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Management and Methods of Avoidance of Complications in Endoscopic Endonasal Transsphenoidal surgery

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Abstract

Background: The concept of endoscopic endonasal transsphenoidal surgery for the removal of pituitary adenomas has evolved since Guiot attempted the first "endoscopic assisted" endonasal approach to the pituitary gland and had to abandon it because of poor visualization.

Aim and objectives: To evaluate complications in endoscopic endonasal transsphenoidal surgery with methods of avoidance and management.

Subjects and methods: This retrospective and prospective study was carried out on 121 patients who were operated on in the Neurosurgery Department at Al Azhar University Hospitals.

Result: Of the 121 patients who were operated in the Neurosurgery Department at Al Azhar University Hospitals, 20 patients (16.5%) showed complications. From the total study group, there was an early postoperative Cerebrospinal Fluid (CSF) leak in 12 patients (10%) and a delayed postoperative CSF leak in 2 patients (1.2%). There was DI in 7 patients (5.8%), while there were no patients (0%) with Transient Hyponatremia or Hypernatremia and New permanent Pan- hypopituitarism in the studied patients. There was one patient (0.8%) with meningitis and three patients (2.4%) with sinusitis in the studied patients. There was epistaxis in 8 patients (6.6%), Pneumocephalus in 1 patient (0.8%), and intracranial hematoma in 7 patients (5.8%).

Conclusion: Ten percent of patients had intra-operative CSF leaks, 3% had Internal Carotid Arteries (ICA) injury, 3% had venous injury, and 1.6% had cardiac complications. Postoperative CSF leaks were common in all patients, with early and delayed leaks in 10% and 1.2%, respectively. Postoperative endocrinal complications included DI in 5.8% of patients, meningitis in 0.8%, sinusitis in 2.4%, epistaxis in 6.6%, pneumocephalus in 0.8%, and intra-cranial hematoma in 5.8% of patients.

Keywords: Avoidance; Complications; Endoscopic endonasal transsphenoidal surgery

1. Introduction

Because the sellar area contains a wide variety of tissue types, the anatomy of the region is complex, and tumors in the sellar region can range in severity from benign to fatal. Adenomas, meningiomas, aneurysms, astrocytomas, and craniopharyngiomas are the five most prevalent lesions, accounting for around 80% of sellar area cancers despite this diversity. Pituitary gland adenomas are the most prevalent lesions in the sellar region. They can be tiny and frequently secretory or bigger and frequently non-secretory.¹

Complications from the carotid artery are equally deadly and frequently cause death or severe disability. When the carotid artery, which is located in the cavernous sinus, is cut, punctured, or avulsed, it can result in arterial

bleeding. A cause of difficulties during transsphenoidal surgery is the cavernous sinus and its contents, aside from the carotid artery.²

More than half a century ago, Gerard Guiot performed transsphenoidal surgery with an endoscope to treat sellar lesions, although his case was mostly unreported for a while. Afterward, ENT surgeons gained comfort using the endoscope while carrying out functional endoscopic sinus surgery, which first demonstrated to them the seller's proximity and path. Jho and Carrau, who invented the pure endoscopic method of treating pituitary tumors two decades prior, came next. Interest in endonasal endoscopic transsphenoidal surgery has grown as a result of these findings, which emphasized the benefits of this method in treating sellar lesions.³

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As a result, the procedure is currently being used in multiple locations worldwide, albeit with minor changes. But for most neurosurgeons, it's a completely new area of expertise.³

The current study aims to evaluate complications in endoscopic endonasal transsphenoidal surgery with methods of avoidance and management.

2. Patients and methods

This retrospective and prospective study was carried out on 20 complicated patients from 121 patients who were operated on at Al-Azhar University Hospitals' neurosurgery department. After receiving a diagnosis of the seller, suprasellar, or para seller lesion, every patient had endoscopic endonasal trans-sphenoidal surgery. Preoperative, intraoperative, and postoperative evaluations were conducted. Both before and after surgery, assessments in the fields of neurology, endocrinology, and radiology were conducted. Prior to the trial, all patients who underwent endoscopic endonasal transsphenoidal surgery for skull base tumors were enrolled and provided informed consent.

Inclusion criteria: suprasellar and seller or parasellar tumors including pituitary (secreting and non-secreting), Both sex (male and female) and Individuals who have recurring tumors.

