Original Article

Complications of endoscopic sinus surgery for chronic rhinosinusitis in a tertiary care teaching hospital in Saudi Arabia

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ABSTRACT

الأهداف: تحديد نسب حدوث المضاعفات بعد عملية الجيوب الانفية بالمنظار والبحث في الأسباب التي ترتبط بحدوث المضاعفات.

المنهجية: تم إدراج جميع المرضى الذين أجري لهم عملية الجيوب الانفية بالمنظار في المدينة الطبية بجامعة الملك سعود خلال الفترة من يناير 2015م حتى مارس 2022م وتم استثناء جميع المرضى الذي أجريت لهم العملية لعلاج مضاعفات التهابات الجيوب الأنفية الحادة أو أورام الأنف والجيوب الانفية أو لإصلاح تهريب في السائل النخاعي والمرضى الذي أجريت لهم عملية الجيوب الانفية الممتدة بالمنظار لأسباب غير متعلقة بالتهابات الجيوب الانفية المزمنة.

النتائج: 1395 مريض تم ضمهم للدراسة واظهرت النتائج أن نسبة حدوث المضاعفات الكبيرة 0.2% ونسبة حدوث المضاعفات الصغيرة 2%، وجدنا أن التجمع الدموي في محجر العين أكثر المضاعفات الكبيرة حدوثاً والالتصاقات أكثر المضاعفات الصغيرة، وجدنا أيضا أن جانبية العملية ووقتها ارتبطت بزيادة خطر حدوث المضاعفات.

الخلاصة: عملية الجيوب الانفية بالمنظار تعتبر عملية آمنة نسبياً، مع تطور فهم التشريح والفسيولوجيا المرضية قلة نسبة المضاعفات، نتائج هذه المراجعة بأثر رجعي اظهرت أن جانبية العملية ووقتها ارتبطت بزيادة خطر حدوث المضاعفات مما يجعلها جديرة بالمزيد من البحث والتقصي.

Objectives: To determine the incidence of complications of endoscopic sinus surgery (ESS) and to investigate the factors associated with the occurrence of complications.

Methods: In this retrospective study, we reviewed the medical records of all patients who had undergone ESS at King Saud University Medical City (KSUMC) between January 2015 and March 2022. Patients who underwent ESS for complicated acute sinusitis, sinonasal malignancy, and cerebrospinal fluid leak repair, and those who underwent extended ESS for indications other than chronic rhinosinusitis were excluded. This study was approved by the KSUMC Institutional Review Board.

Results: We included 1395 patients, 3 of whom had major complications and 28 had minor complications, resulting in an overall major complication rate of 0.2% and a minor complication rate of 2%. The most common major complication was orbital hematoma, and the most common minor complication was synechia. Moreover, the duration of surgery and laterality increased the risk of complications, whereas the use of image guidance had no effect.

Conclusion: Endoscopic sinus surgery is a safe procedure. The operative start time and laterality were associated with an increased risk of complications and warrant further investigation.

Keywords: endoscopic sinus surgery, cerebrospinal fluid leak, epistaxis, orbital hematoma, synechia, complications, sinus surgery, safety, sinusitis

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Chronic rhinosinusitis (CRS) with nasal polyps (CRSwNP) or chronic rhinosinusitis without nasal polyps (CRSsNP) affect 10.9% of the European population and are differentiated and diagnosed by nasal endoscopy and clinical symptoms.[1] Systemic and topical sinus surgery and steroids are the mainstays of management for CRS cases.[2] Nonetheless, with the increased recognition of the role of type 2 immune responses in CRS severity, recurrence, and comorbidities, multiple biologics targeting immunoglobulin E (IgE), Interleukin-4 (IL)-4, IL-5, and IL-13 have been implemented to substantially improve patients' quality of life.[3]

The European Position Paper on Rhinosinusitis and Nasal Polyps 2020 (EPOS 2020) presents a consensus on the indications for biological treatment.[1] Endoscopic sinus surgery (ESS) was established in the 1980s and is now a routine procedure performed by otolaryngologists worldwide. Endoscopic sinus surgery is considered a reasonably safe surgery; however, serious complications may occur.[4-6] Although ESS is an umbrella term, EPOS 2022 defined polypectomy as "the removal of polyps from the nose without altering the bone anatomy, least tissue removal compatible with clinical improvement and conservation of the mucosa as minimal ESS," and "the complete sinus opening including anterior and posterior ethmoidectomy, middle meatal antrostomy sphenoidotomy, and frontal opening" as full house ESS. Extended ESS includes "extension beyond the confines of the sinuses, such as: the skull base, orbit, pterygopalatine, and infratemporal fossa".[1]

