Computerized tomography angiography in isolated third nerve palsies


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Object. The goal of this study was to assess the value of computerized tomography (CT) angiography as a diagnostic tool in isolated oculomotor nerve palsies.

Methods. One hundred consecutive patients who presented with an isolated third nerve palsy were examined by CT angiography. This procedure was followed by conventional cerebral angiography in most patients in whom a vascular abnormality was noted on the CT angiography. Thus, all patients whose symptoms were caused by a compressive aneurysm were identified. The remaining patients were observed clinically to exclude the possibility that a missed cerebral aneurysm caused the isolated third nerve palsy.

Eighteen patients harbored a cerebral aneurysm responsible for causing the isolated third nerve palsy. Most of the remaining patients experienced some degree of spontaneous recovery. There was no clinical evidence to indicate that a case of compressive cerebral aneurysm causing the isolated third nerve palsy had been missed on CT angiography.

Conclusions. Computerized tomography angiography is a reliable diagnostic tool for use in the assessment of patients with an isolated third nerve palsy; it can identify the minority of patients in whom conventional cerebral angiography may be required.

Key Words • third nerve palsy • computerized tomography angiography

In 1933, Dott used the cerebral angiographic technique of Moniz to demonstrate the first image of a posterior communicating artery (PCoA) aneurysm causing an isolated third nerve palsy. Since that time conventional cerebral angiography has been the gold standard technique for imaging such aneurysms; however, it carries a significant risk of permanent neurological deficit, particularly in patients with an underlying vasculopathy. Initially, it was believed that most pupil-sparing, isolated third nerve palsies were not the result of an aneurysm; this belief obviated the requirement for routine angiography. However, subsequent reports of compressive lesions that spare the pupil but cause isolated third nerve palsy have indicated that all patients presenting with an isolated third nerve palsy need to be considered for angiography. Nevertheless, only a minority of such patients harbor an intracranial aneurysm; symptoms in the majority of patients arise from a microvascular cause, usually diabetes and/or hypertension. Therefore, a less invasive technique for imaging in patients with this condition would be highly desirable.

In a previous study from this institute, we undertook a retrospective evaluation of 87 angiographically proven PCoA aneurysms and found that 15 of them caused a third nerve palsy. The aneurysms’ diameters ranged from 4 to 25 mm, well within the resolution of computerized tomography (CT) angiography. In addition, a prospective evaluation of 32 patients who presented with an isolated third nerve palsy demonstrated 17 aneurysms in 13 patients, which were identified initially by CT angiography and confirmed by means of conventional cerebral angiography. Furthermore, those vessels shown to be normal on CT angiography were also confirmed to be normal by means of conventional cerebral angiography. Thus, the former procedure was shown to have a sensitivity of 100% when compared with conventional cerebral angiography in the detection of intracranial aneurysms that cause an isolated third nerve palsy. Consequently, a policy evolved in which the initial imaging in patients who presented with an isolated third nerve palsy would be CT angiography, and conventional cerebral angiography would be reserved for those patients in whom an abnormality had been demonstrated on CT angiography. In the absence of an abnormality on CT angiography, patients were simply assigned to close clinical follow-up review. In this paper we address the safety of such a policy, particularly as it relates to the possibility of missing an intracranial aneurysm.

Clinical Material and Methods

By using the databases of the departments of neurology, neuroophthalmology, and neuroradiology we identified all patients who presented with an isolated third nerve palsy without subarachnoid hemorrhage from February 1989 through February 1996. In the earlier portion of the study
period, the patients underwent CT angiography performed with a Philips 350 scanner (Philips, Eindhoven, The Netherlands); more recently (1990–1996) an Elscint Elite scanner (Elscint, Haifa, Israel) was used. Initially 50 ml of nonionic contrast material was injected intravenously; an additional 50 ml was injected slowly during image acquisition. We obtained 15 to 18 axial slices (3-mm slices using the Philips and 2.5-mm using the Elscint) from the midportion of the pituitary fossa to above the circle of Willis with a 1.5- or 1-mm overlap, respectively. Coronal and lateral oblique multiplanar reconstructions were made using standard computer software. Conventional cerebral angiography was performed in most patients in whom a vascular abnormality had been demonstrated on CT angiography. With the aid of a femoral catheter for arterial injection, we obtained first a carotid and then a vertebral angiogram on the affected side. If an aneurysm was confirmed, four-vessel angiography was completed. We measured the height and length of each aneurysm identified.

Clinical assessment and follow-up review were conducted in the neurological and neuroophthalmological clinics, with particular attention to pupillary involvement and the extent of the third nerve palsy. Following imaging, the patient’s progress was reviewed in these clinics in the majority of cases. In 28 patients, detailed follow-up data were obtained from the referring physician by telephone inquiry so that those patients would not be required to travel long distances for clinical follow-up review.

Results

One hundred consecutive patients who presented with an acute isolated third nerve palsy were evaluated. Fifty-three patients had a pupil-sparing lesion at presentation. The male/female ratio of this group was 47:53; the age range was 7 to 81 years and the median age was 53 years. Forty-seven patients were found to have right-sided palsy and 53 had left-sided palsy.