Exclusion criteria: those who cannot have surgery, those whose sphenoid sinus has not fully contracted, and those who have previously received radiation therapy.

Ethical considerations: The research project has all the required approvals in place. Before beginning the study, official departmental approval for its implementation was obtained from the neurosurgery department. The Ethics Committee at Al-Azhar University in Cairo's Faculty of Medicine gave its approval to the project.

Assessment measures

Clinical assessment: Represented by complete medical history, complete general examination (blood pressure, acromegalic features, and gynecomastia), full neurological examination, and ophthalmological examination including visual field and acuity.

Radiological assessment: Represented by CT brain, CT nasal and para nasal sinuses, and MRI brain with contrast.

Laboratory assessment: Represented by: full pituitary hormonal profile and routine laboratory investigations.

Statistical analysis:

The Statistical Program for Social Science (SPSS) version 24 was used to examine the data. The frequency and proportion of the

qualitative data were reported. When describing quantitative data, the mean \pm SD or median (IQR) was used, depending on whether the data was regularly distributed or not. The mean, often known as the average, is the middle value of a discrete set of numbers; that is, the sum divided by the total number of values. Standard deviation (SD): is a way to quantify how dispersed a group of values is. A low standard deviation (SD) suggests that the values are generally near the set mean, whereas a high SD suggests that the values are dispersed over a larger range. Median: To find the middle number, sort all the data points and select the one that falls in the center. If there are two numbers in the middle, take the mean of those two figures. The statistical dispersion, or the spread of the data, is measured by the inter-quartile range, or IQR. The distinction between the data's 75th and 25th percentiles is how it is defined.

The following tests were done: the independent sample T-test (T), which was used to contrast two groups (given that data are regularly distributed). Mann Whitney U test (MW): when contrasting two groups (for data that is not regularly distributed). A one-way analysis of variance (ANOVA): when comparing more than two groups (for data that are normally distributed). Kruskal Willis test (KW): when comparing data that is improperly distributed (more than two groups). The chi-square test was applied to contrast non-parametric data. Pearson's correlation coefficient (r): test was used to the data correlation. The Post Hoc test was employed to compare various variables numerous times. ROC curve (Receiver Operating Characteristic Curve): was employed to find the negative predictive value (NPV), cutoff value, sensitivity, specificity, and positive predictive value (PPV). Sensitivity: the likelihood that a test will show a positive result when the illness is present. Specificity: the likelihood that a test will come out negative in the absence of the illness. Positive predictive value is the likelihood that the illness exists when the test results are positive. A negative predictive value is the likelihood that the illness won't exist if the test comes up negative. Probability (P-value) where P-values less than 0.05 were deemed significant, P-values less than 0.001 as highly significant, and P-values greater than 0.05 as insignificant.

3. Results

Table 1. An explanation of each patient's demographic information under study.

STUDIED PATIENTS (N = 20)			
SEX	Male	8	40%
	Female	12	60%
AGE (YEARS)	Mean \pm SD	41.4 \pm 12.3	
	Min - Max	28-82	

The average age of all the patients under study

was 41.4 ± 12.3 , with a minimum and maximum age of 28 and 82 years, respectively. Regarding gender, among the patients under study, there were 8 men (40%) and 12 women (60%).

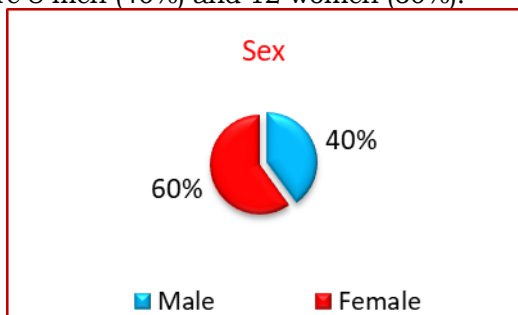


Figure 1. Sex descriptions for each patient under study.

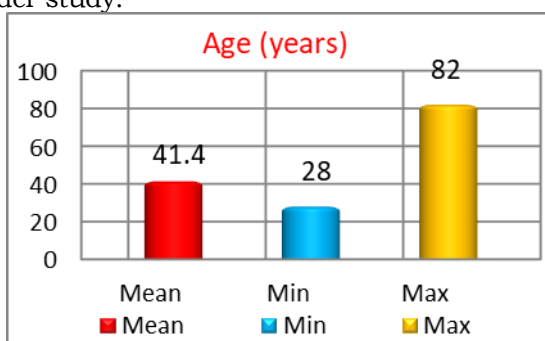


Figure 2. Age descriptions for every subject under study.

