arch. d'Ophtalm. 14:775-786, 1945.
5. BRAIN, R. — Diseases of the Nervous System. Oxford University Press, London, 1962.
6. BREDT, H. — Therapiewoche 7:1-4, 1956.
7. BRUNETTI, L. — Riv. Radiol. e Fis. med. 3:567-602, 1931.
8. DIETZ, H. & SCHÜRMAN, K. — Materia Medica 13:7-19 e 73-86, 1961.
9. FISCHGOLD, H.; BREGEAT, P. & DAVID, M. — La Tomographie de la Base du Crâne en Neuro-Chirurgie et Neuro-Ophtalmologie. Paris, Masson & Cie., 1952.

10. HEINRICH, A. — Zschr. Altersforsch. 2:240, 1940.
11. JULIAO, O. F. & MELARAGNO FILHO, R. — Arq. Neuro-Psiquiat. (São Paulo) 20:255-274, 1944.
12. LEHOCZKY, T. & HALASY, M. — Acta med. (Budapest) 5:215-230, 1955.
13. LIMA, P. A. — Cerebral Angiography. Oxford University Press, London, 1950.
14. LINDGREN, E. — *In* Handbuch der Neurochirurgie, Bd. II. Springer Verlag, Berlin, 1954.
15. LÖHR, W. & JAKOBI, W. — Arch. klin. Chir. 177:510-527, 1933.
16. MELARAGNO FILHO, R. — Afecções vasculares cerebrais. Livraria Luso-Espanhola e Brasileira, São Paulo, 1959.
17. MONIZ, E. — Die cerebrale Arteriographie und Phlebographie. Bd. II. Springer Verlag, Berlin, 1940.
18. NEWTON, R. H.; ADAMS, J. E. & WYLE, E. J. — New England J. Med. 270: 14-18, 1964.
19. RAUSCH, F.; SCHIEFER, W. & STRUCK, G. — Fortschr. Neurol. 24:512-520, 1956.
20. SCHEID, W. — *In* Handbuch der Inneren Medizin, 5 Bd., Teil 3. Springer Verlag, Berlin, 1953.
21. SCHMITZ, E. & SALM-SALM, E. — Albrecht v. Graefes Arch. Ophtalm. 156: 303-312, 1955.
22. SCHÜLER, A. — Wien. Klin. Wschr. 26:642, 1913.
23. SCHÜRMAN, K. — Zbl. Neurochir. 19:346-363, 1959.
24. SCHÜRMAN, K. — Acta Neurochir. Suppl. VII:556-558, 1961.
25. SCHÜRMAN, K. & DIETZ, H. — Zbl. Neurochir. 21:107-126, 1961.
26. SCHÜRMAN, K. — Ärztl. Fortbildung 13:126-132, 1963.
27. TARTARINI, E. & CANDELERO, G. — Sist. nerv. 5:313-320, 1954.
28. TÖNNIS, W. & SCHIEFER, W. — Zirkulationstörungen des Gehirns im Serienangiogramm. Springer Verlag, Berlin, 1959.
29. WECSLER, I. S. — Clinical Neurology. W. B. Saunders Co., Philadelphia-London, 1963.
30. WOLKOFF, K. — Beitr. path. Anat. 91:515-553, 1953.
31. ZACLIS, J. — Arq. Neuro-Psiquiat. (São Paulo) 17:1-22, 1959.
32. ZACLIS, J. & CRUZ, O. R. — Arq. Neuro-Psiquiat. (São Paulo) 19:295-306, 1961.