Introduction

Pituitary adenomas represent a significant health concern, particularly in the elderly population, where age-related complexities can influence treatment decisions. Advancements in surgical techniques, notably the adoption of endoscopic transsphenoidal surgery, are critically appraised, shedding light on their role in enhancing surgical outcomes while minimizing morbidity in elderly patients.

In the realm of general surgery, a notable trend emerges wherein a majority of postoperative deaths are observed in patients aged over 70, with an even heightened risk in those exceeding 80 years [1,2]. The application of this arbitrary age threshold and its comparable prognostic implications in benign intracranial pathology remain inadequately elucidated. Specifically, within the elderly demographic, pituitary tumors constitute 12.9% of primary intracranial tumors, boasting an annual incidence of 18.1 per 100,000 and an overall prevalence of 16.7% in the United States [3].

This brief review addresses the importance of individualized care and decision-making, considering the potential risks and benefits of surgery based on the natural history of diseases.

Nonfunctioning Pituitary Adenomas

Elderly patients often present with a spectrum of pituitary adenomas, including nonfunctioning adenomas, prolactinomas, and growth hormone-secreting adenomas. The majority of pituitary tumors in the elderly are nonfunctioning tumors [4]. Advanced age, growth hormone and sex hormone deficiencies are excluded as indications for surgery. It is noteworthy that postoperative visual disturbances tend to be more severe in elderly patients despite improvements observed in most patients, and the complication rate surpasses twice the incidence in individuals over 70, even when dealing with pituitary tumors of similar size [5,6]. Therefore, the decision of the operation on an asymptomatic or mildly symptomatic patient within these age groups should be considered very carefully. Of course, there are some concerns with conservative treatment, including the rapid visual deterioration and apoplectic event during follow-up. Small pituitary adenomas typically exhibit slow growth, and tumors compressing the optic nerve on magnetic resonance images without the presence of neurologic deficits cause visual disturbance in less than 20% of cases during the regular follow-up. Small pituitary adenomas typically exhibit slow growth, and tumors compressing the optic nerve on magnetic resonance images without the presence of neurologic deficits cause visual disturbance in less than 20% of cases during the regular follow-up. Therefore, the optic compression on images alone could not be the surgical indication [7,8]. However, it is important to note that tumors that have invaded the cavernous sinus have a high growth rate [8]. In the asymptomatic tumors, apoplexy may occur during follow-up, but it is rare, and neurological and endocrine recovery could be expected with conservative treatment, which is more appropriate for older age [9]. If continued growth has been documented and there are no other medical conditions seriously...
imparing the life expectancy, surgery might be considered for asymptomatic patients due to the high complication rate of surgery after age 70, however, it should be individualized for both the surgeon and the patients.

**Cushing Disease**

Whether Cushing syndrome is ACTH-dependent or independent, mortality in Cushing syndrome is elevated compared to the general population and the main cause of death is cardiovascular disease [10]. Considering that the most of the incidental microadenomas are adrenocorticotropic hormone cell adenomas, the evaluation of the excessive cortisol secretion is essential in microadenomas [11]. The mortality rate associated with Cushing disease has been reported to be approximately four times higher than that of the general population, with an even greater prevalence among women. In addition to cardiovascular disease being the most common cause of death, it is crucial to note that persistent hypertension and disruptions in glucose metabolism are identified as independent contributing factors. The absence of effective, curative medical therapy and the notably high mortality rate underscore the imperative for surgical intervention, regardless of age. The incidence of venous thromboembolic events (VTE) in patients with endogenous Cushing syndrome is more than ten times higher versus those with nonfunctioning pituitary adenomas undergoing surgery [12]. Postoperative management should prioritize the mitigation of thromboembolic risk. The persistent risk of VTE during initial months following surgery indicates that hypercoagulability is not immediately reversed with the normalization of cortisol levels, emphasizing the need for ongoing vigilance and preventive measures [13].

**Acromegaly**

The common morphological feature in the elderly is not different with younger ages and includes enlargement of hands, feet, forehead, jaw, and nose. There are complications such as diabetes, sleep apnea, and hypertension. It is thus reasonable to expect an association of acromegaly with higher chances of cancer, increased risks of cardiovascular diseases, and mortality [14]. Overall, the cancer risk was approximately two times higher than that of the general population, including cancers of the digestive system, respiratory system, breast, and lymphoma. Acromegaly patients demonstrated excessive risks of mortality [14–16]. Their overall mortality rate was 41% higher than that of the entire population and the median time to mortality was 4.67 years after the diagnosis of acromegaly [14,17]. It was the cardiovascular event, diabetes, and cancers that directly resulted in mortality, with cancer being the most common cause. The efficacy of surgery in acromegaly has been demonstrated, and the likelihood of hormonal remission is increased if the tumor is removed within the cavernous sinus [18]. Most of the literatures on surgery for older patients with acromegaly considers 65 years of age or older to be advanced and reported the similar surgical complications rate with those in younger ages. However, the number of patients over 70 years of age in these studies is very limited, making it difficult to generalize surgical treatment in this age group [1,19–21]. Therefore, the decision of operation in advanced ages should be based on the concomitant cardiovascular complications, degree of glycemic control, presence of malignancy, and future life expectancy.

**Prolactinomas**

Prolactinoma is the second most common incidental microadenoma [11]. Considering the symptoms and relevant complications caused by hyperprolactinemia, the indications for its treatment are very limited in the elderly. Even if neurological deficits occur due to the mass effect caused by the size of the tumor, most of them are resolved with medication, so there is little role for surgery.

**Conclusion**

Advancements in surgical techniques, notably the adoption of endoscopic transsphenoidal surgery, are critically appraised, shedding light on their role in enhancing surgical outcomes while minimizing morbidity in elderly patients. The key factors determining surgical candidacy include the presence of neurological symptoms, endocrine dysfunction, life expectancy and overall health status. The implications for hormonal outcomes, quality of life, and potential complications are thoroughly discussed, providing a comprehensive overview of the multifaceted considerations in the surgical management of pituitary adenomas in the elderly. In conclusion, surgical intervention for pituitary adenomas in the elderly is a viable and often beneficial option, provided careful patient selection and comprehensive preoperative evaluation.

**Conflicts of interest**

No potential conflict of interest relevant to this article was reported.

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