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Recent Surgical Options of Pituitary Adenoma : Endoscopic Versus Microscopic Surgery

Myung-Hyun Kim

Department of Neurosurgery, Ewha Womans University School of Medicine

= 국문초록 =

뇌하수체 종양에 대한 최신 수술법 : 내시경 수술과 현미경 수술

이화여자대학교 의과대학 신경외과학교실

김 명 현

목 적 : 최근 코를 통한 내시경 수술은 뇌하수체 종양에 대한 효과적인 수술법 중 하나로 알려져 있다. 본 연구에서 저자는 종양 절제 가능 정도, 합병증, 재원 기간 및 수술법의 차이와 장단점 등에 대해 기존의 현미경 수술과 최신 수술법인 내시경 수술을 비교하였다.

방 법 : 1993년 9월부터 2009년 8월까지 이대목동병원에서 수술 받은 64명의 뇌하수체 종양 환자에 대한 자료를 후향적으로 조사하여 나이, 성별, 증상, 재원 기간, 호르몬 결과, 종양의 완전 절제율, 그리고 합병증에 대해 분석하였다.

결 과 : 40명은 현미경 수술을 시행하였고, 24명은 내시경 수술을 시행하였다. 종양의 완전 절제율은 내시경 수술이 현미경 수술보다 우수하였으나 통계적인 차이는 없었다(62.5%, 52.5%). 재원 기간은 내시경 수술을 받은 환자가 짧았다(17days, 10days, p=0.002). 현미경 수술군에서 11건의 수술 후 합병증이 있었으며(27.5%), 5예에서 뇌하수체 기능 저하증을 보였고(12.5%), 5예에서 일시적인 요붕증을 보였으며(12.5%), 그리고 1예에서 뇌척수액 비루를 보였다(2.5%). 내시경 수술군에서는, 4건의 수술 후 합병증을 보였으며(16.7%), 3예에서 뇌척수액 비루를 보였고(12.5%), 1예에서 일시적인 요붕증을 보였다(4.2%).

결 론 : 코를 통한 내시경수술은 보다 우수한 종양 절제를 보장하고, 재원기간을 줄일 수 있으며, 합병증이 적어 뇌하수체 종양에 대한 우선적인 수술로 생각된다.

중심 단어 : 내시경 수술 · 접형동 접근법 · 뇌하수체 종양.

Introduction

Victor Horsley[1] is credited with the first successful transcranial approach for a pituitary tumor in 1889. Halstead[2] and Hirsch[3] introduced the transsphenoidal approach(TSA) to pituitary lesions in the early 1900s. Cushing[4] perfected and popularized the sublabial transseptal approach shortly thereafter, making modifications that reduced morbidity. In the 1960s, Hardy[5] introduced

Address for correspondence: Myung-Hyun Kim, MD, PhD
Department of Neurosurgery, Ewha Womans University School of Medicine, 911-1 Mok-dong, Yangcheon-gu, Seoul 158-710, Korea
Tel : (02) 2650-5088 · 전송 : (02) 2650-5088 · E-mail : kimmh@ewha.ac.kr

the operating microscope for visualization during TSA. Since that time, most skull base surgeons have been trained and are comfortable with this approach aided by the operating microscope.

The emergence of endoscopic endonasal approach (EEA) over the past decade represents the latest development in surgery of the sella. The application of endoscopy to pituitary surgery is based on multiple theoretical advantages including improved visualization, preservation of sino-nasal function, reduced length of hospital stay(LOS), increased patient comfort, and reduced complications. The visualization afforded by straight and angled endoscopes may enhance the identification of critical neurovascular and arachnoid violation and thus decrease the rate of complications. Jankowski et al[6]. were the first to use endonasal endoscopy for the removal of pituitary adenomas. Subsequently, the technique has been perfected and popularized by Jho and Carrau[7]. In TSA, postoperative nasal packing often leads to discomfort, nasal cavity or septal injury, and sinusitis, all of which are avoided with most EEA. However, EEA requires the surgeon to trade the binocular, handless microscope for the monocular, more technically challenging endoscope, a technology with which most neurosurgeons are not as familiar.

