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Case Report

Surgical management of a meningioma in the retrosellar region

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Summary

Lesions ventral to the brainstem in the retrosellar and interpeduncular region are major challenges to the surgeon because of their location at great depth in the centre of the cranial base. We report the operative management of a patient with a meningioma in an unusual location, extending from the upper clivus, retrosellar and interpeduncular region into the suprasellar area up to the level of the foramen of Monro.

A 41-year-old man presented with a 3-month history of progressive visual disturbance, episodic headache and signs and symptoms of endocrinological disturbance. Magnetic resonance imaging (MRI) studies showed a homogeneously enhancing tumour ventral to the brainstem with large cranio-caudal extension from the upper clivus to the suprasellar area.

Operative removal was planned in two stages. First, through a right lateral suboccipital retrosigmoid craniectomy the caudal portion of the tumour at the upper clivus and prepontine region was removed. Second, the residual suprasellar part of the tumour was removed totally through a fronto-lateral craniotomy on the right side one week later.

When a tumour is very large or involves different areas of the skull base, it is necessary to decide between removal in one stage, which requires a complex and time consuming skull base approach, or in multiple stages. Our case demonstrates how a retrosellar meningioma extending to the suprasellar region can be totally removed using two simple skull base approaches without the risk of compromise to venous drainage and without the need for extensive bone removal as described in other skull base approaches.

Keywords: Retrosellar region; clivus; meningioma; brain tumour.

Introduction

Lesions ventral to the brainstem in the retrosellar and interpeduncular region or upper clivus often pose major difficulties to the surgeon because of their location at great depth in the centre of the cranial base. Several approaches to this region have been described [1–6, 8–14, 17–21] but, as a consequence of the small working space between complex neurovascular structures, a tumour with large extensions often cannot be totally removed through a single approach. We report the surgical management of a patient with a meningioma in an unusual location extending from the upper clivus, retrosellar and interpeduncular region to the suprasellar area up to the level of the foramen of Monro. Complete removal of the tumour was achieved in two stages using simple retrosigmoid lateral suboccipital and frontolateral approaches.

Case report

A 41-year-old man presented with a history of progressive visual disturbance and episodic headache for 3 months. For the last 4 weeks he also had complained about chronic fatigue and polyuria. Magnetic resonance imaging (MRI) studies showed a homogeneously enhancing tumour ventral to the brainstem with large cranio-caudal extension from the upper clivus to the suprasellar area displacing the brainstem and third ventricle dorsally. The tumour encased the basilar artery and the upper border reached the level of the foramen of Monro (Fig. 1). On admission the patient had a 40% decrease in visual acuity in both eyes, with a bitemporal lower quadrantic visual field defect. The extra-ocular muscles were intact and no other neurological deficit was found. Endocrinological investigations showed a partial impairment of the corticotropic and gonadotropic axes of the pituitary gland. In view of the extent of the tumour, operative removal was planned in two stages. First, through a right lateral suboccipital retrosigmoid craniectomy, the caudal portion of the tumour located at the upper clivus and prepontine region was exposed. The tumour was compressing the trigeminal nerve caudally and had dense adhesions to surrounding neurovascular structures (Fig. 2). It was vascularised and the consistency was partly fibrotic and partly

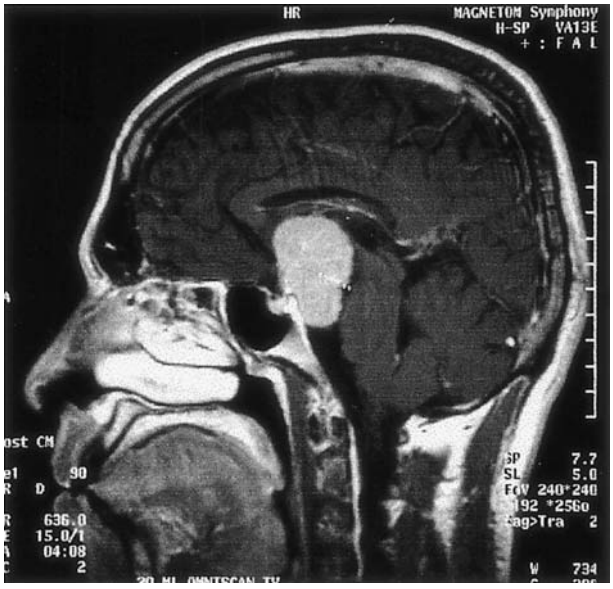

Fig. 1. Gadolinium enhanced T1-weighted sagittal MRI scan showing a homogeneously enhancing well delineated tumour located in the upper clival area extending to the suprasellar region and the level of the foramen of Monro. The third ventricle is compressed and displaced dorso-cranially.