The ESS represents the accepted surgical treatment for chronic rhinosinusitis. The rate of minor ESS complications has been reported as 5% and major complications as 0.5-1%. Differences in study periods and populations caused the reported complication rates to vary widely, with 0.004% to 0.55% of cases reporting cerebrospinal fluid (CSF) leak, 0.02% to 6.6% of cases reporting orbital hematoma or injury, 0.19% to 3.9% reporting severe hemorrhage, and 0.017% reporting toxic shock syndrome (TSS).[6-10] Technological advances over recent years, a better understanding of the pathophysiology of the disease, and better surgical training have improved the outcomes of ESS.[11] However, the current complication rates following ESS have not been well described, especially in the Middle East. Hence, this study evaluated the complication rates associated with ESS at the King Saud University Medical City (KSUMC), a tertiary center in Saudi Arabia.

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Methods. We retrospectively reviewed the medical records of all patients who had undergone ESS at KSUMC from January 2015 to March 2022. The charts of all patients who underwent ESS were reviewed for the following variables: age, gender, nationality, diagnosis, Lund-Mackay score, laterality, asthma, allergy, comorbidities, smoking status, extent and type of surgery, surgical duration, and use of CT guidance. Patients who underwent ESS for complicated acute sinusitis, sinonasal malignancy, and CSF leak repair and those who underwent extended ESS were excluded. The study was conducted according to Good Clinical Practice (GCP), the Declaration of Helsinki, and the local rules and regulations of Saudi Arabia. The study was approved by the Institutional Review Board of the King Saud University Medical College. Data were analyzed using IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, N.Y., USA). Categorical variables were displayed as frequencies and percentages. Means and standard deviations were used to present numerical variables. The chi-square test was used to test for associations between categorical variables. An independent t-test was used to test for associations. Statistical significance was set at $p<0.05$.

Results. Out of 1831 patients who underwent ESS, 1395 met our inclusion criteria. The sociodemographics as shown in Table 1: 1184 (84.9%) patients were medically free, 397 (28.5%) had asthma, 217 (15.6%) had allergic rhinitis, 75 (5.4%) had hypertension, 65 (4.7%) had diabetes, and 62 (4.4%) had aspirin-exacerbated respiratory disease. The patients' diagnoses are presented in Table 1 showing that the most commonly observed diagnoses were CRSwNP in 782 (56.1%), CRSsNP in 377 (27%), and allergic fungal rhinosinusitis in 191 (13.7%) patients.

The primary surgeon was a rhinologist for 1276 (91.5%) patients, with most procedures performed in the morning (904, 64.8%). Regarding the surgical procedure, 448 (32.1%) patients underwent minimal ESS and 947 (67.9%) underwent full house ESS. Furthermore, 156 (11.2%) patients underwent surgery on only one side (unilateral), while 1239 (88.8%) underwent surgery on both sides (bilateral). CT guidance was used for 1175 (84.2%) patients; 1103 (79.1%) patients underwent primary surgery, while 292 (20.9%) underwent revision surgery. The mean surgical duration was 190.72±74.66 minutes, with a mean

Table 1 - Socio-demographic profile and diagnosis of the patients (N=1395).

Charactaristics	n	(%)
Gender		
Male	871	62.40
Female	511	36.60
Undocumented	13	0.90
Nationality		
Saudi	1301	93.30
Non-Saudi	81	5.80
Undocumented	13	0.90
Smoking status		
Smoker	112	8.00
Non-smoker	1283	92.00
Age		
Mean	36.12	
Minimum	7	
Maximum	77	
Range	70	
Standard deviation	13	
Diagnosis		
Chronic rhinosinusitis with nasal polyposis	782	56.1
Chronic rhinosinusitis without nasal polyposis	377	27
Allergic fungal rhinosinusitis	191	13.7
Isolated sinusitis	23	1.6
Antrochoanal polyp	22	1.6

Table 2 - Complications profile of the patients (N=1395).

Questions	n	%
Intracranial complication		
Cerebrospinal fluid (CSF) leak	1	0.10
Orbital complication		
Orbital hematoma	2	0.10
Hemorrhagic complication		
Epistaxis	4	0.30
General complication		
Synechia	22	1.60
Aspiration pneumonia / pneumonitis	2	0.10

postoperative length of stay of 0.79±0.58 days. The mean total Lund-Mackay Score (LMS) was 13.74±7.23. Thirty-one (2.2%) patients experienced postoperative complications, of which 28 (2%) experienced minor complications and 3 (0.2%) experienced major complications (Table 2). Regarding intracranial complications, 1 (0.1%) patient experienced a CSF leak. Two (0.1%) patients had an orbital hematoma, 4 (0.3%) had epistaxis that required intervention, 22 (1.6%) had synechia, and 2 (0.1%) had aspiration pneumonia.

