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Original article

Extended endoscopic endonasal approach to clival and paraclival tumors: Indications and limits

Les abords étendus endoscopiques par voie endonasale des lésions clivales et paraclivales : indications et limites

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ABSTRACT

Objective. – To report our experience with the Extended endoscopic endonasal approach (EEEA) for clival and paraclival tumors.
Design. – Retrospective analysis of a consecutive series of patients.
Results. – Eleven patients were considered: 3 chordomas, 3 meningiomas, 3 metastatic lesions, one chondroma and one chondrosarcoma. Gross total resection (GTR) was achieved in all chordomas and in chondromas with patients free of disease at the last follow-up. The chondrosarcoma was first operated on using a transfacial approach and endoscopy was performed for local progression with subtotal resection. The meningiomas were treated by a combination of transcranial and endoscopic approach due to their extension. The resection was subtotal and the residue treated by radiosurgery. Two patients with rhinopharyngeal carcinoma underwent palliative debulking. One metastatic melanoma that underwent GTR experienced remission. Two patients had postoperative cranial nerve palsy. No other complications were observed.
Conclusions. – EEEA allows a direct access to the skull base. Through a minimal access, it limits the incidence of neurological morbidities. For midline epidural clival tumors, EEEA allows a total excision. It also offers an excellent access to the clival component of intradural lesions. A combined approach permits good tumor control with minimal complications.

Mots clés :
Chordome
Clivus
Méningiome
Endoscopie
Chirurgie de la base du crâne

RÉSUMÉ

Objectif. – Rapporter notre expérience chirurgicale des tumeurs clivales et paraclivales par des abords étendus endoscopiques par voie endonasale.
Matériel et méthode. – Analyse rétrospective d'une série consécutive.
Résultats. – Onze patients ont été opérés. Il s'agissait de 3 chordomes, 3 méningiomes, 3 lésions métastatiques, un chondrome et un chondrosarcome. La résection était totale dans tous les cas de chordome et de chondrome avec absence de récidive au dernier contrôle lors du suivi. Le patient avec le chondrosarcome a été opéré dans un premier temps par un abord transfacial, après la récidive, il a été abordé par voie endoscopique, l'exérèse était subtotale. Les patients ayant des méningiomes ont été opérés par des abords combinés associant des voies transcrâniennes, endoscopiques et de la radiochirurgie. Deux patients ayant un carcinome du rhinopharynx ont été opérés par voie endoscopique endonasale dans un but palliatif avec une exérèse incomplète, concernant le patient avec une métastase d'un mélanome l'exérèse était complète. Deux patients avaient en postopératoire une paralysie d'un nerf crânien. Aucun autre complication n'a été observée.

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Conclusions. – L'abord étendu endoscopique endonasal permet un accès direct à la base du crâne. Grâce à cet accès direct et précis les complications postopératoires sont peu importantes. L'indication majeure reste pour les lésions situées sur la ligne médiane et qui sont extradurales, l'exérèse est le plus souvent totale. Cet abord reste aussi une bonne option pour les lésions intradurales, la combinaison des abords transcrâniens, endoscopiques et radiochirurgie offre un excellent contrôle pour les tumeurs paraclivales avec un minimum de complications.

1. Introduction

The skull base is one of the most fascinating areas in neurosurgery from an anatomical as well as from a surgical point of view. This region is the cradle of a wide variety of benign and malignant lesions and despite the progress of microsurgical techniques, surgery of this region is associated with a significant rate of neurological morbidity. The endonasal transsphenoidal approach was initially reserved to access the sellar region until Weiss [1] first described the extended transsphenoidal approach. More recently, the acceptance and utilization of endoscopes on a regular basis in transsphenoidal surgery have allowed its application to regions far beyond the sella turcica, such as to reach the clival and paraclival region [2–19].

Long-term follow-up studies show that the extent of tumor removal is related to long-term prognosis for the most common clival lesions [20–23]. Gross total removal is therefore mandatory [23] and the selection of the best surgical approach is essential for the achievement of this goal.

In this paper, we describe our experience with the extended endoscopic endonasal approach (EEEA) for clival and paraclival lesions and the limits of this technique.

