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Artigo Original

Interhemispheric occipital transtentorial approach to the pineal region and dorsal midbrain – anatomy and surgical technique

Acesso interhemisférico occipital transtentorial à região da pineal e mesencéfalo dorsal – Anatomia e técnica cirúrgica

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ABSTRACT

We describe the surgical anatomy and technical aspects of the interoccipital transtentorial approach to lesions of the dorsal midbrain and pineal region using the lateral-semiprone position. This approach offers a wide exposure of the posterior midbrain and pineal region tumors, avoiding the risks of the semi-sitting position used for the supracerebellar infratentorial approach. A step-by-step description of the approach is presented, with detailed anatomical pictures and case illustrations.
Key-words: *interhemispheric occipital transtentorial approach; pineal; dorsal midbrain; lateral-semiprone position.*

SUMÁRIO

Descrevemos a anatomia cirúrgica e detalhes técnicos do acesso interhemisférico occipital transtentorial na posição lateral semi-prona para lesões na região posterior do mesencéfalo e da glândula pineal. Esta abordagem oferece uma ampla exposição cirúrgica aos tumores desta região, evitando ainda os riscos da posição semi-sentada usada no acesso supracerebelar infratentorial. A descrição passo-a-passo do procedimento com ilustrações anatômicas é apresentada pelos autores, bem como casos ilustrativos.
Palavras-chave: *acesso interhemisférico occipital transtentorial; pineal; mesencéfalo; posição lateral semi-prona.*

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Introduction

The pineal region is limited dorsally by the splenium of the corpus callosum, ventrally by the quadrigeminal plate and midbrain tectum, rostrally by the posterior aspect of the third ventricle and caudally by the cerebellar vermis[5]. It can be the site of many central nervous system lesions, being responsible for 3-8% of the pediatric brain tumors and less than 1% of adult tumors[3].

Many lesions can affect the posterior midbrain and pineal region, including: (1) germ cell tumors, like germinomas and nongerminomas; (2) pineal parenchymal tumors; (3) glial tumors; (4) miscellaneous tumors; (5) pineal cysts; (6) metastasis; (7) meningeomas; (8) lymphomas and others. Extensive removal is an important outcome factor in most of these lesions, like teratoma, nongerminomatous malignant germ cell tumor, and pineocytoma as well as other benign tumors[6]. Preoperative hydrocephalus, associated with symptoms or signs of increased intracranial pressure (ICP), is very common and can be treated with a ventricular drainage placed before or during the craniotomy. Hydrocephalus usually improves after the tumor is resected and, in many cases, a shunt operation can be avoided. Furthermore, a shunt procedure can cause dissemination of malignant germ cell tumors via the shunting system[6].

The most common surgical routes to treat these lesions are the interhemispheric occipital transtentorial and the infratentorial supracerebellar approach. The choice among them is based on surgeon's preference, as well as on the advantages and disadvantages of each one[1,2,4]. The present work discusses the indications for each approach and proposes a technical modification of the tentorial opening for the interhemispheric occipital transtentorial approach.

Discussion

The infratentorial supracerebellar approach may be selected for lesions located below the vein of Galen and its major tributaries, like tumors in the midline that grow into the lower half of the posterior incisural space, displacing the quadrigeminal plate and apex of the tentorial cerebellar surface. Disadvantages of this route include the risks of the semi-sitting position (although it can also be done in the Concorde position), like air embolism and pneumocephalus, and a very uncomfortable position for the surgeon. This approach is limited in exposing lesions that lie deep in the cerebellomesencephalic fissure and should be avoided in patients with a tentorium that is too steep (i.e. when the angle between the straight sinus and the occipital surface of the cerebellum measured in sagittal midline MRI cuts is obtuse). (Figure 1A&1B). In such cases, excessive retraction or even resection of part of the upper cerebellar vermis is often necessary to reach the lesion.

