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Endoscopic Assisted Microscopic Skull Base Surgery

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ABSTRACT

Background: Over the last decade skull base surgery has been significantly progressed because of the obvious improvements in imaging, anesthetic, surgical techniques as well as the advancement of microsurgical instruments. However, the anatomical complexity of skull base makes dealing with lesions in such area a "surgical challenge". That's why looking for alternative methods is always needed. Meanwhile there have been significant advances in the field of cranial base surgery with the help of endoscopic techniques to manage such lesions.

Objective: To demonstrate the value of endoscope-assisted microsurgical technique for resection of skull base tumors.

Patients and Methods: Twenty patients had skull base tumors were operated through Endoscopic-assisted microscopic skull base surgery technique at Al-Azhar University & Mansoura International Hospital between 2015 to 2017 using a rigid endoscope for inspection of tumor boundaries and neighboring vascularity in addition to confirm the extent of resection. Tumor resection was tried in all cases. Intra-operative resection rate and post-operative radiological outcomes were assessed.

Results: Total resection was done in 10 patients (50%). Subtotal resection was done in the other 10 cases due to excessive bleeding and adhesions of the tumors with vascular structures.

Conclusion: Endoscopic-assisted microsurgical approach is a reliable, safe and effective option for adequate surgical resection of skull base tumors. The technique allowed proper inspection of the tumor relations and vascularity, detection of any residual portions, providing better chance for gross total resection with minimal tissue damage or vascular injury as well as convenient clinical outcome.

Keyword: Endoscopic neurosurgery, Endoscopic-controlled micro neurosurgery, Endoscopic inspection, Endoscopic assisted micro neurosurgery.

INTRODUCTION

The word "*Endoscopy*" originates from two Greek words *endon* (inside) and *scopein* (to watch carefully) [(1)].

Angled mirrors were used in the past to view the hidden areas during surgery. Later on the endoscope was applied as an adjunct tool to the microscope in micro-neurosurgical procedures in order to expose these hidden areas [(2)].

Endoscopic systems have been evolved and improved to provide currently detailed visualisation of variety of the deep structures. The aid of angled scopes in transcranial microscopic dissection is very important to access regions beyond the width of the operative corridor and to offer a substantial advantage for the approaches of the posterior fossa [(3)].

Endoscopic assistance is particularly of great value in order to inspect blind corners, which cannot be visualised with the straight line of vision of the microscope specially when skull base lesions are going to be removed via small craniotomies [(4)].

Endoscopic procedures are classified into: Pure endoscopic neurosurgery (EN), Endoscopic controlled micro neurosurgery (ECM), Endoscopic-assisted micro neurosurgery (EAM), Endoscopic inspection (EI).

(EN) uses the endoscope as the only mean of visualisation with the surgical instruments introduced inside the working channel through a single cranial hole as an entry site. (ECM) uses the endoscope as the only mean of visualisation also however; the surgical instruments do not pass through the working channel but alongside the scope. (EAM) is a micro neurosurgical procedure visually-assisted by the endoscope to visualize and explore hidden corners. (EI) is a technique in which the endoscope may be used in any surgical procedure to inspect only [(5)].

PATIENTS AND METHODS

Patients

Twenty patients admitted in neurosurgery ward of Al-Azhar University & Mansoura International Hospital from 2015 to 2017. Patients evaluated by taking detailed history and clinical examination. Diagnosis of surgical skull base lesion was confirmed by radiological investigations. **The study was approved by the Ethics Board of Al-Azhar University.**

Inclusion criteria

All patients with surgical skull base lesion. A prospective chart review was conducted to identify all patients who underwent microscopic

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surgery for any lesion in the region of the skull base with the assistance of the endoscope. The history & neurological examination had been collected.

Operative approaches

All surgical approaches were done in the supine & lateral position under general anesthesia

I- Retrosigmoid suboccipital approach

The retrosigmoid suboccipital approach was applied for 5 patients in either supine. The endoscope was introduced after complete removal of the tumor to inspect; 1- The CPA to visualize the neurovascular structures near by the lesion. 2- The internal auditory canal (IAC) in order to look for residual tumor at the fundus of the canal.

