Contralateral Approaches to Multiple Cerebral Aneurysms

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ONLINE DIGITAL VIDEO

NOT INFREQUENTLY, PATIENTS with bilateral cerebral aneurysms are encountered. In such patients, the ability to treat bilateral aneurysms through a unilateral approach spares the patient the risk and inconvenience associated with a separate craniotomy. The contralateral approach for aneurysm repair is technically feasible and safe in appropriately selected patients. Herein, we review our technique for maximizing contralateral exposure and clipping contralateral aneurysms through the four anatomic triangles that serve as corridors in this approach.

KEY WORDS: Contralateral approach, Microsurgery, Multiple cerebral aneurysms

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Multiple intracranial aneurysms are present in 14 to 34% of patients with intracranial aneurysms at presentation (6), and in 20 to 40% of these patients, the aneurysms are bilateral (1, 6). This means that roughly 3 to 13% of patients diagnosed with aneurysms have bilateral disease. The ability to treat these patients when feasible through a unilateral craniotomy offers the obvious advantage of avoiding a second craniotomy.

Several authors have reported clipping of contralateral aneurysms in case series and case reports (1–4, 7–9). We previously published a microsurgical anatomic study of the contralateral exposure for the most common sites of anterior circulation aneurysms (5) and completed detailed morphometry to establish a working set of guidelines for neurosurgeons to consult when considering contralateral approaches. We present here our thoughts on patient selection as well as the tenets for approaches to contralateral aneurysms. The basic tenets for all aneurysm surgery, including proximal vascular control, sharp microdissection, and meticulous preservation of perforators, also clearly apply to contralateral approaches.

PATIENT SELECTION

As we previously reported (5), not all anterior circulation aneurysms can be accessed readily via a contralateral approach. In patients with bilateral aneurysms, the selection of the contralateral approach takes into consideration both the patient's clinical condition and specific anatomy. Contralateral lesions that otherwise may be exposed easily also may be more difficult to expose in patients with subarachnoid hemorrhage. Brain swelling and hydrocephalus typically encountered in these patients may make excessive retraction force necessary for contralateral exposure. Dense, inflamed arachnoid adhesions in this setting also can make adequate, safe contralateral exposure difficult.

In patients with unruptured aneurysms, the patient's anatomy will dictate the ease of contralateral exposure of the common anterior circulation aneurysm sites (ophthalmic, posterior communicating, internal carotid artery [ICA] terminus, and middle cerebral artery bifurcation). For the ophthalmic and posterior communicating locations, aneurysms with necks that are located more medially on the ICA are more favorable for a contralateral approach. In our microsurgical study (5), exposure of the middle cerebral artery bifurcation was possible only if the M1 segment was 14 mm or less in length, while the ICA terminus was the most consistently exposed location.

CONTRALATERAL APPROACH (*see video at web site*)

Low Fronto-orbital Extension of the Frontosphenotemporal Craniotomy and Ipsilateral Exposure

The ipsilateral exposure begins with a standard frontosphenotemporal (pterional) craniotomy. To obtain the additional working space needed to gain adequate contralateral exposure, a low fronto-orbital extension is necessary. This is accomplished by meticulous flattening of the inner table of the frontal bone at the anterior extent of the craniotomy using a high-speed drill. After this, the frontal dura is retracted gently and the ridges created by the irregular surface of the orbital roof are also drilled flat. The pyramidal portion of the sphenoid wing adjacent to the sylvian fissure also must be flattened carefully using the high-speed drill so that the lateral extent of the anterior cranial fossa is joined with the anterior extent of the middle cranial fossa.

After opening the dura, the operating microscope is brought into the field and the sylvian fissure is opened widely. Thorough dissection of the fissure is necessary to provide a wide corridor into the basal cisterns containing the circle of Willis. This minimizes the need for retraction of the frontal lobe and provides maximal working space at the depth of the dissection. The proximal sylvian fissure is opened into the carotid and optic cisterns. With entrance into the basal cisterns, egress of cerebrospinal fluid from the subarachnoid space allows relaxation of the brain, further reducing the necessary retraction of the frontal lobe. The ipsilateral anterior cerebral artery is dissected free of the optic nerve and is followed back to the optic chiasm. Exposure of the chiasm allows fenestration of the lamina terminalis with an arachnoid knife, allowing the release of cerebrospinal fluid from the ventricular system, facilitating further relaxation, and allowing safe retraction of the frontal lobes (*Fig. 1*).

