Accuracy of high resolution computed tomography in direct diagnosis of cerebral aneurysms

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Summary. With high resolution computed tomography (CT) of the skull, performing rapid series of 1.5 mm slices during an intravenous bolus injection of contrast medium, an angiography-like image (angio-CT) of the basal cerebral arteries can be obtained. From 76 consecutive angiographically or autopsy-verified cerebral aneurysms of various sizes down to 3 mm in diameter, 74 (97.4%) were shown up by the angio-CT. One ruptured and one incidental aneurysm escaped CT visualization. Besides the correct localization of the aneurysms, angio-CT provides information concerning the size and main direction of the aneurysms and yields, in addition, a coronal view of the aneurysms and their surrounding structures. Pitfalls for mis-diagnosis can be the following: Aneurysms of below 5 mm in diameter, located at the supraclinoid part of the carotid artery, multiple or non-ruptured aneurysms, bony or movement artefacts, poorly contrasted vessels due to wrong injection technique of contrast medium or vasospasm, and incorrect interpretation.

Key words: Cerebral aneurysms - Computed tomography - Cerebral angiography - Subarachnoid hemorrhage

CT permits direct visualization of the subarachnoid hemorrhage and its distribution, of intracerebral hematomas, of cerebral infarction or swelling, and hydrocephalic enlargement of the ventricles. The quantity of subarachnoid blood in CT is an important factor in assessing the risk of development of vasospasm, and the final outcome in patients with ruptured aneurysms [1, 8, 9, 16, 18, 19, 23] and has been shown to be helpful in planning their management [3, 7]. Under certain circumstances the pattern of blood distribution in the subarachnoid space allows some conclusions concerning the side or even the site of the ruptured aneurysm [2, 3, 7, 14, 15, 22, 24]. However, the reliability of such an indirect method is low. As the time interval following aneurysm rupture increases, the blood is reabsorbed, redistributed or washed out of the basal cisterns so that the pattern of blood distribution is of low significance in localizing the ruptured aneurysm. In a previous series of 143 patients with the clinical diagnosis of subarachnoid hemorrhage, correlation between blood distribution in the basal cisterns in CT and the localisation of the aneurysm by angiography has been evaluated [6]: In only 34% of this series did plain CT correctly predict the site of aneurysm rupture as localized by angiography.

With the earlier CT technique only larger aneurysms could be visualized directly by the use of contrast medium [10]. However, the rate of false negative diagnosis in smaller aneurysms ranged between 30% [15] and 58% [7]. In the present study, this question was reexamined, using a high resolution CT-technique. In a consecutive series of 102 patients with suspected cerebral aneurysms, angio-CT was performed with thin slices during administration of intravenous contrast medium. All patients were also examined by cerebral arteriography and/or at autopsy.

Patients and methods

We have studied 102 consecutive, non-selected patients with suspected saccular aneurysm of the cerebral arteries. They had histories of proven or suspected subarachnoid hemorrhage, or suffered from severe epistaxis or eye movement disorders. All were...
routinely studied by a plain CT of the skull, followed by an angio-CT centered at the circle of Willis, all employing high resolution technique (GE 9800).

First, a plain axial CT-Scan with 10 mm slices without contrast was performed across the entire neurocranium taking an average of 5 to 10 minutes.

Subsequently, a so-called angio-CT study was focussed on the circle of Willis with a rapid series of 1.5 mm slices, requiring on average an additional 5 to 10 minutes. A rapid bolus of 100 cc Telebrix 30 was injected in a cubital vein. Following the administration of the first 50 cc of the contrast medium, the CT series started and the injection was finished when about 8 to 10 of the total 12 to 20 slices had been performed. According to the predominant distribution of subarachnoid blood, some further slices were added rostrally up to the bifurcation of the pericallosal arteries or caudally down to the vertebral arteries. The pictures were enlarged 1.5 times. Before copying on films, these pictures were analysed on the viewing monitor. Varying window width and level, the optimal degree of contrast of the vessels and of suspicious contrast-enhancing structures was selected. Sagittal and coronal reconstructions across a possible aneurysm as well as reconstructions along the parent vessel were performed to distinguish between arterial loops, fusiform dilatations and saccular aneurysms. All patients had conventional four vessel arteriography, and fatal cases were examined at autopsy. Patients with angio-CT, but without one of these latter investigations were excluded from this study.

Reports of the angio-CT and angiographies, as well as the original films, were examined and their correlation concerning the site, size and main direction of the aneurysms was assessed. The aneurysm diagnoses made by angio-CT were classified into "certain" or "suspicious" positive or negative categories. Compared with the conventional arteriography or the autopsy, which were esteemed to be objective and accepted investigations, the angio-CT was assessed as a "correct" or "false" positive, suspicious, or negative reading respectively. Additionally, based on the plain CT studies, the distribution and amount of subarachnoid hemorrhage were assessed. In the few cases of false negative or positive aneurysm diagnoses by the first examiner, the original films were checked retrospectively by a second neuroradiologist.

Results

In 33 (32%) of a total of 102 patients with SAH or suspected aneurysms, no aneurysm was found by arteriography (Table 1). Angio-CT was also negative in 30 patients (91%), while in one case a false positive CT diagnosis was made (3%). In 2 other patients (6%) where the angio-CT was suspicious for an aneurysm, the arteriography revealed no aneurysm (Table 4).

In the remaining 69 patients, a total of 76 aneurysms was found. Their distribution is listed in Table 2, and their diameter (ranging between 3.0 and, exceptionally, over 20.0 mm) is listed in Table 3, the