Although recent reports suggest better results are possible with EEA as compared with TSA[8-15], the increasing popularity of EEA supports the need for more outcome data to confirm the role of this technique in pituitary surgery. Claims of overall superiority of the purely endoscopic approach to the microscopic technique remain unsubstantiated. In this study, we report on the surgical results and outcomes for a consecutive series of patients undergoing EEA for pituitary tumor treatment comparing with those of TSA.

Materials and Methods

1. Patients data

Retrospective data were collected on patients who were surgically treated for pituitary adenomas at Ewha Womans University Mokdong Hospital in south Korea between September 1993 and August 2009. Age, sex, presenting symptoms, LOS, surgical approach, pathological findings, gross total removal(GTR) of tumor, tumor recurrence, and postoperative complications were noted. All patients underwent multiple endocrinological study including cortisol, free thyroxine, thyrotropin(TSH), corticotrophin(ACTH), prolactin(PRL), growth hormone(GH), luteinizing hormone(LH), follicle-stimulating hormone(FSH), insulin-like grown factor(IGF)-I. The tumor pathological type was determined by a board-certified pathologist using the appropriate immunostaining. Achievement of GTR was determined by neuroradiologists on MR images obtained postoperatively as routine care.

2. The meaning of GTR

The aim of treatment was to remove the tumor in its totality without causing hypopituitarism. The criteria for disease control were tumor total removal in nonfunctioning adenomas and hormonal control in functioning adenomas. The success of the tumor removal is based on both MRI findings with contrast obtained at 3 months after surgery and the surgeon's intra-operative vision. The tumor is considered to be totally removed when the surgeon's vision and MRI image examination documents no residual tumor. The resection is considered subtotal when more than 80% of the lesion has been removed and partial resection when less than 80% has been removed[8)9)11-13].

The criteria for acromegaly control used were the current internationally accepted criteria for biochemical "cure" of the disease : the nadir GH level after oral glucose should be less than 1 ug/l, and the IGF-1 should be age and sex-matcher. The criteria for Cushing's disease control used were an early morning cortisol level measurement(<100 nmol/l requiring substitutive therapy) obtained in the first 48 h after surgery along with suppression to the low-dose dexamethasone(1 mg) overnight test and normalization of the 24-h urinary free cortisol(both at 4 and 6 week follow-up). Prolactinomas were considered under control when serum prolactin after surgery was <20 ng/ml[8)9)11-13].

3. Endoscopic transsphenoidal surgical technique

24 patients underwent 27 EEA procedures using a 0-degree endoscope with a lens diameter of 4mm(Karl

Storz, Tuttlingen, Germany). The operation takes place with a patient in a supine position with the head fixed in a three-pin Mayfield holder. The head of the bed is parallel to the floor with the neck neutral and rotated toward the side of the surgeon. The nostrils and nasal cavity were prepared as usual manner. After entering the nostril, the middle turbinate was immediately visualized and lateralized, and then the sphenoid ostia was identified. Suction cautery was used to dissect the posterior nasal septum and mucosa off of the face of the sphenoid. A sphenoidotomy was created using high-speed drill, forceps and punches. Often, the drill was used to open the anterior sellar floor, especially in cases of intrasellar tumor. The dura mater was cauterized, and a cruciate incision was made within the dura. Following resection of the pituitary lesion, a 30 or 45° endoscope was used to assess the surgical site for residual disease or extrasellar extension. Routinely abdominal fat was harvested to prevent CSF leak. Postoperatively, no nasal splints or packs were placed[7].

4. Statistical analysis

Microscopic and endoscopic resection outcomes were compared using a 1-tailed, equal-variance t-test. Items were considered statistically significant if the probability value was < 0.05. Statistical analyses were computed using SPSS software.

Results

1. General patient characteristics and presentations

From September 1993 to August 2009, 72 patients were admitted in our center for surgical treatment of pituitary adenomas. During follow-up, 8 patient was missed. So 64 patients were included in this study, who were underwent TSA or EEA procedures. Males and females represented 43.8%(28patients) and 56.2%(36patients) of these, respectively. The mean age of the studied population was 43±14years old(range 14−77 years). According to the size of the lesion, 60(93.8%) tumors were classified as macroadenomas(larger than 10mm in diameter, mean size of the lesions : 21.6± 9.7mm)(Table 1). Headache and visual complaints were present in 43(67.2%) and 38(59.4%) patients, respectively. In TSA group, gross total removal(GTR) of the tumor was accomplished in 21(52.5%) of 40 patients ; GTR of the tumor was achieved in 15(62.5%) of 21 patients who were assessed after undergoing endoscopic resection(Fig 1). EEA group showed larger mean size of tumor, more supra-or parasellar extension, and shorter

