Evolution of Sinonasal Symptoms Following Endoscopic Anterior Skull Base Surgery

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ABSTRACT

To assess the severity and evolution of sinonasal symptoms in patients following endoscopic anterior skull base surgery to define the typical postoperative course. Design: Cross sectional study. Participants include 69 patients who underwent endoscopic skull base surgery by a dual surgeon team (otolaryngologist and neurosurgeon) from January 2008 to August 2009. Main outcome measures: Sinonasal Outcomes Test (SNOT)-20 survey scores at preoperative and at three postoperative time points. An ordinal logistic regression model was used to analyze the data, summarizing the relationship between the outcome (SNOT score) and the predictor (time point) using an odds ratio. Scores for the symptoms of need to blow nose, sneezing, runny nose, postnasal discharge, thick nasal discharge, ear fullness, and facial pain showed significant worsening at the early postoperative time point. These symptoms showed significant improvement over time; however, scores for post nasal discharge remained high at the late time period compared with baseline. All patients will experience considerable sinonasal symptoms following transnasal endoscopic skull base surgery. Postnasal discharge and thick nasal discharge improve significantly over time. Symptoms approach baseline by 6 to 9 months following surgery.

KEYWORDS: Skull base, sinonasal, endoscopic, sinus surgery

The popularity of the endoscope to treat sinus disease grew rapidly in the 1980s and 1990s as otolaryngologists such as Kennedy and Stammberger found success with this technique. The endoscope offered previously unparalleled visualization of the sinus cavities, and as this technique became more widespread, it was eventually adopted for use in transsphenoidal pituitary surgery.¹ The first significant patient series for endoscopic transsphenoidal pituitary surgery, which illustrated the safety and efficacy of this technique, was published in 1997 by Jho and Carrau.² Endoscopic pituitary surgery showed distinct advantages over using the operating microscope. Improved visualization, which

included a wider and angled view, made the operation safer and allowed more thorough inspection of the operative field. This technique of a minimally invasive endoscopic transnasal transsphenoidal approach is increasingly being utilized for lesions of the sella and anterior skull base.³ This approach avoids a septoplasty and a sublabial incision compared with microscopic approaches previously utilized.⁴

The endoscopic approach requires the expertise of a two surgeon team composed of an otolaryngologist and a neurosurgeon, each of whom performs essential portions of the procedure, to provide a safe approach to anterior skull base lesions. Although sinonasal outcomes

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after endoscopic sinus surgery have been previously studied,⁵⁻⁷ this is the first case series that specifically examines the postoperative sinonasal symptoms and outcomes for patients undergoing transnasal endoscopic skull base surgery. These symptoms were quantified using the established Sinonasal Outcomes Test-20 (SNOT-20) originally developed by Piccirillo to study rhinosinusitis patients.⁸ The results of this study provide an understanding of the typical postoperative course for these patients and can aid the practitioner in counseling patients regarding their expected sinonasal sequelae and recovery time.

METHODS

Patients who underwent endoscopic transnasal transphenoidal skull base surgery (eTNTS) by a dual surgeon team (otolaryngologist and neurosurgeon) at a single institution were included in this study, and institutional review board approval was obtained. The technique for eTNTS included elevation of a nasoseptal flap, partial middle turbinectomy, posterior septectomy, posterior ethmoidectomies, and wide sphenoidotomy, followed by tumor exposure and extirpation. Reconstruction was performed using the nasoseptal flap. In cases with a significant intraoperative cerebrospinal fluid leak, an abdominal fat graft was utilized as well. Nasal packing consisted of bioresorbable Nasopore sponges (Stryker, Kalamazoo, MI) and petrolatum impregnated gauze strips in cases where an abdominal fat graft was used. The gauze packing was removed by postoperative day 3 to 5. Postoperative care included twice daily nasal saline irrigation and regular in-office sinus debridement.

Patients who underwent eTNTS were recruited consecutively, with the first patient undergoing surgery in January, 2008. The SNOT-20 is a validated, widely used, disease-specific, health-related quality of life measure for rhinosinusitis.⁸ The first 10 items pertain to specific physical sinonasal symptoms, whereas the final 10 items address more global systemic and psychological symptoms. We assessed the differences in the SNOT-20 scores between three postsurgical time intervals versus baseline in a series of 69 patients. We defined the three postsurgical time intervals as early (36 to 101 days), middle (106 to 190 days), and late (202 to 300 days).

