



Clinical Study

Risk of post-operative pneumocephalus in patients with obstructive sleep apnea undergoing transsphenoidal surgery



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ABSTRACT

Patients undergoing transsphenoidal surgery (TSS) have an anterior skull base defect that limits the use of positive pressure ventilation post-operatively. Obstructive sleep apnea (OSA) can be seen in these patients and is treated with continuous positive airway pressure (CPAP). In our study we documented the incidence of pre-existing OSA and reported the incidence of diagnosed pneumocephalus and its relationship to OSA. A retrospective review was conducted from a surgical outcomes database. Electronic medical records were reviewed, with an emphasis on diagnosis of OSA and documented symptomatic pneumocephalus. A total of 324 patients underwent 349 TSS for sellar mass resection. The average body mass index of the study cohort was 32.5 kg/m². Sixty-nine patients (21%) had documented OSA. Only 25 out of 69 (36%) had a documented post-operative CPAP plan. Out of all 349 procedures, there were two incidents of pneumocephalus diagnosed. Neither of the patients had pre-existing OSA. One in five patients in our study had pre-existing OSA. Most patients returned to CPAP use within several weeks of TSS for resection of a sellar mass. Neither of the patients with pneumocephalus had pre-existing OSA and none of the patients with early re-initiation of CPAP developed this complication. This study provides preliminary evidence that resuming CPAP early in the post-operative period might be less dangerous than previously assumed.

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1. Introduction

Endoscopic transsphenoidal surgery (TSS) has replaced open microsurgery as the preferred approach for sellar masses. Endoscopic TSS spares the patient a large craniotomy but leaves them with an anterior skull base defect. Pneumocephalus has been described in relation to anterior skull base defects on numerous occasions [1–3] and has specifically been linked to endonasal surgery, seen in conjunction with small bone defects, durotomy, and high-flow cerebrospinal fluid (CSF) leaks [2,4]. Previous literature has described multiple instances of symptomatic pneumocephalus following transsphenoidal sellar mass resection [2,5]. Several authors have reported the association of positive pressure ventilation (PPV) use in the post-operative period and development of symptomatic pneumocephalus [2,3,6]. There is a concern that pre-existing diseases such as obstructive sleep apnea (OSA) might necessitate use of early post-operative PPV, which may then

increase the risk of post-operative pneumocephalus in this population.

OSA is a frequent comorbidity among patients with pituitary tumors, particularly those with acromegaly [7]. In addition, the hormonal imbalance caused by the pituitary adenomas often leads to obesity, further increasing the rates of OSA in this population [7–9]. The preferred treatment of OSA is PPV in the form of a continuous positive airway pressure (CPAP). The American Society of Anesthesiology published guidelines in 2006 recommending initiation of early post-operative PPV in patients with diagnosis of OSA to prevent respiratory events and hypoxemia after surgery [10]. Given the concerns of post-operative pneumocephalus in patients undergoing TSS for pituitary adenoma, a group with higher incidence of pre-existing OSA, the timing of initiation of CPAP is controversial. The aims of this present study were: (1) to determine the rate of OSA among patients undergoing TSS for pituitary tumors, and (2) to report the incidence of symptomatic pneumocephalus in this group of patients. The final goal of our project was to explore the relationship between endoscopic TSS, OSA, and post-operative pneumocephalus.

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2. Methods

2.1. Study design

After obtaining the appropriate Institutional Review Board approval, we reviewed information from a prospectively maintained surgical outcomes database to identify patients who underwent TSS for resection of sellar masses. We specifically looked at patients who underwent transsphenoidal sellar mass resection between July 2008 and August 2014 at a single institution. There were three different neurosurgeons and four different otolaryngologists involved in the care of these patients. Patients who underwent expanded endonasal approaches for more extensive skull base lesions were excluded from this analysis.

2.2. Data collection

Patients were identified in the prospective outcomes database and were reviewed retrospectively for a variety of patient measures using their electronic medical records. The data points obtained included, but were not limited to, presence of apoplexy, endocrine abnormalities, peri-operative risk assessment, uninostril or binostril approach, septoplasty, presence of intra-operative CSF leak, and repair method. Pre-operative imaging was used to look at aspects of the tumor including size, cavernous sinus involvement, suprasellar extension, hemorrhage, and optic apparatus compression. Post-operative pathology was also analyzed to confirm tumor histology and the specific functionality of the tumor.

