

Surgical Outcomes of Endoscopic Endonasal Surgery for Nonfunctioning Pituitary Neuroendocrine Tumors (PitNETs) in Elderly Patients: A Comprehensive Analysis Beyond Age

Background & Objective

Background:

- The rapid growth of the elderly population presents a challenge in surgical decision-making for PitNETs. The validity of chronological age as a contraindication for surgery remains debated.

Objective:

- To evaluate the independent effect of age on **surgical safety and functional outcomes** using Propensity Score Matching (PSM) to control for comorbidities.

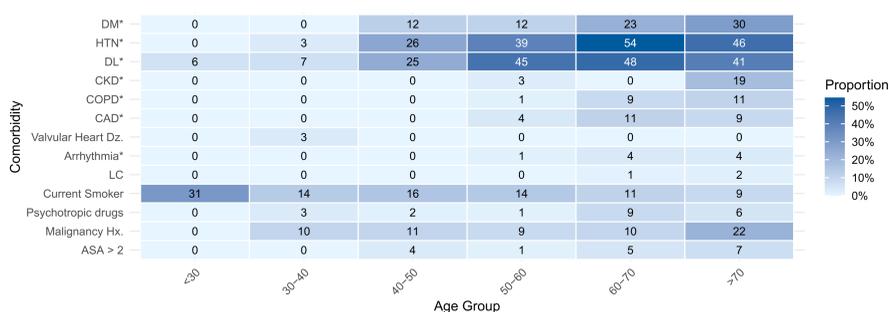


Figure 1. Heatmap of Comorbidities in Age Groups

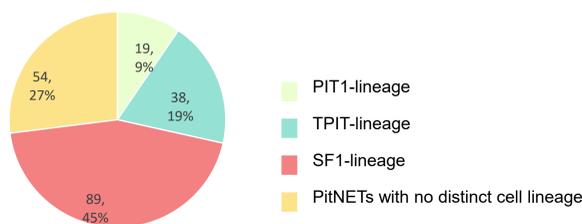


Figure 2. Distribution of Tumor Pathology

Methods and Materials

Study Design: Retrospective analysis of 305 patients with nonfunctioning PitNETs (Mar 2020 – Feb 2024).

Grouping:

- Elderly Group: Age ≥ 65 years (n=105)
- Younger Group: Age < 65 years (n=200)

Statistical Analysis:

- 1:1 Propensity Score Matching (PSM)** was performed using preoperative variables to ensure balanced comparison (n=105 per group).
- Tailored Regression Models** were applied to analyze surgical, endocrinological, and visual outcomes.

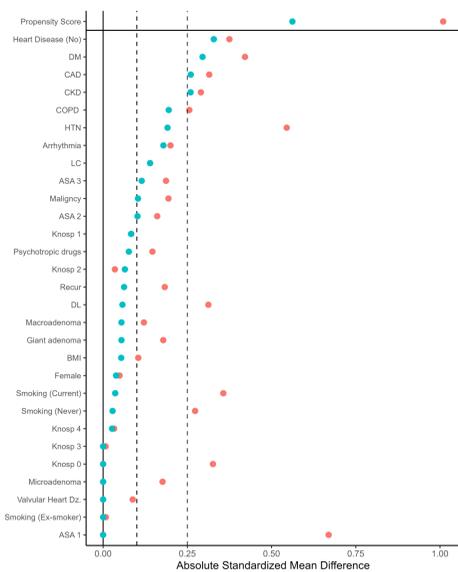


Figure 3. Covariate Balance Before and After Propensity Score Matching

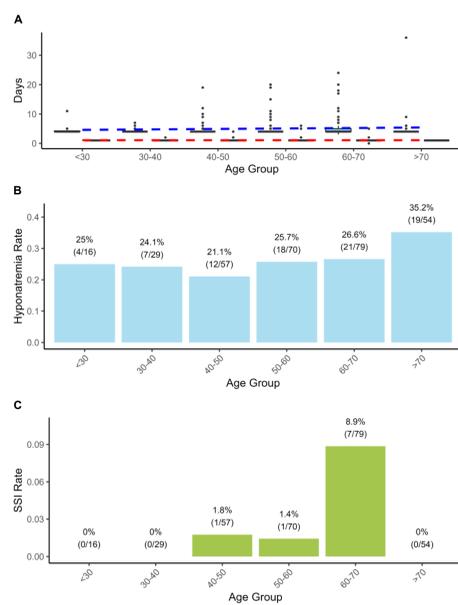


Figure 4. Comparison of Surgical Outcomes Between Age Groups (A) Length of Stay (LOS), (B) Hyponatremia Rates, (C) Surgical Site Infection (SSI).

