The aim of a study of Butenschoen et al. was to analyze the postoperative improvement of visual function after adenoma resection and to identify prognostic factors for the postoperative clinical recovery. They performed a retrospective analysis of all consecutive patients treated via a transsphenoidal approach for pituitary neuroendocrine tumors from April 2006 to December 2019 in a high-volume neurosurgical department. The primary outcome was postoperative visual acuity and visual field impairment; the clinical findings were followed up to 3 months after surgery and correlated with clinical and radiographic findings. In total, 440 surgeries were performed in our department for tumors of the sella region in a time period of 13 years via a transsphenoidal approach, and 191 patients included in the analysis. The mean age was 55 years, and 98% were macroadenomas. Mean preoperative visual acuity in patients with preoperative impairment (n = 133) improved significantly from 0.64/0.65 to 0.72/0.75 and 0.76/0.8 (right eye R/left eye L) postoperatively and at 3 months follow-up ($p < 0.001$). Visual acuity significantly depended on Knosp classification but not Hardy grading. The strongest predictor for visual function recovery was age. Transsphenoidal pituitary tumor resection remains a safe and effective treatment in patients with preoperative visual impairment. It significantly improves visual acuity and field defects after surgery, and recovery continues at the 3 months follow-up examination [1)].

**2015**

A retrospective review of adult patients who underwent transsphenoidal surgery for pituitary tumors at Barrow Neurological Institute (January 2011-March 2014) was performed to identify causes of unplanned readmission within 30 days of surgery. Patient demographics, tumor details, surgical complications, and endocrine function were documented.

Of 303 patients who had transsphenoidal surgery, 27 (8.9%) were readmitted within 30 days. Most of the 27 (15 [55.6%]) had delayed hyponatremia. Other causes were diabetes insipidus (4 [14.8%]), adrenal insufficiency (2 [7.4%]), and Cerebrospinal fluid fistula, epistaxis, cardiac arrhythmia, pneumonia, urinary tract infection, and hypoglycemia (1 each [3.7%]). Outpatient sodium screening was performed as needed. In cases of hyponatremia, the mean postoperative day of readmission was day 8 (range, 6-12 days) and the mean serum sodium was 119 mmol/L (range, 111-129 mmol/L). Numerous patient and surgical factors were examined, and no specific predictors of readmission were identified. They developed an outpatient care pathway for managing hyponatremia with the goal of improving readmission rates.

This study establishes a quality benchmark for readmission rates after transsphenoidal surgery for pituitary lesions and identifies delayed hyponatremia as the primary cause. Implementation of an outpatient care pathway for managing hyponatremia may improve readmission rates [2)].

---

Fifty-five patients ≥ 70 years of age (average age 72.5 years, range 70-84 years) underwent endoscopic surgery for treatment of PAs. The mean follow-up period was 50 months (range 12-144 months). The most common symptoms were visual impairment in 38 (69%) patients, headache in 16 (29%) patients, and complete ophthalmoplegia in 6 (10.9%). Elderly patients presented a higher incidence of ophthalmoplegia ($p = 0.032$) and a lower frequency of pituitary apoplexy before surgery ($p < 0.05$). Tumors with cavernous sinus invasion were treated surgically less frequently than in younger patients. Although patients with an American Society of Anesthesiologists score of 3 were more common in the elderly group ($p < 0.05$), no significant difference regarding surgical time, extent of resection, and hospitalization were observed. Elderly patients presented with more complications than patients < 60 years (32.7% vs 10%, $p < 0.05$). Complications observed in the elderly group included 5 Cerebrospinal fluid fistulas (9%), 2 permanent diabetes insipidus cases (3.6%), 4

postoperative refractory hypertension cases (7.2%), 1 myocardial ischemia (1.8%), and 1 death (1.8%). Postoperative new anterior pituitary deficit was more common in the younger group (< 60 years old: 17.7%) than in the elderly (≥ 70 years old: 12.7%); however, there was no statistical difference [3].

**2004**

White et al. compared 50 patients undergoing sublabial transseptal transsphenoidal surgery from 1996 to 1999, as well as 50 patients undergoing endoscopic surgery from 2000 and 2002. There was no di erence in the intra- operative blood loss and the incidence of diabetes insipidus between the two groups. However, they showed that endonasal complications were much lower in the endoscopic group compared to the sublabial group [4].

**2002**

In a series of 146 consecutively treated patients who underwent an endoscopic endonasal transsphenoidal approach to the sellar region for resection of pituitary neuroendocrine tumors between January 1997 and July 2001.