soft. After stepwise tumour reduction, the oculomotor nerve was identified and the tumour capsule was gently dissected away. The hard and fibrotic part of the tumour was removed using bipolar coagulation and sharp dissection with microsurgical scissors. Complete removal of the lower portion of the tumour, in the upper clival and prepontine region, was achieved with preservation of surrounding structures including the superior cerebellar, basilar and posterior cerebral artery. The tumour matrix could then be detached at the upper clival region, dorsum sellae and posterior clinoid process. The postoperative course was uneventful and neurological examination did not show any new deficits. Histological studies showed a meningioma of meningotheliomatous type. An MRI scan was performed to assess the dimensions of the residual suprasellar portion of the tumour (Fig. 3).

The second operation was performed a week later. The residual tumour was approached through a right fronto-lateral craniotomy. Parts of the tumour were exposed between the compressed right optic nerve and internal carotid artery (Fig. 4). A piecemeal reduction of the tumour was performed and, despite intense vascularisation with arterial feeders from the internal carotid artery, the tumour was finally totally removed. A postoperative MRI scan confirmed the total removal of the tumour (Fig. 5). After operation the patient complained of episodes of mental depression and slight double vision with minimal functional impairment of the right oculomotor nerve, which improved subsequently. Endocrinological evaluation of the pituitary gland showed a partial impairment of the somatotropic axis and gonadotropic insufficiency. Treated with testosterone replacement therapy, the patient recovered promptly and he returned to normal daily activities after discharge.

Discussion

Lesions frequently encountered at the ventral aspect of the brainstem at the tentorial incisural, the retrosellar and parasellar area and upper clivus regions include aneurysms, arterio-venous malformations, cavernous malformations, craniopharyngiomas and tumours arising from the clivus or petroclival region such as chordomas and meningiomas.

The operative management of lesions in these locations is difficult because of the deep location and close relationships to important neurovascular structures. The operative field is restricted and the extensive approach needed for total removal of a tumour with large extensions can create additional morbidity.

Several approaches have been used to reach the retrosellar interpeduncular region and the upper clival or petroclival area [1–6, 8–10, 12–13, 17, 19, 21]. Many of these approaches represent variations of the classical pterional [21], subtemporal [3] and lateral suboccipital retrosigmoid [18, 22] routes with variable

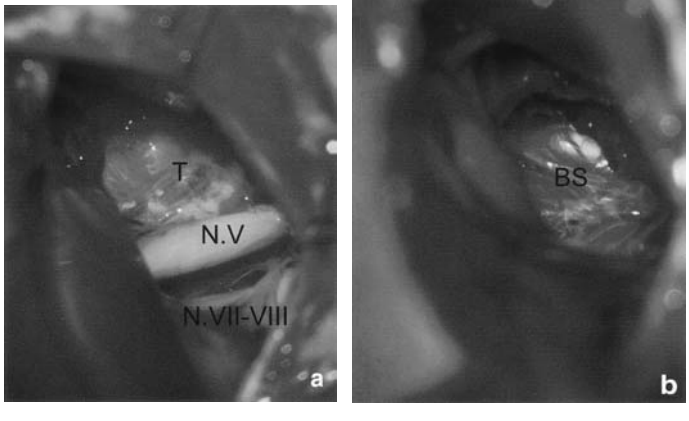

Fig. 2. (a) Via a right sided lateral suboccipital retrosigmoid approach, an intra-operative picture showing the tumour mass (*T*) lying ventral to the brainstem in the prepontine cistern compressing the trigeminal nerve (*N.V*) caudally. VIIth–VIIIth cranial nerve group (*N.VII–VIII*). (b) A complete removal of the caudal part of the tumour could be achieved showing the brainstem (*BS*) without any residual tumour in this area

