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Open thrombectomy and reconstruction of the rolandic vein in a parasagittal meningioma: recovering motor evoked potentials. Illustrative case

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BACKGROUND Parasagittal meningiomas commonly invade the superior sagittal sinus (SSS) and cortical veins. Reconstructing the veins can be challenging after radical meningioma removal, especially when major venous sinuses and veins are involved. The authors present a video showcasing the reconstruction of the rolandic vein during surgery for a large parasagittal meningioma. The video shows the surgical technique and motor evoked potential recovery after venous drainage returns to normal.

OBSERVATIONS A 59-year-old woman had been experiencing progressive weakness in her right lower limb over the past year. Magnetic resonance imaging revealed a consistent enhanced mass in the left parasagittal region over the motor area, indicating meningioma. Magnetic resonance venography showed a complete blockage of the SSS. The patient experienced the loss of motor evoked potentials after tumor removal and thrombosis of the rolandic vein. An open thrombectomy was performed, and the vein was reconnected to the SSS. The patient recovered her basal motor evoked potential.

LESSONS The video of a rolandic vein reconstruction emphasizes the significance of preserving and restoring venous blood flow in eloquent areas. Monitoring is crucial during meningioma surgery involving the SSS and cortical veins in the motor area to identify and reverse any motor and sensory deficits, ensuring optimal resection while maintaining the patient's quality of life.

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KEYWORDS meningioma; rolandic vein; anastomosis; motor evoked potential

Parasagittal meningiomas are challenging due to their proximity to the superior sagittal sinus (SSS) and cortical veins. Different levels of compromised venous blood flow are observed based on the extent of tumor invasion in such vascular structures. Tumor resection should be performed with electrophysiological motor and sensory monitoring to diagnose and reverse motor and sensory disturbances during surgical removal.

In this report, we present the case of an otherwise healthy female with progressive weakness in her right lower limb over the past year who was diagnosed with a large parasagittal meningioma in the left motor area. The patient underwent successful total tumor removal. Transoperative diagnosis revealed the loss of motor evoked potentials and thrombosis of the rolandic vein. An open thrombectomy of the vein was performed, reconnecting the vein to the SSS and restoring the normal motor evoked potentials. Here, with a nuanced video, we emphasize the importance of monitoring and venous reconstruction during surgery to preserve the patient's quality of life.

Illustrative Case

A 59-year-old female with no prior medical history presented with progressive weakness in her right lower limb over the past year. Magnetic resonance imaging (MRI) showed a large, uniform, enhanced lesion in the middle third of the parasagittal sinus, indicating a meningioma. Magnetic resonance venography (MRV) revealed a complete blockage of the SSS by the lesion, with the left rolandic vein attached to and pushed forward by the tumor (Fig. 1).

The patient underwent surgery through a standard biparietal craniotomy, crossing the midline and exposing the SSS. Motor evoked

ABBREVIATIONS MRI = magnetic resonance imaging; MRV = magnetic resonance venography; SSS = superior sagittal sinus. INCLUDE WHEN CITING Published November 25, 2024; DOI: 10.3171/CASE24601. SUBMITTED September 6, 2024. ACCEPTED September 30, 2024.

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FIG. 1. Axial (A) and axial and sagittal (B) MRI revealed a large meningioma in the left middle third of the parasagittal sinus and falx. MRV (C and D) showed the relationship between the rolandic vein (red arrow) and the anterior portion of the tumor.

potentials were recorded from both sides of the body. The patient was positioned supine with the head in a neutral position and flexed to expose the middle third of the SSS. A U-shaped skin incision was made, starting 1 cm posterior to the coronal suture, crossing the midline, and extending 4 cm posterior to the superior rolandic point. The dura was opened in a flap along the midline, exposing the full extent of the meningioma. An arachnoidal plane dissection was performed to free the rolandic vein from the anterior border of the tumor. The meningioma, which showed evident pial invasion, was successfully removed from the compressed motor area. The falx was coagulated and opened to remove the tumor of the contralateral side, and the meningioma was resected from the SSS, posterior to the point of drainage of the left rolandic vein. At this time, motor evoked potentials were no longer present on the right side of the body. An inspection revealed a partial thrombosis of the left rolandic vein related to a small tear in its attachment to the SSS. An open thrombectomy was performed using a combination of a hook, forceps manipulation, and warm saline washing. This led to a restoration of blood flow in the rolandic vein and SSS. An 8-0 suture was used to reconnect the superior wall of the vein to the SSS (Fig. 2). The motor evoked potentials gradually returned to preoperative levels over the next few minutes (Fig. 3). The tumor was completely removed, including the part of the bone that was affected by the lesion. The patient was discharged 4 days after the operation, with a slight motor deficit in the right foot. Full recovery to the preoperative level was achieved within 4 weeks. MRI and MRV revealed total removal and patency of the venous blood flow in the rolandic vein (Fig. 4, Video 1).