Table 1. General characteristics and analysis of 64 pituitary adenomas

Parameter	Microscopic group(TSA)	Endoscopic group(EES)	p value
Total number of patients	40	24	
Male	17(42.5%)	11(45.8%)	0.799
Female	23(57.5%)	13(54.2%)	0.800
Age in years(range)	41(14−73)	47(21−77)	0.910
Mean follow-up in months	44.7(16−140)	53.8(16−106)	0.344
Mean size of tumors	1.94+1.5 mm	2.54+1.8 mm	0.027*
Macroadenoma	38(95%)	22(91.7%)	0.080
Microadenoma	2(5%)	2(8.3%%)	0.553
Supra-or parasellar extension	19(47.5%)	18(75%)	0.027*
Cavernous sinus involvement	4(10%)	7(29.2%)	0.049*
Gross total removal	21(52.5%)	15(62.5%)	0.354
Hospital stay(days)	17(7−48)	10(3−31)	0.002*
Postoperative CSF leakage	1/40(2.5%)	3/24(12.5%)	0.183
Transient DI	5/40(12.5%)	1/24(4.2%)	0.221
Postoperative hypopituitarism	5/40(12.5%)	0(0%)	0.023*

TSA : trans-sphenoidal microscopic approach, EEA : endoscopic endonasal approach, CSF : cerebrospinal fluid, DI : diabetes insipidus, * : statistically significant value(p,0.05)

hospital stay than TSA group(Table 1). Non-functioning adenomas represented most of the lesions(40 cases, 62.5%). The most common hormone-secreting lesions were GH secreting pituitary adenomas(13 adenomas, 20.3%), followed by prolactinomas(8 adenomas, 12.5%).

2. Subgroup analysis

1) Chromophobe adenomas

Nonfunctioning adenomas were the most common single subgroup of pituitary adenomas operated in this series(40 cases, 62.5%), of these, 22 underwent TSA, and 18 underwent EEA. In TSA group, 21 tumors(95.5%) were macroadenomas and the mean size was 22.3±10 mm. 15 tumors(68.2%) showed suprasellar extension, and 2(9.1%) showed invasion of cavernous sinus. In 15 cases(68.2%), gross total resection was possible and no residual tumor or tumor regrowth was observed during the follow up. In 7 patients, complete resection was not achieved during the first procedure : 4 had subtotal resection and 3 partial resection. All patients in the group of partial resection and 3 patients in the group of subtotal resection were referred to radiotherapy. In EEA group, 16 tumors(88.9%) were macroadenomas(mean size 25.2+12 mm), suprasellar extension in 13 cases(72.2%) and cavernous invasion in 5 cases(27.8%). Total resection was possible in 11 cases(61.1%), and subtotal resection in 7(38.9%). 5 cases were referred to radiotherapy. 2 cases with subtotal resection are under clinical observation and have not presented any symptoms during the follow up(Table 2).

2) Growth hormone-secreting adenomas

Acromegaly was the most common hormone-secreting pituitary adenoma subgroup in our series(13 cases, 20.3%). 9 cases were underwent TSA and 4 underwent EEA. In TSA group, mean size was 16+2 mm. Supra-