An ordinal logistic regression model was used to analyze the data. The model uses general estimating equations to adjust for the fact that observations across time points are not strictly independent as some patients completed the survey more than once and therefore had more than one observation. The model summarizes the relationship between the outcome (SNOT-20 score) and the predictor (time point) using an odds ratio. The baseline was chosen as the reference category for the purpose of the analysis. An odds ratio greater than 1 indicates that the odds of having a higher (worse) score

are greater relative to baseline (the reference category). An odds ratio of less than 1 indicates that the odds of having a higher score is smaller relative to baseline. An odds ratio close to 1 indicates that there is no difference in score between the postsurgical time point versus baseline.

SNOT-20 scores were also compared descriptively by cross tabulating the ordinal outcome (0 to 5) for each item versus time point (baseline, early, middle, and late). The simple summary statistics, including 25th percentile (Q1), median, 75th percentile (Q3), mean and standard deviation, for each item at each time point are also reported.

RESULTS

There were 69 patients who participated in the study. Transnasal endoscopic operations were performed not only for pituitary lesions but also for meningiomas and other anterior skull base lesions. A nasoseptal flap reconstruction was performed in most cases. There were 22 men and 47 women. The age range was 16 to 81 years. A total of 31 patients completed preoperative surveys, 38 patients completed a survey in the early time period, 23 in the middle, and 12 in the late time period.

Table 1 shows the simple summary statistics at each time point, including Q1 (25th percentile), median, mean, and Q3 (75th percentile). Fig. 1 shows the mean SNOT-20 score for each questionnaire item over time. The baseline scores were normal for items 1 to 10, the physical sinonasal symptoms, whereas they were relatively higher for items 11 to 20, the global system and psychological symptoms. Scores for items 1 (need to blow nose), 5 (postnasal discharge), 6 (thick nasal discharge), 12 (wake up at night), 13 (lack of a good night's sleep), 14 (wake up tired), 15 (fatigue), and 16 (reduced productivity) all had the highest mean scores at the early time point; however, items 13 (lack of a good night's sleep), 14 (wake up tired), and 15 (fatigue) also had the highest baseline scores. In contrast, items 4 (cough), 7 (ear fullness), 9 (ear pain), and 20 (embarrassed) all had the lowest early time point mean scores. Scores for middle and late time periods returned to near baseline for most items except for items 5 (postnasal discharge) and 6 (thick nasal discharge). Item 8 (dizziness) was the only item that had mean scores lower than baseline at all postoperative time points. Scores for items 11 to 20 did not show significant change from baseline through all postoperative time periods.

Table 2 shows the ordinal logistic regression results at each time point for each questionnaire item. As seen in Table 2, for items 1 (need to blow nose), 2 (sneezing), 3 (runny nose), 7 (ear fullness), and 10 (facial pain/pressure), the odds of having a higher (worse) score was significantly greater in the early postsurgical time point relative to baseline. In addition, for item 6 (thick