Results

A. Baseline Characteristics

- Comorbidities:** Elderly patients had a significantly higher burden of **hypertension and diabetes mellitus**.
- Tumor Pathology:** **Gonadotroph** lineage was predominant in the elderly (62.9%), while **Ki-67 index** was significantly lower (Median 1.80 vs 2.40, $p < 0.001$).

B. Surgical Safety & Efficacy

- Gross Total Resection (GTR):**
 - Achieved in 84.8% of patients in both groups ($p > 0.99$).
 - Multivariable Regression: **Age** was **NOT** a significant predictor of GTR (OR 0.99, 95% CI 0.96–1.02, $p = 0.665$).
 - Significant Predictors:** Knosp grade (OR 0.17, $p < 0.001$) and tumor size (OR 0.95, $p = 0.012$) were the only independent risk factors.
- Complications:**
 - No significant difference in major complications (CSF leak, infection, hematoma) after PSM adjustment.
 - Multivariable Regression: **Age** was **NOT** associated with overall complications (OR 1.35, 95% CI 0.44–4.72, $p = 0.605$).
 - Significant Predictors:** BMI (OR 1.24, $p = 0.032$), Dyslipidemia (OR 3.82, $p = 0.038$) and CAD (Coronary Artery Disease) (OR 12.35, $p = 0.009$) were identified as risk factors.

C. Functional Outcomes

- Endocrinological Outcome (Age-dependent)**
 - Maxstat analysis identified Age 57 as the critical threshold for hormonal recovery ($p < 0.001$), validated by Bootstrap Boosting (1,000 iterations).
 - Recovery rates dropped significantly after age 57 (60.7% vs. 33.1%).
- Visual Outcome (Age-independent)**
 - Visual recovery was independent of age.
 - Driven primarily by **GTR achievement** and **preoperative severity**.

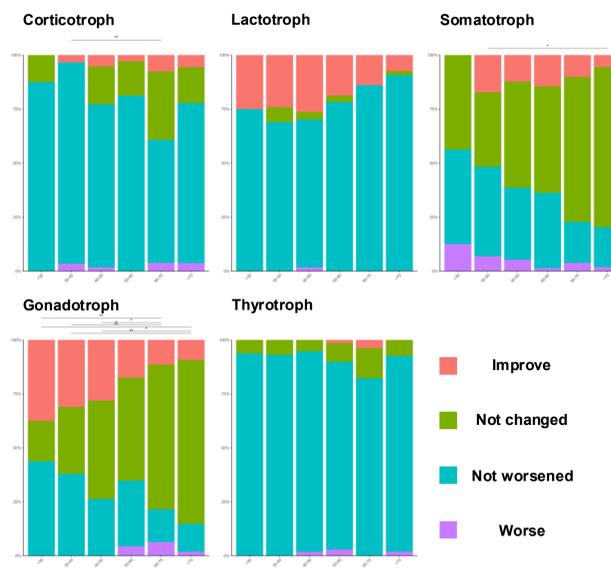


Figure 5. Endocrinologic Outcome According to Age

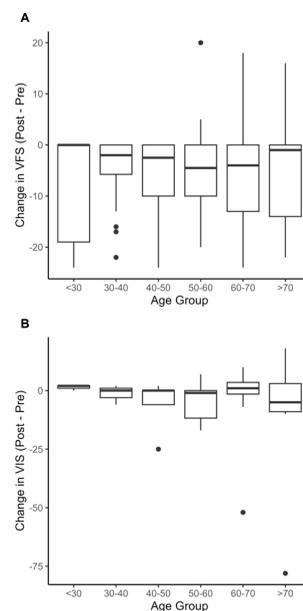


Figure 6. Visual Outcome According to Age (A) Visual Field Score (VFS) Changes, (B) Visual Impairment Score (VIS) Changes.

Discussion

A. Is Surgery Safe in the Elderly?

- Comparable Outcomes:** Despite a higher burden of comorbidities (HTN, DM), elderly patients achieved similar rates of **GTR and complications** compared to matched younger controls.
- Clinical Implication:** This confirms that **chronological age alone** is **NOT** a valid contraindication for endoscopic endonasal surgery.

B. Mechanical vs. Biological Recovery

- Visual Recovery (Age-Independent):** Visual improvement was driven by mechanical decompression (GTR), showing no difference between age groups.
- Hormonal Recovery (Age-Dependent):** In contrast, hormonal recovery significantly declined after age 57, likely reflecting the physiological limits of pituitary regeneration in aging.

Conclusions

- Chronological age alone** is **NOT** a contraindication for endoscopic pituitary surgery.
- When comorbidities are managed, surgical safety and visual outcomes in elderly patients are **comparable** to younger patients.
- However, **limited hormonal recovery potential** (Age > 57) should be discussed during preoperative counseling.

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Declarations

Ethical Approval: This study was approved by the Institutional Review Board of SNUH (IRB No. 2507-164-1659).
Conflict of Interest: The authors have no conflicts of interest to declare.

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