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Intraarterial Papaverine as an Adjunct to Transluminal Angioplasty for Vasospasm Induced by Subarachnoid Hemorrhage

Kimberly Livingston¹ and Leo N. Hopkins^{1,2}

Summary: Basilar artery vasospasm refractory to medical therapy was confirmed by clinical deterioration and angiography in a 47-year-old man; successful passage of a nondetachable balloon system and angioplasty were facilitated by intraarterial papaverine.

Index terms: Vasospasm; Arteries, transluminal angioplasty; Arteries, basilar

Intraarterial papaverine facilitated transluminal angioplasty in a case of postoperative vasospasm following surgical clipping of a basilar tip aneurysm. Our technique is described.

Case Report

A 47-year-old man with a ruptured basilar artery aneurysm (Hunt-Hess (1) grade 2) underwent uneventful surgical clipping on posthemorrhage day 2 (Fig. 1A). Five days after the hemorrhage, the patient stopped following commands despite medical therapy including nimodipine, hypervolemia, and induced hypertension. Computed tomography revealed mild, right hemispheric edema; angiography demonstrated severe basilar artery vasospasm. The patient was transferred to our institution for emergency angioplasty. He was intubated and unarousable with decorticate posturing to painful stimulation (Hunt-Hess (1) grade 4).

In the angiography suite, the patient was pharmacologically sedated and paralyzed, and 5" topical nitropaste was given. The right femoral artery was catheterized with placement of an 8-F sheath (Terumo Corporation, Tokyo, Japan) with heparin flush pack. A coaxial system using a 7.3/5.0-F guide catheter (Interventional Therapeutics Corporation, South San Francisco, CA) and .038 angled guide wire (Terumo) was advanced into the left vertebral artery. Angiography showed severe spasm of the basilar artery and distal vertebral arteries bilaterally (Fig. 1B). Next, a roadmap was created, and the Tracker catheter (Target Therapeutics, Fremont, CA) with nondetachable balloon (Interventional Therapeutics) was then advanced into the distal left vertebral artery. This vessel was extremely narrowed. Resistance secondary to vasospasm prevented pas-

sage into the basilar artery. Advancement of the angioplasty balloon was made possible by the intraarterial administration of 120 mg of papaverine hydrochloride over approximately 2 minutes. This was associated with transient sinus tachycardia but no other signal changes. Repeat angiography showed less narrowing (Fig. 1C). The angioplasty balloon was then easily advanced into the basilar artery, and angioplasty of the entire basilar artery and distal left vertebral artery was carried out. Repeat angiography immediately following angioplasty revealed excellent flow through the basilar artery, with improved flow through the superior cerebellar and right posterior cerebral arteries. The left posterior cerebral artery filled via persistent fetal circulation with left internal carotid injection. The patient followed commands again within 2 hours of the procedure and was alert without focal deficit 8 hours later. This improvement persisted throughout his remaining hospital course. Follow-up angiography 6 days later revealed persistence of normal vessel caliber and flow (Fig. 1D).

Discussion

Papaverine has been shown to decrease tone in all smooth muscle and has been used to treat cerebral and peripheral ischemia, myocardial ischemia, ureteral colic, biliary colic, and gastrointestinal colic (2). Although vasodilator properties of papaverine have been observed both centrally and peripherally, these effects on cerebral arterial spasm are short-lived (P. Purdy, personal communication). However, this transient vasodilatory effect is well suited to selective intraarterial injection as an adjunct to angioplasty in cases where severe vasospasm otherwise precludes passage of the balloon catheter. Additionally, papaverine-induced vasodilation may lessen subsequent blood vessel wall trauma (3) induced by the inflation of the angioplasty balloon. Patients should be monitored during papaverine administration

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A

Fig. 1. Forty-seven-year-old man with subarachnoid hemorrhage from basilar tip aneurysm.

A, Anteroposterior projection, preoperative left vertebral injection angiogram depicting basilar-tip aneurysm.

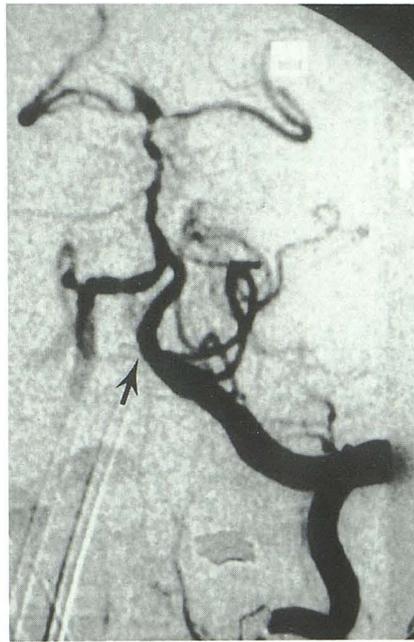
B, Anteroposterior projection, postoperative left vertebral angiogram depicting diffuse vasospasm; apparent residual neck filling is large perforating vessel origin. Arrow points to site of superselective papaverine administration.