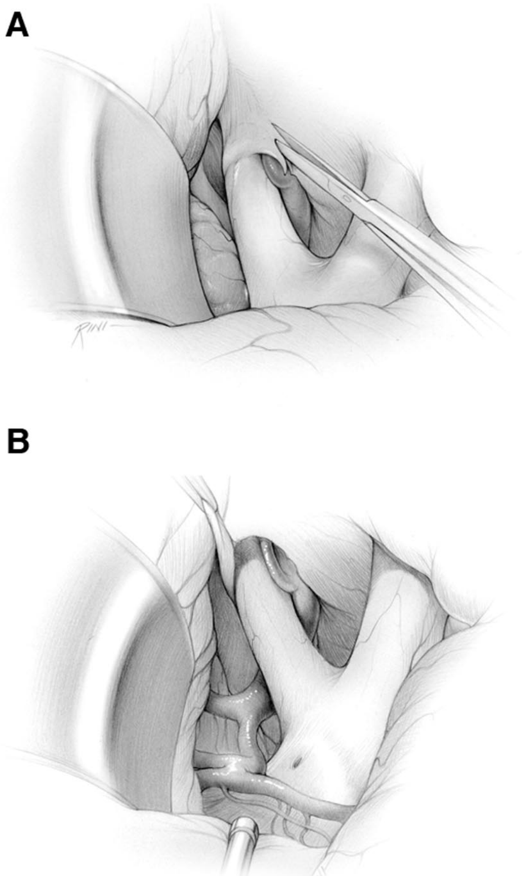

FIGURE 1. *Illustrations of the technical nuances in achieving initial contralateral exposure.* A, *the contralateral falciform fold is opened to allow safe mobilization of the contralateral optic nerve.* B, *lamina terminalis fenestration and cerebrospinal fluid drainage allow further retraction of the contralateral frontal lobe exposing the contralateral carotid artery as far as its termination (reprinted with permission* from, *Oshiro EM, Rini DA, Tamargo RJ: Contralateral approaches to bilateral cerebral aneurysms: A microsurgical anatomical study.* ***J Neurosurg*** *87:163–169, 1997 [5]).*

Exploration of the Interoptic Space

After exposure of the optic chiasm and fenestration of the lamina terminalis, the interoptic space is dissected and explored. Through the triangular space (*Fig. 2*) bordered by the optic nerves and planum sphenoidale, the necessary exposure is obtained to access the contralateral ophthalmic and posterior communicating artery origins. Before dissection of this space and exploration of the medial wall of the contralateral carotid, the contralateral optic nerve must be mobilized to allow its safe manipulation. This is accomplished by opening the contralateral falciform fold as far as the roof of the optic canal (*Fig. 1*). This prevents injury to the optic nerve from the sharp edge of this fold when the nerve is displaced superiorly and laterally. If necessary, the contralateral optic canal can be unroofed using a high-speed drill to facilitate further mobilization of the optic nerve. The optic nerve is then retracted laterally, thus exposing the medial aspect of the proximal contralateral carotid (*Fig. 1*). Dissection in this location provides contralateral proximal control and exposes the origin of the contralateral ophthalmic artery (*Fig. 3*) and, when it is medially located, the origin of the contralateral posterior communicating artery (*Fig. 3*).

Exploration of the Contralateral Opticocarotid Space

The triangle defined by the lateral border of the contralateral optic nerve (chiasm and tract), the inferior aspect of the

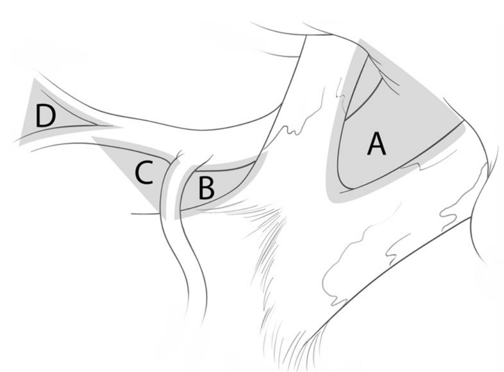

FIGURE 2. *Illustration of the triangular spaces allowing exposure of contralateral aneurysms:* A, *the interoptic space;* B, *the opticocarotid space;* C, *the supracarotid space;* D, *the middle cerebral artery space (reprinted with permission* from, *Oshiro EM, Rini DA, Tamargo RJ: Contralateral approaches to bilateral cerebral aneurysms: A microsurgical anatomical study.* ***J Neurosurg*** *87:163–169, 1997 [5]).*

