

## Superselective Injection of BCNU through a Latex Calibrated-Leak Balloon

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Carmustine (BCNU) has been used extensively to treat glioblastomas by injection through a catheter placed in the cervical internal carotid artery. The technique causes severe pain to the eye and has resulted in ipsilateral blindness. The use of a latex calibrated-leak balloon positioned above the ophthalmic artery in the internal carotid artery or in one of its branches appears to circumvent the ocular complications mentioned. At an infusion rate at 125 ml/hr the balloon does not inflate and does not occlude the artery. This new technique has been used to treat 10 patients without complications.

Carmustine (BCNU) injected through a catheter tip placed in the cervical internal carotid artery has been widely used in the chemotherapeutic treatment of glioblastomas. This technique has occasionally resulted in ipsilateral blindness [1-5]. At best, the procedure causes redness and severe pain to the eye on the side of the injection. In addition, healthy brain tissue supplied by the anterior and posterior cerebral arteries receives an unavoidable exposure to the drug. Eye pain and the risk of ipsilateral blindness may be avoided by a change in technique.

We used a new latex calibrated-leak balloon (Debrun no. 17;

Ingenor Co., Paris 75020, France) in conjunction with a 2 French Pursil catheter (Ingenor Co.) and a plastic chamber for injection (Becton-Dickinson Co., Rutherford, NJ; in future, Ingenor Co.) (fig. 1). With the catheter, the balloon is positioned above the ophthalmic artery and as close as possible to the main artery supplying the glioblastoma. The balloon does not occlude the vessel during infusion [6]. The latex calibrated-leak balloon retains its elasticity after repeated injections. Since the balloon size is controlled, the balloon can remain small during constant infusion (fig. 2). This appears to prevent any damage to the vessel wall or the balloon itself, while permitting limited blood flow and maintaining patency of the balloon opening. If a forceful injection is made, the balloon will obstruct the vessel lumen and transmit the injection force through the calibrated-leak tip without damage to the vessel or balloon. Experimental forceful injection in vitro results in only 4-5 mm diameter maximum distention (fig. 3). Repeated injections under these conditions do not reduce the elasticity or increase the diameter of the balloon.

### Technique

Preliminary computed tomographic and angiographic studies should be performed in order to determine the exact boundaries

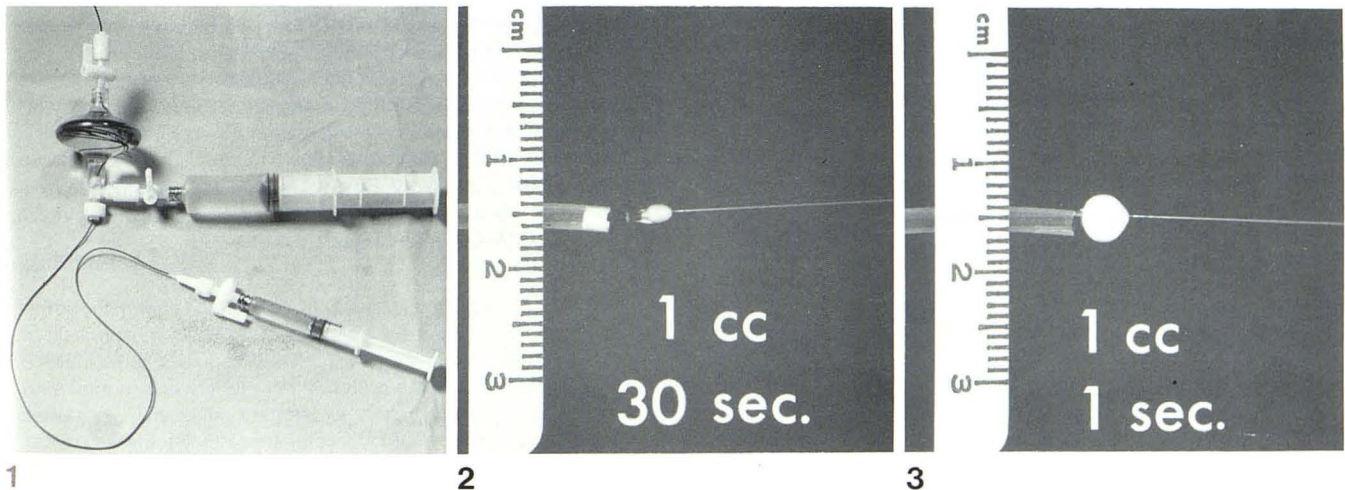


Fig. 1.—2 French Pursil catheter (Ingenor) and introducer (Becton-Dickinson).

