Skull Base and Endoscopic Neurosurgery

ENDONASAL ENDOSCOPIC TRANS-SPHENOIDAL SURGERY FOR PITUITARY ADENOMAS IN ALGERIA
Single-Center Expertise and Evolution of Surgical Practices

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ABSTRACT
Endonasal endoscopic trans-sphenoidal surgery, introduced in Algeria in 2003, has profoundly transformed the management of pituitary adenomas. We report a retrospective study including 224 patients operated on between 2014 and 2021 at the Department of Neurosurgery of Frantz Fanon University Hospital Center in Blida, aiming to evaluate the clinical outcomes and safety of this approach.
Macroadenomas accounted for 79% of cases, and the endonasal endoscopic approach was used in 95% of procedures. No postoperative mortality was observed. The main complications were transient diabetes insipidus (9.2%), cerebrospinal fluid rhinorrhea (3.67%), meningitis (2.4%), and permanent hypopituitarism (0.57%).
These results confirm that endonasal endoscopic trans-sphenoidal surgery represents a safe and effective approach in the Algerian context. The experience of Frantz Fanon University Hospital Center in Blida illustrates the evolution and maturation of endoscopic pituitary surgery in Algeria, made possible through close multidisciplinary collaboration between neurosurgeons, endocrinologists, and radiologists. The sustainability of these results relies on continued training, maintenance of a structured multidisciplinary organization, and the development of prospective multicenter studies.

Keywords: *Pituitary adenomas; Endonasal endoscopic surgery; Trans-sphenoidal approach; Postoperative complications; Multidisciplinary collaboration; Algeria*

INTRODUCTION

Pituitary adenoma surgery has undergone major evolution over recent decades. Initially performed using a microscopic trans-sphenoidal approach, this technique had limitations related to restricted visualization and limited access to suprasellar extensions (17,20). The introduction of endonasal endoscopic trans-sphenoidal surgery in Algeria in 2003 marked a decisive turning point in the management of pituitary adenomas (3,4).

Objectives of the Study

The objective of this study is to present the experience of Frantz Fanon University Hospital Center in Blida in the management of pituitary adenomas using endonasal endoscopic trans-sphenoidal surgery, through a series of 224 patients operated on between 2014 and 2021. This analysis aims to evaluate clinical outcomes, complication profiles, and the effectiveness of this technique in the Algerian context, while highlighting the evolution of pituitary adenoma management strategies and the progressive adoption of the endoscopic approach in Algeria.

Evolution of Pituitary Adenoma Surgery

Endonasal endoscopic trans-sphenoidal surgery is now considered the technique of choice for the treatment of pituitary adenomas. Since its introduction, it has been adopted as a first-line approach in the majority of cases, except for invasive adenomas with lateral extension. This approach minimizes incisions and provides improved visualization of the sellar region (Figure 1), contributing to reduced hospital stay and postoperative complications (19).

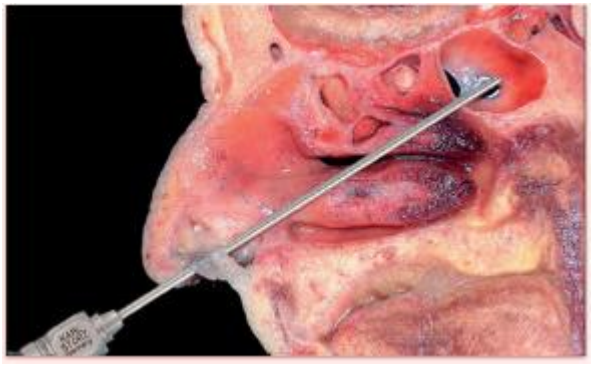

Figure 1: The endonasal endoscopic approach to the sellar region represents an evolution of the conventional trans-sphenoidal technique performed using an operating microscope.

Globally, endonasal endoscopy has been widely adopted as the preferred technique for pituitary adenoma treatment (7,9,13). Studies demonstrate favorable outcomes in terms of tumor resection rates and complication management, including hypopituitarism and cerebrospinal fluid leaks (10,16,22). Doherty et al. (2015) showed that endoscopic surgery allows more complete tumor resection while reducing the risk of complications such as cerebrospinal fluid leaks and hypopituitarism (10). Liu et al. (2016) compared endoscopic and microscopic surgery and concluded that both techniques provide similar resection rates, but endoscopy offers an advantage in reducing complications (16). Joo et al. (2019) confirmed that endoscopic surgery is becoming the preferred method due to its ability to minimize postoperative complications (12). Zada et al. (2019) specifically addressed complications associated with this approach, noting that cerebrospinal fluid leaks can be better managed endoscopically compared with more invasive approaches (22). Patel et al. (2019) emphasized that this approach not only allows more effective adenoma resection but also improved management of hypopituitarism-related complications (18,19).

