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Clinical Study

Pure endoscopic expanded endonasal approach for olfactory groove and tuberculum sellae meningiomas

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ABSTRACT

The expanded endoscopic endonasal (EEE) approach for the removal of olfactory groove (OGM) and tuberculum sellae (TSM) meningiomas is currently becoming an acceptable surgical approach in neurosurgical practice, although it is still controversial with respect to its outcomes, indications and limitations. Here we provide a review of the available literature reporting results with use of the EEE approach for these lesions together with our experience with the use of the endoscope as the sole means of visualization in a series of patients with no prior surgical biopsy or resection. Surgical cases between May 2006 and January 2013 were retrospectively reviewed. Twenty-three patients (OGM n = 6; TSM n = 17) were identified. In our series gross total resection (GTR) was achieved in 4/6 OGM (66.7%) and 11/17 (64.7%) TSM patients. Vision improved in the OGM group (2/2) and 8/11 improved in the TSM group with no change in visual status in the remaining three patients. Post-operative cerebrospinal fluid (CSF) leak occurred in 2/6 (33%) OGM and 2/17 (11.8%) TSM patients. The literature review revealed a total of 19 OGM and 174 TSM cases which were reviewed. GTR rate was 73% for OGM and 56.3% for TSM. Post-operative CSF leak was 30% for OGM and 14% for TSM. With careful patient selection and a clear understanding of its limitations, the EEE technique is both feasible and safe. However, longer follow-ups are necessary to better define the appropriate indications and ideal patient population that will benefit from the use of these newer techniques.

1. Introduction

The management of anterior skull base meningiomas (ASM), including olfactory groove meningiomas (OGM) and tuberculum sellae meningiomas (TSM), has evolved over the past decade. Following the introduction and successful application of endoscopic techniques for paranasal and sellar pathologies, expanded endoscopic endonasal techniques (EEE) have made resection of intra-dural lesions, including ASM, feasible.

OGM represent approximately 10% of all intracranial meningiomas and arise from the cribriform plate and/or the frontosphenoid suture. They often present with loss of olfactory nerve function, varying degrees of edema and mass effect involving the frontal lobes [1]. TSM represent 5–10% of intracranial meningiomas, and are believed to arise from the tuberculum sella, chiasmatic sulcus and diaphragma sellae [2,3]. Their location and proximity to critical neurovascular structures make them surgically challenging. They commonly present with insidious visual disturbance [4,5] with endocrine dysfunction tending to be a late consequence [6]. Visual field loss and reduced visual acuity typically occurs through displacement of the chiasm posteriorly and the optic nerves superolaterally, respectively [4,7]. However there is a spectrum based on size and growth patterns, wherein some OGM can extend to involve anatomical regions where TSM typically arise.

There are a number of well-established microsurgical transcranial approaches that have been used and are considered the standard of care for the resection of ASM [5–11]. However there remains some concern regarding the transcranial approaches. The multiple methods suggest that no one approach is optimal and all of the open approaches involve some degree of frontal lobe brain retraction and long-term encephalomalacia [6,12,13]. Likewise the limited tunnel view optics of the microscope results in decreased illumination and access of deep seated structures. Recognized complications include injury of the optic apparatus or its blood supply with post-operative worsening of vision [13].

In an effort to address these limitations and minimize manipulation of the brain and neurovascular structures, as well

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as bring about early devascularization of the tumor and allow better visualization of the perichiasmatic anatomy, the techniques used for the endoscopic transnasal approach to pituitary and sella/parasellar lesions have been considered. They hold the promise of significant advantage over open approaches and as a result the EEE approach has been advocated as a surgical approach that can allow for access and removal of select anterior skull base tumors.

While the feasibility of these innovative approaches has been documented, the indications and limitations of the EEE approach remain to be fully delineated. [14–16]. Indeed there remains significant controversy among skull base surgeons as to whether there are any indications for the use of these techniques for these specific lesions [17–19]. Although many studies have been published to demonstrate the safety and effectiveness of this approach, a study that compares open to endoscopic approaches with data from multiple institutions and long-term follow-up is needed. In this article, we report our own experience with the EEE approach for OGM and TSM using the endoscope as the sole means of visualization ("pure" EEE). In addition, we review the available literature regarding the use of the pure EEE approach for these lesions in order to provide a summary of the current understanding in this field and determine if there are important factors that can be used as common indicators for selecting a patient subpopulation with OSM and TSM that might benefit from this approach.

