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Rotational Angiography Assessment of Cerebral Aneurysms

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PURPOSE: To compare rotational angiography with conventional digital subtraction angiography in the assessment of cerebral aneurysms. **METHODS:** Conventional digital subtraction angiography and rotational angiography were compared in 57 patients investigated for the preoperative diagnosis of subarachnoid hemorrhage and in 13 patients after surgery. Images were compared for location, visibility of the aneurysmal neck, vascular branch anatomy, projection, size, presence of spasm, and shape of the aneurysm. **RESULTS:** Rotational angiography was superior to the digital angiogram in assessing aneurysms and vascular anatomy in the following percentage of cases: 12% for location, 46% for the presence of a neck, 32% in the assessment of branch anatomy, 19% for projection, 12% for size, 3.5% for spasm, and 19% for shape. After surgery, rotational angiography more clearly demonstrated the presence or absence of a neck in 69% of the cases. **CONCLUSIONS:** Rotational angiography often allows better visualization of vascular anatomy and therefore improves the angiographic assessment of aneurysms when compared with conventional digital subtraction angiography, making it an excellent adjunct in the investigation of subarachnoid hemorrhage. The lack of subtraction artifacts from the surgical clips and multiple angles of view also allow better assessment of the presence or absence of a residual neck in postoperative cases.

Index terms: Aneurysm, cerebral; Angiography, comparative studies; Angiography, technique

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Investigation of subarachnoid hemorrhage is a major responsibility of the practicing neuroradiologist. Negative angiograms have been reported in 15% (1) of angiograms in the investigation of proved subarachnoid hemorrhages. Confusing complex anatomy or vasospasm may be responsible for many negative angiograms. Postoperative assessment of an aneurysm may be difficult because of the superimposition of vascular clips. Digital rotational angiographic techniques have been developed to improve diagnostic accuracy. Cornelis et al (2) first proposed an angiographic rotation technique in 1972. Voight et al (3) and Thron and Voight (4) introduced the technique into clinical use. Schumacher et al (5) further

described an improved digital rotational technique for the assessment of a variety of neuro-radiologic problems. With current technology one is able to obtain cinematic-quality rotational angiograms (6, 7). To date, we have studied more than 130 patients with rotational angiography and routinely use it in the investigation of cerebral aneurysms. The purpose of the present study is to evaluate the role of rotational angiography versus conventional digital angiography in the investigation of patients with subarachnoid hemorrhage and its role in postoperative assessment of aneurysms.

Methods

Fifty-seven patients in a 4-month period had angiograms for investigation of computed tomographic evidence of subarachnoid hemorrhage, abnormal magnetic resonance findings, or a positive lumbar puncture. Thirteen patients were studied postoperatively. The spin angiogram was performed: (a) whenever we identified an aneurysm; (b) when there was superimposition of vascular anatomy in a region of a suspected aneurysm; or (c) after surgery.

The present study is a retrospective comparison of the spin angiogram with the digital-subtraction angiogram by

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Percentage of times the dynamic spin angiogram was judged superior to the digital-subtraction angiogram

	Aneurysm Search, %	Postoperative Assessment, %
Location	12	...
Neck	46	69
Branches	32	23
Projection	19	23
Size	12	...
Spasm	3.5	...
Shape	19	...

a group of two vascular neurosurgeons and two neuroradiologists. The results represent a group consensus. Comparison was made in relation to the location, visibility of the aneurysmal neck, vascular branch anatomy, projection, size, presence of spasm, and shape of an aneurysm. The conventional digital angiogram was considered the standard of reference, and we are reporting the percentage of cases in which information in addition to that standard was gained when rotational angiography was used.

