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ORIGINAL CONTRIBUTION

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Characterization of chronic rhinosinusitis patients undergoing endoscopic sinus surgery under local anesthesia: a real-world study*

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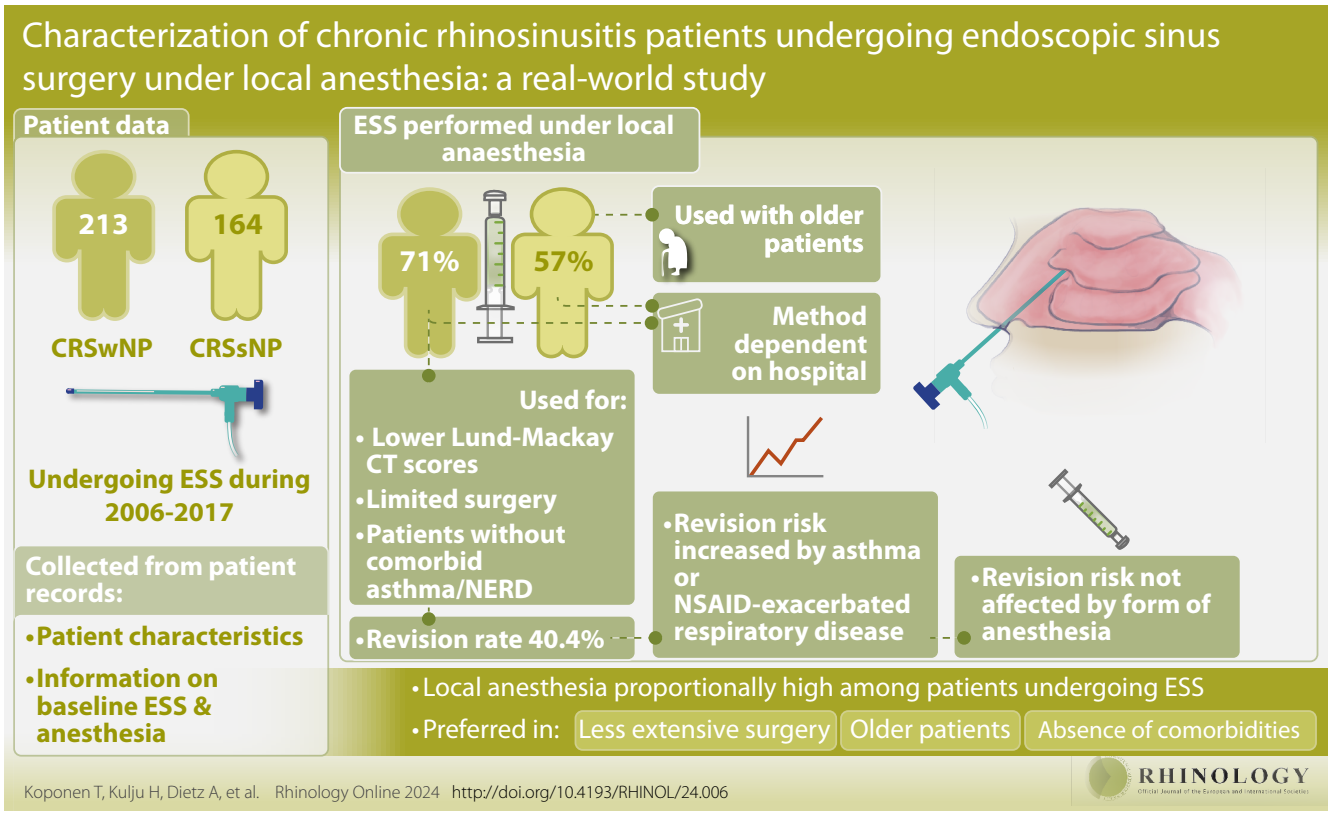

Abstract

Objectives: Uncontrolled chronic rhinosinusitis with/without nasal polyps (CRSwNP and CRSsNP) forms a major public health problem often requiring endoscopic sinus surgery (ESS). There is lacking knowledge of ESS under local anesthesia. As the decision for applying local anesthesia is often based on individual patient-related factors, the aim of this retrospective study was to characterize local anesthesia of ESS among CRSwNP patients and CRSsNP patients.

Methods: Data on 213 CRSwNP and 164 CRSsNP patients undergoing ESS during 2006-17 were gathered. Patient characteristics, information on baseline ESS and anesthesia were collected from patient records.