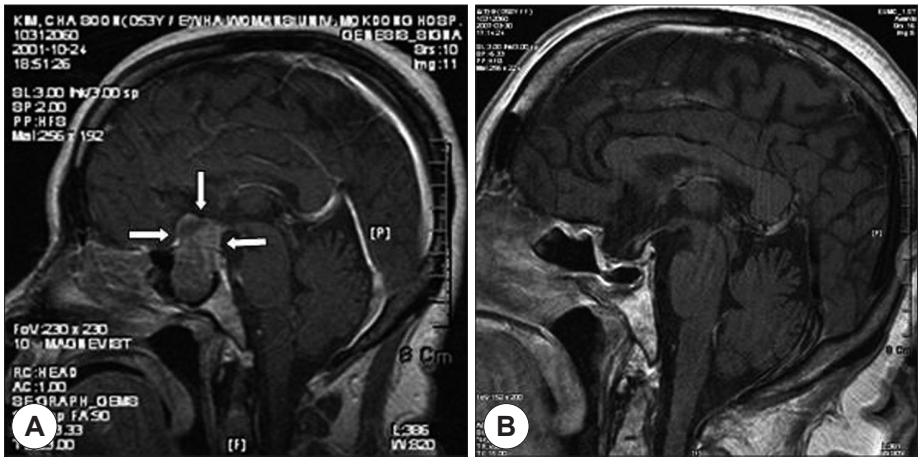

Fig. 1. Pre-and post-operative sagittal MR images of illustrative case. A : Pre-operative image : A pituitary macroadenoma(white arrow, 2.1*3.1*3.7) eroding sellar turcica elevated optic chiasm and pituitary stalk. B : Post-operative image : Tumor was totally removed, optic chiasm and pituitary stalk was downward migrated.

Table 2. Characteristics of 40 chromophobe adenomas

Parameter	Microscopic group(TSA)	Endoscopic group(EES)	p value
Total number of patients	22(100%)	18(100%)	
Macroadenoma	21(95.5%)	16(88.9%)	0.037*
Microadenoma	1(4.5%)	2(11.1%)	0.460
Mean size of tumor	20+7 mm	25.2+12 mm	0.117
Supra- or parasellar extension	15(68.2%)	13(72.2%)	0.787
Cavernous sinus involvement	2(9.1%)	5(27.8%)	0.148
Gross total removal	15(68.2%)	11(61.1%)	0.192

TSA : trans-sphenoidal microscopic approach, EES : endoscopic endonasal surgery, * : statistically significant value

sellar extension was not visible in all tumors, 1 showed cavernous invasion. Hormonal control was achieved only in 3(33.4%) after surgery. Six cases did not achieve hormonal control after surgery and have been using somatostatin analogues post-operatively. In EEA group, mean size was 29+8mm. Hormonal control was achieved in 3 cases(75%) after surgery and have not presented recurrence during the follow-up(Table 3). Only one patient have been using somatostin analogues post-operatively.

3) Prolactinomas

Surgical resection of prolactinomas was performed in selected cases : cystic chiasmatic compressive lesions, no hormonal control with use of medical therapy, important medical therapy side effects or refusal to clinical treatment. Macroadenomas were present in 7 patients (mean size 24.5+15 mm, 87.5%). About 6 cases(75%) presented as predominantly cystic adenomas. Of these, 6 underwent TSA, 2 underwent EEA. In TSA group, we achieved an overall hormonal control in only 2 patients(25%) including one microadenoma. The six patients who did not achieve hormonal control after endoscopic resection were submitted to medical therapy. In EEA group, hormonal control was achieved in all cases after surgery without recurrence during the follow up (Table 4). No patient was submitted to radiotherapy for adjuvant treatment.

3. Complications

In 64 total procedures, there were no surgery-related or postoperative deaths or cerebral vascular accidents. Postoperative CSF leaks occurred in only 1 patient(2.5%) in TSA group compared with 3 patients (12.5%) in EEA group. The patient with the postoperative CSF leak in TSA group required surgical repair. Of the 3 patients with postoperative CSF leaks in EEA group, 1 required surgical intervention and in 2 patients the leak resolved with conservative treatment. The common complications in TSA group were transient diabetes insipidus(DI) in 5 cases(12.5%), hypopituitarism in 5(12.5%), but there was no permanent DI. Only one(4.2%) case who underwent EEA experienced transient DI postoperatively(Table 1).

4. Hospital stay

The average LOS for TSA group was 17days (7−48 days). The average hospital stay for EEA group was 10days (range 3−31days). There was a significant difference

Table 3. Characteristics of 13 growth hormone secreting adenomas

Parameter	Microscopic group(TSA)	Endoscopic group(EES)	p value
Total number of patients	9	4	
Macroadenoma	9(100%)	4(100%)	
Microadenoma	0(0%)	0(0%)	
Mean size of tumor	16+2 mm	29+8 mm	0.072
Supra-or parasellar extension	0(0%)	3(75%)	0.058
Cavernous sinus involvement	1(11.1%)	2(50%)	0.278
Gross total removal	3(33.4%)	3(75%)	0.035*