Complications were divided into groups (nasofacial, sphenoid sinus, sella turcica, supra or parasellar, and endocrine complications) according to the anatomical structures and the systems involved. Overall, a decreased incidence of complications has been observed, compared with large historical series of the traditional microsurgical transsphenoidal approach, likely because of the overview inside the anatomy facilitated by the endoscope, and the decreased surgical trauma.

Transsphenoidal surgery, either microscopic or endoscopic, is a safe procedure in experienced hands, but serious complications still occur and must be reduced as much as possible. Additional improvement can be expected with greater experience and new technical developments. A coordinated team effort with other dedicated colleagues from different specialties is advised [5].

**1997**

Questionnaires regarding 14 specific complications of transsphenoidal surgery were mailed to 3172 neurosurgeons. The data reported were analyzed from the 958 respondents (82%) who reported performing the operation. The neurosurgeons surveyed were asked to estimate the number of transsphenoidal operations performed, to identify any complications observed, and to estimate the percentage of operations that had resulted in any of the 14 specific complications. The 958 respondents were placed into three experience groups, based on the number of transsphenoidal operations performed. The data were analyzed by using chi 2 tests and Spearman correlation coefficients. The secondary objectives were met through a detailed review of the literature, in light of our experience.

Of the respondents, 87.3% reported having performed < 200 operations and 9.7% reported 200 to 500 previous operations. The remaining 3% reported more than 500 previous operations. More extensive previous experience with transsphenoidal surgery was associated with a greater likelihood of having witnessed each specific complication. The mean operative mortality rate for all three groups

was 0.9%. Anterior pituitary insufficiency (19.4%) and diabetes insipidus (17.8%) were complications with the highest incidence of occurrence. The overall incidence of cerebrospinal fluid fistulas was 3.9%. Other significant complications, such as carotid artery injuries, hypothalamic injuries, loss of vision, and meningitis, occurred with incidence rates between 1 and 2%. An inverse relationship was found between the experience group and the likelihood of complications, as indicated by significant negative Spearman correlation coefficients for all but 2 of the 14 complications listed in the survey ($P < 0.05$). Thus, increased experience with transsphenoidal surgery seems to be associated with a decreased percentage of operations resulting in complications. Some caution should be exercised in interpreting these data, because they are based on the respondents' estimates.

Transsphenoidal surgery seems to be a reasonably safe procedure, with a mortality rate of less than 1%. However, a significant number of complications do occur. The incidence of these complications seems to be higher, with statistical significance, in the hands of less experienced surgeons. The learning curve seems to be relatively shallow, because a statistically significantly decreased incidence of morbidity and death could be documented after 200 and even 500 transsphenoidal operations. Better understanding of the indications for transsphenoidal surgery and improved familiarity with the regional anatomy should further lower the incidence of death and morbidity resulting from this procedure in the hands of all neurosurgeons [6].

1)
Butenschoen VM, Schwendinger N, von Werder A, Bette S, Wienke M, Meyer B, Gempt J. Visual acuity and its postoperative outcome after transsphenoidal adenoma resection. Neurosurg Rev. 2020 Oct 10. doi: 10.1007/s10143-020-01408-x. Epub ahead of print. PMID: 33040306.
2)
Bohl MA, Ahmad S, Jahnke H, Shepherd D, Knecht L, White WL, Little AS. Delayed Hyponatremia Is the Most Common Cause of 30-Day Unplanned Readmission After Transsphenoidal Surgery for Pituitary Tumors. Neurosurgery. 2016 Jan;78(1):84-90. doi: 10.1227/NEU.0000000000001003. PubMed PMID: 26348011.
3)
Gondim JA, Almeida JP, de Albuquerque LA, Gomes E, Schops M, Mota JI. Endoscopic endonasal transsphenoidal surgery in elderly patients with pituitary adenomas. J Neurosurg. 2015 Jul;123(1):31-8. doi: 10.3171/2014.10.JNS14372. Epub 2015 Apr 3. Review. PubMed PMID: 25839926.
4)
White DR, Sonnenburg RE, Ewend MG, Senior BA: Safety of minimally invasive pituitary surgery compared with a traditional approach. Laryngoscope 114:1945-1948, 2004
5)
Cappabianca P, Cavallo LM, Colao A, de Divitiis E. Surgical complications associated with the endoscopic endonasal transsphenoidal approach for pituitary adenomas. J Neurosurg. 2002 Aug;97(2):293-8. PubMed PMID: 12186456.
6)
Ciric I, Ragin A, Baumgartner C, Pierce D. Complications of transsphenoidal surgery: results of a national survey, review of the literature, and personal experience. Neurosurgery. 1997 Feb;40(2):225-36; discussion 236-7. Review. PubMed PMID: 9007854.