The subcallosal area is the inferomedial portion of the frontal lobe located rostral to the corpus callosum. Reaching the subcallosal region has been a challenge for neurosurgeons because of its deep location and close relationship with important vascular structures. Inferior routes, such as the fronto-orbitozygomatic transsylvian approach, or anterior routes, such as the infratemporal interhemispheric approach, have been most commonly used to approach lesions in the subcallosal area.2–5,8–10,12,14,15,20 The hazard of anterior and inferior routes to the subcallosal region is possible damage to the branches of the anterior cerebral artery (ACA), particularly the hypothalamic and subcallosal branches. Injury to these arterial branches may result in memory impairment, amnestic-confabulatory syndrome, or hypothalamic problems. Additionally, a transventricular prefrontal approach, which is a route

**Contralateral anterior interhemispheric-transcallosal-transrostral approach to the subcallosal region: a novel surgical technique**

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**OBJECTIVE** The authors report a novel surgical route from a superior anatomical aspect—the contralateral anterior interhemispheric-transcallosal-transrostral approach—to a lesion located in the subcallosal region. The neurosurgical approach to the subcallosal region is challenging due to its deep location and close relationship with important vascular structures. Anterior and inferior routes to the subcallosal region have been described but risk damaging the branches of the anterior cerebral artery.

**METHODS** Three formalin-fixed and silicone-injected adult cadaveric heads were studied to demonstrate the relationships between the transventricular surgical approach and the subcallosal region. The surgical, clinical, and radiological history of a 39-year-old man with a subcallosal cavernous malformation was retrospectively used to document the neurological examination and radiographic parameters of such a case.

**RESULTS** The contralateral anterior interhemispheric-transcallosal-transrostral approach provides access to the subcallosal area that also includes the inferior portion of the pericallosal cistern, lamina terminalis cistern, the paraterminal and paraolfactory gyri, and the anterior surface of the optic chiasm. The approach avoids the neurocritical perforating branches of the anterior communicating artery.

**CONCLUSIONS** The contralateral anterior interhemispheric-transcallosal-transrostral approach may be an alternative route to subcallosal area lesions, with less risk to the branches of the anterior cerebral artery, particularly the anterior communicating artery perforators.

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**KEY WORDS** anatomy; cavernous malformation; corpus callosum; interhemispheric transcallosal; subcallosal region; surgical approach; surgical technique
from the superior aspect, has been described as a way to reach the chiasmatic or hypothalamic regions situated behind the subcallosal region.19 We describe a novel surgical route from the superior anatomical aspect—a contralateral anterior interhemispheric-transcallosal-transrostral approach for reaching the subcallosal area. We also report an illustrative case of a patient with a subcallosal cavernous malformation and an anteriorly located developmental venous anomaly.

**Methods**

Three formalin-fixed and artery/vein silicone-injected adult cadaveric heads were studied under 6× and 40×
magnification using a Zeiss Surgical Microscope (Carl Zeiss AG) to assess the relationships between the transventricular route and the subcallosal region. The clinical, radiological, and surgical history of a 39-year-old man with a subcallosal cavernous malformation was reviewed retrospectively to document the neurological examination and radiographic parameters of such a case.

Results

Surgical Technique

For a contralateral anterior interhemispheric-transcallosal-transrostral approach, the patient is placed in the supine position with the head elevated 45° above the heart level. After head fixation, the sagittal plane is aligned parallel to the floor, allowing the surgeon’s hands to work naturally from side to side (Fig. 1). The side of the lesion being surgically treated is placed superiorly for an optimal view of the approach, with the nonlesion side placed downward.21

A linear skin incision is made precoronally and perpendicular to the midline, with one-third of the incision on the lesion side (ipsilateral side) and the other two-thirds on the nonlesion side (contralateral side). Then, 2 bur holes are placed over the superior sagittal sinus, and another bur hole is placed approximately 3–4 cm lateral to the midline. After removing the bone, the dura mater is opened in a U shape and retracted with tension sutures over the sinus. The interhemispheric fissure is easily opened and accessed in a trajectory from the coronal suture level to the anterior one-third of the body of the corpus callosum to reach the foramen of Monro, which is located at the

FIG. 2. Anatomical dissection. A: Medial view shows the trajectory (yellow dashed line) of the anterior interhemispheric-transcallosal-transrostral approach to the septal region (blue circle). B: Superior view of the lateral ventricle shows the rostrum of the corpus callosum, which forms the floor of the frontal horn of the lateral ventricle. A paramedian rostral incision (green dashed line) is made 15 mm anterior to the foramen of Monro. C: Oblique view shows the relationship of the rostrum of the corpus callosum, the septal region, and the ACA. The yellow dashed arrow shows the superior route to the rostrum of the corpus callosum through the left lateral ventricle to reach the right subgenual region. Dissections prepared by Kaan Yağmurlu, MD. Reproduced with permission from the Rhoton Collection (http://rhoton.ineurodb.org), CC BY-NC-SA 4.0 (http://creativecommons.org/licenses/by-nc-sa/4.0).
same coronal level as the junction of the coronal suture and sagittal sinus in the midline.