VIDEO 1. Clip showing the rolandic vein open thrombectomy and reconstruction. Click here to view.

Informed Consent

The necessary informed consent was obtained in this study.

Discussion

Observations

Luigi Rolando described the fissure of Rolando, also known as the central sulcus. The rolandic vein is a critical superficial vein located at the central sulcus, anterior to the superior anastomotic vein (vein of Trolard).¹ As described initially by Cushing et al., the parasagittal meningiomas in the middle third are associated with the SSS and rolandic veins.² Venous patency is vital during meningioma surgery to prevent malignant edema and venous infarction.^{3–7} Venous reconstruction techniques involve using various autologous venous grafts and dural reconstruction.

Conducting a preoperative venous study is essential for defining the surgical strategy in cases of parasagittal meningiomas. The surgical treatment of parasagittal meningiomas is controversial in the literature, with some authors advocating radical removal with sinus reconstruction and others recommending subtotal removal with sinus preservation.^{8,9} The surgical approach should expose all the limits of the tumor as well as both sides of the SSS, even in cases of subtotal occlusion. This is important because there is a risk of venous complications and retrograde thrombosis during the surgical manipulation of the sinus.^{4,10}

The loss of muscle motor evoked potentials at the end of surgery is linked to long-term motor deficits, known as muscle motor evoked potential-related deficits. However, there is growing evidence that motor deficits can occur even if there is no change in muscle motor evoked potentials, especially after surgery in nonprimary regions involved in motor control.¹¹ We advocate for the resection of



FIG. 2. Partial thrombosis of the left rolandic vein after tumor removal (A). Open thrombectomy (B). Reconstruction of the rolandic vein connected to the SSS to restore normal blood flow (C).

parasagittal meningiomas located at the middle third, directly related to motor areas, to involve bilateral motor evoked potential monitoring.^{5,7} In this case, evidence of lower motor evoked potentials indicated early

rolandic vein retrograde thrombosis, which allowed for surgical correction. Such electrophysiological signals prevented complications such as bleeding or swelling associated with delayed venous congestion.



FIG. 3. Intraoperative motor evoked potential (MEP monitoring. Basal motor evoked potential (A); loss of MEP during rolandic vein thrombosis (B); and MEP recovery after venous blood flow restoration (C).



FIG. 4. Postoperative MRI showing complete removal (A and B). MRV indicated preservation of the left rolandic vein (red arrows, C and D).

The literature describes various techniques for venous reconstruction, including the use of autologous venous grafts, end-to-end anastomosis, reimplantation of the veins in the reconstructed sinus, and dural grafts.^{3,4,8,10,12} However, the reported patency of vein reconstruction is approximately 50%.^{10,12}

In this case, the chosen approach involved performing mechanical thrombectomy, using abundant warm saline for washing while avoiding intravenous heparin. The procedure also included performing a primary suture in an end-to-end fashion at the point of laceration of the rolandic vein in the SSS. It was anticipated that the veins would not clot if the venous flow was maintained in both directions. Postoperative MRV confirmed the patency of the anastomosed vein.

Lessons

Preserving the veins during surgery for meningiomas that involve the prominent sinuses and cortical veins is crucial. Monitoring sensorimotor function during surgery for motor area tumors is crucial for the early detection of complications such as venous thrombosis, which may require reconstructive correction to prevent further consequences. In this case, early monitoring signalization detected a partial occlusion of the rolandic vein, allowing for the vein to be cleaned and reconstructed before any adverse local brain reactions were observed.

The straightforward open thrombectomy technique involves using warm saline and performing a direct end-to-end anastomosis to reconstruct the superior wall of the rolandic vein up to its drainage point in the SSS. This approach avoids the higher risks of thrombosis associated with graft interposition. A full exposition of both sides of the SSS is essential to the diagnosis and repair of any venous injury related to SSS manipulation.

To our knowledge, this is the first video-documented case in the literature of a meningioma invading the SSS where the rolandic vein reconstruction was performed during surgery. The experience reported demonstrates that performing open cleaning and reconstruction of cortical veins is feasible during meningioma surgery.

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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.

Author Contributions

Conception and design: da Silva, Marrone, Secco. Acquisition of data: da Silva, Marrone, Secco. Analysis and interpretation of data: da Silva, Marrone, Secco, Thibes. Drafting the article: da Silva, Vidaletti, Marrone. Critically revising the article: da Silva, Vidaletti, Marrone. Reviewed submitted version of manuscript: da Silva. Approved the final version of the manuscript on behalf of all authors: da Silva. Administrative/technical/ material support: da Silva. Study supervision: da Silva, Marrone. Video audio editing: Vidaletti. Translation: Thibes.

Supplemental Information

Videos

Video 1. https://vimeo.com/1015273438.

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