Imaging Studies

The results of CT angiograms were normal in 72 patients and abnormal in 28 patients. Of the 28 CT angiograms revealing abnormalities, 18 showed one or more aneurysms and 10 demonstrated an abnormality unrelated to an aneurysm (Table 1). There were no complications of CT angiography.

Conventional cerebral angiography was performed in 23 patients, confirming aneurysms in 14 patients and unrelated abnormalities in six patients and showing no abnormality in three patients. Conventional cerebral angiography also demonstrated one small 2-mm asymptomatic PCoA aneurysm on the opposite side from the clinical lesion, which had been interpreted as an infundibulum when viewed on the CT angiogram. Four patients whose aneurysm appeared on CT angiography did not undergo conventional cerebral angiography. These included two patients with giant intracavernous carotid artery aneurysms, one patient with a PCoA aneurysm who was considered unfit for surgery because of respiratory problems, and one patient with a large PCoA aneurysm that was confirmed at surgery. In addition, four patients in whom unrelated abnormalities were demonstrated on CT angiography did not undergo conventional angiography. These included two patients who harbored an infundibulum of the PCoA, one hyperlipidemic patient with basilar dolichoectasia, and one patient with diabetes and hypertension who had a persisting embryonic trigeminal artery.

The size of the aneurysm causing the third nerve palsy was measured in all 18 patients. The smallest recorded diameter was 2 mm (range 2–20 mm, mean 7 mm, median 5 mm). The largest recorded diameter was 30 mm (range 5–30 mm, mean 9.8 mm, median 8.5 mm). The smallest maximum diameter was 5 mm. Therefore, no aneurysm smaller than 5 mm in at least one dimension resulted in a third nerve palsy in the absence of subarachnoid hemorrhage.

Illustrative Cases

Case 1. This 31-year-old man presented with a sudden onset of left-sided headaches and a pupil-sparing left-sided third nerve palsy of 10 days’ duration. Computerized tomography angiography showed a 7-mm PCoA aneurysm on the left side, which was confirmed by conventional cerebral angiography (Figs. 1 and 2).
Case 2. This 66-year-old woman presented with a 6-month history of left-sided headache and drooping of the left upper eyelid. She had a partial left-sided third nerve palsy that involved the pupil. Computerized tomography angiography showed a partially filling PCoA aneurysm on the left side, which was confirmed by conventional cerebral angiography (Figs. 3 and 4). Although the patient’s CT angiogram demonstrated both thrombosed and non-thrombosed components of the aneurysm and its relation to the skull base, the cerebral angiogram was less informative because it revealed only that portion of the aneurysm that contained flowing blood.

Clinical Follow-Up Review

Seventy-seven patients did not undergo conventional cerebral angiography and were closely observed clinically. No patient was lost to clinical follow up. Five patients died within 1 month after they underwent CT angiography. The causes of death were meningeal non-Hodgkin’s lymphoma in two patients, meningeal carcinoma secondary to a bronchogenic carcinoma, Escherichia coli septicemia secondary to a urinary tract infection with meningeal involvement, and cardiac failure with severe atrioventricular dissociation in one patient with diabetes and one with hypertension. The remaining 72 patients were observed for a median period of 9 months (mean 16.9 months, range 2–75 months). Forty-four patients achieved a complete recovery, 24 patients an incomplete recovery, and in four patients their conditions were unchanged. Of these four patients, one developed classic clinical and imaging signs of posterior scleritis, another an infiltrative orbital tumor, and a third dysthyroid ophthalmopathy; the fourth, who was followed for 1 year, had very poorly controlled diabetes. In the remaining patients no clinical feature developed that might suggest progression of the third nerve palsy, further neurological involvement, or a missed aneurysm. Of the four patients with unrelated abnormalities demonstrated on CT angiography, in whom conventional cerebral angiography was not performed, each achieved a complete spontaneous recovery.

Discussion

In isolated third nerve palsies a compressive aneurysm appears to be the cause in a minority of patients; in this series the rate was 18%. In previous series an aneurysm has been demonstrated in only 3.1 to 5.2% of patients; the 18% prevalence of aneurysms in our series may represent an overestimate caused by a referral pattern that led the patients to a specialist regional neurological and neurosurgical service. Nevertheless, the majority of patients who present with an isolated third nerve palsy usually undergo conventional cerebral angiography to exclude an underlying aneurysm, whether clinically the lesion has spared the pupil or not. The risk of a permanent...
neurological deficit following conventional angiography varies in different series from 0.6 to 5%.

Furthermore, many patients with an isolated third nerve palsy have other evidence of vascular disease, particularly hypertension and diabetes mellitus. Although the overall risk of conventional cerebral angiography and the risk to patients with mild cerebrovascular disease has been quantified, there is almost certainly a greater risk to severely vasculopathic patients. Fortunately, the advent of CT angiography makes possible less invasive imaging of the circle of Willis and its branches.