TSA : trans-sphenoidal microscopic approach, EES : endoscopic endonasal surgery, * : statistically significant value

Table 4. Characteristics of 8 prolactinomas

Parameter	Microscopic group(TSA)	Endoscopic group(EES)	p value
Total number of patients	6	2	
Macroadenoma	5(83.3%)	2(100%)	
Microadenoma	1(16.7%)	0(0%)	
Mean size of tumor	23.7+13 mm	20.5+10 mm	0.629
Supra- or parasellar extension	3(50%)	2(100%)	0.076
Cavernous sinus involvement	1(16.7%)	0(0%)	0.363
Gross total removal	2(33.4%)	2(100%)	0.076

TSA : trans-sphenoidal microscopic approach, EES : endoscopic endonasal surgery

between the 2 groups(p=0.002)(Table 1).

5. Technical Analysis(TSA vs EEA)

The microscopic approach is relatively familiar to neurosurgeon, gives 3-dimensional view, permits the use of well organized various instruments, involving general microscopic tools, for example, bipolar forceps. But the endoscopic surgery gives us only 2-dimensional view, and permits only limited use of specialized instruments. As we can only have tunnel-vision through the nasal speculum in TSA, often we cannot look around the corner of pituitary fossa. Sometimes we need to perform the blind procedure. The surgeon's hand may obstruct the linear microscopic vision. The handling of nasal cavity and sphenoid sinus may be more extensive than EEA. This needs postoperative nasal packing, and prolonged hospitalization(Table 5, Fig. 2).

Discussion

The results of EEA for tumor resection and hormonal control of pituitary adenomas have been extensively compared to the results obtained by TSA[9-16]. However, no conclusive evidence of different surgical results has been demonstrated except shorter hospital stay in EEA[10)11)16)]. In our series, GTR with EEA(62.5%) was superior to that with TSA(52.5%) in spite of higher rate of suprasellar extension and cavernous sinus invasion in EEA group, but this was not significant. Our GTR was lower than reported series in both groups[9-16)]. The main limitation for GTR was the presence of cavernous sinus invasion. Tumor size has been demonstrated to be closely related to the extent of resection obtained by EEA. In our series, most of the tumors were macroadenomas. The size of the lesions treated in our center is larger than

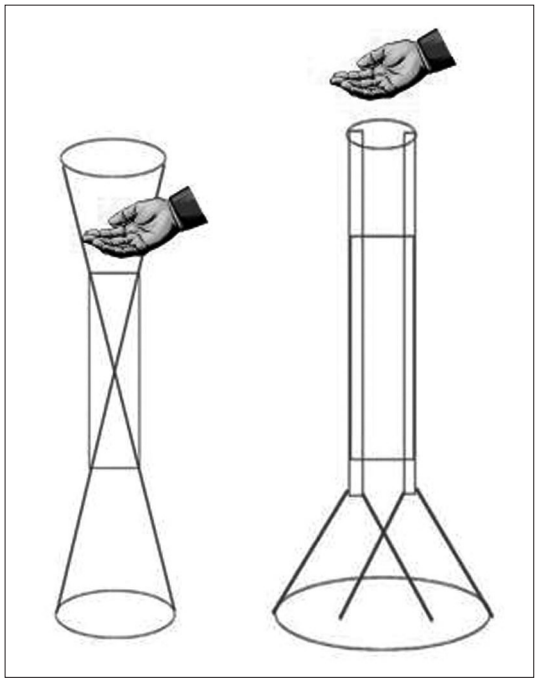

Fig. 2. The simplified drawing of operative fields in TSA and EES. In TSA, the surgeon's hand often hinder the tunnel vision in TSA, because the hand should work in the midway from microscope and operating field as usual microscopic surgery. But, EES provides the surgeon a large operating space, permitting free maneuvering of instruments in the nasal cavity.

