MAYO CLINIC

CASE REPORT

Real-Time Cineangiography Visualization of Cerebral Aneurysm Rupture in an Awake Patient: Anatomic, Physiological, and Functional Correlates

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Abstract

Intracranial aneurysms are common and, on a population-based perspective, are a major cause of morbidity and mortality as a result of mass effect or rupture. Cerebral angiography is the primary technique used for the diagnosis of cerebral aneurysms, and the imaging data have additional utility for planning medical, endovascular, or surgical treatments. An extremely rare periprocedural complication of cerebral angiography is rupture of the aneurysm, either as a chance phenomenon or as a result of some physiologic change or mechanical effect. We report on a single awake, alert patient who experienced intraprocedural aneurysm rupture that was recorded in real time during diagnostic cerebral angiography and subsequently proved fatal. Rupture occurred shortly after the completion of contrast material injection into a semi-open vascular bed and appeared to be temporally unrelated to any supranormal change in systemic physiology. No therapeutic endovascular procedure was planned or attempted. From the high-quality sequential, frame-by-frame images, and electronic sedation and anesthesiology records, plus our own real-time observations (G.L., W.L.L.), we were able (for educational purposes) to reconstruct the time course of rupture of the aneurysm, the velocity and pattern of blood escaping the aneurysm and entering the subarachnoid space, and other physiologic and functional correlates (blood pressure changes, alterations in consciousness) that may be critical to our understanding of the mechanism and consequences of aneurysm rupture.

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Intracranial aneurysms occur in approximately 2% to 3% of the population and are the most common cause of nontraumatic subarachnoid hemorrhage (SAH).[1] The incidence of aneurysmal SAH in the United States is estimated between 16,000 and 30,000 per year.[2] Short-term mortality after SAH can be as high as 45%, with most deaths due to the initial hemorrhage, rebleeding, vasospasm of cerebral vessels (eg, resulting from vessel exposure to extraluminal hemoglobin), or major medical complications.[3-5] Survivors often suffer from persistent neurological deficits that have a significant impact on quality of life. As such, a primary goal in the management of patients with intracranial aneurysms involves detection and treatment before catastrophic rupture to avoid the adverse sequelae of SAH.

Cerebral angiography continues to be the criterion standard technique to diagnose and characterize the anatomy of cerebral aneurysms, and the imaging data have additional utility for planning medical, endovascular, or surgical treatments. Angiographic diagnosis and subsequent treatment via coil embolization can be performed during the same procedure, provided certain anatomic criteria are met. Procedural-related rupture during *diagnostic angiography* is extraordinarily rare, but has been reported.[6-8] In contrast, during *endovascular treatment* of intracranial aneurysms, intraprocedural aneurysmal rupture can occur in as many as 8% of the cases and, when it occurs, carries a mortality rate of up to 38%. It is often attributed to guidewire perforation, microcatheter perforation, or coil perforation,

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and less commonly to elevation of intraaneurysmal pressure induced by injection of contrast medium.[9-13]

Although an appreciation of the dynamics and consequences of aneurysm rupture is critical for developing a downstream understanding of patient outcomes, published reports on real-time imaging of an awake patient experiencing aneurysm rupture during diagnostic angiography are extremely rare. We report a case of an alert, communicative patient who experienced rupture of a cerebral aneurysm during diagnostic-only cerebral digital subtraction angiography. Aneurysm rupture in this patient ultimately proved fatal.

REPORT OF A CASE

A 71-year-old woman presented to Mayo Clinic for evaluation and workup of a 2-day history of headache and evoked (see below) diplopia. Her medical history was significant for multiple intracranial aneurysms and SAH for which she underwent clipping of 2 aneurysms and coiling of a third aneurysm many years before presentation. She initially presented to an outside hospital. Computed tomography (CT) imaging of the head was completed, which showed postsurgical changes from her aneurysm clipping and coiling, with evidence of a new basilar artery aneurysm. There was no evidence of intracranial hemorrhage at this time. Inasmuch as neurosurgical services were not available at the referring hospital, the patient was transferred to Mayo Clinic specifically for neurosurgical evaluation and possible intervention. Coexisting diseases included asthma and possible hypertension.

Upon arrival at Mayo Clinic, the patient was admitted to an intensive care unit. Neurologic examination showed no evidence of cranial nerve palsies despite the patient reporting a sensation of diplopia with extreme upward and lateral gazes. The patient was classified as Hunt Hess grade 1 because there was no radiological or clinical evidence of aneurysm rupture.[14]

Diagnostic cerebral angiography was pursued to evaluate the aneurysm seen on CT. The patient, who was awake and alert, was positioned supine on the table for cineangiography, and standard American Society of Anesthesiologists physiologic monitors were applied. During the procedure, blood pressure was monitored using a noninvasive blood pressure cuff (set to cycle at 3-minute intervals), and blood pressure data along with other physiologic data were recorded using the Mayo Integrated Clinical Systems Chart Plus electronic anesthesia record. Sedation was provided by a trained registered nurse, who administered total intravenous doses of fentanyl 25 μg and midazolam 0.5 mg.

Arterial access was obtained through the patient's right femoral artery. The right carotid artery was selectively cannulated, and the catheter tip was subsequently redirected to the junction of the subclavian artery and origin of the right vertebral artery, proximal to the previously coiled basilar artery tip aneurysm (Figure 1). The intravascular distance from the catheter tip to the initial component of the target aneurysm was later estimated to be 37 cm.

The patient was instructed to hold her breath during radiocontrast injection, which she did after taking a deep inspiration. Approximately 2 to 5 seconds after initiating the breath-holding maneuver, angiography was initiated. Angiography was performed by the angiographer (G.L.) by manual injection of 12 mL of Omnipaque 300 mg/mL contrast solution (General Electric), via a stopcock, into

FIGURE 1. Anterior/posterior angiographic image of intravascular catheter tip (indicated by arrow) at the junction of the subclavian artery and the origin of the right vertebral artery. CRAN = cranial; FD = field; LAO = left anterior oblique.