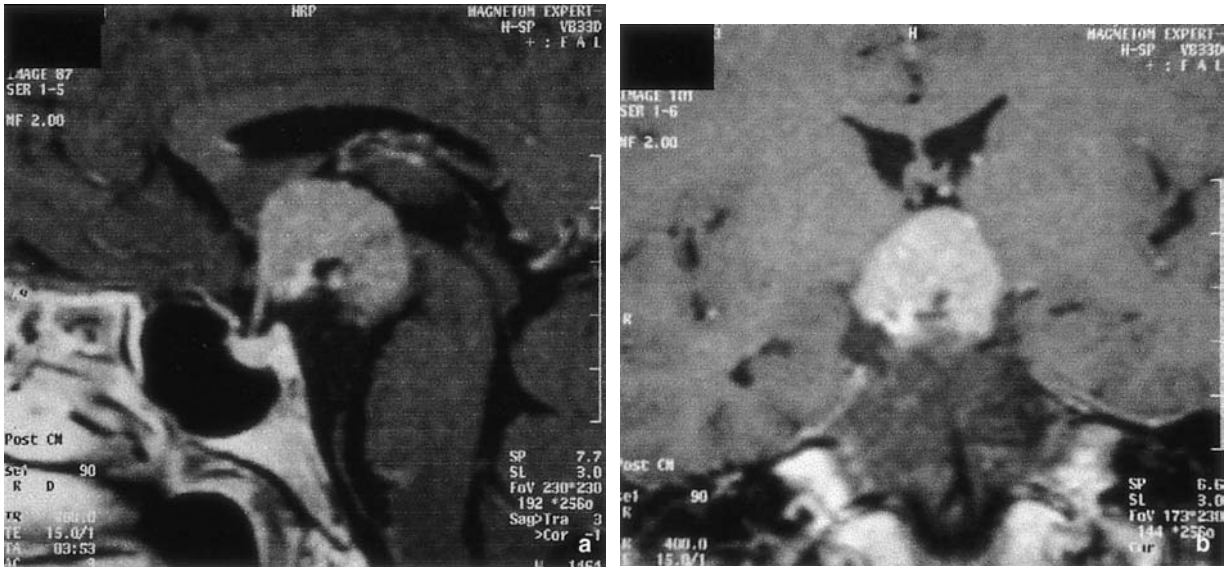

Fig. 3. First postoperative sagittal (a) and coronal (b) gadolinium enhanced T1-weighted MRI demonstrating complete removal of the lower portion of the tumour in the prepontine region

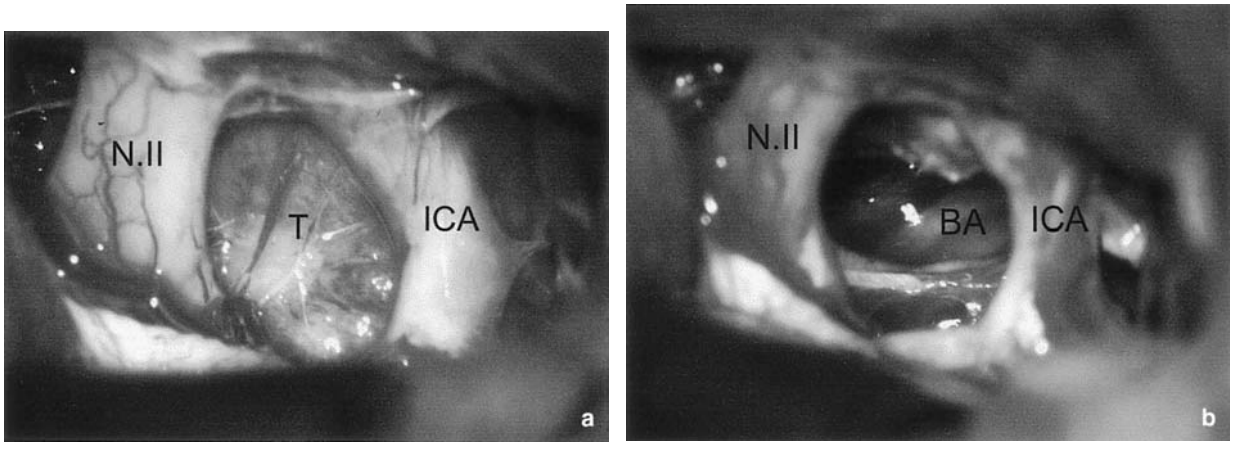

Fig. 4. (a) Intra-operative picture via a right sided frontolateral subfrontal approach showing the remaining suprasellar portion of the tumour (*T*) between the right optic nerve (*N.II*) and the internal carotid artery (*ICA*). (b) After piecemeal reduction a complete removal could be performed. The basilar artery (*BA*) can be seen in the depth between the right optic nerve (*N.II*) and the internal carotid artery (*ICA*)

amounts of extra bone resection, depending upon the extent of the lesion.