Table 1 Descriptive Summary Data for SNOT-20 Items Across Time Points

SNOT-20 Survey Item	Statistic	Time Point				SNOT-20 Survey Item	Statistic	Time Point			
		Baseline	Early	Middle	Late			Baseline	Early	Middle	Late
Q1: Need to Blow Nose	Q1	0.0	1.0	0.0	0.0	Q11: Difficulty Falling Asleep	Q1	0.0	0.0	0.0	0.0
	Median	0.0	2.0	1.0	1.0		Median	0.0	0.0	0.0	0.0
	Mean	0.9	1.8	1.2	1.0		Mean	0.9	1.1	1.0	0.8
	SD	1.3	1.3	1.2	1.1		SD	1.5	1.3	1.3	1.1
Q2: Sneezing	Q3	2.0	3.0	2.0	1.5	Q12: Wake Up at Night	Q3	1.0	2.0	2.0	1.5
	Q1	0.0	0.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
	Median	0.0	1.0	0.0	0.5		Median	0.0	1.0	0.0	1.5
	Mean	0.5	1.3	0.6	0.8		Mean	1.2	1.7	1.2	1.4
Q3: Runny Nose	SD	1.1	1.2	1.0	1.0	Q13: Lack of a Good Night's Sleep	SD	1.6	1.8	1.6	1.3
	Q3	1.0	2.0	1.0	1.5		Q3	2.0	3.0	2.0	2.0
	Q1	0.0	0.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
	Median	0.0	1.0	1.0	0.0		Median	1.0	1.5	0.0	0.0
Q4: Cough	Mean	0.7	1.2	0.9	0.5	Q14: Wake up Tired	Mean	1.6	1.8	1.2	1.0
	SD	1.1	1.1	1.1	0.7		SD	1.6	1.8	1.6	1.3
	Q3	1.0	2.0	1.0	1.0		Q3	3.0	3.0	3.0	2.5
	Q1	0.0	0.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
Q5: Postnasal Discharge	Median	0.0	0.0	0.0	0.0	Q15: Fatigue	Median	1.0	1.5	1.0	1.0
	Mean	0.3	0.6	0.5	0.7		Mean	1.5	1.7	1.4	1.3
	SD	0.8	1.1	0.8	1.2		SD	1.7	1.6	1.5	1.4
	Q3	0.0	1.0	1.0	1.0		Q3	3.0	3.0	3.0	2.5
Q6: Thick Nasal Discharge	Q1	0.0	1.0	0.0	0.0	Q16: Reduced Productivity	Q1	0.0	0.0	0.0	0.0
	Median	0.0	2.0	1.0	0.5		Median	1.0	1.0	1.0	1.0
	Mean	0.5	2.0	1.2	1.2		Mean	1.4	1.5	1.3	1.3
	SD	1.2	1.4	1.2	1.3		SD	1.6	1.4	1.4	1.4
Q7: Ear Fullness	Q3	0.0	3.0	2.0	2.5	Q17: Reduced Concentration	Q3	3.0	3.0	3.0	2.5
	Q1	0.0	1.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
	Median	0.0	2.0	1.0	0.0		Median	0.0	1.0	0.0	0.5
	Mean	0.4	2.2	1.5	0.7		Mean	1.2	1.4	0.8	1.2
Q8: Dizziness	SD	0.9	1.5	1.4	1.0	Q18: Frustrated/ Restless/Irritable	SD	1.5	1.6	1.2	1.3
	Q3	0.0	3.0	3.0	1.0		Q3	3.0	3.0	2.0	2.5
	Q1	0.0	0.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
	Median	0.0	0.0	0.0	0.0		Median	0.0	1.0	0.0	0.0
Q9: Ear Pain	Mean	0.7	0.4	0.6	0.6	Q19: Sad	Mean	1.1	1.3	0.8	1.0
	SD	1.0	0.9	0.9	1.0		SD	1.5	1.6	1.2	1.3
	Q3	1.0	0.0	1.0	1.0		Q3	2.0	2.0	1.0	2.5
	Q1	0.0	0.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
Q10: Facial Pain/Pressure	Median	0.0	0.0	0.0	0.0	Q20: Embarrassed	Median	0.0	0.0	0.0	0.0
	Mean	0.1	0.2	0.1	0.1		Mean	1.0	1.0	0.6	1.1
	SD	0.4	0.6	0.5	0.3		SD	1.4	1.5	0.9	1.4
	Q3	0.0	0.0	0.0	0.0		Q3	2.0	2.0	1.0	2.5
	Q1	0.0	0.0	0.0	0.0		Q1	0.0	0.0	0.0	0.0
	Median	0.0	0.5	0.0	0.0		Median	0.0	0.0	0.0	0.0
	Mean	0.6	1.0	0.6	0.3		Mean	0.7	0.7	0.3	0.4
	SD	1.2	1.3	1.0	0.7		SD	1.4	1.4	0.6	0.9
	Q3	0.0	2.0	1.0	0.5		Q3	1.0	0.0	0.0	0.5

Q1, 25th percentile; Q3, 75th percentile; SD, standard deviation.

