Disparities in Postoperative Complications Following Endoscopic Sinus Surgery

Varun Gopal[1], Brian Ellis[1], Maaz Imam, MsPH[1], Kenan Najjar[1], and Nasser Gayed, MD[1]
[1] Carle Illinois College of Medicine, Urbana, IL

Abstract

Introduction
Surgical and diagnostic endoscopic sinus procedures can result in serious post-procedure complications. This study investigated the relationship between demographic factors and complication risk following sinus procedures to better understand and address potential inequalities.

Methods
Using the NIH's All of Us database, this retrospective cohort study analyzed U.S. adults who underwent sinus procedures from 1993 to 2022. Patients were stratified by age as well as self-reported race, ethnicity, sex, socioeconomic status (SES), and education to identify factors associated with higher complication incidence. The primary outcome was postprocedural complication categorized as hemorrhagic, infectious, visual disturbance, or cerebrospinal fluid (CSF) leak. Logistic regression was used to adjust the odds ratio.

Results
Among 7724 patients (65.7% White, 14.7% Black, 15.6% Other, 2.4% Asian, 1.5% Multiracial), 466 (6.0%) experienced complications: 287 (61.6%) infectious, 128 (27.5%) hemorrhagic, 28 (6.0%) visual disturbances, and 23 (4.9%) CSF leaks. Black, compared to White, patients were more likely (OR 1.81, 95% CI [1.37-2.38], p<0.0001) to develop complications, including hemorrhagic (2.04 [1.23-3.36], p=0.005) and infectious (1.58 [1.11-2.23], p=0.01). Hispanic/Latino, compared to non-Hispanic/Latino, patients had increased infectious risks (2.16 [1.034-4.09], p=0.028). Male, compared to female, patients had lower complication risk (0.78 [0.62-0.97], p=0.025). No significant trends were noted for other racial groups, or by age, SES, or education.

Conclusion
These findings suggest higher complication risks for historically marginalized groups—Black, Hispanic/Latino, and Female patients—that are not explainable by common causes of demographic inequality. Further research is needed to identify drivers of these disparities.

Introduction

Endoscopic sinus surgery and diagnostic sinus procedures are common procedures for rhinosinusitis and other sinus diseases. While mostly low risk, they can have serious complications including hemorrhage, infection, cerebrospinal fluid leak, and visual injury [1]. Large-scale studies have estimated overall complication rates ranging from 1–3% depending on population and methodology, with risks influenced by factors such as surgical extent, revision status, and comorbidities [1-2].

Despite this work, most research reports aggregate complication rates without stratifying outcomes across demographic groups. Emerging evidence suggests sex, race, and socioeconomic status may influence surgical risk, with men experiencing higher rates of postoperative hemorrhage and Hispanic and Black children more likely to undergo urgent sinus procedures and face increased postoperative complications compared to White children [3-4].

Disparities in surgical outcomes in other fields are linked to systemic inequalities in access to care. However, data on similar disparities exist in sinus procedures remains limited. To address this gap, we analyzed a large, diverse, nationally representative cohort to investigate the relationship between demographic factors and complication risks following sinus procedures.

Methods

This retrospective cohort study was performed on the National Institutes of Health's (NIH) *All of Us* database. This study used data from the *All of Us* Research Programs Controlled Tier Dataset, version 7, available to authorized users on the Research Workbench.
Patients in the United States who underwent sinus procedures from 1993 to 2022 were identified and stratified by the self-reported demographic factors: age, race, ethnicity, sex, socioeconomic status, and education. The primary outcome was dveelopment of a complication, occurring within 30 days of the sinus procedure, with the exception of CSF leaks which were deemed complications if they occurred within 180 days.
Multivariate logistic regression was used to adjust odds ratios, based on stratified factors.

Conclusions

This work indicates greater complication rates in historically marginalized communities, even when controlling for socioeconomic status and age, common social determinants of health.
We recognize limitations with our study, mainly due to the limitations of a database. Due to the multiple ways patients were stratified for analysis, many patient sub-cohorts became less than 20, necessitating us to discard those findings in following with *All of Us* guidelines. Additionally, we are limited to the variables available in the database.
That being said, further research is needed to identify the reasons for the observed increased complication rates in these populations, so that strategies can be developed to ensure that all patients can benefit from potentially life-saving sinus procedures.

Results

A diverse sample of 7724 patients was collected (65.7% White, 14.7% Black, 15.6% Other, 2.4% Asian, 1.5% Multiracial) across ages, racial background, annual income level, gender and ethnicity. (Table 1)
The overall complication rate was 6.0% with 61.6% of those being infectious (including sinusitis and bacterial meningitis, 27.5% being hemorrhagic(including epistaxis, injuries to nearby blood vessels, or other kind of related post-procedural hemorrhage), 6.0% being visual (including new onset diplopia, epiphora, optic nerve injury, blindness or strabismus), and 4.9% being CSF leaks. (Table 2)
Compared to white patients, black patients were more likely overall to develop complications (OR 1.81, 95% CI [1.37-2.38], p<0.0001), as well as more likely to specifically develop hemorrhagic (2.04 [1.23-3.36], p=0.005) and infectious (1.58 [1.11-2.23], p=0.01) complications. Hispanic/Latino patients were more likely to develop infectious complications when compared to non-Hispanic/Latino patients (2.16 [1.034-4.09], p=0.028). Male patients were less likely overall to develop complications when compared with female patients (0.78 [0.62-0.97], p=0.025). No additional significant trends were noted in any other studied demographic predictors. (Table 3)