The start time of the operation was significantly associated with the incidence of postoperative complications (p=0.037), and patients who underwent the procedure in the morning had a significantly higher rate of complications than that of patients who underwent the procedure in the afternoon (2.8% vs. 1%). Laterality was also significantly associated with the incidence of postoperative complications (p=0.049); those who underwent bilateral surgery had a higher rate of complications than that of patients who underwent unilateral surgery (0% vs. 2.4%). The incidence of postoperative complications was also significantly associated with the surgical duration (in minutes) (p=0.022), with those with postoperative complications having a significantly higher mean surgery duration than that of patients who did not have postoperative complications (222.17±70.03 vs. 190.04±74.63). Age, gender, nationality, smoking, aspirin-exacerbated respiratory disease, asthma, allergic rhinitis, diabetes, hypertension, comorbidities, diagnosis, primary surgeon, extent of surgery, CT guidance, type of surgery, undergoing septoplasty, and total LMS were not significantly associated with the incidence of postoperative complications. Table 3 outlines factors associated with the incidence of postoperative complications.

Discussion. The ESS is a routine procedure performed by otolaryngologists worldwide for the treatment of chronic rhinosinusitis as well as in many extended applications in the nasal cavity, periorbital region, and anterior skull base.[12] In 2006, Dalziel et al[13] carried ouy a systematic review of the complications associated with ESS in the setting of nasal polyposis and included 42 studies from 1994 to 2004, with most studies published in the 1990s. The overall complication rate for ESS ranged from 0.3 to 22.4%, with minor and major complication rates ranging from 1.1 to 20.8% and 0 to 1.5%, respectively.[13] In our cohort, the overall complication rate was 2.2%, with major and minor complication rates of 0.2% and 2%, respectively. Recent studies by Suzuki et al[6] and Krings et al[14] assessing ESS complications revealed comparable results to those of the present study and were within the same range.

Nasseri et al[15] and Restrepo et al[16] reported that the operative start time was not associated with increased risk of intra- or postoperative complications. In our study, surgeries performed in the morning (8:00 AM–12:00 PM) were associated with higher incidences of complications than surgeries performed in the afternoon (1:00 PM-4:00 PM); this can be explained by our tendency to operate on complex cases in the morning.

Table 3 - Factors associated with incidence of complications post-op.

Variables	Incidence of complication post-op		*P*-value
	No	Yes	
Age (mean, standard deviation)	36.09±13	37.52±13.41	0.560
Gender (n, %)			0.676
Male	851 (97.7)	20 (2.3)	
Female	501 (98)	10 (2.0)	
Nationality (n, %)			0.329
Saudi	1274 (97.9)	27 (2.1)	
Non-Saudi	78 (96.3)	3 (3.7)	
Smoking status (n, %)			0.339
Smoker	111 (99.1)	1 (0.9)	
Non-smoker	1254 (97.7)	29 (2.3)	
Aspirin exacerbated respiratory disease (n, %)			0.765
Yes	61 (98.4)	1 (1.6)	
No	1304 (97.8)	29 (2.2)	
Asthma (n, %)			0.550
Yes	387 (97.5)	10 (2.5)	
No	978 (98)	20 (2.0)	
Allergic rhinitis (n, %)			0.090
Yes	209 (96.3)	8 (3.7)	
No	1156 (98.1)	22 (1.9)	
Diabetes (n, %)			0.161
Yes	62 (95.4)	3 (4.6)	
No	1303 (98)	27 (2)	
Hypertension (n, %)			0.751
Yes	73 (97.3)	2 (2.7)	
No	1292 (97.9)	28 (2.1)	
Medically free (n, %)			0.074
Yes	1162 (98.1)	22 (1.9)	
No	203 (96.3)	8 (3.8)	
Diagnosis			0.624
Chronic rhinosinusitis with nasal polyposis	366 (97.1)	11 (2.9)	
Chronic rhinosinusitis without nasal polyposis	763 (97.6)	19 (2.4)	
Primary surgeon (n, %)			0.303
Rhinologist	1247 (97.7)	29 (2.3)	
Non-rhinologist	118 (99.2)	1 (0.8)	
Starting time of the operation (n, %)			0.037*
Morning	879 (97.2)	25 (2.8)	
Afternoon	473 (99.0)	5 (1.0)	
Extent of surgery (n, %)			0.518
Minimal endoscopic sinus surgery	440 (98.2)	8 (1.8)	
Full house	925 (97.7)	22 (2.3)	
Laterality (n, %)			0.049*
Unilateral	156 (100)	0 (0)	
Bilateral	1209 (97.6)	30 (2.4)	
CT guidance (n, %)			0.381
Used	1148 (97.7)	27 (2.3)	
Not used	217 (98.6)	3 (1.4)	
Type of surgery (n, %)			0.137
Primary	1076 (97.6)	27 (2.4)	
Revision	289 (99.0)	3 (1.0)	
Septoplasty (n, %)			0.056
Done	715 (97.1)	21 (2.9)	
Not done	650 (98.6)	9 (1.4)	
Actual surgery duration (in minutes) (mean, standard deviation)	190.04±74.63	222.17±70.03	0.022*
Post-op length of stay (in days) (mean, standard deviation)	0.78±0.56	1.17±1.09	< 0.001*
Total Lund Mucky Score (mean, standard deviation)	13.8±7.23	11.23±6.80	0.054

