Cost-Effectiveness of Endoscopic Versus Microscopic Transsphenoidal Surgery for Pituitary Adenoma

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BACKGROUND: **Endoscopic transsphenoidal surgery (ETPS) has become increasingly popular for resection of pituitary tumors, whereas microscopic transsphenoidal surgery (MTPS) also remains a commonly used approach. The economic sustainability of new techniques and technologies is rarely evaluated in the neurosurgical skull base literature. The aim of this study was to determine the cost-effectiveness of ETPS compared with MTPS.**

METHODS: **A Markov model was constructed to conduct a cost-utility analysis of ETPS versus MTPS from a single-payer health care perspective. Data were obtained from previously published outcomes studies. Costs were based on Medicare reimbursement rates, considering covariates such as complications, length of stay, and operative time. The base case adopted a 2-year follow-up period. Univariate and multivariate sensitivity analyses were conducted.**

RESULTS: **On average, ETPS costs $143 less and generates 0.014 quality-adjusted life years (QALYs) compared with MTPS over 2 years. The incremental cost-effectiveness ratio (ICER) is −$10,214 per QALY, suggesting economic dominance. The QALY benefit increased to 0.105 when modeled to 10 years, suggesting that ETPS becomes even more favorable over time.**

CONCLUSIONS: **ETPS appears to be cost-effective when compared with MTPS because the ICER falls below the commonly accepted $50,000 per QALY benchmark. Model limitations and assumptions affect the generalizability of the conclusion; however, ongoing efforts to improve rhinologic morbidity related to ETPS would appear to further augment the marginal cost savings and QALYs gained. Further research on the cost-effectiveness of ETPS using prospective data is warranted.**

INTRODUCTION

The transsphenoidal approach to the pituitary gland was first developed in the early 20th century by Schloffer, Cushing, and Hirsch.[1] Utilization expanded rapidly with the introduction of the operating microscope by Jules Hardy in the 1960s, and again with improvements in surgical safety and efficacy established by Wilson, Weiss, Laws, and others in the 1980s.[2] Sinonasal morbidity was mitigated by the microscopic endonasal approach described by Griffith and Veerapen in 1987; this was further improved on by advances described by Cooke and Jones in 1994.[3] This latter approach has become the most widely implemented in present day pituitary surgery.[3] Endoscopy represents one of the latest major advancements in the evolution of pituitary surgical technique.

Various authors have suggested that endoscopic transsphenoidal pituitary surgery (ETPS) may have certain advantages compared with microscopic transsphenoidal pituitary surgery (MTPS).[4,5] For example, endoscopy provides improved visualization that results in improved likelihood of gross total tumor resection, increased endocrine remission rates, improved visual outcomes, and decreased likelihood of tumor recurrence.[6-10] Theodosopoulos et al.[11] demonstrated that the extent of gross total resections with ETPS was 66.7% and that only 14.8% of

Key words
- Cost-utility analysis
- Endoscopic surgery
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- Quality of life
- Transsphenoidal surgery

Abbreviations and Acronyms
CUA: Cost-utility analysis
ETPS: Endoscopic transsphenoidal pituitary surgery
ICER: Incremental cost-effectiveness ratio
ICH: Intracranial hematoma
MTPS: Microscopic transsphenoidal pituitary surgery
QALY: Quality-adjusted life year
SIADH: Syndrome of inappropriate antidiuretic hormone

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subtotal resections were initially misclassified (via endoscopic visualization) as gross total resection. This contrasted with a misclassification rate of 66% with MTPS.[11] The endoscopic endonasal approach has also been associated with fewer surgical complications and shorter hospital stay.[6-10]

In the United States alone, >5,000 people undergo pituitary adenoma resection each year, with an associated surgical cost of >$100 million.[12] In an era of scrutinized allocation of medical resources, it is important to examine if the clinical advantages of ETPS versus MTPS are also cost-effective.[6,10,12-19] A cost-utility analysis (CUA) is usually used to determine cost-effectiveness in health care, with utility referring to quality of life data (in units of quality-adjusted life years [QALYs]). Ideally, any increased cost associated with novel interventions or technologies is offset by improved QALYs to result in a favorable incremental cost-effectiveness ratio (ICER). Rarely, an increase in QALYs can be achieved for less cost, a situation referred to as economic dominance. The purpose of this study was to perform a CUA of ETPS versus MTPS for management of pituitary tumors.