Figure 1 Graph showing mean SNOT-20 scores across time points: baseline ◆; early (36–101 days) ■; middle (106–190 days) ▲; late (202–300 days) X. Scores for items 1 (need to blow nose), 5 (postnasal discharge), 6 (thick nasal discharge), 12 (wake up at night), 13 (lack of a good night's sleep), 14 (wake up tired), 15 (fatigue), and 16 (reduced productivity) all had the highest mean scores at the early time point. These scores gradually returned to baseline, except for item 5 (postnasal discharge), which remained relatively high even at the late time period. Scores for items 11–20, the global systemic and psychological symptoms, remained at similar levels through all time periods.

nasal discharge), the odds of having a worse score was significantly greater in both early and middle postsurgical time points relative to baseline, whereas for item 5

(postnasal discharge), the odds of having a worse score was significantly greater in all three time points relative to baseline. The odds for having a worse score during the different postoperative time periods were not significantly different for items 11 to 20, the global systemic and psychological symptoms.

Fig. 2 shows the comparison of odds ratios over the different time points. As a general trend, the early time point was associated with worse scores for the physical sinonasal symptoms relative to baseline, as evidenced by the relatively large odds ratios for items 1 (need to blow nose), 2 (sneezing), 5 (postnasal discharge), 6 (thick nasal discharge), 7 (ear fullness), and 10 (facial pain/pressure). However, the scores tended to improve over time, as evidenced by the odds ratios becoming closer to 1 for many of the items. Again, items 5 (postnasal discharge) and 6 (thick nasal discharge) had the highest odds ratios for early versus baseline scores, but these ratios improved in the middle and late time periods. The odds ratios for items 11 to 20, the global systemic and psychological symptoms, remained close to 1 for all time periods.

DISCUSSION

Although use of the endoscope to perform minimally invasive pituitary surgery has allowed for decreased complications and shorter hospital stay, patients undergoing this procedure will still experience some sinonasal

Table 2 Ordinal Logistic Regression Results for SNOT-20 Items Compared with Baseline

SNOT-20 Questions	Comparison of Time Points		
	Comparison	Odds Ratio	p
Q1: Need to Blow Nose	Early vs Base	4.29	0.0013
	Middle vs Base	1.84	0.2395
	Late vs Base	1.49	0.5152
Q2: Sneezing	Early vs Base	5.01	0.0005
	Middle vs Base	1.22	0.7360
	Late vs Base	2.23	0.2171
Q3: Runny Nose	Early vs Base	3.11	0.0153
	Middle vs Base	1.63	0.3779
	Late vs Base	0.99	0.9851
Q4: Cough	Early vs Base	2.45	0.1136
	Middle vs Base	2.56	0.1477
	Late vs Base	2.67	0.1914
Q5: Postnasal Discharge	Early vs Base	14.06	< 0.0001
	Middle vs Base	5.50	0.0028
	Late vs Base	4.45	0.0404
Q6: Thick Nasal Discharge	Early vs Base	15.59	< 0.0001
	Middle vs Base	6.72	0.0006
	Late vs Base	2.16	0.2485
Q7: Ear Fullness	Early vs Base	3.51	0.0201
	Middle vs Base	2.86	0.0990
	Late vs Base	2.60	0.2593

Table 2 (Continued)

SNOT-20 Questions	Comparison of Time Points		
	Comparison	Odds Ratio	p
Q8: Dizziness	Early vs Base	0.40	0.0819
	Middle vs Base	0.78	0.6404
	Late vs Base	0.65	0.5009
Q9: Ear Pain	Early vs Base	1.13	0.8798
	Middle vs Base	0.90	0.9157
	Late vs Base	0.83	0.8666
Q10: Facial Pain/Pressure	Early vs Base	3.14	0.0307
	Middle vs Base	1.73	0.3689
	Late vs Base	0.95	0.9463
Q11: Difficulty Falling Asleep	Early vs Base	1.46	0.3956
	Middle vs Base	1.48	0.4526
	Late vs Base	1.07	0.9291
Q12: Wake Up at Night	Early vs Base	1.97	0.1153
	Middle vs Base	1.12	0.8207
	Late vs Base	1.74	0.3461
Q13: Lack of a Good Night's Sleep	Early vs Base	1.14	0.7474
	Middle vs Base	0.56	0.2470
	Late vs Base	0.47	0.2648
Q14: Wake up Tired	Early vs Base	1.09	0.8365
	Middle vs Base	0.99	0.9893
	Late vs Base	0.67	0.5335
Q15: Fatigue	Early vs Base	1.38	0.4468
	Middle vs Base	1.03	0.9552
	Late vs Base	0.85	0.8019
Q16: Reduced Productivity	Early vs Base	1.43	0.3945
	Middle vs Base	0.97	0.9456
	Late vs Base	0.96	0.9570
Q17: Reduced Concentration	Early vs Base	1.19	0.6898
	Middle vs Base	0.61	0.3170
	Late vs Base	0.97	0.9589
Q18: Frustrated/Restless/Irritable	Early vs Base	1.30	0.5236
	Middle vs Base	0.77	0.5794
	Late vs Base	0.87	0.8489
Q19: Sad	Early vs Base	0.96	0.9236
	Middle vs Base	0.68	0.4270
	Late vs Base	1.07	0.9242
Q20: Embarrassed	Early vs Base	0.73	0.5232
	Middle vs Base	0.44	0.1838
	Late vs Base	0.67	0.6479