Table 2. An explanation of the comorbidities in every patient under study.

COMORBIDITIES	STUDIED PATIENTS (N = 20)	
	NO.	PERCENTAGE
DM	3	15%
HTN	4	20%
Smoking	6	30%

Among the patients under study, there were three (15%) with diabetes mellitus, four (20%) with hypertension, and six (30%) who smoked.

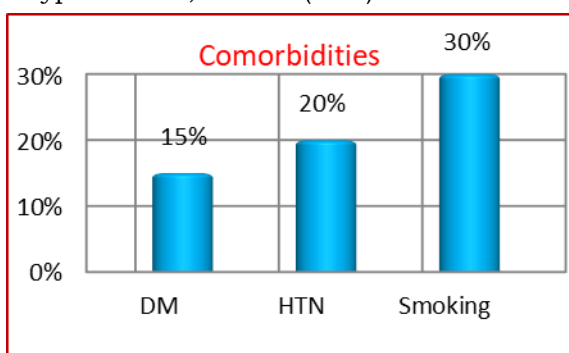


Figure 3. An explanation of the comorbidities in every patient under study.

Table 3. An explanation of each patient's clinical presentation that was examined.

CLINICAL PRESENTATION	STUDIED PATIENTS (N = 20)	
	NO.	PERCENTAGE
Headache	18	90%
Diminution of vision	18	90%
Visual field defect	18	90%
2ry Amenorrhea	6	30%
Menstrual irregularity	2	10%

Galactorhea	4	20%
Acromegalic Features	2	10%
Erectile dysfunction	9	45%
Gynecomastia	2	10%
Loss of Libido	6	30%
Loss pubic, axillary hair	0	0%

Headache, diminution of vision and visual field defect were presented in 18 patients (90%), menstrual irregularity, acromegalic features and gynecomastia were presented in 2 patients (10%), 2ry amenorrhea and loss of libido were presented in 6 patients (30%), galactorhea was presented in 4 patients (20%) and erectile dysfunction was presented in 9 patients (45%) while there were patients (0%) presented by loss of pubic hair or axillary hair in the studied patients.

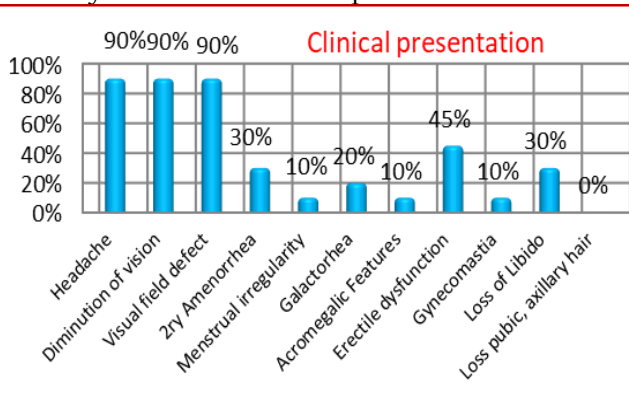


Figure 4. An explanation of each patient's clinical appearance in the study.

Table 4. percentage of complications from total studied group

COMPLICATION	TYPE	NO. TOTAL = 121	PERCENTAGE
CSF LEAK	early post-operative Cerebrospinal Fluid (CSF) leak	12/121	10%
	Delayed post-operative Cerebrospinal Fluid (CSF) leak	2/121	1.2%
ENDOCRANIAL INFECTION	DI	7/121	5.8%
	Meningitis	1/121	0.8%
HEMORRHAGE	Sinusitis	3/121	2.4%
	ICA injury	4/121	3%
	Venous injury	4/121	3%

Table 5. An explanation of the pre- and post-operative imaging for each patient under study.

PRE - OPERATIVE IMAGES	STUDIED PATIENTS (N = 20)		
	NO.	PERCENTAGE	
PRE - OPERATIVE IMAGES	MRI	20	100%
	CT	20	100%
POST - OPERATIVE IMAGES	MRI	20	100%
	CT	14	70%

All of the patients in the study had MRIs and CT scans performed before to surgery, and all of the patients had MRIs and CT scans performed after surgery, with 14 patients (or 70%) receiving CT scans.