Table 5. Technical analysis of operative procedures in TSA and EES

	TSA	EES
View of angle	Only Though Speculum	70 degrees
Illumination	Medium	Excellent
Retractor	Speculum	Endoscope shaft
Look around corner	Difficult	Easy
Bleeding control	Good	Good
Tumor resectability	Medium	Exellent
Postop ambulation	Delayed	Immediate
Submucosal dissection	Anterior Naris	Base of septum
Septal fracture	Entire Length	Only base
Middle choncha	Bilaterally Retracted	Unilaterally retracted
Sellar reconstruction	Sinus Oblireration	Only sellar floor

TSA : trans-sphenoidal microscopic approach, EES : endoscopic endonasal surgery

the size of the adenomas treated by other authors[9-17]. We believe this explain why our GTR are inferior to the results presented by others, that report levels of overall gross total resection from 62 to 93%[9-11)16)18)20)]. Jain et al[17]. analyzed the relation between the size of pituitary adenomas and outcome in a series of 20 patients treated by EEA. They observed that tumor volume of less than 5ml and no parasellar or suprasellar extension are favorable variables for total removal. Tabaee et al[16]. observed that the only significant predictor of the extent of tumor removal was maximum tumor size. Larger tumors were associated with visual dysfunctions, longer procedures and duration of hospital stay. There is a three fold decrease in GTR for every 1 cm increase in tumor size.

The proportion of endocrine active adenomas has been reported to be from 27% to75%[17]. Hormone-secreting adenomas have the potential to cause severe endocrinological and metabolic dysfunction, in addition to mass effect. Endocrine-active adenomas were found in 37.5% of our patient population. Hormonal control results after the endoscopic resection of GH-secreting adenomas varies from 65 to 85% in the literature[10)11)16)19-21)], presenting superior results when compared to microsurgery series(52−85%)[10)22-24)]. We obtained 75% of hormonal control in spite of higher suprasellar extension or cavernous invasion in EEA. GTR of prolactinomas was performed in all cases with EEA compared with 2 in 6 cases of TSA group, but this result was not significant due to sample size. The superiority of EEA for hormonal control of prolactinomas has not been conclusively demonstrated. A randomized study comparing the results of EEA versus TSA demonstrated similar results in terms of prolactinoma resection and hormonal contro[l9)].

In TSA, we should use the nasal speculum[4)5)]. When a transsphenoidal speculum is used, the surgeon's operating space is limited by the tubular-shaped tunnel. A surgeon's mobility is restricted while using the surgical instruments. EEA without the use of retractor[7)] provides the surgeon a large operating space, permitting free maneuvering of instruments in the nasal cavity. Also, the surgeon's hand often hinder the tunnel vision in TSA, because the hand should work in the midway from microscope and operating field as usual microscopic surgery. In our experience, the advantages of EEA were manifold. The patient did not require a sublabial or nasal mucosal incision and mucosal dissection from the nasal septum. Postoperative nasal packing was not necessary so that the patient has a free nasal airway postoperatively. This facilitated a quick patient recovery and early discharge from the hospital. We did not remove the middle turbinate, just pushed away from the operative corridor. The less nasal cavity injuries, without the use of nasal speculum or fluoroscopy and fast recovery of patients also are benefits reported in the literature[9)13)]. Also, a panoramic vision inside the surgical area, a superior close up of the anatomy, and an improved working angle represent some of the advantages brought by the use of EEA. But, EEA may present some particular limitations, such as a narrow channel to the sella, necessity of special instrumentation, different kind of view what requires different skills, and some experience of the surgeon with the use of the endoscope[25)]. The loss of the three-dimensional vision in the endoscopic surgery has been advocated as one of the most important disadvantages of the technique. Distance perception was not satisfactory with the endoscope. A surgeon inexperienced with the technique may become frustrated by the small operating space. It is undeniable that there is a remarkable difference when compared to the microscopic view, but we believe the surgeon can perfectly overcome it based on the knowledge of anatomic landmarks and with movements of the endoscope.

There is a significant amount of literature assessing the learning curve for a new surgical procedure. The learning curve can be defined as a time after which a procedure may be performed safely and with a plateau in efficiency. Sonnenburg et al[26]. examined the learning curve in EEA in their experience with 45 procedures performed. In dividing their procedures into groups of 15, they found no significant differences with respect to postoperative complications, concluding that there did not seem to be a significant learning curve for the transition from traditional methods to endoscopic resection. Whereas, O'Malley et al[14]. postulated that the significant part of the learning curve would be achieved after 17 endoscopic procedures, but this number was only an estimate and could be affected by the familiarity of the team with the endoscopic equipment, the referral pattern as to the type and size of

tumors, and surgical simulation or practice in cadavers prior to performing the surgical procedure.