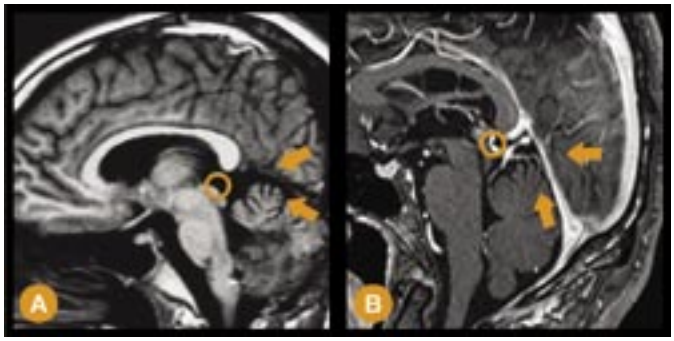

Figure 1: The supra-cerebellar infratentorial and the occipital transtentorial routes are compared using sagittal midline MRI cuts in two distinc subjects (the star indicates the pineal region and the arrows show the direction of either route). The angle between the straight sinus and the occipital surface of the cerebellum is markedly more obtuse in subject (B) thus making the occipital transtentorial route preferable. Note that in subject (A) both routes seem to be equivalent.

The occipital transtentorial approach is selected for lesions centered at or that extend above the tentorial edge. It may also provide a better angle of access for some lesions involving the ipsilateral half of the cerebellomesencephalic fissure and posterior part of the ambient cistern[6]. We have used this approach successfully in our cases of pineal and posterior midbrain lesions with no extra morbidity in a lateral-semiprone position, described as follows:

The patient is positioned in a lateral-semiprone position with the approach side down (i.e., a right lateral position for a right side approach) with the head fixed in a three-point fixation device. The head is elevated so as to leave the sinus confluence slightly above the right atrium in order to decrease intracranial pressure and avoid air embolism. The head is then rotated 60 degrees towards the floor. The torso is also rotated so as to alleviate the rotation of the neck and the head is slightly extended in order to avoid jugular vein compression (Figure 2A&B). Illustrative case I: pilocytic astrocytoma of the posterior midbrain (Figs. 3&4) and illustrative case II: germinoma of the pineal region (Figs.5&6) depict the procedure in a stepwise fashion. An occipitoparietal scalp flap is prepared with a craniotomy that exposes the superior sagittal, the transverse and the straight sinus completely. The occipital lobe below the lambdoid suture is usually free of bridging veins to the superior sagittal sinus, making it a good surgical route[5]. The occipital lobe can then be retracted away from the midline (in the lateral-semiprone position the occipital lobe naturally "falls away" from the midline by gravity). At times, bridging veins from the basal surface of the occipital lobe to the tentorium need to be sacrificed during retraction.

Figure 2: Anterior (A) and lateral (B) views of the patient's positioning in the surgical table.

Figure 3: Illustrative case I : Pre-operative MRI scans(A:coronal; B: axial; C: sagittal cuts) of a pilocytic astrocytoma of the left posterior midbrain. Post-operative images(D:coronal; E: axial; F: sagittal cuts) showing complete removal of the tumor.

After the occipital lobe is retracted and the tentorial incisura is reached, the tentorium is divided. At this point we have introduced a slight modification to the original technique where instead of cutting the tent along the straight sinus we do it in an oblique way. By starting near the confluence of the straight and the transverse sinuses we proceed towards the tentorial edge to a point located 2-3cm lateral to the falco-tentorial junction. In that manner, a triangular dural flap is created that can be retracted superiorly along with the straight sinus in order to improve exposure of the midline, as well as, of the contralateral structures (Figure 4A,B,C,D, and Figure 6 A&B).