In this series, the cause of the isolated third nerve palsy in 18 patients was an aneurysm, the majority of which were located in the PCoA. A total of 22 aneurysms were demonstrated. Four of these aneurysms were asymptomatic: two PCoA aneurysms found in two patients who had bilateral PCoA aneurysms, one small (2 × 2-mm) basilar bifurcation aneurysm, and one anterior communicating artery aneurysm. Four patients in whom an aneurysm was demonstrated on CT angiography did not undergo conventional cerebral angiography; their aneurysms included two giant intracavernous carotid artery aneurysms, one PCoA aneurysm demonstrated at surgery, and one PCoA aneurysm in a patient deemed unfit for surgery because of respiratory disease. In six patients unrelated abnormalities identified on CT angiography were also confirmed by conventional cerebral angiography. Four patients, in whom an abnormality unrelated to an aneurysm was revealed on CT angiography, did not undergo conventional cerebral angiography. These patients experienced complete spontaneous clinical recovery, including two patients with an infundibulum of the PCoA, one hyperlipidemic patient with basilar dolichoectasia, and one patient with diabetes and hypertension who had a persisting embryonic trigeminal artery.

The possibility of missing an intracranial aneurysm in those patients in whom conventional cerebral angiography was not performed is obviously a potential cause for concern. Therefore, we conducted an active and detailed clinical follow-up review of all patients who did not undergo conventional angiography. No patient was lost to follow up and there was no clinical evidence to suggest that we had missed an underlying intracranial aneurysm that could cause the third nerve palsy. In those patients who died in whom no recovery took place, a clear cause for the isolated third nerve palsy was determined to be of an unrelated nature; the remaining patients showed a complete or incomplete recovery. Possible spontaneous recovery from a partial isolated third nerve palsy due to a PCoA aneurysm has previously been reported in one patient; however, the aneurysm on that occasion was 7 mm in diameter and would not have been missed on CT angiography.

In this study and a previous series reported from this institute, 28 cerebral aneurysms have been identified as causing a compressive isolated third nerve palsy. The smallest of these aneurysms measured at least 5 mm in maximum diameter, which is well within the resolution of CT angiography, but the majority were larger in size (median maximum diameter 10 mm).

Recent studies have demonstrated the value of CT angiography when combined with conventional cerebral aneurysm and its surrounding vessels on CT angiography. These patients experienced complete spontaneous clinical recovery, including two patients with an infundibulum of the PCoA, one hyperlipidemic patient with basilar dolichoectasia, and one patient with diabetes and hypertension who had a persisting embryonic trigeminal artery.

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Recent studies have demonstrated the value of CT angiography when combined with conventional cerebral angiography in the evaluation of abnormalities in the circle of Willis. Pitfalls such as the difficulty of evaluating the relationship between a cerebral aneurysm and its surrounding vessels on CT angiography have been identified. Indeed, it has even been suggested that CT angiography may eliminate the requirement for preoperative conventional angiography in selected cases. Fortunately, in some series three-dimensional CT angiography has failed to identify some cerebral aneurysms whose maximum diameters were smaller than 5 mm, although in other series cerebral aneurysms as small as 2 mm were detected.

In one series three-dimensional CT angiography was shown to be superior to magnetic resonance angiography and digital subtraction angiography in the diagnosis of small cerebral aneurysms (< 3 mm in diameter). The present study includes one small 2-mm basilar bifurcation aneurysm initially recognized on CT angiography. An awareness of observer variation in the interpretation of CT angiograms is, of course, essential.

A specific indication for the use of this procedure alone has not as yet been identified, but this series clearly demonstrates that it is the initial imaging investigation of choice in patients with an isolated third nerve palsy and to identify that minority of patients who require conventional cerebral angiography. Our only exception to this rule is the imaging of patients with an allergic diathesis, because clearly the use of contrast media should be minimized in these patients, and in such circumstances, conventional cerebral angiography, controlled by systemic steroid administration, may be indicated.

Magnetic resonance angiography provides an alternative noninvasive technique in the identification of intracranial aneurysms; however, its role is limited because intracranial aneurysms smaller than 5 mm in diameter may well be missed. Furthermore, this procedure is more time consuming and expensive than CT angiography, although, obviously, the risks of using ionizing radiation and contrast agent are avoided. Major advantages of CT angiography are that it is noninvasive, simple to perform, less time consuming than other studies (5 minutes), and relatively inexpensive; it can be performed as an outpatient procedure, carries much less risk than conventional cerebral angiography, demonstrates both filling and nonfilling components of a cerebral aneurysm, and gives an excellent illustration of the relationship of a circle of Willis aneurysm to surrounding skull base structures. It is noteworthy that there were no complications in this series. Further developments in spiral CT angiography, with reduced slice thickness and rapid acquisitions, offer improved resolution and the possibility of the acceptance of routine CT angiography of the circle of Willis.

Conclusions

Computerized tomography angiography is the initial imaging study of choice when a patient presents with an acute isolated third nerve palsy in the absence of subarachnoid hemorrhage. This imaging option serves to identify safely that minority of patients who require conventional cerebral angiography.
Imaging in third nerve palsy

Acknowledgments

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