The pterional approach was described by Yasargil [21] to reach aneurysms of the basilar apex. The interpeduncular fossa is accessed through a space between the optic nerve and internal carotid artery or between the artery and the oculomotor nerve after opening the Liliequist's membrane. The working space at the tentorial notch is very narrow and the view of the uppermost aspect of the interpeduncular cistern and the superior clival region is limited.

The subtemporal approach [3, 18] provides a good exposure of the tentorial notch and the upper and middle clivus. Exposure of the middle clivus can be achieved by splitting the tentorium. Nevertheless, retraction of the temporal lobe may cause damage to temporobasal veins with secondary venous infarction of the temporal lobe.

The extradural, subtemporal, transpetrosal-transtentorial approach [9] can provide access to the petroclival region up to the cavernous sinus. Various modifications of this technique that aim to extend the view

Fig. 5. Postoperative sagittal (a), coronal (b) and axial (c) gadolinium enhanced T1-weighted MRI studies after the second operation showing total tumour removal

of the operative field have been reported [10]. The subtemporal transpetrosal approach requires exposure of the cranial nerves V–VIII, the internal carotid artery, the semicircular canals and the cochlea and can be complicated by damage to these structures.

The orbitozygomatic infratemporal approach [5] can provide wide exposure of the interpeduncular fossa and retrosellar region but more extensive bone removal in the frontolateral basal region is needed. A combination with a transcavernous approach was suggested in order to enlarge the area of exposure around the interpeduncular and prepontine cisterns but opening of the cavernous sinus is potentially hazardous as the oculomotor nerve and the intracavernous carotid artery may be damaged.

Our experience with several different skull base approaches in the past has led to our present philosophy, that the approaches should be as simple as possible. Extensive craniotomies like the orbitozygomatic infratemporal approach can be considered in special cases, where tumors show broad expansion in the anterior, middle and posterior fossa as is seen in en plaque skull base meningiomas.

In order to gain wide access to tumours extending from the suprasellar area down to the foramen magnum, Malis used a combined supra and infratentorial approach. This consisted of a posterior temporal craniotomy, a suboccipital craniectomy and mastoidectomy; after exposure of the transverse and sigmoid sinus, the dura was opened above and below the tentorium and the sigmoid sinus was ligated lateral to the entrance of the vein of Labbe, in order to preserve venous drainage [11]. With division of the tentorium, this approach provides a good multi-angled exposure of the tentorial notch and petroclival region. Unfortunately death as a result of sigmoid sinus ligation has been reported [7, 20].

A modified, combined supra-infratentorial, presigmoid approach with preservation of the transverse and sigmoid sinuses has been proposed (presigmoid approach) [1, 6, 12]. This aims to avoid postoperative complications resulting from disturbed venous drainage. Since 1985, this approach was used successfully in our department to remove large tumours involving the petroclival region. This experience showed that, despite preservation of the large venous sinuses, prolonged retraction of the sinuses risked sinus thrombosis, while in some cases, coagulation of some basal veins impeded the venous drainage of the temporal lobe resulting in intracerebral bleeding.

In the patient reported, the meningioma extended from the upper clival region upwards to the suprasellar region, reaching almost to the foramen of Monro. Although the combined supra-infratentorial presigmoidal approach would have enabled total removal of the tumour, we used separate simple retrosigmoid lateral suboccipital and frontolateral approaches to remove the tumour in 2 stages with the aim of minimising risks and complications as a result of disturbed venous drainage.

The retrosigmoid suboccipital approach can be used for a variety of posterior fossa lesions, including clival lesions. A modification of this classic approach, introduced by the senior author (M.S.), incorporates intradural drilling of the suprameatal petrous bone to allow access to the middle fossa [16]. The surgical technique and the surgical treatment of various lesions have been described in detail previously [13–16]. Although it is

often necessary to work between the cranial nerves, excellent exposure is gained from the foramen magnum up to the middle and upper clival area. Nevertheless, clival tumours with a very high suprasellar extension cannot be easily removed.

As the first step, the lower part of the meningioma at the upper clival and retrosellar area was removed through a classical lateral suboccipital approach. Despite the great depth of the working area, the tumour was completely removed from this region without damage to neurovascular structures in the vicinity.

