National Trends in Surgery for Sinonasal Malignancy and the Effect of Hospital Volume on Short Term Outcomes

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**Abstract**

Objective/Hypothesis: Sinonasal carcinomas are a collection of highly morbid neoplasms originating from the nasopharynx and paranasal sinuses. Over the last two decades, an aggressive combination of surgery, radiation, and chemotherapy has been used to treat sinonasal malignancies. We sought to characterize the trends in initial management of sinonasal malignancy and the impact on hospital volume on the surgical care and outcomes.

Methods: We performed a retrospective cohort study with times trends of patients admitted for surgical resection of sinonasal malignancy in the National Inpatient Sample (NIS) between 1988 and 2009. Subset analysis was performed on patient cohorts with skull base involvement, orbit or maxillary involvement, or requiring radical neck dissection. Patient characteristics as well as hospital attributes were correlated with patient morbidity and mortality.

Results: Over the course of 22 years, we identified 3850 cases of sinonasal surgery patients from 879 hospitals. 14.9% of patients had complications and 0.8% of hospitalizations resulted in mortality. Cardiopulmonary complications, including pulmonary collapse and myocardial infarctions, and infectious causes, most commonly urinary tract infections and site infection, accounted for 41.5% and 25.7% respectively of all complications. Hemorrhagic complications requiring transfusion were also present in 16.1% of cases with complications.

Cases requiring neck dissection, had orbital or maxillary sinus involvement, or had skull base involvement had higher rates of morbidity and mortality. 24.4% of such high risk surgeries had complications, compared to 11.3% of cases without such extranasal involvement. We identified 32 hospitals which averaged more than 5 cases per year and accounted for 28% (1097) of all sinonasal surgery cases. These hospitals were more represented in high risk cases – accounting for 32.4% of cases requiring neck dissection, 44.9% of cases with orbital involvement, and 45.7% of cases with skull base involvement.

Conclusions: This study reflects changing trends in the epidemiology and primary management of sinonasal cancer. Greater patient age was associated with higher morbidity and mortality. Complicated cases requiring neck dissection, had skull base or orbital involvement had higher rates of complications but were not associated with higher mortality. High volume hospitals were associated with higher complication rates, but this trend was associated with overrepresentation of complicated cases with skull base involvement, orbital involvement, and neck dissection.

**Introduction**

Sinonasal carcinomas are a collection of highly morbid neoplasms originating from the nasopharynx and paranasal sinuses. These cancers are typically of epithelial cell origin, with the majority being squamous cell carcinomas, although a wide range of tumors can originate from the sinonasal cavities. Sinonasal carcinomas are typically initially asymptomatic, however local invasion can result in a constellation of symptoms including chronic nasal discharge, epistaxis, congestion, anosmia, neuropathies, edema, and visual disturbances. Exhibiting local invasion but uncommon to present with lymph node or distant metastases, sinonasal cancers often present with advanced disease.

Sinonasal cancers are uncommon – accounting for only between 1 – 3% of head and neck cancers [1,2]. Given the low incidence and heterogenous histology of sinonasal cancers, there are no randomized trials for the treatment of these cancers. Primary treatment of sinonasal cancers can include radiotherapy alone approach or involve surgical resection and postoperative radiotherapy, although there is a high incidence of local recurrence and insufficient evidence to suggest the superiority of either approach.

A few institutions have published their experiences with sinonasal cancers [1,3,4,5,6,7], however these institutional case series each have fewer than 75 patients each and represent different perspectives in time and approach to sinonasal cancers. An early case series from University of Florida discussed the experience with a primarily radiotherapy only approach with 52% 5 year actuarial survival [3], while a more recent case series from MDACC with more inclusion of surgery and post-operative radiotherapy suggested a 82% 5-year survival. Case studies have suggested between 28 – 41% local recurrence and between 40 – 82% 5-year actuarial survival.

With limited individual institution experience with sinonasal cancer, we seek to examine contemporary patterns of sinonasal cancer surgery. In this study, we investigate the surgical outcomes of patients of patients with sinonasal cancer surgery through analysis of a national inpatient database, and evaluate the impact of hospital volume on short term outcomes.

**Materials and Methods**

**Data Source**

A retrospective cross-sectional analysis of patients who underwent surgical resection of primary cancer of nasal cavities and paranasal sinuses was performed using data from the National Inpatient Sample (NIS) from the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality. The NIS is the largest database of all-payer inpatient discharge information, sampling approximately 20% of all nonfederal US hospitals and including approximately 9 million hospital admissions each year. Each NIS entry includes all diagnosis and procedure codes of activity during the patient’s hospitalization at the time of discharge as well as patient demographics, hospital characteristics, and short-term complications of the hospitalization.