All endoscopic reports in the literature indicate a lower complication rate when compared with microscopic surgery[19)24)25)27)28)]. CSF leakage, DI, nasal complication, and endocrine disturbance were major complications in recent pituitary surgery. Interestingly, Neal et al[29)]. found a greater incidence of CSF leaks in the patients with microscopically resected tumors, which was a trend that we did not see. They did report an increased rate of DI in their microscopic group, which is consistent with our data.

CSF leak is one of the most important complications of pituitary surgery. It was present in 2.5% of the patients in TSA group, 12.5% in EEA group. The variation of endoscopic surgery series is : 1.2−6%[8)10)11)19)27)], and the microsurgery series reports : 0.9−3%[25)28-30)]. No case of CSF leak was associated with the development of meningitis. These patients needed to be placed lumbar drainage for 5days. The higher rate of CSF leakage in our EEA group means more careful reconstruction needed. Recently we changed our packing method using bioglue, and it was successful. Although there were more intraoperative and postoperative CSF leaks in the endoscopic group as a whole, this was not statistically significant.

There was no permanent DI was observed in our series, an inferior rate than that observed in the literature (1.0−3.42%)[8)10)11)19)27)]. Transient DI was observed in 12.5% in TSA group, whereas 4.2% in EEA group. All patients presented good outcome after intensive care management. Massive manipulation to achieve gross total resection might cause endocrine dysfunction, such as hypopituitarism or transient DI, as shown in our TSA group, 12.5% each, but only one case in EEA group. Theses complications are related to the manipulation of the gland during surgery. They are foreseeable and preventable with careful maneuvers during the dissection of the tumor. The experience of the surgeon in recognizing and sparing the normal pituitary tissue allows the preservation of pituitary functionality. Whether the decreased incidence of DI was related to the better optics of the endoscope needs to be evaluated in a larger group of patients.

Nasal complications are reduced first because the endoscopic technique 'skips' the nasal phase since it starts in the sphenoethmoidal recess ; moreover, I think that active and constant collaboration with an ear, nose and throat surgeon would be beneficial with respect to any nasal alterations which may result. This could improve nasal functionality. I did not observe postoperative sinusitis in short-or long-term follow-up. A 1-month postoperative ear, nose and throat check-up may also play an active role. I have not had postsurgical mucoceles, but the mean follow-up is too short to exclude this possibility. Moreover, EEA utilizing a natural cavity with the enlargement of the natural ostia can reduce the possibility of their postoperative closure and thus reduce the possibility of the development of sphenoid mucoceles.

Lesions of the internal carotid artery is reported in the literature in 0−0.68% of patients treated by the endoscopic approach[8)12)14)21)]. Other frequent complications mentioned in literature, as ischemia, hematoma, vision deterioration, ophtalmoplegia and intracerebral hemorrhage,were not observed in our series. The mortality rate varies from 0 to 0.68%, but there was no mortality in our series.

Koren et al[13)]. reported that the endoscopic approach allows a shorter hospitalization time(by about half) than the microscopic approach. In our study, endoscopic surgery reduced hospital stay by about 7days, perhaps because there were fewer surgical complications and less need for wound packing and wound management. About half of our EEA patients were able to discharge the day after operation . Furthermore, patients were more comfortable after the endonasal approach. The most common cause of delay in the patient's discharge in our EEA series was postoperative CSF leakage(12.5%), whereas, transient DI(12.5%) and hypopituitarism(12.5%) in TSA patients.

Our study presents some limitations. It is a retrospective experience, the data are largely descriptive and it is a non-randomized, single surgeon study design. There was no direct comparison between the traditional microscopic and endoscopic procedures. We have no data to demonstrate that endoscopy provides a measurable difference in outcome as compared to the microsurgical transsphenoidal technique, and therefore, it is not possible to definitively prove the superiority of endoscopic visualization. Another limitation is the short follow up period of some patients in our series, considering that

recurrence of functioning adenoma may occur after many years.

Conclusion

In pituitary surgery, the use of endoscope may give us more successful outcome and the higher satisfaction of patient. But still the endoscopic vision is 2-dimensional, and so learning curve exists for a surgeon who is not familiar with the endoscope. Its use requires different surgical skills during the entire procedure. Practice can overcome this problem.

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