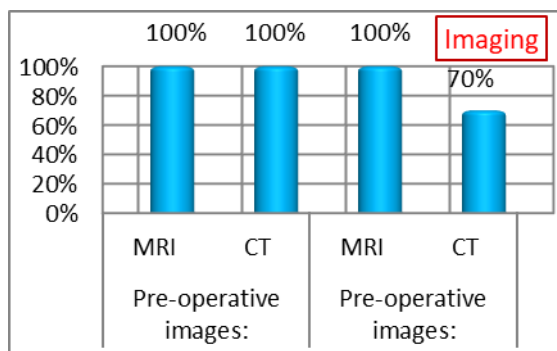


Figure 5. An explanation of the pre- and post-operative imaging for each patient under study.

Table 6. Description of Type of Sphenoidal pneumatization for each patient under study.

TYPE OF SPHENOIDAL PNEUMATIZATION	STUDIED PATIENTS (N = 20)		
	Pre - Sellar	4	20%
Sellar	16	80%	

In four patients (20%), sphenoidal pneumatization was pre-Sellar, and in sixteen patients (80%), it was Sellar.

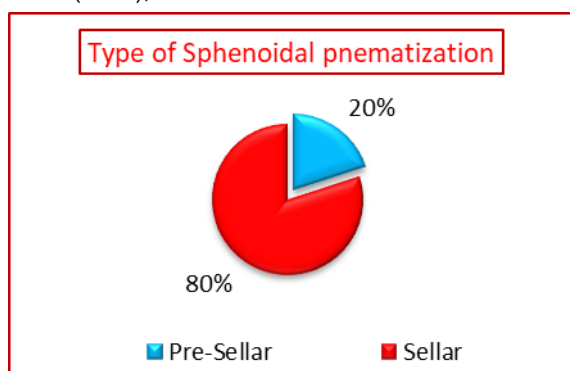


Figure 6. Description of Type of Sphenoidal pnenmatization for each patient under study.

Table 7. Description of intra - operative complications in all complicated patients.

INTRA - OPERATIVE COMPLICATIONS	STUDIED PATIENTS (N = 20)		
	CSF leak	7	35%
ICA injury	4	20%	
Venous injury	4	20%	
Cardiac complications	2	10%	

There were 7 patients (35%) with intra - operative CSF leak, 4 patients (20%) with ICA injury, 4 patients (20%) with venous injury and 2 patients (10%) cardiac complications.

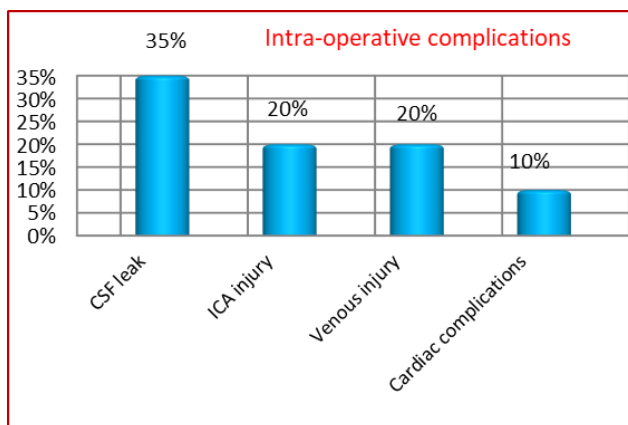


Figure 7. Describe the post-operative problems experienced by each patient under study.

Table 8. An explanation of the CSF leak following surgery for every complicated patient under study.

POST - OPERATIVE LEAK	STUDIED PATIENTS (N = 20)		
	Non	6	30%
Early	12	60%	
Delayed	2	10%	
Late	0	0%	

Twelve patients (60%) experienced an early post-operative CSF leak, two patients (10%) experienced a delayed post-operative CSF leak, and six patients (30%) experienced no post-operative CSF leak.