All of the spin angiograms were performed on a General Electric (Milwaukee, Wis) Advantx angiography system equipped for dynamic spin angiography. The patients were studied supine on the angiogram table with the L-U arm positioned perpendicular to the floor. After centering the region of interest in the middle of the fluoroscopic image and checking the image intensifier and x-ray tube for clearance and position throughout its arc of travel, contrast was injected and the L-U arm rotated through 180°. During the 3 to 5 seconds needed to perform the exam, up to 250 images (1024 × 1024 matrix) were obtained. These images were displayed in a continuous

sequence to give a cinematic effect. During the spin angiogram, 15 mL of contrast material was injected over 3 seconds. This technique takes 5 to 10 minutes of additional time to set up and to perform. Total radiation dose to the patient was approximately 60 Gy for the spin.

Results

Rotational angiography was often superior to or equivalent to expertly performed digital-subtraction angiograms (see Table). Rotational angiography was superior in the assessment of vascular branch anatomy and in the assessment of the neck of an aneurysm (32% and 46%, respectively). In 3 (5%) of 57 patients an aneurysm or additional aneurysms were identified only using rotational angiography (Fig 1). The postoperative assessment for the presence or absence of a residual neck was improved in 69% of cases (Fig 2).

In 9 (16%) of 57 cases in which the digital subtraction angiogram clearly showed normal vascular anatomy without evidence of an aneurysm, no additional information was obtained by performing rotational angiography. No complications were encountered while obtaining the rotational angiogram.

Discussion

Rotational angiography was superior in sorting out confusing anatomy when vascular loops were present by unwinding superimposed