II- Pterional approach

(4 patients) were operated in supine position. Sylvian fissure was opened under microscope then two brain spatulas were subsequently applied to expose the ipsilateral optic nerve. The endoscope was introduced after complete removal of the tumor to inspect if there is residual tumor

III- Far lateral approach

(4 patients) were operated in lateral position. The endoscope was introduced after complete removal of the tumor under microscopic vision to inspect if there is residual tumor.

Postoperative

Particular attention was paid to the value of the endoscope as an adjuvant tool to the operating microscope during the microsurgical procedure as well as postoperative morbidity and mortality resulted from the endoscopic-assisted technique.

Diagnosis of SOL was confirmed histologically. Follow up radiological assessment through MRI brain with and without contrast was done for SOL group to detect complete removal, residual tumor, or recurrence.

Surgical tools

All surgeries were performed with the microscope and the rigid endoscope

RESULTS

This work was carried out on 20 patients who were operated upon for skull base tumors by endoscopic-assisted microscopic in the period from 2015 to 2017. There were 60% males while there were 40% females. The age ranged from 8 to 63 years old with a mean of 39.30 years. Types of the skull base tumors in this study was pituitary adenoma 30 %, CPA schwannoma 25%, foramen magnum meningioma 20%, fontal lymphoma 5 %, craniopharyngioma 10 %, sellar abscess 5 % & supra sellar meningioma 5 %.

Clinical presentation:

Headache was the most common presentation and it was found in 50 % of the patients. Severity of headache ranged from mild to severe form.

Table (1): Clinical picture among the studied group.

Clinical picture	The studied group (n=20)	
	No	%
Headache	10	50.0
Diminished hearing	4	20.0
Facial palsy	4	20.0
Diminished of vision	3	15.0
Disturbed conscious level	3	15.0
No perception to Light	3	15.0
Acromegaly	1	5.0

Complications among the studied group:

3rd nerve palsy in 2 cases (10 %). 2 case died (one case Lt vestibular schwannoma old age died due to chest infection & the second case craniopharyngioma young age died two days after surgery perhaps due to thalamic insult)

Total removal of the lesion was confirmed in 50 % of cases by the follow up MRI post-operative. Post-operative follow up MRI was done in 80% & follow up CT was done in 20 % of cases

Endoscope more visualize in all cases, showing residual tumor in 6 cases & removal of the tumor in intracanalicular part by the endoscope.

Benefits of endoscope among the studied group:

More visualize in 20 cases (100%), showing residual tumor in 6 cases (30%) & removal of the intracanalicular part under endoscopic vision in 2 cases (10%)

Endoscopes provided more information to evaluate the tumor and neurovascular relationship than what was possible with microscope alone. A 30° lens endoscope was more suitable to evaluate the most lateral part of auditory canal. No cases of thermal injury or other complications that resulted from the use of the endoscope were encountered in our study. The use of endoscopes did not significantly increase the time of the operation as the average time of the endoscopic-assisted procedure was 20 minutes in our study.

CASES

Case 1

Male Pt., 27 years old, complaining of Lt facial palsy (LMNL) & hearing loss. MRI brain showed Lt CPA schwannoma

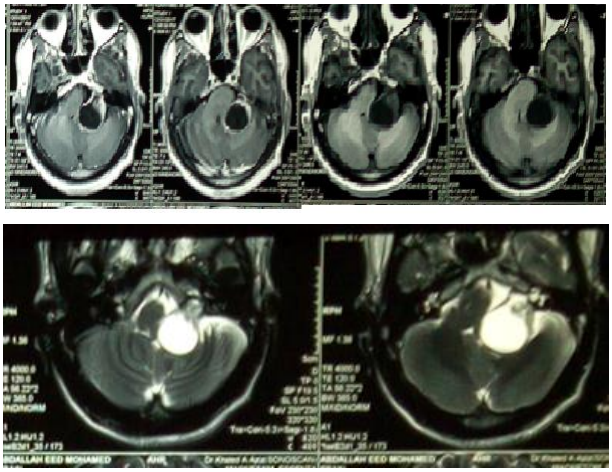

Fig. (1): Pre-operative image showing Lt CPA schwannoma.