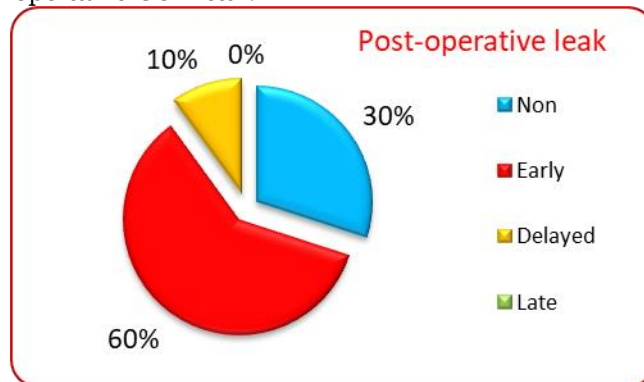


Figure 8. A description of each patient's post-operative CSF leak in the study.

Table 9. An explanation of the endocrine problems that followed surgery for every complicated patient in the study.

POST - OPERATIVE ENDOCRINAL COMPLICATIONS	STUDIED PATIENTS (N = 20)		
	Transient Hyponatremia or Hypernatremia	0	0%
New permanent Pan-hypopituitarism	0	0%	
DI	7	35%	

Seven patients had DI (35%) while there were no patients (0%) with Transient Hyponatremia or Hypernatremia and New permanent Pan-hypopituitarism in the studied patients.

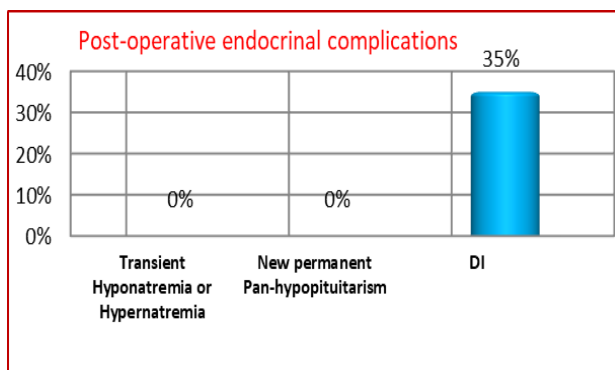


Figure 9. an explanation of the post-operative endocrine problems experienced by each patient under study.

4. Discussion

Our results supported with Charalampaki et al.⁴ They sought to provide a retrospective examination of the problems that developed in 150 consecutive patients who had the sella region surgically resected using an endoscopic endonasal transsphenoidal method in order to remove intra- and suprasellar lesions. They examined 150 patients (70 men and 80 women), with a mean age of 57 years (range 26 to 88 years), who had endonasal transsphenoidal surgery performed under endoscopy to address sellar lesions.

Agam et al.⁵ They used an institutional database to retrospectively evaluate the complication rates related to the removal of transsphenoidal pituitary adenomas (PAs). a review of 1153 transsphenoidal pituitary adenoma resections carried out in the past. It was observed that 52.8 patients were male, and 53.1% of patients were female (611). 49.5 (± 16.4) years was the mean age (SD).

Furthermore, Goyal et al.⁶ who sought to remove the tumor safely and completely without creating hypopituitarism. In total, 83 individuals with pituitary adenoma had surgery in the Neurosurgery Department of the Artemis Hospital in Gurgaon for the purpose of their study. Of the patients, 40 (48.19%) were female and 43 (51.81%) were male. 14 to 70 years old was the age range, and the mean \pm standard deviation (SD) was 42.78 ± 14.09 .

Frank et al.⁷ also set out to compare the endoscopic method in pituitary surgery with the traditional approach. A total of 381 patients were examined, with a median follow-up of 54 months (range: 15 to 94); 208 of the patients had functional adenomas, while 173 did not.

With reference to our findings, the pre- and postoperative image descriptions for every patient under investigation. Pre-operatively, all of the patients in the study underwent CT and MRI scans, and post-operatively, 14 patients (or 70%) underwent CT and all of the patients underwent

MRI scans.

We discovered that every patient under study had the same type of sphenoidal pneumatization. In four patients (20%), sphenoidal pneumatization was pre-Sellar, and in sixteen patients (80%), it was Sellar.

The description of intraoperative problems in every patient under observation was demonstrated by the current investigation. Seven patients (5.7%) experienced intraoperative CSF leakage, four patients (3%) sustained ICA injuries, four patients (3%) experienced venous injuries, and two patients (1.2%) experienced cardiac problems.

