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Osmotic Disruption of the Blood-Ocular Barriers

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Supraophthalmic internal carotid artery infusion of BCNU for brain tumor chemotherapy has been promoted as a method to reduce ocular complications [1-4]. The placement of microcatheters into the supraclinoid carotid artery can occasionally result in selection of the ophthalmic artery, middle cerebral artery, or anterior cerebral artery. This report describes an avoidable complication of microcatheter placement related to hyperosmolar contrast material. The authors suggest that low-osmolality contrast agents be used whenever microcatheters are advanced into the supraclinoid carotid.

Subjects and Methods

A 42-year-old woman with recurrent right frontotemporal gemistocytic astrocytoma with vascular proliferation was undergoing her fourth chemotherapy treatment. An Ingenor jet-controlled calibratedleak balloon catheter was delivered into the right supraclinoid carotid artery. To document catheter position and flow characteristics, approximately 1-2 ml of Renografin-60 (meglumine sodium diatrizoate) was injected and digital subtraction angiography (DSA) images were obtained. The DSA images revealed that the catheter tip was lodged in the proximal ophthalmic artery obstructing flow (Fig. 1). Approximately 5-10 sec elapsed before the catheter could be withdrawn from the ophthalmic artery, and during this period fluoroscopic observation revealed the presence of contrast material in that vessel. The catheter was repositioned into the supraophthalmic portion of the carotid artery (Fig. 2) and 200 mg/M² of BCNU was infused over 30 min. One hour after the procedure the patient complained of severe right orbital pain. The eye was grossly swollen, chemotic, proptotic, and 20/200 vision was recorded. Funduscopic examination revealed small hemorrhages and diffuse retinal edema. These findings partially resolved over the following 48 hr, and her vision on the right improved to 20/80. An identical situation evolved in the case of a 24year-old woman with recurrent right parietal glioblastoma multiforme resulting in selective catheterization of the ophthalmic artery. However, in this case, metrizamide (220 mgl/ml) was used as the contrast agent and there were no ocular complications.

Discussion

The ocular complication described in the first case appears to be related to the radiographic contrast material, which has direct chemotoxicity [5] as well as high osmolality (1420 mOsm) [6]. Intra-arterial delivery of hyperosmotic agents can

Fig. 2.—DSA image documents that catheter is located in supraclinoid carotid. There is no evidence of reflux into ophthalmic artery.

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lead to disruption of the blood-brain barrier and blood-ocular barriers [7]. Two main blood-ocular barriers have been documented. The blood-aqueous barrier is formed by an epithelial barrier located in the nonpigmented layer of the ciliary epithelium and in the posterior iridal epithelium. The blood-retinal barrier is located at two levels, forming an outer barrier in the retinal pigment epithelium and an inner barrier in the endothelial membrane of the retinal vessels [8]. Hypertonic solutions have been shown to disrupt osmotically the blood-ocular barriers in a manner analogous to osmotic blood-brain barrier disruption [8, 9]. In primates, disruption of the blood-aqueous barriers by Conray-60 produced alterations in the cell morphology and extravasation of Evans blue dye from the vascular space into the anterior chamber. The effects of Conray-60 on the blood-retinal barrier were less severe. Although there was extravasation of Evans blue albumen complex, there was less alteration in cell morphology [9].

In summary, these two cases suggest that ocular complications with selective intra-arterial chemotherapy can be avoided if the following suggestions are implemented. First, use of an opaque catheter tip should make it possible to follow the course of the catheter into the supraophthalmic carotid artery by careful use of fluoroscopy without injection of contrast medium. Second, since inflation of the balloon when the tip is in the proximal ophthalmic artery is associated with ischemia and high risk of dissection, the balloon should not be inflated if it is in the third segment of the internal carotid artery, especially if it is at all possible that it is lodged on the ophthalmic artery. Finally, use of low-osmolality contrast agents offers additional safety when used in conjunction with flow-directed catheters [10].

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