C, Anteroposterior projection, left vertebral angiogram following intraarterial injection of 120 mg of papaverine, showing improvement in vessel caliber (arrow).

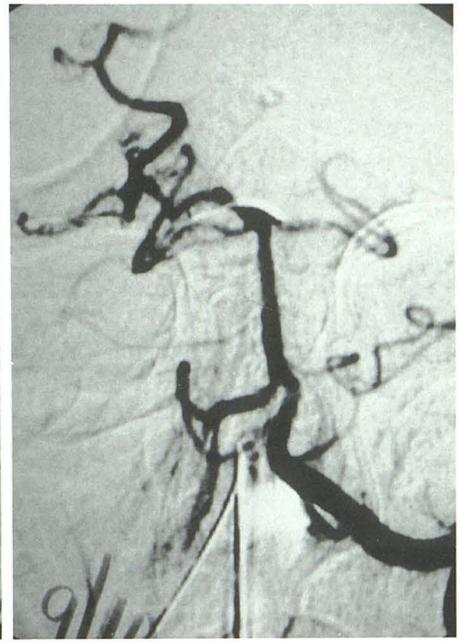
D, Anteroposterior projection, left vertebral angiogram 6 days after angioplasty depicting persistence of normal vessel caliber and flow. Left posterior cerebral artery fills via persistent fetal circulation with left internal carotid artery injection (not shown).



B



C



D

as sedation, conduction defects, and cardiac arrhythmias are possible (4).

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perspective, specialization has been taken to an absurd limit. This has occurred in the article by Fujita et al, who analyzed the asymmetric appearance of vertebral arteries with relative angulation in MR images. This effect was fully analyzed for the iliac arteries 5 years ago in an article in *Radiology* in 1987 (2).

An invitation is extended to neuroradiologists and, for that matter, to all radiologic subspecialists to rejoin the radiologic community. There is a wealth of knowledge and expertise within the broader discipline, particularly in the developing new technologies. Sometimes discovering that the wheel has already been invented is more effective than reinventing it oneself.

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Reply

Before I noticed the asymmetric appearance of vertebral arteries during routine head MR examinations, I had read the article by Mayo et al in *Radiology* describing the asymmetric appearance of the iliac arteries and the theoretical analysis of the phenomenon. Therefore, it is certain

that our article, which describes the identical phenomenon in the underlying physical principle, was inspired by a preliminary knowledge that originated from their article. Although the physical principle is exactly the same and the style may be similar, which frequently occurs in scientific writing, the materials included some relatively new techniques and the context was written with emphasis on neuroradiologic aspects of the phenomenon. In writing the article, I tried to take great care so that the credit for the first discovery of the phenomenon would be ascribed to them. Therefore, I believe that our article does not take credit from them, but rather it reevaluates and reinforces their work from a neuroradiologic perspective.

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Editor's note:

In reply to the letter from Drs. Henkelman and Mayo, *AJNR* certainly does not wish to "reinvent the wheel." In fact, every effort is made not to republish material that has appeared in other journals. However, the issue here appears to be one that resembles the difference between theoretical and applied mathematics. As Dr. Fujita acknowledges, Drs. Henkelman and Mayo described the phenomenon. Dr. Fujita properly acknowledged their report in his bibliography and further confirmed their work by applying it in another situation. I think it is legitimate science to give further credence to a theory by applying it to a similar but different anatomic location, much in the way that an applied mathematician would show that a theorem is valid by showing its practical application.

From a purely informational standpoint, it might be unlikely that neuroradiologists would have read the article by Mayo et al on the basis of the heading under which it appeared. The first authors called it a "disappearing vessel" whereas the later authors referred to an "asymmetric appearance" of vessels.

Erratum

Lee R. Guterman's name was omitted from the byline of the March 1993 issue article, "Intraarterial Papavarine as an Adjunct to Transluminal Angioplasty for Vasospasm Induced by Subarachnoid Hemorrhage" (*AJNR: Am J Neuroradiol* 1993;14:346-347). Dr. Guterman, of the Department of Neurosurgery of the School of Medicine and Biomedical Sciences at the State University of New York at Buffalo, should have been listed as second author, between coauthors Kimberly Livingston and Leo N. Hopkins.