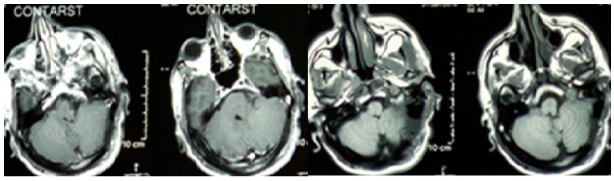

Fig. (2): Post-operative MRI axial T1 & T1 with contrast showing complete removal of the schwannoma.

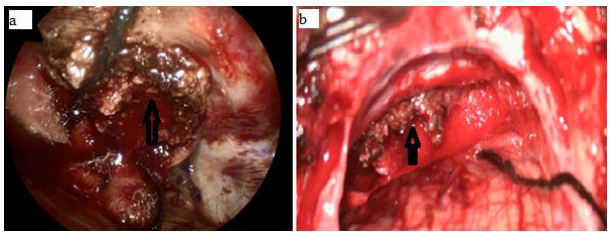

Fig. (3): (a) Endoscopic intraoperative view showed intracanalicular part of tumor on the opposite side figure (b) showing the same tumor by the microscope.

Case 2

Female Pt, 25 years old, Hx of sellar abscess, complaining from headache. MRI brain showed supra sellar abscess.

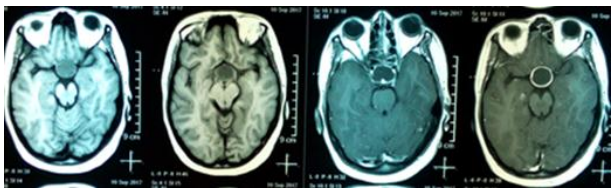

Fig. (4): MRI axial (T1 & T1 with contrast) showing recurrent sellar abscess.

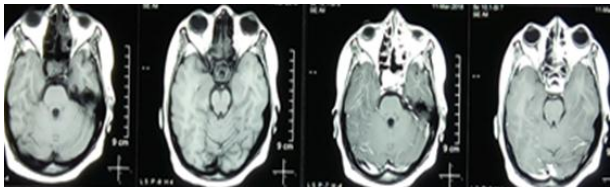

Fig. (5): Post-operative MRI axial (T1 & T1 with contrast) showing evacuated complete abscess.

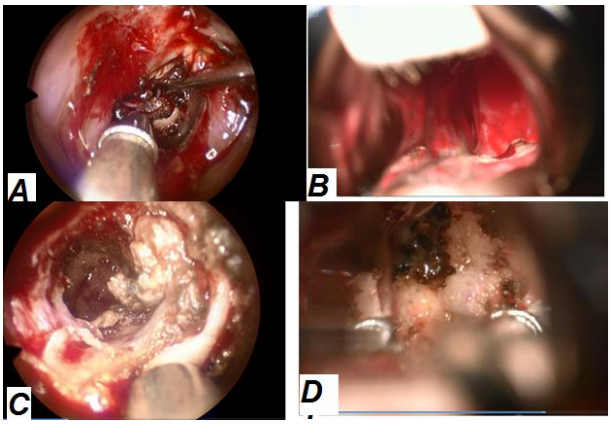

Fig (6): A & C showing endoscopic trans nasal approach. B & D showing microscopic trans nasal approach view.

DISCUSSION

Technical considerations

Since Perneczky has pioneered the concept of endoscopic-assisted microsurgery [6], several reports suggested the beneficial effect of using the endoscope to perform intracranial microsurgical procedures [7].