The suprasellar part of the tumour was reached through a frontolateral approach. This simple approach, which can be performed in a very short time without any extensive removal of bony structures, provides access to a variety of lesions at the anterior skull base and para- or suprasellar region. The removal of the suprasellar portion of the meningioma, reaching up to the foramen of Monro, was achieved without any difficulties so that finally, the meningioma was removed totally.

Conclusion

Operations in the centre of the cranial base, as the upper clival, parasellar and suprasellar areas, remain a challenge to neurosurgeons. When a tumour grows to a considerable size or occupies different areas of the skull base, a choice has to be made between removal in one stage, requiring a complex and time consuming skull base approach, or in multiple stages. We present a patient with a retrosellar upper clival meningioma extending to the suprasellar region, in order to show how total removal was achieved using two simple skull base approaches, without compromise of the venous drainage or damage to important neurovascular structures.

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Comments

First of all, I would like to congratulate the authors on their successful resection of this large rare meningioma located ventral to the brainstem in the retrosellar and interpeduncular region in 2 stages using a simple retrosigmoid lateral suboccipital and frontolateral approach.

Even in their two staged surgery, the resectabiltity of the tumor would be mostly affected by the consistency of the tumor, because of the great depth of working area and very narrow space via their approach.

The orbitozygomatic approach can be tailored depending upon the pathology, size and location of the tumour and pre-operative finding of the intracranial venous system. With combination of the epidural approach with minimal opening of the venous system of the cavernous sinus (CS) in the parasellar region, the orbitozygomatic approach provides better exposure of the retrosellar region and interpeduncular fossa, and yet good preservation of the basal venous structures so that the possibility of hemorrhagic infarction of the temporal lobe is very low.

With a combination of the transcavernous approach, if possible, this orbitozygomatic approach will give the best and excellent exposure of the interpeduncular fossa via a wide space between the entirely exposed optic nerve and internal carotid artery (ICA) with opening the distal ring of it or between the ICA and the oculomotor nerve with opening its dural sheath within the lateral wall of the CS. Even hard tumor can be totally removed in one stage via a very wide and shallower exposure of the fossa. It also can provide a better exposure of the upper and middle clivus.

A. Hakuba

The authors should be commended for a beautifully presented and treated central skull base meningioma, which they successfully treated in two stages. The MR images before first surgery, then the intra-operative images at first surgery, and equally the postoperative images following the first surgery, and again intraoperative MR images at second surgery, and then postoperative MR images after the second surgery are very good. From the pre-operative MR images the location, spread, as well as the size and shape of the meningioma are well presented. It is clear that the lesion originated from the dorsum sellae, and upper clival region (sagittal cut). The lesion was slightly eccentrically located (more to the right side) which indicates that the tumor originated also from the posterior clinoid process (axial cut), and the globular shape of the lesion projecting upward into the third ventricle and even further up, is nicely seen in the coronal cuts. Partial resection of the lesion through the suboccipital retrosygmoid approach is nicely presented in MR images, following first surgery. At the second stage, the tumor was completely resected by the pterional approach.

It is very true what the authors claim, that meningiomas at this location are not frequent. In our series of meningiomas of the central skull base treated in the last 20 years, we had only six cases which represents 0.7% of all lesions. Regarding the origin of these lesion, we named them: ''dorsum sellae, posterior clinoid process, and upper clival meningiomas''. These meningiomas of globular shape increased in volume in an upward direction toward the hypothalamus and III-rd ventricle, rather than extending their area of the dural involvement. This is, of course, not the case in ''en plaque'' meningiomas in this region until the very late stage of their growth, when they are not operable anymore. In our experience, the dorsum sellae, posterior clinoid process and upper clival globular meningiomas can be completely resected in one stage by using the approach to the central skull base at which the sphenoid wing, anterior clinoid process, proximal and lateral walls of the optic canal and the optic strut are resected extradurally; then, with additional resection of the posterior clinoid process and dorsum sellae, these meningiomas are devascularized at their origin, and then complete resection can be achieved. The critical points in the resection of these lesions are: dissection of perforators, as well as dissection of the pituitary stalk and dissection of the tumor from the visual apparatus and the hypothalamus. Damage to any of the above mentioned neural and/or vascular structures does result in serious postoperative neuroendocrinological and/or neuro-ophthalmological deficits. Though nicely delineated from the surrounding structures, well-shaped lesions at this location do require a lot of surgical skill and experience, and above all, good judgement, not only on when and where to start and how to conduct but also when to stop the surgical procedure in order not to cause permanent neurological deficits.

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