METHODS

Study Population

The Markov model was populated with a synthesis of input values from different sources. Quality of life data and complication probabilities were derived from a nonblinded multicenter exploratory prospective cohort study comparing 235 MTPSs and ETPSs.[20] This was supplemented by cost data, where appropriate, from Oosmanally et al.,[21] Little et al.,[22] and Rudmik et al.[23] Eligible patients from the multicenter cohort study were ≥18 years of age with pituitary pathology that had a planned primary or secondary transsphenoidal surgery in the outpatient neurosurgical setting between October 2011 and August 2013. Patients with a history of prior radiotherapy to the paranasal sinus region or skull base were excluded.

Model Description

A Markov model was constructed to evaluate the costs and utility (in QALYs) of ETPS and MTPS (Figure 1). A transition cycle length of 3 months was chosen to best accommodate the trial data. In each Markov cycle, a patient could experience any of the rhinologic and/or neurologic complications peri- and postoperatively. Rhinologic complications consisted of sinusitis, septal perforation, moderate to severe synechiae, mucopurulence, and crusting. All rhinologic complications were considered transient, with resolution or correction (i.e., significant septal perforations were primarily repaired), within 6 months of the initial surgery. Neurologic complications included cerebrospinal fluid leak, meningitis, carotid artery injury, nerve injury, visual loss, permanent diabetes insipidus, transient diabetes insipidus, syndrome of inappropriate antidiuretic hormone (SIADH), epistaxis, surgical death, and intracranial hematoma (ICH). Among these, cerebrospinal fluid leak, meningitis, transient diabetes insipidus, SIADH, and ICH were considered transient; therefore, the associated costs and disutility were assumed not to last beyond 6 months. In contrast, visual loss, permanent diabetes insipidus, and nerve injury were assumed to be permanent conditions, incurring costs and disutility beyond the 6-month postoperative period.

The analysis was performed from the perspective of a U.S. health care third-party payer; therefore, only direct medical costs were considered. The primary effectiveness outcome was utility, described by the unit QALYs. Comparative cost-effectiveness was measured as an ICER for ETPS. For the base case analysis, we compared ETPS and MTPS for a patient with a pituitary tumor projecting costs and effectiveness over a 2-year postsurgical period. An annual discount rate of 3% was applied to both costs and utility.[24] This analysis followed the guidelines of the Panel on Cost-Effectiveness in Health and Medicine convened by the U.S. Public Health Service in 1993. The purpose of this panel was to establish a set of methodologic recommendations that would

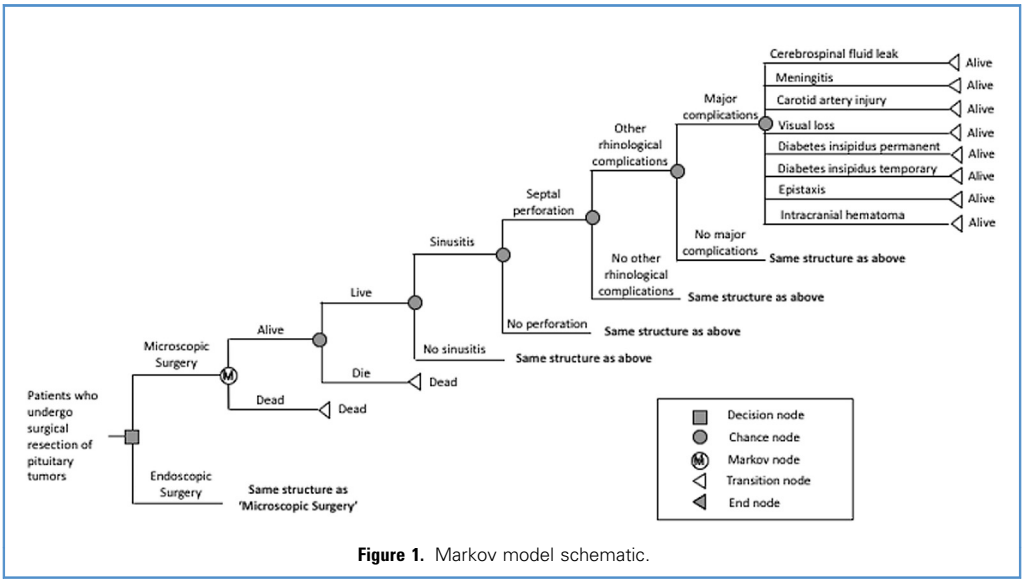

Figure 1. Markov model schematic.