Fig. 2.—Balloon does not inflate during infusion of BCNU at constant rate of 125 ml/hr.

Fig. 3.—Forceful injection in vitro through latex calibrated-leak balloon results in maximum diameter of 5 mm. Balloon does not burst.

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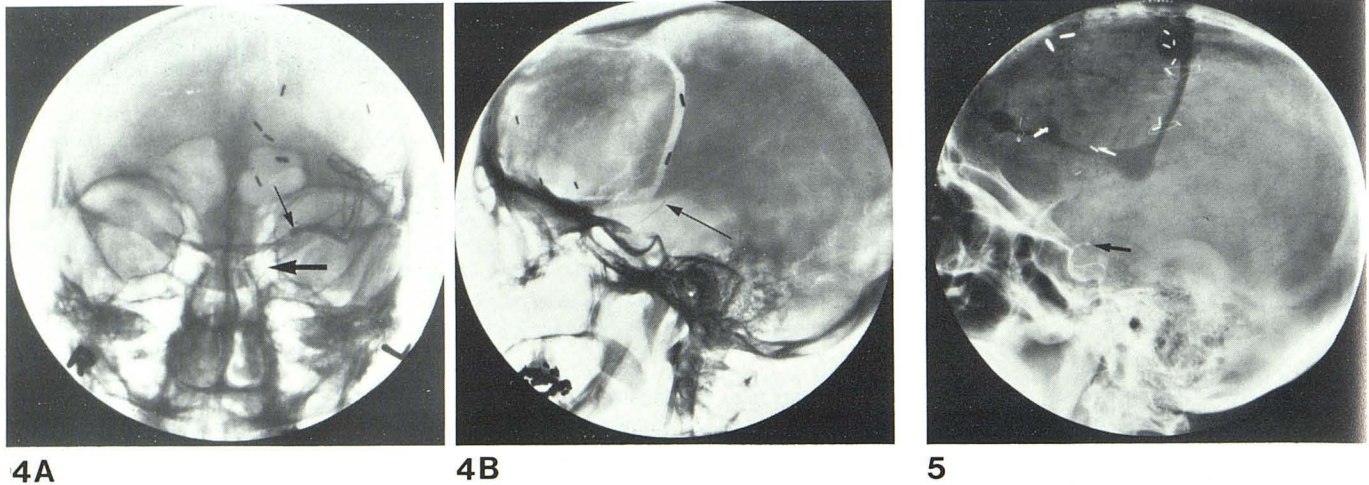


Fig. 4.—A, Balloon (small arrow) inflated in main stem of middle cerebral artery with forceful injection of contrast medium. Anteroposterior view. Catheter in carotid siphon (large arrow). B, Lateral view in same patient during injection of contrast medium at rate of 125 ml/hr. Balloon (arrow) does not inflate.

Fig. 5.—Balloon (arrow) positioned at end of internal carotid artery above ophthalmic artery in a case of glioblastoma fed by branches of anterior cerebral and middle cerebral arteries.

and feeding vessels of the lesion to be treated. To begin the procedure, the balloon catheter is introduced through the plastic chamber via the femoral artery into the main stem of the middle cerebral artery, if this vessel is the only supply to the tumor (fig. 4). If the tumor supply is from the anterior and middle cerebral arteries, the balloon is then positioned just beneath the supraclinoid bifurcation of the internal carotid artery (fig. 5). The balloon remains in one of these two positions throughout the treatment. Infusion is at the rate 125 ml/hr, which does not completely obstruct the blood flow of a normal vessel. During the infusion, fluoroscopy is used to spot-check the position of the balloon. Since the balloon is more apt to move when positioned just below the supraclinoid carotid bifurcation, it is particularly important to fluoroscopically monitor its position. The entire procedure takes about 90 min.

The appropriate dose of BCNU is currently being evaluated in a dose escalation protocol. The total amount required varies according to the geometry of the vessels.

This change in infusion technique with the catheter positioned above the ophthalmic artery appears to have eliminated the problems that have previously been reported with this procedure. We have observed no blindness, eye pain, rupture of vessels, or adverse effects associated with the anticoagulant [7]. The only complaint we noted in using this technique was mild unilateral headache, reported by two of our 10 patients.

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