*Significant at level 0.05

Despite the fact that revision ESS is considered more complex than primary ESS due to distorted anatomy and scarring, Krings et al[14] and King et al[17] reported that the complication rate of primary ESS is similar to that of revision ESS; furthermore, our study revealed similar findings. In the early 1920s, nasal surgery was considered dangerous and could lead to patient mortality through an unintended breach of the skull base. Thus, CSF leaks must be detected to avoid morbidity from complications such as pneumocephalus and meningitis. It is a rare complication related to technical or anatomical elements; therefore, the preoperative identification of anatomical variations in the skull base is important to avoid this complication.[18-20] Dalziel et al[13] reported that CSF leaks occurred in 0.1% of cases, whereas we reported CSF leak in a 36-year-old woman (CRSwNP, LMS=18) who underwent primary bilateral full-house ESS and septoturbinoplasty under CT guidance. The anterior skull base height was moderate (5.5 mm) and type 2 according to the Keros classification.[21,22] A junior fellow performed the procedure under the supervision of a senior faculty member and encountered a skull base injury during frontal recess dissection that injured the lateral lamella of the cribriform plate. A middle turbinate mucosal graft was used to repair the injury, and the patient tolerated the procedure well without subsequent sequelae.

The incidence of orbital complications during ESS is low, but they are associated with significant morbidity. A good preoperative assessment should include a review of radiological studies to assess the LMS, detect anatomical variants, and evaluate the course and position of the anterior ethmoid artery (AEA).[23] Ramakrishnan et al[8] reported orbital complications in 0.07% of patients, whereas Dalziel et al[13] reported that orbital hematoma occurred in 0–4% of the study population. Two of the 1395 patients (0.14%) in our study had orbital hematomas. The first was a 40-year-old man (CRSwNP, LMS=24) who underwent primary bilateral full-house ESS and septoturbinoplasty under CT guidance. His anterior skull base height was moderate (6.5 mm) and Keros type 2.[21,22] A senior fellow operated under the supervision of a senior faculty member and the patient encountered an injury to the AEA during frontal recess dissection. The artery retracted into the orbit, necessitating endoscopic orbital decompression, and the patient tolerated the procedure well with no visual issues. The second case was that of a 62-year-old man (CRSsNP, LMS=11) who underwent primary bilateral full-house ESS under CT guidance, and his anterior skull base height was moderate (6.8 mm)[21] and Keros type 2.[22] A senior faculty member performed the operation, and the patient experienced injury to the AEA during frontal recess dissection. An ophthalmologist assessed the patient intraoperatively, and lateral canthotomy and cantholysis followed by endoscopic medial orbital decompression were performed. The patient tolerated the procedure well and experienced no visual issues. In both patients, the AEA was low in the mesentery was below the skull base, with supraorbital ethmoid cells extending above the artery. Identifying AEA using radiology to review its length and variation in its course provides essential information in candidates for ESS to reduce the risk of inadvertent injury.[24]

Dalziel et al[13] also reported that the median percentage of epiphora was 0.5%, which was not observed in our study population. Owing to the small number of patients with major complications, a subgroup analysis of major complications could not be performed. Dalziel et al[13] reported a 10.4% median percentage of synechia formation, in contrast to 1.6% in the present study. Despite contradictory reports on whether using a middle meatal spacer decreases synechia formation,all of our cases were performed using an absorbable spacer, either PosiSepX® or Nasopore®.[25]

Rudmik et al[26] estimated that a ESS associated with a major complication would cost $16,877. A systemic review estimated that a straightforward ESS would cost $8,968 (2014 USD).[27] ESS is more cost-effective than dupilumab for the upfront management for CRSwNP, including ESS associated with complications.[28]

Study limitations. First, unrecorded confounding factors, including individual anatomical distortions and the duration of anesthesia, may have affected the complication rate. Second, this was a retrospective observational study without randomization.

In conclusion, ESS is a safe procedure; with technological advances, a better understanding of anatomy and pathophysiology, and improved surgical training, ESS often results in good outcomes and few complications. The overall complication rate following revision ESS is similar to that following primary ESS, the operative start time and laterality being associated with an increased risk of complications. Therefore, they merit further investigation.

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