The diagnosis of OSA was based on patients self-report during their initial pre-operative history and physical examination. For patients with OSA, further chart review was performed to find an apnea-hypopnea index. Records were reviewed for documentation of post-operative management of these patients, specifically identifying the use of CPAP during the early post-operative period. All patients were retrospectively assessed for documentation of post-operative pneumocephalus on imaging.

For patients with documented pneumocephalus, we performed further analysis to look for the circumstances that prompted imaging in these patients, including thorough details of their clinical course.

2.3. Statistical analysis

Mean and standard deviation were calculated for continuous variables and frequency was calculated for categorical variables.

3. Results

3.1. Patient demographics

From July 2008 to July 2014, 324 patients underwent 349 TSS for sellar mass resection. One hundred and seventy-eight patients (55%) were females and the average age was 50 years. Acromegaly was seen in 22 patients (7%), hyperprolactinemia in 43 patients (13%) and Cushing's disease in 30 patients (9%). Fourteen patients suffered from pre-operative apoplexy (4%). The average body mass index of our patients was 32.5 kg/m² (±7.7). The average American Society of Anesthesiologists Grade of our patients was 2.7 (±0.6) and the average Mallampati score was 2.0 (±0.9) (Table 1).

3.2. Surgical details

All of our patients underwent a transsphenoidal approach for their procedure. Three hundred and three (87%) of the cases were done endoscopically, with the rest completed microscopically early

Table 1

Demographic data of patients undergoing transsphenoidal surgery for a sellar mass

Patient characteristic	N
Patients	324
Females	178 (55%)
Mean age, years (±SD)	50 (±17)
Mean BMI (±SD)	32.5 (±7.7)
Endocrine abnormality	172 (53%)
Acromegaly	22 (7%)
Hyperprolactinemia	43 (13%)
Cushing's syndrome	30 (9%)
Mean ASA grade (±SD)	2.7 (±0.6)
Mean Mallampati score (±SD)	2.0 (±0.9)
Obstructive sleep apnea	69 (21%)

ASA = American Society of Anesthesiology, BMI = body mass index, SD = standard deviation.

on in the study period before the endoscopic procedure was adopted as the sole means of approaching these lesions. On histology, 262 (81%) patients had adenomas, four (1%) patients had craniopharyngiomas and 58 (18%) had other findings including Rathke's cleft cysts, meningiomas and metastatic disease. Nineteen percent of surgeries were done through binostril access, and septoplasty was performed in 236 patients (73%). Twenty-five percent of patients were noted to have an intra-operative CSF leak, which was repaired (Table 2).

3.3. OSA

Sixty-nine patients (21%) had documented OSA. Of the patients with acromegaly, four (18%) had OSA. Of the patients with Cushing's disease, 10 (33%) had OSA, and of those with hyperprolactinemia, four (9%) had OSA. Only 25 out of 69 (36%) had a documented post-operative plan in the chart that addressed management of OSA. The plan consisted of strict avoidance of CPAP for a varying number of days post-operatively, with the use of supplementary oxygen by tent mask if necessary. However, there were two patients who had documented early post-operative CPAP use while in the hospital to manage post-operative hypoxemia. After discharge, patients were generally advised to avoid CPAP use for 2–4 weeks following their procedure but the exact timing of resumption of CPAP use was seldom documented. Regardless of the duration of time off PPV, no patients with OSA were diagnosed with pneumocephalus.

3.4. Cases of pneumocephalus

In this population, early post-operative imaging is performed only when a patient develops symptoms concerning for a complication. Of the 349 TSS, two (0.6%) patients had post-operative imaging that demonstrated the presence of pneumocephalus. Both

Table 2

Operative findings in patients undergoing transsphenoidal surgery for a sellar mass

Operative characteristics	N (324, 348*)
Tumor histology	
Adenoma	262 (81%)
Craniopharyngioma	4 (1%)
Other	58 (18%)
Apoplexy	14 (4%)
Endoscopic	303 (87%)
Binostril access	67 (19%)
Septoplasty*	236 (73%)
Intra-operative CSF leak	86 (25%)

CSF = cerebrospinal fluid.

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