Are Endoscopic Sinus Surgery Complications Improving Over Time and With the Adoption of Image Guidance?

Katherine Lauritsen MBS[1,2] Arman Saheed MD[3], Vijay Ramakrishnan MD[1]

[1.] Indiana University School of Medicine, Department of Otolaryngology, Indianapolis, IN 46202 [2.] Rutgers, New Jersey Medical School, Newark, NJ 07103 [3.] University of Colorado Anschutz School of Medicine, Aurora, CO 80045

Abstract

Background: Update the incidence of major complications following endoscopic sinus surgery (ESS) and examine trends in intraoperative image guidance (IGS) use and its relationship to major complications.

Methods: Queried the TriNetX Research Network for ESS patients (2010-2023). Major complications (cerebrospinal fluid (CSF) leak, orbital injury, and significant epistaxis) were identified using relevant ICD and CPT codes within conservative postoperative timeframes. Trends in IGS use were assessed, and complication rates were compared across age groups (pediatric <12, adolescent (12-17), and adult >18-<65) and time periods (2010-2016 vs 2017-2023). An overall rate of "other" perioperative complications, including emergency room visit, stroke, heart attack, embolic/thrombosis event, and death within 30 days of ESS, was also calculated. Categorical variables were compared using chi-squared test and z-test, and Kaplan-Meier and Cox-regression tests were used to evaluate complication occurrence and hazard ratios.

Results: The overall rate of major complications was CSF leak 0.9%, orbital injury 0.2%, and epistaxis 2.3%. "Other" complications occurred in 3.2%. IGS was used in ~43% of cases, increased over time (p<.001), and was associated with lower CSF leak rates (0.8 vs 0.95%, p = 0.003), increased epistaxis rates (2.5 vs 2.1%, p<.0001), and no significant difference in orbital injury. CSF leak was higher in patients under 18 (p<.001), while adults had higher rates of epistaxis (p=.007).

Conclusions: Surgical complications in ESS remain low, but postoperative epistaxis is higher than previous estimates, alongside a higher rate of anticoagulation use. IGS use has increased over time and is associated with a decreased risk of CSF leak, implicating a justification for proper reimbursement.

Introduction

Endoscopic Sinus Surgery (ESS) is a common treatment option for many sinonasal diseases, including **refractory chronic rhinosinusitis (CRS).** Data on rates of major complications of the intervention, including cerebrospinal fluid **(CSF) leak, orbital injuries, and epistaxis** requiring transfusion, are cited from nearly two decades ago. This study uses a **modern national database** to provide a much-needed update to the literature that reflects rapid advancements in training, technology, and techniques in endoscopic sinus surgery, including the use of **intraoperative image guidance (IGS).**

Timeline of Functional Endoscopic Sinus Surgery (FESS) and Data on Complications

TriNetx 2010-2023

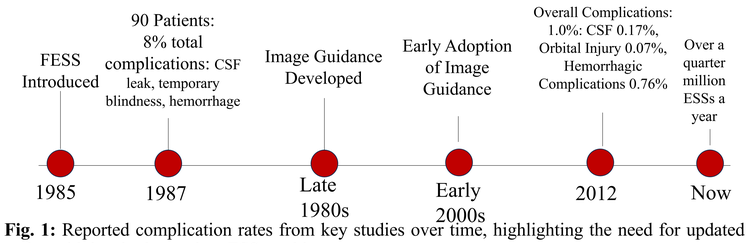
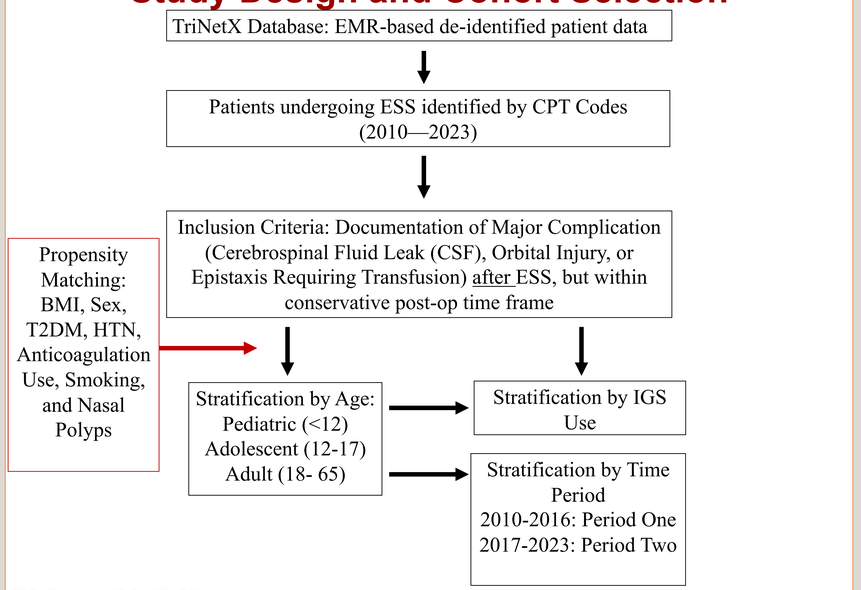


Fig. 1: Reported complication rates from key studies over time, highlighting the need for updated real-world data in the modern ESS world.