**Data Extraction**

All available data from 1988 through 2009 were queried and patients admitted for primary head and neck cancer with a primary procedure of surgical resection in the maxillary, frontal, ethmoid, or sphenoid sinuses were identified. Potentially higher risk surgeries were identified by orbital or skull base involvement as well as surgeries requiring neck dissection. Incidences of in-hospital mortality as well perioperative morbidity such as post-operative infections, cardiopulmonary complications, hemorrhagic complications, nerve palsies, and deep vein thrombosis were identified.

**Statistical Analysis**

The total number of hospitalizations was plotted annually from 1988 to 2009 and hospital volume was also assessed for each hospital in the database. Hospital level data was stratified by hospital caseload to compare complication rates between high and low volume hospitals. The Pearson chi-square test was used to analyze differences in low-volume and high-volume hospitals as well as differences in complication rates. Logistic regression models were used to assess the influence of patient demographics and hospital characteristics on complication rates. All analyses were performed using Python 2.7 (Python Software Foundation, www.python.org) and R 2.13 (R Foundation, www.r-project.org).

**Results**

We identified 3850 cases of sinonasal surgery between 1988 and 2009 (Figure 1). Patients had a mean age of 61 years old and stayed on average 6.8 days in the hospital. Consistent with previous accounts, we found a male predominance with 57.2% of all patients. The volume of sinonasal cancer surgery has not changed appreciably over the last twenty years, however a greater proportion of these surgeries are now being performed at higher volume centers (Figure 1, R2 = 0.268, p > 0.001).

In order to investigate the impact of surgical volume on short term outcomes, we separated hospitals into centers that perform relatively many sinonasal cancer surgery cases ( greater than 5 case per year) and centers that performed relatively few sinonasal cancer surgery cases (less than 5 cases per year). We identified 32 hospitals which averaged more than 5 cases per year and accounted for 28% of all sinonasal surgery cases. These hospitals were more represented in high risk cases – accounting for 32.4% of cases requiring neck dissection, 44.9% of cases with orbital involvement, and 45.7% of cases with skull base involvement despite being only 3.6% of all hospitals that performed sinonasal cancer surgery (Table 2). High volume centers tended to be teaching hospitals (P > 0.001), and large, urban hospitals were also more represented (Table 3).

Less than 1% of hospitalizations resulted in short term mortality and 36.9% of patients had complications ranging from neuropathies and visual impairment to infections and cardiopulmonary arrest (Table 4). Cardiopulmonary complications were the most common class of complications, representing about half of all complications, while visual defects and neuropathies directly resulting from the surgery was present in a minority of cases. Cases requiring neck dissection, had orbital or maxillary sinus involvement, or had skull base involvement had higher rates of morbidity and mortality - 24.4% of such high risk surgeries had complications, compared to 11.3% of cases without such extranasal intervention.

**Discussion**

Sinonasal cancers are a collection of morbid neoplasms that is often initially treated with surgery and adjuvant radiotherapy. These cancers initially can be clinically silent or mimic benign disease such as sinusitis or upper respiratory infections, evidenced by the proportion of high stage disease during presentation. This study confirms the late initial presentation, as evidenced by the fact that 20.2% of surgeries in this database required neck dissection or had skull base or orbital involvement.

High volume institutions take care of sicker patients and more complex cases, as evidenced by the greater proportion of neck dissections, orbital resections, and neurosurgical involvement, however there was no statistically significant difference in complication mortality rate between high and low volume centers. Aggregate patient race, sex, age, and insurance status did not vary between high and low volume centers.

One limitation of this study is that the National Inpatient Sample does not keep track of long term outcomes from these hospitalizations. While we are able to show there is little perioperative mortality (0.8%), this study is unable clarify the disparate long term survivals described in institutional case series. Further investigation would be necessary to compare the efficacy of various treatment options.

[1] MDACC <http://www.ncbi.nlm.nih.gov/pubmed?term=18164845> n = 62

[2] Barnes L, Tse LLY, Hunt JL, et al. Tumours of the nasal cavity and paranasal sinuses: Introduction. In: Pathology and Genetics of Head and Neck Tumours, Barnes L, Eveson JW, Reichart P, Sidransky D. (Eds), IARC, Lyon 2005. p.9.

[3] FLORIDA <http://www.ncbi.nlm.nih.gov/pubmed/3335447/> n = 48

[4] DENMARK <http://www.ncbi.nlm.nih.gov/pubmed?term=20001493> n = 242

[5] UCLA <http://www.ncbi.nlm.nih.gov/pubmed/11753979>

[6] WASHU <http://www.ncbi.nlm.nih.gov/pubmed/2846481> n = 62

[7] Earlier Denmark <http://www.ncbi.nlm.nih.gov/pubmed/11321654> n = 315

<http://www.uptodate.com/contents/paranasal-sinus-cancer?source=search_result&search=sinonasal+cancer&selectedTitle=1%7E150>

<http://onlinelibrary.wiley.com/doi/10.1002/lary.22447/full>