In Algeria, although the technique is increasingly used, challenges remain regarding team training and access to advanced equipment. However, several centers, such as the Blida University Hospital Center, demonstrate a growing commitment to integrating this method in alignment with international standards to provide high-quality care to patients with this pathology.

Importance of Multidisciplinary Collaboration

The success of endonasal endoscopic trans-sphenoidal surgery relies on close collaboration between neurosurgeons, endocrinologists, and radiologists. This multidisciplinary approach is essential to optimize patient management, particularly for complex cases requiring rigorous endocrine and radiological follow-up. Effective collaboration also ensures appropriate postoperative hormone replacement therapy, a critical component of care for patients undergoing pituitary adenoma surgery (15).

Principles of Surgical Management

In our series, surgical management of pituitary adenomas was primarily based on endonasal endoscopic trans-sphenoidal surgery, currently recognized as the reference approach for most indications (7,9,13). This technique was used in the majority of cases, while microscopic trans-sphenoidal surgery was reserved for a limited number of selected patients, particularly those with complex or recurrent adenomas or specific anatomical situations (14,16). The surgical strategy was defined based on clinical, radiological, and endocrine data, taking into account tumor characteristics, extension, and anatomical context (15).

Anatomical Considerations

Surgical success depends on precise knowledge of the anatomy of the sellar region and adjacent structures. The surgical approach involves the nasal cavity for access preparation, the sphenoid sinus for exposure of the sella turcica, and the sellar region for tumor excision. Rigorous mastery of these anatomical landmarks is essential to achieve effective tumor removal while preserving surrounding neurovascular structures, particularly the optic chiasm and internal carotid arteries (Figure 2).

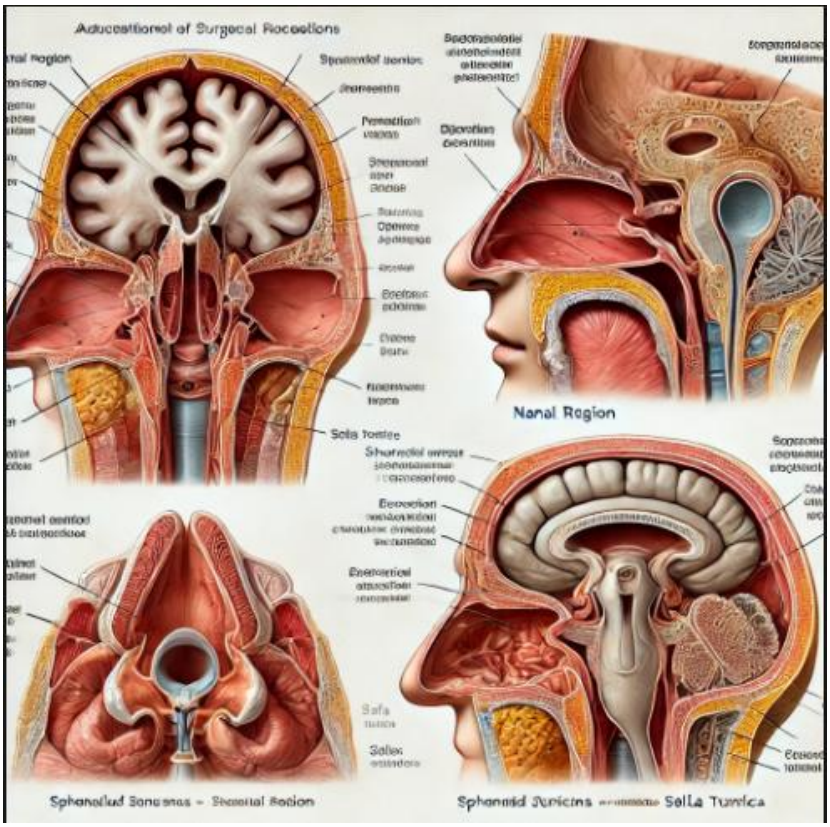

Figure 2: Educational illustration of the main anatomical structures involved in the endonasal endoscopic approach to the sellar region.