2. Methods

In this retrospective study, we reviewed the medical records of a consecutive series of patients who underwent an EEEA for clival and paraclival lesions between 2009 and 2013 at the department of neurosurgery of the university hospital of Lausanne, Switzerland. The clinical presentation, pathology, location and preoperative extension, surgical approach, extent of resection, complication rate and oncological outcomes were analyzed.

2.1. Preoperative evaluation

All patients were evaluated preoperatively using magnetic resonance imaging (MRI), high-resolution computed tomography (CT) scan with bone windows and CT angiography. The MRI evaluation used both T1- and T2-weighted images, with and without contrast enhancement, to provide information about the extension of the lesion and its relationship to the neurovascular structures, especially the internal carotid artery (ICA) and the cavernous sinus. The CT scan with 3D reconstruction provided information regarding the anatomy of the central skull base, posterior fossa bone structures and nasal structures. Particular attention was paid to the location of foramen lacerum and vidian canal, the degree of aeration of paranasal sinuses and the anatomy of the septae within the sphenoid sinus. CT angiography was used to detail the location of ICA and its relationship with the tumor.

A preoperative nasal endoscopy was used to evaluate and plan the nasal access for the surgery.

2.2. Surgical procedure

An interdisciplinary team composed of a neurosurgeon (M.M. or R.T.D.) and an otolaryngologist (C.I. or P.P.) performed all the EEEAs utilizing a transclival approach, as previously described [4,6–11,14,16–18,24]. Neuromonitoring constituted an essential part of the procedure, as performed by our neurophysiologist (E.P.). Electrodes are placed to monitor the function of the cranial nerves during the surgery. The principal motor cranial nerves at risk are rostrocaudally the oculomotor (III), trochlear (IV), abducens (VI), facial (VII), glossopharyngeal (IX), vagus (X), spinal (XI) and hypoglossal (XII) nerves. They are monitored using free running electromyography (EMG) and compound muscle action potential (CMAP) after direct nerve stimulation using monopolar 1 Hz, monophasic negative 200 μs duration, 1 to 5 mA intensity stimulation. More specifically, oculomotor and abducens nerve are monitored by measuring eyeball movements in a diagonal and horizontal plane using intradermal electrodes placed horizontally and vertically close to the eyes and capturing the displacement of the retina dipole. This monitoring was particularly useful when the lesion invaded the cavernous sinus, was in contiguity with the superior orbital fissure or with the tentorial fissure. Facial nerve branches are monitored using bipolar electrodes placed in the frontalis, orbiculis oculi, orbiculis ori and mentalis muscles. Glossopharyngeal and vagus nerve are monitored using contact electrodes incorporated in the endotracheal tube (Xomed®). Electrodes inserted into the trapezius muscle and tongue muscles are used for monitoring the spinal and hypoglossal nerve function.

When brainstem compression is suspected, the brainstem function is continuously monitored using somatosensory evoked potential (SSEP) and brain stem auditory potentials (BAEP). Alert criteria are a reduction of SSEP/BAEP/CAMP amplitude of more than 50% or spontaneous EMG bursts lasting more than 30 s. In our experience, CMAP evoked by monopolar stimulation of 2 mA or less, suggested close proximity to cranial nerve nuclei and/or branches. A neuronavigational system is used during the surgical resection for intraoperative image guidance as well as a Doppler ultrasonography to localize vascular structures (sphenopalatine artery, ICA and basilar artery).

2.3. Selection and extent of the surgical approach

The choice of the appropriate approach for each patient depends on the location and extent of the lesion. The clivus separates the nasopharynx from the posterior cranial fossa. It is composed of the basisphenoid (posterior part of the sphenoid body) and the basiocciput (basilar part of the occipital bone). Classically, the clivus has been divided into three parts: an upper, middle and lower third. This classification is purely anatomical and does not correlate precisely with the surgical corridor necessary to access these lesions. The extent of bone removal depends on the localization and extent of the lesion in the tridimensional space.

The various endoscopic approaches have been widely described and intuitively three corridors may be recognized in the sagittal

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