Methods: Study Design and Cohort Selection



IRB Exempt (IRB#27455), retrospective cohort using de-identified data

Fig 2: Flow diagram illustrating the retrospective cohort study design. Eligible patients who underwent ESS were identified in the TriNetX database and included based on inclusion/exclusion criteria. The flow diagram summarizes patient selection and stratification.

Variables and Statistical Analysis

Primary Outcomes (Major Complications):

CSF Leak (Within 12 months)
- ICD-10: G96.0, G00, G03
- CPT: 62272

Orbital Injury (Within 6 weeks)
- ICD-10: H53.19, H05.2, H54.X
- CPT: 67900, 67500, 67311-67316

Epistaxis Requiring Transfusion (Within 3 months)
- ICD-10: R04.0
- CPT: 36430

Secondary Outcomes:

Emergency Room Visit, Myocardial Infarction, Embolic/Thrombotic Event, Death (Within 30 days)

Statistical Analysis: Descriptive, Kaplan-Meir Survival Analysis, Log-Rank test, Cox-Proportional Hazard (TriNetX Data Analytics Software), Chi-squared (IBM SPSS v29.0), Pairwise z-Test (GraphPad PRISM)

Results

A.	Overall Cohort N= 150,775	Adult Cohort (>18-<65 Years) N=143,542	Adolescent Cohort (>12-<18 Years) N=6386	Pediatric Cohort (<12 Years) N=5435

B.	CSF Leak (% Risk)	Orbital Injury (% Risk)	Hemorrhage (% Risk)
Total	1372/144638 (.9%)	331/ 145694 (.23%)	3180 /140254 (2.3%)
No IGS	592/62036 (.95%)	118/ 63590(.19%)	1223/61677 (2.1%)
IGS	515/63049 (.8%)	140/62542 (.24%)	1539/59566 (2.5%)
Hazard Ratio (CI)	0.8 (0.746,0.945)	1.2 (0.926, 1.51)	1.2 (1.11, 1.30)
Percentage Total IGS Used	43.6%	42.9%	42.7%

C.	CSF Leak (%Risk)	Orbital Injury (% Risk)	Hemorrhage (% Risk)
2010-2016	513/51165 (1.00%)	144/50838 (.28%)	992/49866 (1.99%)
2017-2023	936/102780 (.91%)	206/105219 (.2%)	2381/99133 (2.4%)
	p= .0784	p= 0.0006	p= <.0001

D.	CSF Leak (% Risk)	Orbital Injury (% Risk)	Hemorrhage (% Risk)
<12 years	85/5149 (1.7%)	20/5209 (.38%)	98/4898 (2.0%)
12-18 years	77/6064 (1.3%)	<10/6084 (.164%)	104/5770 (1.8%)
>18 - <65 years	1238/136741 (.9%)	305/138766 (.22%)	3047/132956 (2.3%)
	p <0.001	p= .021	p=.023

Table 1: Results. A. Cohort Numbers **B.** Overall rates of complications, with and without the use of IGS from 2010-2023 in the propensity-matched cohort. **C.** Overall rates of complications across two time periods in the propensity-matched cohort. **D.** Overall rates of complications by age group from 201—2023 in the propensity-matched cohort.

Conclusions

- **Major complications after ESS remain rare**, with stable rates of CSF leak and orbital injury over the past decade.
- **Postoperative epistaxis is more frequent than previously reported**, which may reflect a surgical population with an increasing age, comorbidities, and higher rates of anticoagulation use.
- The use of **image guidance is associated with fewer intracranial complications**, although slightly higher rates of epistaxis, suggesting that it may be used more frequently in complex cases.
- Updated complication estimates support **improved shared decision-making** and counseling for patients undergoing ESS.
- Surgical/medical guidelines for performing ESS on more complex patients with anticoagulation use would be useful for defining risk predictions for these patients.
- Future work can refine rates of major complications by the complexity of ESS.

References

1. Stankiewicz JA. Complications of endoscopic intranasal ethmoidectomy. Laryngoscope 1987; 97:1270-1273.
2. Ramakrishnan VR, Kingdom TT, Nayak JV, Hwang PH, Orlandi RR. Nationwide incidence of major complications in endoscopic sinus surgery. Int Forum Allergy Rhinol 2012; 2:34-39.