Clinical Considerations

Surgical indications were based on clinical presentation and primarily included opto-chiasmatic syndrome with visual disturbances due to optic chiasm compression, neuroendocrine manifestations related to hypothalamic-pituitary syndrome, secreting or non-secreting endocrine disorders, as well as intracranial hypertension syndrome observed in advanced or invasive forms (15,18).

Preoperative Considerations

Preoperative management relied on thorough clinical evaluation to identify neurological and endocrine signs, complemented by systematic neuroradiological assessment using computed tomography and magnetic resonance imaging to define tumor location and

extensions (13,14). Multidisciplinary consultation involving neurosurgeons, endocrinologists, and radiologists was systematically conducted to optimize therapeutic strategy and perioperative hormonal management (2,15,21).

Organization of the Surgical Protocol

The operative strategy followed a standardized protocol adapted to tumor characteristics and the clinical context of each patient. This organization ensured homogeneous and reproducible management, facilitating operative safety, postoperative outcome analysis, and comparison with international literature data (7,10,22).

MATERIALS AND METHODS

Study Type

This was a retrospective descriptive study conducted over an eight-year period, including patients operated on for pituitary adenoma between January 2014 and December 2021 at the Department of Neurosurgery of Frantz Fanon University Hospital Center in Blida.

Study Population

The study included 224 patients surgically treated for pituitary adenoma via the trans-sphenoidal approach. The majority of procedures were performed using the endonasal endoscopic approach, while the microscopic approach was reserved for a limited number of selected cases, particularly complex or recurrent adenomas.

Data Collection and Analysis

Clinical, neuroradiological, and endocrine data were collected from medical records. Analysis focused on preoperative characteristics, including neurological and endocrine symptoms, imaging findings (CT and MRI), and pre- and postoperative hormonal assessments. Postoperative outcomes and complications were evaluated to assess the effectiveness and safety of the surgical technique.

Surgical Technique

Surgical management was primarily based on endonasal endoscopic trans-sphenoidal surgery. Procedures were performed under general anesthesia using a standardized technique. The approach included endonasal access to the sphenoid sinus, followed by opening of the sella turcica and tumor excision under endoscopic control.

RESULTS

Demographic and Clinical Characteristics

The series included 224 patients operated on for pituitary adenoma. Among them, 119 were male (53.3%) and 105 female (46.7%). Morphologically, macroadenomas represented the majority of cases, involving 176 patients (79%), while microadenomas were observed in 48 patients (21%).

Regarding functional profile, 40.2% of adenomas were non-secreting, while 59.8% were hormonally active. The surgical approach was predominantly endonasal endoscopic, performed in 95% of patients, whereas microscopic trans-sphenoidal surgery was required in 5% of cases.

Annual Evolution of Surgical Activity

Analysis of annual case distribution between 2014 and 2021 revealed fluctuations in the number of operated cases. Surgical activity remained relatively stable between 2014 and 2018, with a progressive increase reaching a peak of 45 procedures in 2018 (20.08%).

From 2019 onward, a significant decrease in the number of interventions was observed, with 20 cases in 2019 (8.92%), 11 cases in 2020 (4.91%), and only 4 cases in 2021 (1.78%). This decline coincided with the COVID-19 pandemic period, during which non-urgent surgical procedures were significantly reduced.

Table 1. Annual distribution of operated cases (2014–2021)

Year	Number of cases	Percentage
2014	36	16,07 %
2015	33	14,73 %
2016	35	15,62 %
2017	40	17,85 %
2018	45	20,08 %
2019	20	8,92 %
2020	11	4,91 %
2021	4	1,78 %

Postoperative Complications

Postoperative complications observed in this series were generally rare. No mortality was recorded (0.00%).

Postoperative meningitis occurred in 2.4% of patients, with favorable outcomes following appropriate treatment. Cerebrospinal fluid rhinorrhea was observed in 3.67% of cases, sometimes requiring additional surgical management.

Transient diabetes insipidus was the most frequent endocrine complication, identified in 9.2% of patients. Permanent hypopituitarism was reported in 0.57% of cases.

Intraoperative endoscopic photographs taken on November 14, 2021, illustrate the different stages of pituitary adenoma excision using the endonasal endoscopic trans-sphenoidal approach (Figure 3).