morbidity in the postoperative period. The results of our study using the SNOT-20 questionnaire suggest that the most significant early morbidity is in the areas of physical nasal and facial symptoms, including need to blow nose, sneezing, runny nose, postnasal discharge, thick nasal discharge, ear fullness, and facial pain. No other symptom or quality of life measure showed significant worsening in the postoperative period compared with baseline. It is possible that this is due to already elevated scores in these areas at the time of the baseline survey, as evidenced by the overall elevated mean baseline scores for lack of a good night's sleep, wake up tired, and

fatigue. These global systemic symptoms did show improvement compared with baseline over time, but these results did not reach statistical significance.

Both postnasal discharge and thick nasal discharge showed statistically significant improvement over time; however, the scores for postnasal discharge were still significantly elevated compared with baseline even at the late time point. This suggests that these symptoms are the most persistent, and while patients can expect consistent improvement, it may take up to a year until these symptoms return to baseline. However, the mean scores for these symptoms did not exceed 2.5,

Figure 2 Graph showing comparison of odds ratios over time. The odds ratios were relatively high for items 1 (need to blow nose), 2 (sneezing), 5 (postnasal discharge), 6 (thick nasal discharge), 7 (ear fullness), and 10 (facial pain/pressure) during the early postoperative period. However, the scores tended to improve over time, as evidenced by the odds ratios becoming closer to 1 for many of the items by the late time period. Items 5 (postnasal discharge) and 6 (thick nasal discharge) had the highest odds ratios for early versus baseline scores, but these ratios improved in the middle and late time periods. The odds ratios for items 11–20, the global systemic and psychological symptoms, remained close to 1 for all time periods.

which suggests that while these are the most notable symptoms, they are not severe.

Postoperative care of the sinuses, including frequent saline irrigation and sinus debridement, is important in these patients. Subjective complaints of crusting and congestion were frequent during the first several weeks, but these diminished over time, particularly as patients were encouraged to irrigate their sinuses more regularly. Loss of smell was universal during the initial postoperative period, as noted in patient's subjective description of symptoms in progress notes, but this gradually returned to normal by 3 to 6 months.

This study was not a longitudinal one but more closely resembles a cross-sectional design. Of the 69 patients who participated, 31 had available baseline scores, but of these 31 patients only 10 also had available postsurgical scores. A total of 42 patients completed the survey once, 19 completed the survey at two different time points, and 8 completed the survey at three different time points. Although the SNOT-20 is primarily used to assess effectiveness of sinusitis treatment modalities, it does provide a valuable and quantifiable quality of life measurement for rhinosinusitis symptoms. As endoscopic anterior skull base surgery results in an induced rhinosinusitis during the postoperative period, assessment of sinonasal symptoms using the SNOT-20 is a

reasonable method to measure progress in recovery. The results from this initial study lend support for the hypothesis that although sinonasal symptoms are significantly affected in the early postoperative period following endoscopic anterior skull base surgery, they improve with time and return close to baseline within 6 to 9 months. An ideal study would follow a large series of patients longitudinally, with collection of preoperative and regular postoperative SNOT-20 surveys for a year or longer, and future such studies are planned.

In conclusion, patients undergoing minimally invasive endoscopic skull base surgery will experience some sinonasal morbidity in the postoperative period, most notably within the first 3 months. Consistent care of the sinus cavities, including regular saline irrigation and debridement, will enhance the speed of recovery. Patients can expect that sinonasal symptoms will consistently improve over time with almost all symptoms except for postnasal discharge returning to baseline by approximately 9 months after surgery.

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