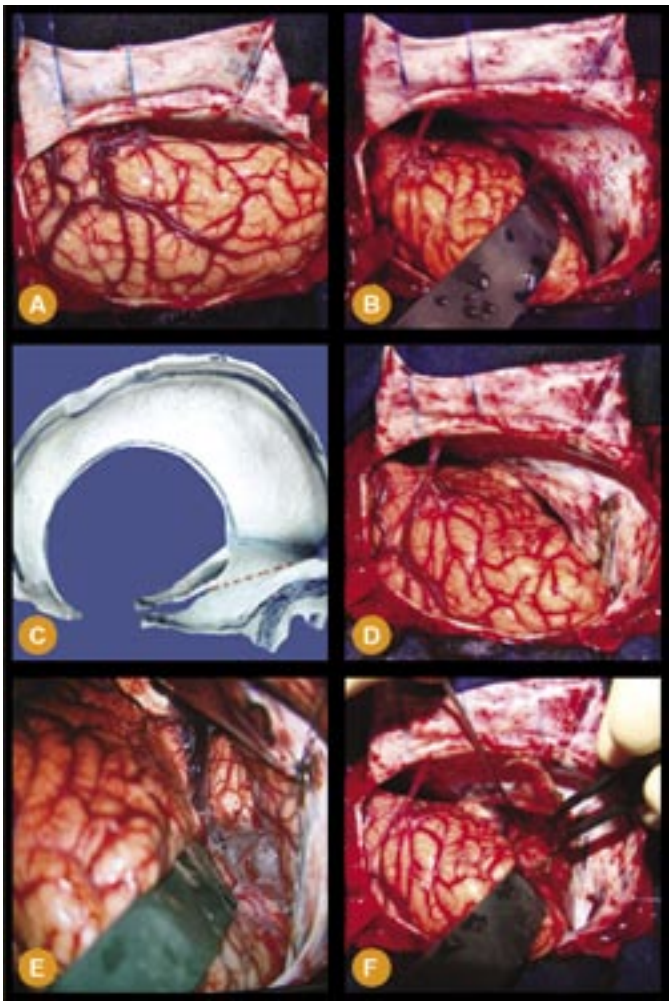

Figure 4: Illustrative case I : Surgical pictures: (A) An left occipitoparietal scalp flap is prepared with a craniotomy that exposes the superior sagittal, the transverse and the straight sinus completely; (B) The occipital lobe can then be retracted away from the midline exposing the falx, the straight sinus and the ipsilateral tentorium; (C) Schematic rendering of the opening of the tentorium(dashed lines); (D) The tentorium is cut and (E) lifted with sutures exposing the surface of the tumor; (F) The tumor is then totally removed.

The thick arachnoid is now sharply and carefully dissected using microsurgical techniques to expose the deep venous system and the anatomic structures of the pineal region(Figure 6A,B,C,D). The vein of Galen, both basal veins, and the pre-

central cerebellar vein are identified. The latter is generally coagulated, allowing for the superior displacement of the entire venous complex without adding any extra morbidity. The internal cerebral veins are usually elevated by the tumor and the vein of Galen and its tributaries tightly cover the dorsal posterior portion of pineal region tumors. The vein of Galen and both internal cerebral veins are generally located above the tumors, both basal veins are displaced superiorly and laterally, and the precentral cerebellar vein is displaced posterior and superiorly. In the occipital transtentorial approach, the basal vein and the precentral cerebellar vein are usually on the way to access the tumor. The tumor is approached through the opening between the vein of Galen, ipsilateral basal vein, and the coagulated precentral cerebellar vein. Tumor resection is performed between the veins. The deep veins must be preserved and gentle occipital lobe is mandatory to avoid postoperative homonymous hemianopsia[6] (Figures 5&6).