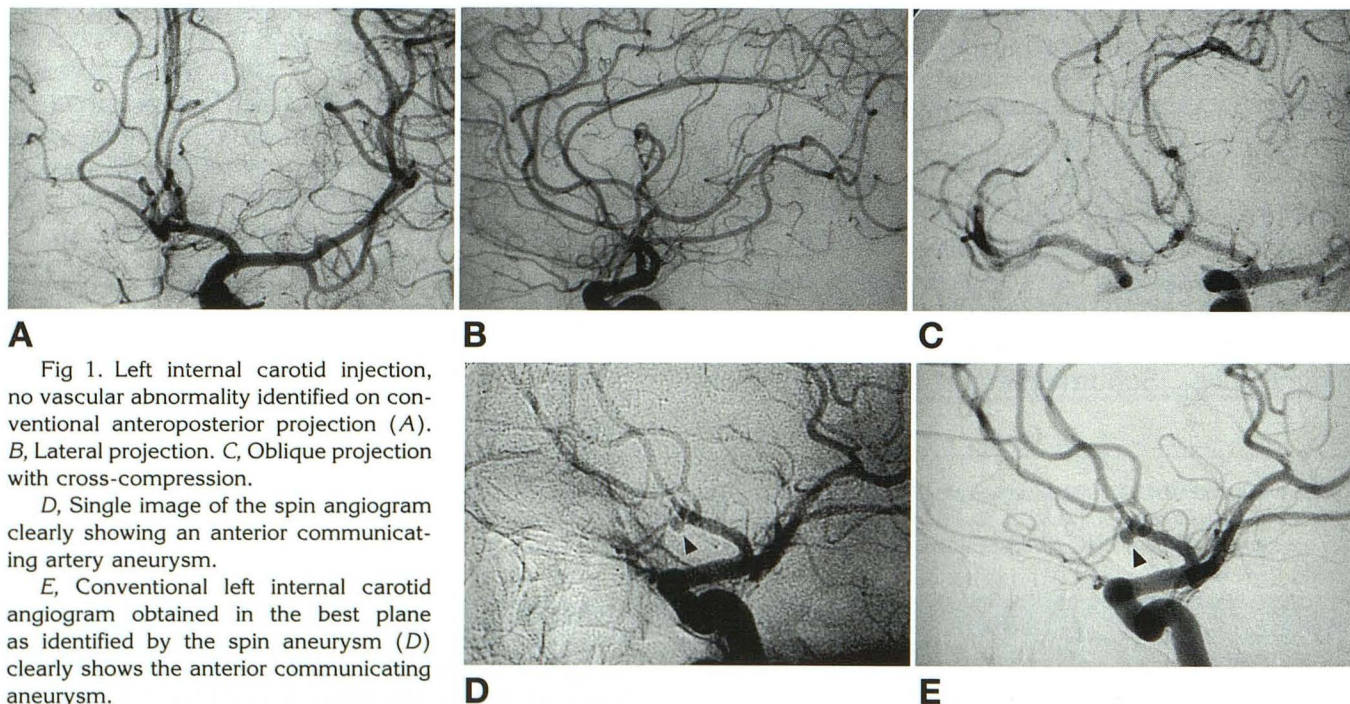


Fig 1. Left internal carotid injection, no vascular abnormality identified on conventional anteroposterior projection (A). B, Lateral projection. C, Oblique projection with cross-compression.

D, Single image of the spin angiogram clearly showing an anterior communicating artery aneurysm.

E, Conventional left internal carotid angiogram obtained in the best plane as identified by the spin aneurysm (D) clearly shows the anterior communicating aneurysm.

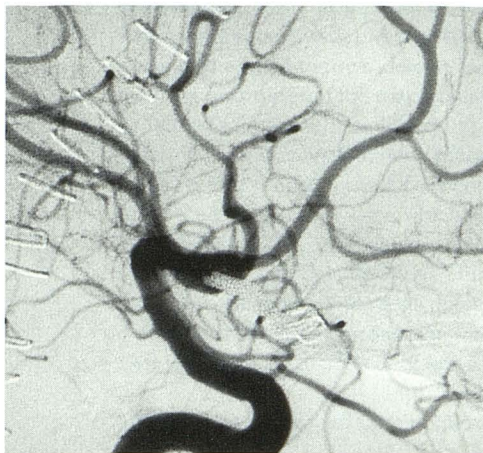
**A****B****C**

Fig 2. A, Anteroposterior view shows subtraction artifact from the aneurysm clip. No residual neck was identified.

B, Lateral view shows no evidence of a residual neck.

C, The spin angiogram (image 97 of 180) shows a residual neck.

(Note.—The rotational technique is used only to search for subtle residual necks. The single representative image shown here does not show the residual neck well; however, on the monitor the neck is clearly seen.)

branch anatomy allowing the investigator to appreciate normal as well as abnormal vascular anatomy with more certainty. This technique allowed us to find three aneurysms that we did not find with conventional digital-subtraction angiography. When an aneurysm was identified, rotational angiography improved visualization of the neck. For example, in anterior communicating aneurysms, the identification of the anterior most A-2 segment aids the neurosurgeon in the approach to the aneurysm. Rotational angiography can also be used at the time of endovascular treatment of an aneurysm. The improved visibility of the neck can help the interventionalist determine the best approach in placing a microcatheter into an aneurysm. Improvement in determining the projection of the aneurysm may alter the surgical approach. For presence of spasm, the rotational angiogram often gave supplementary information but did not alter the treatment of patients.

Rotational angiography is also better at showing the presence or absence of a residual neck in the postoperative assessment of aneurysms because of multiple rotational viewpoints and lack of subtraction artifacts from aneurysm clips. Rotational angiography improved visibility of vascular branch anatomy after surgery, allowing better assessment of the preservation of parent arteries.

We are unable to perform digital subtractions with our rotational technique, although there are other systems that have this capability. We get excellent visibility with this technique and do not need subtractions.

Even with the introduction of new technologies such as magnetic resonance angiography and high-resolution, contrast-enhanced, high-speed computed tomography, digital angiography remains the standard of reference in the assessment of vascular abnormalities. Rotational angiography with rapid acquisition of 1024×1024 -pixel resolution fluoroscopic images has become an important adjunct to digital-subtraction angiography in the radiographic assessment of cerebral aneurysms.

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