Endoscopes are used in adjunct to the microscope to achieve better functional results with less morbidity. Endoscopes have the ability to provide high magnification and illumination of the operative field as well as the possibility to look around the corner. Thus, allowing more safe radical surgeries. With the help of the endoscope several clinical applications and smaller incisions for surgical approaches are now achievable leading to minimal postoperative pain, faster rehabilitation, better cosmetic results and shorter hospitalization [8].

Because of their superior optical quality and maneuverability, only rigid scopes are used for endoscopic-assisted brain microsurgery. The light intensity and the depiction of important anatomical details are improved by the intraoperative use of endoscopes. Endoscopic-assisted microsurgery provides maximum efficiency to remove the lesion with maximum safety for the patient.

Endoscopic-assisted microsurgical approach is a reliable, safe and effective option for adequate surgical

resection of skull base tumors. The technique allowed proper inspection of the tumor relations and vascularity, detection of any residual portions, providing better chance for gross total resection with minimal tissue damage or vascular injury as well as convenient clinical outcome. It proved very useful for tumors that can insinuate themselves around corners between neurovascular structures and going to hidden pockets like epidermoids [9].

Attia et al. [9] study endoscope-assisted microsurgery was performed. This technique allowed good microsurgical access assisted with excellent lighting and visualization through the endoscope. With a total gross resection in 90% of patients, in our study total gross resection was done in 50 % of cases.

Before 1990, all operations of the CPA were performed under the microscopic visualisation only [10]. Hitotsumatsu et al. [11] pointed that during conventional microsurgery the illumination may be poor due to small craniotomy and narrow surgical field. However, the endoscope can bring light inside the depth providing the surgeon with an excellent panoramic view (especially with angled endoscopes) to differentiate precisely between the pathological and normal anatomy.

Therefore, the endoscope had provided the operator with superior intraoperative illumination and magnification of the surgical field in addition to the possibility of 'looking around the corner', which is considered one of the most important advantages of the endoscope. Therefore, EAM facilitated more radical and safe surgeries [12].

Abolfotoh et al. [13] study concluded that EAM provided simultaneous microscopic and endoscopic visualization and dissection techniques through skull base approaches to the CPA tumors and it overcame some of the shortcomings of the endoscopic-assisted surgery. Further, it extended the surgical field and increased the radicality of tumor resection with good functional outcomes.

Presutti et al. [14] study proved that combined microscopic/endoscopic procedures proved to be effective in the treatment of petrous apex lesions, allowing less destructive approaches compared to exclusive microscopic procedures.

Attia et al. [9] study concluded that EAM was highly valuable in patients with CPA epidermoids and in patients with medial sphenoid wing meningioma and was less valuable in patients with suprasellar meningiomas.

In our study. The use of endoscope was highly valuable with CPA tumors (Reterosigmoid approach) & suprasellar tumors (supraorpital approach). While, it was less valuable in suprasellar tumors (pterional approach) & foramen magnum (far lateral approach)

CONCLUSION

Although, the endoscope as a visual tool had solved many of the disadvantages of the microscope, it still can see only from its tip with lack of backward or sideways vision which makes it risky to move the endoscope in the operative field. From here came the idea to combine the characteristics of both tools in one procedure to complement each other through the application of the endoscope into the field under direct vision of microscope "endoscope-assisted technique". This help to obtain the perfect vision and orientation of all of the surgical field even the field behind the tip of the endoscope as well as the hidden corners to take care of the neurovascular structures not to damage them. In addition, to keep in mind always that the angled endoscopes have a sharp front edge compared with a 0° endoscope, which prevents the surgeon from seeing the trajectory of the insertion behind the lens. That is why it is important to apply the endoscope under the operating microscope to inspect the position of the endoscope because the shaft can injure anatomical structures.

We recommend EAM as a safe procedure to deal with different situations in which the microscopic view alone failed to provide us with complete image to make a right final decision. We expect more development and advances of endoscopic instruments which will make the endoscope is the perfect tool assisting the microscope.

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