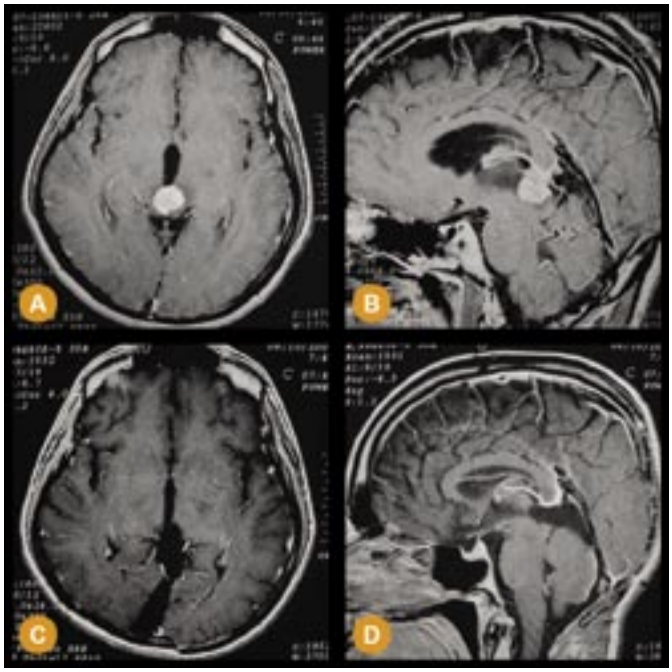

Figure 5: Illustrative case II : Pre-operative contrast MRI scans(A: axial; B: sagittal cuts) of a germinoma of the pineal region. Post-operative images(C: axial; D: sagittal cuts) showing complete removal of the tumor.

Identification of the vein of the lateral mesencephalic fissure is an important landmark when one intends to access the upper brainstem. The vein lies over the lateral mesencephalic sulcus, located in the posterior part of the cerebral peduncle, which is one of the so-called safe entry zones into the brainstem and can be easily reached through the interhemispheric occipital transtentorial approach.

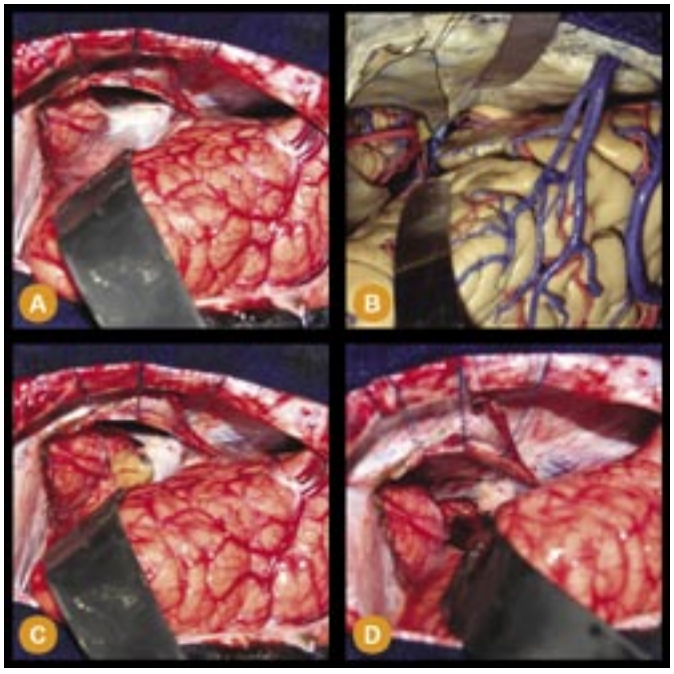

Figure 6: Illustrative case II: Surgical pictures: (A) A right occipitoparietal craniotomy is prepared, the occipital lobe is retracted, the tentorium is cut and lifted with sutures. that covers the quadrigeminal cistern is exposed; (B) Anatomical especimen showing the opening of the tentorium and the pineal region; (C) The thick arachnoid membrane is dissected exposing the surface of the tumor; (D) The tumor is then totally removed.

Conclusion

The interhemispheric occipital transtentorial approach using the lateral-semiprone position can be safely applied to a wide variety of lesions of the dorsal midbrain and pineal region while providing a very comfortable position for the surgeon.

The modified tentorial opening has proven to be a useful aid in improving the exposure of such a complex region.

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Disclosure statement

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