With this technique, at a deeper location, both cingulate gyri may be adjacent to each other because the falx cerebri does not touch the surface of the anterior one-third of the body of the corpus callosum. The cingulate gyri may hide the corpus callosum and pericallosal arteries, making dissection in this area more difficult. The pericallosal arteries are meticulously dissected and retracted laterally, and the corpus callosum is incised longitudinally 1.5–2 cm by starting at the point corresponding to the same coronal level as the coronal suture and proceeding forward to enter the lateral ventricle, which has been positioned downward (nonlesion side). After exposure of the foramen of Monro, the surgeon progresses forward to observe the rostrum of the corpus callosum, which forms the floor of the frontal horn of the lateral ventricle. A paramedian incision to the rostrum of the corpus callosum is made longitudinally by starting 1.5 cm anterior to the foramen of Monro and the column of the fornix to avoid damage to both the fornix and the anterior commissure. The opening of the rostrum of the corpus callosum exposes the contralateral subcallosal region on the lesion side, the ACA, and the anterior communicating artery (ACoA) and its branches (Fig. 2).

Illustrative Case

A 39-year-old man with partial complex seizures was diagnosed with a cavernous malformation and an associated anteriorly located developmental venous anomaly in the left subcallosal area (Fig. 3). The patient underwent a contralateral (right side) anterior interhemispheric-transcallosal-transrostral approach to the lesion. When the rostrum of the corpus callosum was opened on the right side, a yellowish lesion was identified in the contralateral subcallosal area (left side). The lesion was removed along with the adjacent hemosiderin-stained tissue, while preserving the venous anomaly (Fig. 4). Following an uneventful postoperative course, MRI studies showed gross-total resection of the lesion, and the patient’s antiepileptic drugs were discontinued 2 months later.

Discussion

The advantage of the contralateral anterior interhemispheric-transcallosal-transrostral approach over the others described in the medical literature is that it provides improved situational access to the subcallosal area. This area also includes the inferior portion of the pericallosal cistern, the lamina terminalis cistern, the paraterminal and parolfactory gyri, and the anterior surface of the op-
tic chiasm, without encountering the critical perforating branches of the ACoA.

The contralateral anterior interhemispheric-transcallosal-transrostral approach provides direct and better lateral exposure to the contralateral hemisphere (lesion side) than the exposure provided by an ipsilateral approach, even with minimal hemisphere retraction. After opening the interhemispheric fissure, the lesion is pulled by gravity in the opposite direction to provide a better view for the surgeon, with less of a requirement for retraction of the nonlesion hemisphere with the assistance of gravity. The trajectory from above, through the lateral ventricle, provides exposure to the bilateral ACA in the subgenual region. The removal of the lesion via the contralateral route is easier and safer than its removal via an ipsilateral route because of greater lateral exposure.

The subcallosal area is bordered superiorly by the rostrum and genu of the corpus callosum, posteroinferiorly by the lamina terminalis, and posteriorly by the paraterminal and paraolfactory gyri. The most common approaches
to the subcallosal area are a fronto-orbitozygomatic craniotomy with a transtemporal supracallosal route and an anterior frontal craniotomy with an anterior subtemporal interhemispheric approach.\textsuperscript{3} Waldron and Lawton\textsuperscript{16} noted a supracallosal infratentorial route to cavernous malformations in the anterior inferior part of the basal ganglia in 5 patients, 2 of whom had transient neurologic deficits. Rangel-Castilla and Spetzler\textsuperscript{2} also used an orbitozygomatic supracallosal infratentorial approach for removal of cavernous malformations located in the anteroinferior region of the thalamus. They reported that 20\% of patients had postoperative transient hemiparesis related to a small internal capsule stroke. In the subcallosal area, this complication may be related to cisternal lesions because superiorly or posteriorly directed ACoA aneurysms are commonly treated via a fronto-orbitozygomatic approach. With a transylvian, subfrontal, anterior interhemispheric dissection of the lamina terminalis and the inferior pericallosal cisterns, this complication may be related to accidental injury of the subcallosal artery, causing memory impairment and amnestic-confabulatory syndrome.

The transventricular prefrontal approach described by Yoshimoto et al.\textsuperscript{19} has been used to remove exophytic chiasmal-hypothalamic astrocytomas extending into the anterior third of the lateral ventricle by entering through the bulk of the tumor. In our case, the presence of a cavernous malformation with an anteriorly located venous anomaly draining into the anterior septal vein prompted a surgical approach from above the lesion, rather than from an anterior or inferior route. Such an approach also helps to avoid manipulation of the critical perforating arteries. In our contralateral anterior interhemispheric-transcallosal-transrostral approach, the dissection into the rostrum of the corpus callosum must be made 15 mm away from the anterior limit of the column of the fornix. At this point, a safe entry zone exists that avoids damage to the anterior commissure, which has a mean distance from the foramen of Monro of 3.3 mm (range 1.9–5.4 mm), as described in anatomical studies, and 6.7 mm (range 1.8–14.5 mm), as described in radiological studies.\textsuperscript{6,17,18}

Although our patient had no postoperative neurological or neuropsychological deficit, the transcallosal approach has been associated with adverse functional outcomes for memory and executive functions, and with learning impairment.\textsuperscript{1,11} However, most of these studies included patients who underwent resections of lesions via the transcallosal approach with manipulation of the fornix.

Conclusions

The contralateral anterior interhemispheric-transcallosal-transrostral approach may be an alternative route to lesions in the subcallosal area, with less risk to the branches of the ACA, particularly the ACoA perforators.

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Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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