Postoperative imaging was performed to evaluate the operated region and detect potential early complications. A control CT scan performed on postoperative day one (POD1), November 15, 2021, demonstrated a satisfactory appearance of the sellar region after surgery, with no evidence of immediate postoperative complications (Figure 4).

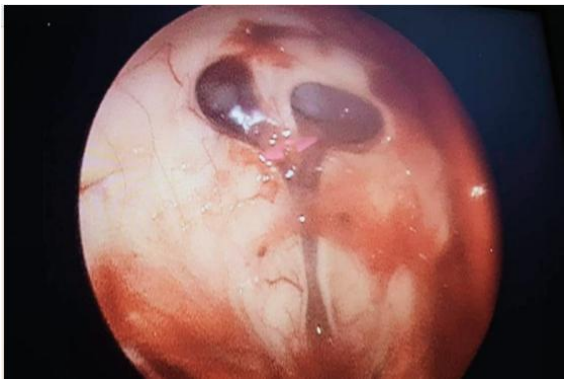

Figure 3. Intraoperative endoscopic photographs

Intraoperative endoscopic photographs illustrating the different stages of pituitary adenoma resection using the endonasal endoscopic trans-sphenoidal approach (procedure performed on November 14, 2021).

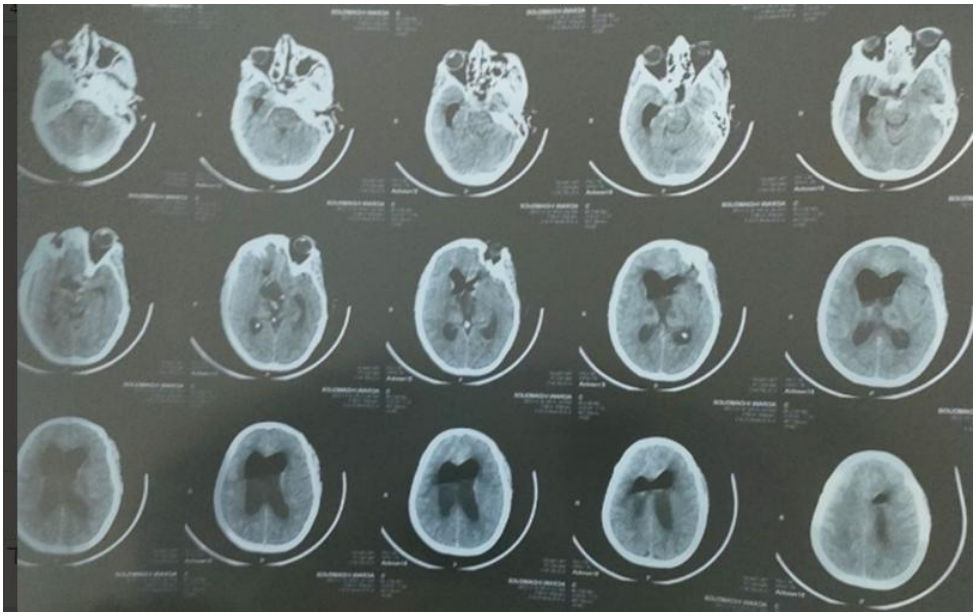

Figure 4. Postoperative computed tomography scan

Control computed tomography scan performed on the first postoperative day (POD 1), on

ovember 15, 2021, showing the appearance of the sellar region after surgery, with no evident immediate postoperative complications.

DISCUSSION

Endoscopic trans-sphenoidal surgery for pituitary adenomas has become the method of choice due to its numerous advantages (6,7,9,13). According to Boccaletti et al. (2020), the use of the endoscope allows deeper and less invasive exploration of the sellar region, reducing the risk of brain trauma and improving cosmetic outcomes (6). This technique is currently used as first-line treatment for most pituitary adenomas, except invasive adenomas with lateral extension (12,14).

Our results are consistent with those reported by Liu et al. (2018) and Jiao et al. (2017), who also observed low complication rates and good pituitary adenoma control (11,15). However, challenges remain, particularly for invasive adenomas with lateral extension, which may require more complex surgical approaches or combination with other techniques (14,16).

Advantages of Endonasal Endoscopic Trans-Sphenoidal Surgery

Endonasal endoscopic trans-sphenoidal surgery has established itself as the preferred method for pituitary adenomas due to several significant advantages:

Wide and multi-axial visualization: The use of a 30° endoscope provides optimal visualization, improving exploration of intra- and suprasellar regions and facilitating access to difficult-to-reach areas, thereby enhancing surgical precision (8,13).