Table 1: Characteristic Demographics of Patient Cohort (% of total patients)

Age		Race		Annual Income, in thousands ($)		Gender		Ethnicity	
45-54	942 (12.2%)	White	5073 (65.7%)	<50	2509 (32.5%)	Female	4699 (60.8%)	Non-Hispanic / Latino	6418 (83.1%)
55-64	1608 (20.8%)	Black	1135 (14.7%)	50-100	1636 (21.2%)	Male	2970 (38.5%)		
65-74	1988 (25.7%)	Asian	189 (2.4%)	100-150	961 (12.4%)	Other	55 (0.7%)	Hispanic / Latino	1193 (15.4%)
75-84	1585 (20.5%)	Multiple	119 (1.5%)	150-200	457 (5.9%)				
85-100	486 (6.3%)	Other	1208 (15.6%)	>200	810 (10.5%)				

Table 2: Complication Rates by Sub-Category in Patient Cohort

Complication Group	Included Diagnoses	Number of Patients
Infectious	Acute sinusitis, bacterial meningitis	287 (3.72%)
Hemorrhagic	Epistaxis, Internal carotid artery injury, unspecified postprocedural hemorrhage or blood vessel damage	128 (1.66%)
Visual	Diplopia, Epiphora, optic nerve injury, blindness, strabismus	28 (0.36%)
CSF Leak	Cerebrospinal fluid leak	23 (0.3%)
All complications		466 (6.0%)

Table 3: Odds Ratio of the Development of Post-Procedural Complication with Demographic Predictors [95% Confidence Interval] (p-value)

	Age (Compared with ages 45 - 54)				Race (Compared with White Race)				Annual Income Level (Compared with <$50,000)				Gender (compared with Female)		Ethnicity (Compared with non-Hispanic/ Latino)
	Age 55-64	Age 65-74	Age 75-84	Age 85-100	Black/African American	Asian	Multiracial (2+ races)	Other	$50,000 - $100,000	$100,000 - $150,000	$150,000 - $200,000	> $200,000	Male	Other gender	Hispanic/Latino
All Complications	0.97 [0.70 - 1.37] (p=0.863)	1.08 [0.78 - 1.50] (p=0.663)	1.08 [0.76 - 1.54] (p=0.682)	0.81 [0.46 - 1.36] (p=0.44)	1.81 [1.37 - 2.38] (p<0.0001)***	0.15 [0.008 - 0.67] (p=0.058)	1.03 [0.36 - 2.36] (p=0.95)	0.69 [0.36 - 1.37] (p=0.273)	0.89 [0.66 - 1.21] (p=0.465)	0.97 [0.67 - 1.4] (p=0.884)	0.86 [0.5 - 1.4] (p=0.558)	1.16 [0.78 - 1.7] (p=0.443)	0.78 [0.62 - 0.97] (p=0.025)*	0.48 [0.27 - 2.26] (p=0.47)	1.57 [0.82 - 2.84] (p=0.152)
Infectious	1.03 [0.69 - 1.57] (p=0.885)	0.93 [0.62 - 1.41] (p=0.721)	0.91 [0.59 - 1.42] (p=0.687)	###	1.58 [1.11 - 2.23] (p=0.01)*	###	###	0.34 [0.16 - 0.77] (p=0.008)**	0.96 [0.64 - 1.41] (p=0.822)	1.15 [0.72 - 1.79] (p=0.558)	###	1.34 [0.83 - 2.14] (p=0.219)	0.75 [0.56 - 0.98] (p=0.041)*	###	2.16 [1.03 - 4.09] (p=0.028)*
Hemorrhagic	###	1.37 [0.78 - 2.53] (p=0.296)	1.37 [0.74 - 2.65] (p=0.329)	###	2.04 [1.23 - 3.36] (p=0.005)**	###	###	3.49 [0.92 - 11.6] (p=0.06)	0.79 [0.45 - 1.33] (p=0.389)]	###	###	###	0.89 [0.59 - 1.33] (p=0.578)	###	0.46 [0.13 - 1.71] (p=0.251)
Visual	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###
CSF Leak	###	###	###	###	###	###	###	###	###	###	###	###	###	###	###

###: *All of Us* guidelines dictate that calculations performed with a group of less than 20 must be censored for participant privacy; *p < 0.05, **p<0.01 ***p<0.001

Acknowledgements

We gratefully acknowledge *All of Us* participants for their contributions without whom this research would not have been possible. We also that the National Institutes of Health's *All of Us* Research Program for making available the participant data and cohort examined in this study.
We would also like to acknowledge and thank the Carle Illinois College of Medicine faculty for their support with this research endeavor, especially Dr. Nasser Gayed for his continuous support and guidance.

References

1. https://pubmed-ncbi-nlm-nih-gov.proxy2.library.illinois.edu/22311839/
2. https://pubmed-ncbi-nlm-nih-gov.proxy2.library.illinois.edu/39881591/
3. https://pubmed-ncbi-nlm-nih-gov.proxy2.library.illinois.edu/39881591/
4. https://onlinelibrary-wiley-com.proxy2.library.illinois.edu/doi/full/10.1002/lary.29047?