INCIDENCE AND SIGNIFICANCE OF EARLY FILLING OF VEINS IN NORMAL INTERNAL CAROTID ANGIOGRAPHY

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Since the discovery of cerebral angiography by Moniz in 1927, this unique method of investigation has been studied extensively and has become an important aid to the neurologist and neurosurgeon in the diagnosis of intracranial lesions. As the literature on the subject became more voluminous, more points of interest and debate began to appear. It is true, as once pointed out by Johanson,8 that in the angiographic literature, interest has been focussed mainly on the displacement of arteries and the existence of pathological vessels. The appearance of veins was not often taken into consideration. During the last few years, however, there has been increasing interest in the phlebogram and its diagnostic value. Recently Steinhart and his co-workers22 reported that they could localize brain tumors in 90 per cent of cases from their phlebograms and without previous knowledge of the arteriograms. In 14 per cent of these cases the value of the phlebogram exceeded that of the arteriogram.

One of the most interesting observations that gave added support to the diagnostic value of veins in cerebral angiography was the angiographic demonstration by Tönnis23 of arteriovenous communications in glioblastomas. The presence of such communications gave rise to the phenomenon of “early appearance of veins” in the angiogram. The significance of this “early” appearance of veins in glioblastomas as well as in other brain tumors was subsequently stressed repeatedly both by Tönnis and his assistants as well as by others.4,8,9,11,16-20,24-28 Tönnis and Schiefer27 stated that arteriovenous communications could be observed both radiologically (as “early veins”) as well as at operation (by the presence of red arterial blood in cortical veins) not only in glioblastomas, but also in malignant astrocytomas and oligodendrogliomas, in sarcomas and in metastases. They emphasized the fact that this early appearance of veins in angiograms in all probability denoted the presence of a malignant intracranial tumor.

It is this increasing significance of “early veins” that stimulated the present study. It will be our aim in this paper, the first of a series dealing with “normal and pathological early veins,” to attempt to clarify the concept of “early veins” and to try to find out their possible incidence and significance in the “normal cerebral angiogram.” For a better understanding of the subject under discussion, we found it essential to study first the timing and order of appearance and disappearance of veins in the normal internal carotid angiogram.

“Normal” Material. Two groups of cases were studied: (1) 34 angiograms obtained by rapid serial technique; (2) 220 angiograms obtained by ordinary or routine serial technique (in our material we used the 4-film technique).

It is true that rapid serial angiography would supply the most precise information in the majority of problems under discussion. However, the routine 3- or 4-film method is the more popular technique and is the only one available in most neurosurgical centers; even in the most elaborate centers the rapid serial technique is reserved for special cases.
only. It therefore is our opinion at present, and until the time comes when rapid serial angiography completely replaces ordinary serial angiography, that we should try to obtain the maximal possible information from films taken by the routine technique. In the present study most of the observations and conclusions will be drawn from films taken by the rapid serial technique, but these will be compared with data inferred from routine serial films as much as possible. The potential possibilities of the latter technique should by no means be overshadowed by the more elaborate achievements of modern rapid technique.

"Normal" Cases. Though carotid angiography now is regarded as a safe procedure, it is not yet so absolutely safe as to be attempted experimentally on a normal individual or a "volunteer." All the "normal" cerebral angiograms described in the literature are "normal" only from the point of view of the "angiogram" per se. An individual whose angiogram is stamped as "normal," must have carried such a cerebral ailment as to have necessitated the undertaking of a carotid puncture for angiography.

Schurr and Wickbom21 defined their "normal angiograms" as those in which no displacement of vessels or other abnormality was visible in any part of the film and when the clinical diagnosis was such that they did not consider it likely that the part of the circulatory system being studied was affected to any significant extent by the disease. Among their "normal" cases were patients with focal epilepsy, otitic hydrocephalus, meningitis, penetrating head injuries, subarachnoid hemorrhage, cerebral arteriosclerosis, thrombosis in the opposite hemisphere, etc.

Greitz23 32 patients with "normal" angiograms had headache (12 cases), epilepsy (14 cases), hemangioma of calvarium (1 case), dermoid of facial bone (1 case), arteriovenous malformation of the external carotid (1 case) and single cranial nerve palsies (3 cases).

Concerned as we were with the timing and variations in venous filling, we insisted on avoiding "normal angiograms" of patients harboring a disease that might in any way impede or disturb the venous circulation. Cases of raised intracranial tension (e.g., hydrocephalus, subarachnoid hemorrhage, meningitis, etc.) were excluded; the effect of such a rise of tension in slowing down the cerebral circulation is a common observation in many angiograms. Moreover, acute head injuries with their concomitant edema and venous impediment, as well as post-traumatic conditions with accompanying fibrosis and possible venous obstruction, were rejected. Consequently we were able to limit our cases of routine angiography to patients with epilepsy. Therefore, all the 220 "normal routine serial angiograms" were obtained from patients complaining of idiopathic or focal epilepsy with no demonstrable neurological or angiographic pathology. The group of "normal rapid serial angiograms," on the other hand, included in addition to 17 cases of epilepsy, 5 cases of headache; 7 cases of patients who underwent angiography for suspected vascular processes, but in whom no evidence of vascular pathology was found by angiography; 3 cases of Parkinsonism with no vascular pathology; 1 case of sarcoma of the skull with no intracranial extension; and a case of small hypophysial adenoma with no rise of intracranial tension. Most of these patients had undergone air studies and a good percentage of them were followed-up by control examination and angiography for months or years.

Techniques Used. The techniques of angiography, both routine and rapid methods, were fully described, among others by Tönnis and Schiefer,27 and will not be given in detail here. However, since we are concerned with the time relationship of the filling of various veins, it is essential to give some information on the intervals of time between the films that we used in both methods:

(a) Routine 4-film technique: In all our 220 cases examined by this technique, the interval of time between each 2 films was fixed automatically at 0.55 of a second (Tönnis-Bergerhoff's -4-4-4 interval type).