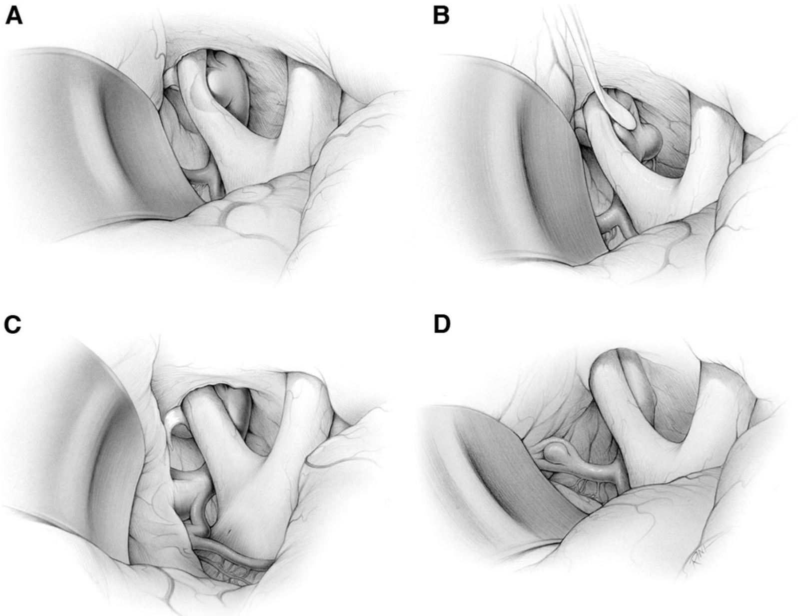

FIGURE 3. *Illustrations of exposure of contralateral aneurysms through a frontosphenotemporal approach.* A, *ophthalmic region aneurysm;* B, *posterior communicating region aneurysm;* C, *carotid termination aneurysm; and* D, *middle cerebral aneurysm (reprinted with permission* from, *Oshiro EM, Rini DA, Tamargo RJ: Contralateral approaches to bilateral cerebral aneurysms: A microsurgical anatomical study.* ***J Neurosurg*** *87:163–169, 1997 [5]).*

A1 segment of the contralateral anterior cerebral artery, and the medial aspect of the distal contralateral carotid artery define the contralateral opticocarotid space (*Fig. 2*). Lateral displacement of the carotid artery through this triangle located superior to the optic apparatus allows exploration of the medial aspect of the contralateral carotid. This corridor affords the best opportunity to access the contralateral anterior choroidal origin. In the setting of a long supraclinoid carotid or prefixed chiasm, the origin of the posterior communicating artery also can be accessed through this triangle. Exploration of the posterior communicating artery origin also is possible through this triangle when the posterior communicating artery origin is located distally on the carotid artery.

Exposure of the Contralateral ICA Termination in the Supracarotid Space

The contralateral carotid termination can be exposed by dissection following the course of the contralateral carotid distally or by following the course of the contralateral A1 segment of the anterior cerebral artery proximally. After the carotid termination is reached, dissection of the contralateral M1 segment of the middle cerebral artery and elevation of the contralateral frontal lobe completes the exposure of the contralateral supracarotid space. This triangular space is defined by the initial segments of the anterior and middle cerebral arteries and the contralateral basomedial frontal lobe (*Fig. 2*). Through this space, carotid termination aneurysms can be exposed and treated (*Fig. 3*). The contralateral carotid termination is the contralateral aneurysm location that can be exposed most consistently (5).

Exposure of the Contralateral Middle Cerebral Artery Bifurcation

The contralateral M1 segment of the middle cerebral artery then can be exposed sequentially by careful dissection along its inferior aspect with careful attention to preservation of lateral lenticulostriate perforators. Dissection along the M1 segment distally allows further safe retraction of the frontal lobe as it is freed from the contralateral temporal lobe. In patients with favorable anatomy, the middle cerebral artery can be dissected as far as its bifurcation to allow treatment of aneurysms in this location (*Fig. 3*). This is generally possible when the M1 segment is 14 mm or less in length (5).

CONCLUSION

Not infrequently, patients with bilateral cerebral aneurysms are encountered. In such patients, the ability to treat bilateral aneurysms through a unilateral approach spares the patient the risk and inconvenience associated with a separate craniotomy. This contralateral approach is technically feasible and safe in appropriately selected patients.

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Acknowledgments

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COMMENTS

This operative nuance article nicely illustrates techniques for the surgical exposure of contralateral aneurysms. Other adjunctive techniques that may be useful in such exposures include the use of lumbar subarachnoid drainage for additional cerebrospinal fluid withdrawal and brain relaxation, as well as the addition of a modified orbitozygomatic extension to the described craniotomy (1).

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This report reviews the concerns regarding the clipping of aneurysms from a contralateral approach. The various anatomical landmarks that demarcate corridors of dissection are nicely outlined. Clipping contralateral aneurysms during elective cases for unruptured aneurysms may have a benefit in saving the patient a future craniotomy. Whether or not the added time, dissection, and retraction is justified in a patient with a ruptured aneurysm and an incidental contralateral aneurysm, remains to be determined.

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