Reduced hospitalization: The minimally invasive nature of the procedure allows faster recovery and significantly shorter hospital stays compared to traditional surgery (1,7).

Reduction of rhinological complications: This technique minimizes nasal morbidity and improves postoperative comfort, which is particularly appreciated by patients (9,17).

Absence of brain retraction: Unlike traditional techniques, endoscopy preserves surrounding brain structures, reducing the risk of neurological injury (14,20).

Study Limitations

Several limitations should be acknowledged, particularly the retrospective design of the study, which may introduce bias in outcome analysis. Additionally, the limited sample size in certain subcategories, especially invasive adenomas, restricts the generalizability of some results (16). Prospective multicenter studies are needed to confirm these observations and refine therapeutic management protocols (15).

Importance of the Learning Curve

As emphasized by Patel et al. (2019), mastering endoscopic surgery requires a significant learning curve (18,19). Training of surgical teams and collaboration with endocrinologists and radiologists are essential to ensure optimal patient management. Our results confirm that this approach is safe and effective; however, continuous training and interdisciplinary exchange remain crucial to minimizing risks and maximizing patient benefits (21).

Introduction of Endonasal Endoscopic Surgery in Algeria

The introduction of endonasal endoscopic trans-sphenoidal surgery in Algeria in 2003 marked a decisive turning point in the management of pituitary pathologies (3). This major advancement was made possible thanks to Professor Bouyoucef K. and his team of neurosurgeons, who modernized pituitary adenoma treatment by offering a less invasive alternative to traditional techniques. This method enabled deeper exploration and more precise excision of adenomas, improving clinical outcomes while reducing postoperative morbidity (4).

Structuring the Medical Community

Professor Bouyoucef K. also played a central role in structuring the medical community around endonasal endoscopic surgery. In 2015, he founded the Algerian Society of Pituitary Pathologies (SAPH), an initiative aimed at promoting research, continuous

training, and exchange of best practices in pituitary disease management. This society played a fundamental role by enabling practitioners, particularly neurosurgeons, endocrinologists, and radiologists, to share knowledge, resources, and platforms to discuss the latest scientific and surgical advances (5).

Contributions of Other Algerian Experts

In parallel with these efforts, other Algerian experts significantly contributed to advancing knowledge in endoscopic surgery. Professor Tliba S., for example, published several works on postoperative complication management in endoscopic pituitary adenoma surgery, emphasizing the importance of continuous training and optimization of postoperative protocols to improve long-term surgical outcomes (21). Similarly, Professor Bouaita K. conducted studies on pituitary adenoma treatment techniques and long-term outcomes of endoscopic surgical interventions (2). Professor Morsli A. also made essential contributions, particularly by refining surgical techniques and actively participating in mentoring young neurosurgeons.

Interdisciplinary Collaboration and Development of Endoscopic Surgery

Interdisciplinary collaboration between neurosurgeons, endocrinologists, and radiologists has been a key factor in the success of endonasal endoscopic surgery in Algeria (15,21). This approach has not only improved care quality but also ensured optimal management of patients with pituitary adenomas. The experience accumulated across different healthcare centers, particularly at Frantz Fanon University Hospital Center in Blida, has enabled refinement of surgical techniques and strengthening of the multidisciplinary approach essential to patient care.

CONCLUSION

Endonasal endoscopic trans-sphenoidal surgery has established itself as the reference technique in the management of pituitary adenomas due to its recognized advantages in surgical visualization, reduced morbidity, and rapid postoperative recovery. The results obtained at Frantz Fanon University Hospital Center in Blida confirm the effectiveness and safety of this approach and are consistent with data reported in international literature.

The experience of the Department of Neurosurgery at Blida University Hospital Center illustrates the evolution and maturation of endoscopic pituitary surgery in Algeria, made

possible through the commitment of national pioneers and the development of close multidisciplinary collaboration between neurosurgeons, endocrinologists, and radiologists. This dynamic has significantly improved patient care quality while reducing postoperative morbidity.

However, the sustainability of these results depends on continued training of surgical teams, maintenance of a structured multidisciplinary approach, and the development of prospective multicenter studies to consolidate these achievements and further optimize long-term outcomes.

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