2. Materials and methods

2.1. Patient characteristics

Following institutional Research Ethics Board approval a prospectively maintained database of all surgical cases between May 2006 and January 2013 was retrospectively reviewed. Twenty-three patients with ASM were identified who had pure EEE approach surgery. A retrospective chart review was carried out to obtain details of patient demographics, and signs and symptoms on presentation and follow-up. This included pre- and post-operative ophthalmology assessments and endocrine abnormalities, MRI for tumor volume, surrounding edema, vascular encasement and the relationship of the tumor to the optic apparatus, and the operative record for the duration of operation, blood loss and any operative complications. Other parameters documented included hospital length of stay, pathology reports, and pre-operative and follow-up visit reports. Neurocognitive assessments were available for a small cohort of this population (Table 1).

2.2. Radiological assessment

Our routine institutional practice is to undertake pre-operative MRI with and without administration of gadolinium contrast. In

Table 1a
Demographics and clinical characteristics of olfactory groove meningioma patients

Age/Sex	Symptoms	Tumor size (cm)	GTR	Post-op CSF leak	Re-operation for CSF leak	Length of stay (days)	Visual improvement	Follow-up (months)
53/F	H/a	3.5 × 3.5 × 3.1	Yes	No	No	5	Yes	3
65/F	Incidental	4.1 × 4.2 × 2.2	No	No	No	10	N/A	3
53/F	Incidental	2.2 × 2.5 × 2.9	Yes	No	No	5	N/A	3
33/F	Visual changes	4.2 × 4 × 3.6	Yes	Yes	Yes	18	Yes	3
43/F	H/a, seizures, personality changes	3.4 × 4.6 × 4.9	No	Yes	Yes	7	N/A	9
75/F	Incidental	3.5 × 3.5 × 3.1	Yes	No	No	7	N/A	3

CSF = cerebrospinal fluid, GTR = gross total resection, F = female, H/a = headache, N/A = not applicable Post-op = post-operative.

Table 1b
Demographics and clinical characteristics of tuberculum sellae meningioma patients

Age/Sex	Symptoms	Pre-op endocrine abnormality	Tumor size (cm)	GTR	Post-op CSF leak	Re-operation for CSF leak	Post-op endocrine abnormality	Length of stay (days)	Visual improvement	Follow-up (months)
39/F	H/a	Hypothyroid, elevated prolactin	1.7 × 1.4 × 1.4	Yes	No	No	Elevated prolactin	5	N/A	16
76/M	H/a, memory changes, visual changes	No	1.4 × 1.4 × 1.5	No	No	No	No	5	No	1
60/F	Hypopituitarism	Hypopituitarism	1.7 × 1.6 × 1.3	No	No	No	Hypopituitarism	10	No	19
40/F	Visual changes	No	2.5 × 2.3 × 1.5	Yes	No	No	Transient DI	10	Yes	22
73/F	Visual changes	No	0.8 × 0.9 × 1	Yes	No	No	No	5	Yes	26
45/F	Visual changes	No	2.9 × 2.8 × 1.5	Yes	Yes	Yes	No	19	Yes	3
69/M	Visual changes	No	2.4 × 2.3 × 1.9	Yes	No	No	No	4	Yes	9
44/F	Visual changes	No	1.7 × 1.5 × 1.4	Yes	No	No	No	4	Yes	7
76/F	Visual changes	No	2.8 × 2.3 × 2	Yes	No	No	No	9	No	4
88/F	Visual changes	No	2.9 × 2.3 × 1.7	No	No	No	No	14	Yes	6
85/F	Visual changes	No	3.2 × 2.5 × 2.4	No	No	No	No	4	No	12
68/M	Visual changes	No	3.2 × 3.1 × 2.2	No	No	No	No	5	Yes	14
52/F	H/a	No	3.3 × 3.1 × 2.8	No	No	No	No	6	No	3
77/M	H/a	No	2.4 × 2.8 × 2	Yes	Yes	Yes	Transient DI	19	Yes	5
63/F	H/a	No	1.7 × 1.3 × 1	Yes	No	No	No	7	N/A	2
68/F	Visual changes, anosmia	No	1 × 1.5 × 1.5	Yes	No	No	No	5	Yes	2
62/F	Incidental	No	2.7 × 2.7 × 2.1	Yes	No	No	No	5	N/A	3

CSF = cerebrospinal fluid, DI = diabetes insipidus, GTR = gross total resection, F = female, H/a = headache, M = male, N/A = not applicable Pre-op = pre-operative, Post-op = post-operative.