Clip-Grafts for Aneurysm and Small Vessel Surgery*

Part 3: Clinical Experience in Intracranial Internal Carotid Artery Aneurysms

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A PROGRESS REPORT on the use of the clip-graft for intracranial internal carotid artery aneurysms is now indicated. Experience with the clip-graft for anterior communicating aneurysms will be considered separately in a future communication.

This report considers technical and anatomical details important to the selection and use of the various sizes of clip-grafts for carotid artery aneurysms. Errors and complications are discussed in some detail so that hopefully they may be avoided in the future. Since this has not been designed as a treatise on aneurysms in general, the problems of "spasm," selection of cases, and timing of surgery are not dealt with separately but only as they apply to the subject matter presented.

General Technical Considerations

Position of the Patient. The patient is placed in a supine position with one shoulder elevated on a roll. The neck is slightly extended and turned 45° away from the side of the aneurysm. When spinal fluid drainage is instituted, in this position the brain naturally falls away from the optic nerve and carotid artery on the side of the surgery. This facilitates the operative exposure to be described below, and holds brain retraction to a minimum. This position also allows free venous drainage from the head if the shoulder has been properly elevated. Furthermore, slight extension of the patient's head allows exposure of the ipsilateral common carotid artery in the neck if this be part of the planned procedure.

Operative Exposure of Sphenoid Wing and Dura. The procedure is essentially as described previously, but for completeness will be summarized here.[12] The internal carotid artery is approached through a small frontotemporal bone flap hinged on the temporalis muscle and down the sphenoid wing, a portion of which is resected. The dura is opened in a semi-lunar fashion, allowing equal exposure of frontal and temporal lobes for their symmetrical retraction.

Spinal Fluid Drainage. We usually place an ordinary lumbar puncture needle in the patient's lumbar region for spinal fluid drainage. After removal of the stylet, with the aid of a hemostat the needle is bent at right angles a short distance from the skin and then connected to a sterile IV administration unit which in turn is connected to an empty IV bottle. A standard lumbar puncture needle has functioned better than a malleable needle. The flow is checked after the patient has been repositioned for surgery following lumbar puncture. However, no more fluid is drained at this point than will fill the tube of the intravenous administration set.

It is strongly recommended that spinal fluid drainage not be instituted until the dura has been opened because of the increase in epidural bleeding and the possibility of premature rupture of the aneurysm. The latter occurred in one patient when the dura was being tacked to the galea along the edges of the craniotomy. Spinal fluid drainage had changed the size and shape of brain structures adjacent to the aneurysm, thus causing premature rupture.

Visualization of Internal Carotid Artery and Application of Clip Graft. The operating microscope is utilized after spinal fluid drainage has been instituted and the bridging veins severed. Initially the optic nerve is identified and then the arachnoid incised with the tip of a No. 11 blade. The dissec-

Received for publication October 21, 1968.
Revision received February 14, 1969.
* Supported by U.S. Public Health Grants NB-06822, NB-05651, and NB-06826.

tion of the arachnoid is always on the surface of the artery away from the projection of the aneurysm. The initial area of dissection is therefore dictated by the arteriographic picture.

We recommend that the internal carotid artery be visualized to its bifurcation before application of the clip-graft. In cases where the aneurysm ruptures prematurely this has not always been possible. The clip-graft can be correctly applied in spite of bleeding if one is able to visualize the carotid artery. It is important to see that the clip completely surrounds the vessel by noting that a full vessel enters one end of the clip and leaves the other. One must be sure that the clip has not been applied obliquely thus occluding the lumen of the vessel or impairing blood flow. One must also be careful not to apply the clip-graft too far distally lest the origin of the A-1 segment of the anterior cerebral artery from the internal carotid artery be compromised, or the middle cerebral and anterior cerebral arteries be compressed together in the distal end of the clip, thus causing embarrassment to the circulation through both vessels.

Hypotension. Following the method of Drake, surgery of these aneurysms has been performed under moderate and at times rather marked hypotension.[4] It has been our practice to lower the blood pressure as the major structures at the base of the brain are approached. Blood pressure has been controlled by the depth of anesthesia rather than by blocking agents. As the optic nerve and carotid artery are approached and the arachnoid surrounding these structures dissected free, we usually maintain the blood pressure in the neighborhood of 60 to 80 systolic and on special occasions lower it to 50.

After clipping of the aneurysm, blood pressure is restored to normotensive levels. Closure of the dura should not be started until the blood pressure is normal. In one case a postoperative subdural hematoma was felt to be directly related to failure to note this precaution; a small arterial bleeder developed on the tip of the retracted temporal lobe when the blood pressure returned to hypertensive levels.

Hyperoncotic Agents. If spinal fluid drainage does not provide adequate room, urea has been used; however this or any other hyperoncotic agent transiently increases the blood volume making it much more difficult to control the patient's blood pressure. An additional consideration is the marked diuresis following surgery and the possibility of the so-called "rebound phenomenon." The immediate postoperative electrolyte and fluid balance as well as accurate determination of the patient's true blood volume are complicated by the use of this agent.

Exposure of Common Carotid Artery in the Neck. Exposure of the common carotid artery in the neck prior to the intracranial approach has not been a uniform practice but has been used in selected cases. This surgical exposure has been timed in a number of cases, and it has been found to take only 10 minutes. The additional dissection necessary to expose the internal carotid artery has added too much time to the surgical procedure to justify its routine use. Also, significant atherosclerosis is not common below the bifurcation, and the chance of damage to the vessel wall from temporary occlusion is not as great. The precautionary placement of umbilical tape around the common carotid artery has proved to be of immense help in controlling bleeding from the ipsilateral carotid artery in three cases of operative rupture.

External Hypothermia. Early in the series moderate external hypothermia was used routinely. Although it was never proven, an impression developed that hypothermia might add to the development of "vasospasm." We have now abandoned its routine use for carotid artery aneurysms because it creates unjustified delay in the procedure as well as complications of its own. An additional consideration has been that aneurysms in this location have been repaired with the clip-graft without the use of temporary clips on the internal carotid artery or its major branches.

Circulatory Considerations

The anatomical configuration of the circle of Willis is of utmost importance in planning the surgery.[7] Particular attention should be directed to the origin of the posterior cerebral artery. It is necessary to know if this artery fills only from the posterior communicating artery, as is the case in a fetal circula-