A new surgical approach to subcortical lesions: balloon inflation and cortical gluing

Technical note

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A cortical incision performed with inflation of a balloon to create a channel has been used in an approach to deep lesions with minimal damage to cerebral tissue. The balloon is slipped over a blunt needle and, once in place, is inflated through the needle. Postoperative sealing of the incision with fibrin glue avoids the subdural collection of cerebrospinal fluid such as is sometimes observed when the ventricle is opened during surgery.

KEY WORDS • subcortical lesion • balloon inflation • fibrin glue • wound closure • surgical approach

SUBCORTICAL lesions within the cerebral hemispheres cannot be reached surgically without some destruction of the normal nervous tissue that covers them. Although they can sometimes be approached through a so-called "nonfunctional area," more often the resulting cortical destruction will be responsible for some postoperative sequelae. Thus, it is of utmost importance to reduce the loss of normal cortical neurons as much as possible. Conventional approaches to deep subcortical lesions include resection of the cortex and the creation of a channel down to the surface of the tumor. The first part of this article describes a new technique that minimizes the cortical damage due to this surgical approach.

Surgical approaches to deep cerebral tumors often require the opening of a ventricle either because the lesion cannot be reached without a transventricular approach (such as a thalamic tumor), because the lesion is located within the ventricle, or because part of a ventricular wall is invaded by the lesion. In some cases a communication is established between the ventricle and the subdural space; this often leads to development of a subdural collection of cerebrospinal fluid (CSF) which persists after surgery. The conventional treatment for such collections is the insertion of a subdural peritoneal shunt; however, in most cases (especially when the communication is large) this technique will be inefficient since it will drain both the ventricle and the subdural space without establishing any pressure difference between the two compartments. Thus, the best method is to prevent such postoperative CSF collections. The second part of this article presents a new technique that allows closure of the cortical opening and avoids these subdural collections.

Operative Techniques

Balloon Inflation

The principle behind the proposed approach to subcortical lesions is to separate the nerve fibers rather than to destroy them, and to utilize the viscoelastic properties of the brain to enlarge the approach. The most simple situation is the surgical approach to a lateral ventricle (Fig. 1). The thickness of the cerebral mantle between the cortical surface and the ependymal wall is estimated by a simple tap performed at the place where the ventricular approach will be made. The finger of a surgical rubber glove is cut off and slipped over and fastened to a blunt needle. The knot fastening the rubber finger to the needle should be tightened at a distance from the tip equal to the thickness of the cerebral mantle. Thus, the length of the balloon, which will later be inflated by an injection of saline through the needle in the rubber finger, will be equal to the distance between the ventricle and the cortical surface (Fig. 1).

The needle with the uninflated rubber finger is inserted toward the ventricle until its tip is in the ventricle under the ependymal wall (Fig. 1A). A linear incision...
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![Diagram](image)

**Fig. 1.** Surgical approach to the lateral ventricle. Insertion of the needle with the uninflated balloon (A) and inflation of the balloon with isotonic saline (B).

of the cortex is then made on both sides of the needle and the superficial cortical vessels and a section of the arachnoid are coagulated. The length of this linear incision will be the diameter of the communication that will be created between the ventricle and the cortical surface. At this point the balloon can be inflated. Inflation should be performed very slowly by gradual injection of saline through the needle. The two lips of the cortical incision are spread apart within a few minutes. The balloon is then removed and retractors are positioned. Thus, without suction of any gray or white matter of the cerebral hemispheres, a channel is created between the cortical surface and the lateral ventricle.

The same technique applies to the approach to deep tumors. However, it is not possible in this case to determine the precise position of the lesion and its distance from the surface. At our institution we use one of two methods for this determination; intraoperative ultrasonography (Fig. 2) is probably the simpler of the two. This shows the tumor and gives a precise estimate of its distance from the cortical surface; in addition, it gives the opportunity to check the position and inflation of the balloon. The other method combines computerized tomography stereotactic guidance with conventional open surgery. With this technique, the needle with the balloon is guided stereotactically and the depth to which it should be inserted is precisely known.

One important advantage inherent in this operative technique is that, since surgical approach is nothing but an enlarged slit in the cerebral mantle, it is possible at the end of the procedure to draw together and glue closed the lips of the cortical lesion. This technique is described below.

**Cortical Gluing**

Study of the clinical use of fibrin sealants has demonstrated their adhesive, hemostatic, healing, and probably antimicrobial properties. It is also known that, unlike cyanoacrylate adhesives, fibrin adhesives do not induce an inflammatory reaction. In view of these findings, we started in 1988 to seal cortical incisions with fibrin glue. We have used this technique especially in cases where a communication has been established between the ventricle and the subdural space.

Several fibrin sealants are available on the market in Europe. We use a fibrin glue that is soluble at room temperature and can be prepared rapidly. Its adhesive capacity is good after 1 minute of tissue contact and increases during the following 2 hours. The glue, a mixture of fibrinogen, fibronectin, Factor XIII, and aprotinin, is drawn up into a syringe. A second syringe containing the thrombin is placed in parallel. The two syringes are simultaneously depressed in the same needle causing the thrombin to transform the fibrinogen into a soluble network which is applied on the two lips of the cortical incision (Fig. 3). Care is taken that no glue is released inside the ventricle.

The two cortical lips are then drawn together by applying gentle pressure on the brain and are maintained in this position for a few minutes. More glue is then placed on the cortical surface over the incision. The soluble fibrin network is rapidly stabilized into an insoluble fibrin network under the influence of Factor XIII. Thus, the cortical opening is closed by a glue which actually reproduces the last phase of coagulation. The aprotinin contained in the fibrin glue will inhibit fibrinolysis by serum or tissue proteases for 2 or 3 weeks. With the fibrin glue preparation that we use, the risk of viral contamination can be considered nearly nil.

**Discussion**

The balloon inflation subcortical approach was first used in our institution after an experimental study in 1983 by Shahbabian, et al., demonstrated that this

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* Biocol distributed by Biotransfusion, Villebon sur Yvette, France.
technique minimized the neurological deficits related to this type of operation. We have used it since without any complication.

The cortical gluing method has been used in 15 patients between 1988 and 1990. The lesions treated include 13 tumors requiring the opening of a ventricle (Fig. 4), one tumor without access to a ventricle, and one callosotomy. To date, no other report dealing with the use of fibrin adhesive on the cortex has been published. Among our 15 patients, a postoperative subdural collection developed in only two cases; these were both due to a discrepancy between the size of the skull and the size of the brain after tumor removal. They were easily and rapidly cured after insertion of a shunt into the subdural space, a result that would not have been obtained if the communication between the ventricles and the subdural space had not been closed. There were no complications related to the cortical gluing, and no postoperative epilepsy was observed in this series of patients. The method has thus proved its efficiency and
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demonstrates that a cortical incision can be glued safely
with a biological fibrin sealant.

**Conclusions**

The technique described in this article minimizes
cerebral damage resulting from a surgical approach to
subcortical lesions. Moreover, it allows the gluing of
the cortical incision with a fibrin adhesive at the end of
the surgical procedure, thus avoiding postoperative sub-
dural CSF collections whenever the ventricle has been
opened.

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Manuscript received May 18, 1990.
Accepted in final form October 26, 1990.
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J. Neurosurg. / Volume 74 / June, 1991