We discovered that every patient under study had a description of a postoperative CSF leak. Twelve patients (10%) experienced an early postoperative CSF leak, and two patients (1.2%) experienced a delayed postoperative CSF leak. An account of the endocrine problems following surgery for every patient under investigation. Seven patients (5.7%) had DI, while none of the patients in the study had either transient hyponatremia hypernatremia or new, permanent pan-hypopituitarism.

This investigation demonstrated that every subject under scrutiny had a description of infection. Among the patients under study, one patient (0.8%) had meningitis, and three individuals (2.4%) had sinusitis.

With reference to our findings, here is the list of additional problems in every patient under investigation. Eight patients (6.6%) had epistaxis, one patient (0.8%) had pneumocephalus, and seven patients (5.7%) had intracranial hematomas.

Laws et al.⁸ stated that the most frequent postoperative complication after EEA is a postoperative CSF leak. Postoperative CSF leak rates as high as 40% were observed in early series describing the EEA, although more recent series have shown leak rates as low as 2.9% Paluzzi et al.⁹

Agam et al.⁵ found that 56.8% of tumors (655 patients) had invasive tumors and that the mean tumor diameter was 21.4 mm. Adenomas that did not function accounted for 54.6% of the patients; secreting adenomas included GH (14.6%), prolactinoma (14.1%), ACTH (12.2%), and miscellaneous (5.0%) adenomas. 49.5 years old (SD 16.4) was the average age at the time of surgery. Men were older (53.2 vs 46.4 years, $p < 0.001$) at the time of operation. A mean difference of 49.1 versus 53.3 years, $p = 0.008$, was seen between patients receiving endoscopic surgery and those undergoing microscopic surgery. They showed that subsequent surgical problems included the following: vision loss (0.6%), stroke (0.3%), cranial nerve paresis (0.8%), meningitis (1.0%), abdominal hematoma or infection (0.2%),

and carotid artery injury (0.1%). Epistaxis accounted for 1.1% of these additional complications. According to their findings, 0.26% of people died or suffered a serious injury. Comparing endoscopic and microscopic surgery, no variations in the incidence of complications were noted.

Cappabianca et al.¹⁰ Retrospective examination of 146 consecutively treated patients who received endoscopic endonasal transsphenoidal approach to the sellar area for pituitary adenoma excision was carried out with the purpose of evaluating postoperative complications associated with the surgical method. According to their findings, transsphenoidal surgery—whether done endoscopically or microscopically—is safe when performed by skilled professionals, although major side effects still happen and need to be minimized.

Abhinav et al.¹¹ sought to manage pituitary adenomas after endoscopic transsphenoidal surgical difficulties. They noted that following transsphenoidal surgery, epistaxis may manifest instantly or later. After surgery, mild bloody discharge is typical and indicates mucosal bleeding from sinonasal tissue; nevertheless, in approximately 3% of instances, there may be substantial epistaxis that necessitates further care.

Ciric et al.¹²; Kabil et al.¹³ They came to the conclusion that transsphenoidal surgery appeared to be a rather safe treatment, with a less than 1% death rate. On the other hand, a considerable amount of difficulties do arise. In the hands of less experienced surgeons, the incidence of these problems appears to be higher, with statistical significance. Given that a statistically significant reduction in morbidity and death might be observed after 200 or even 500 transsphenoidal procedures, the learning curve appears to be somewhat shallow.

Ciric et al.¹² showed that subarachnoid hemorrhage, vasospasm, tension pneumocephalus, and CSF leakage (4–5%) are problems related to the sella turcica after a microscopic transsphenoidal approach.

Solomichuk et al.¹⁴ showed that following EEA, pneumocephalus may develop both acutely and slowly. Pneumocephalus may arise as a result of a one-way valve that allows air to enter from the extracranial space through CSF drainage (which can happen by mechanisms like blowing the nose or insufflating air following dural closure).

4. Conclusion

From the total studied group (121 patients), ten percent of patients had intra-operative CSF leaks, 3% had Internal Carotid Arteries (ICA) injury, 3% had a venous injury, and 1.6% had cardiac

complications. Postoperative CSF leaks were common in all patients, with early and delayed leaks in 10% and 1.2%, respectively. Postoperative endocrinal complications included DI in 5.8% of patients, meningitis in 0.8%, sinusitis in 2.4%, epistaxis in 6.6%, pneumocephalus in 0.8%, and intra-cranial hematoma in 5.8% of patients.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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