Results: ESS was performed under local anesthesia in 121 (57%) CRSsNP patients and, in the CRSwNP group in 117 (71%) patients. The anesthesia method was dependent on the hospital in both CRSsNP and CRSwNP groups in adjusted models. In the CRSsNP group ESS was performed under local anesthesia for older patients. In the CRSwNP group, local anesthesia was more frequent in patients with lower Lund-Mackay score of computed tomography scans, limited surgery and for patients without co-morbid asthma or NERD. In CRSwNP group the revision ESS rate was 40.4%. Asthma or NSAID-exacerbated respiratory disease also significantly increased revision ESS risk in Cox´s multivariable models, whereas aesthesia form did not.

Conclusions: Our study indicates a high proportion of local anesthesia among patients who undergo ESS. Local anesthesia is preferred over general anesthesia in less extensive surgery, older patient groups and CRSwNP without co-morbidities. Regional differences of anesthesia form might signify a potential need to unify practices.

Key words: sinusitis, endoscopic sinus surgery, chronic rhinosinusitis, NSAID exacerbated respiratory disease. nasal polyps

Introduction

Chronic rhinosinusitis (CRS) is a medical condition with a prevalence of about 5-12% in the general population (1). Together with its main co-morbidity, asthma, CRS forms a common public health problem [1]. CRS is characterized by chronic inflammation with mucus hypersecretion and oedema. The diagnosis of chronic rhinosinusitis in adults requires nasal blockage and/or nasal discharge as well as one or more of the following: facial pain or pressure; reduction or loss of smell; symptoms lasting for 12 or more weeks [1].

CRS can be divided into two clinical phenotypes based on nasal endoscopy, CRS with nasal polyps (CRSwNP) and without nasal polyps (CRSsNP) [1]. CRS affects a significant portion of the population, with a clear distinction in prevalence and impact between those with nasal polyps and those without, emphasizing the need for tailored treatment approaches based on severity [2]. Moreover, CRS can be subdivided into two major endotypes, T helper cell 2 (T2) -low (neutrophilic) and T2-high (eosinophilic) phenotypes [1]. Most CRS cases exhibit a T2-high inflammatory pattern, characterized by elevated levels of interleukin-4 (IL-4), IL-5, IL-13, and eosinophilia, which suggests a significant role of T2 immune responses [1]. CRSwNP and the triad of NSAID-exacerbated respiratory disease (NERD), asthma and CRSwNP, represents a common, complex and poorly understood medical condition [2] associated with increased morbidity and postoperative relapses [3-5]. The treatment of CRS consists of prolonged medical anti-inflammatory treatment [6], including intranasal corticosteroids and nasal irrigation with saline [1]. If medical treatment fails to show results, additional CT imaging is suggested, and endoscopic sinus surgery (ESS) may be considered. The goal of ESS is to create better conditions for local treatment, improve sinus ventilation and facilitate mucociliary clearance [1]. ESS should be considered when symptoms have not resolved after 8 weeks of intranasal corticosteroids, a Lund-Mackay (LM) score of ≥ 1 and a short-course of systemic corticosteroids (CRSwNP) or broad spectrum / culture-directed antibiotic (CRSsNP) [1]. ESS has been shown to improve health-related quality-of-life (HRQOL) and productivity, and to decrease cost of treatment in CRS [7-9]. ESS is tailored to the extent of the disease and symptoms. Usually ESS includes uncinectomy, middle meatal antrostomy and opening of the ethmoid bulla. In polyposis, recurrent disease may be treated with progressively extended procedures. Mean revision rate of ESS in Finland is 10%, but it is higher in CRSwNP and in severe disease [10,11]. Half of patients operated for CRSwNP have been operated earlier [11]. ESS can be performed both in local and general anesthesia. In most countries, ESS is usually performed under general anesthesia [12]. The use of local anesthesia depends on patients and the extent of the surgery [2]. ESS under local anesthesia has been an option in Finland since the 1990's [13] and its prevalence is relatively high. A Finnish study comparing ESS and balloon sinuplasty has showed that 74% patients underwent ESS with local anesthesia [12].

The benefits of ESS under local anesthesia include shorter total operation duration, faster recovery, decreased emesis, nausea, and epistaxis [14] as well as fewer resources are needed. The benefits of ESS under general anesthesia include pain management, decreased risk of aspiration with intubation, and less co-operati-

on required between patient and surgeon [14]. Complication rate between local and general anesthesia is debatable, with one study [15] reporting an 8.7% vs. 2.4% complication rate respectively while another study reporting 1.4% [16] complication rate under local anesthesia. However, comparison is challenging as usually less invasive ESS is performed under local anesthesia. So far, there is inadequate characterization of CRSsNP and CRSwNP patients undergoing ESS in local anesthesia as compared with the patients undergoing ESS in general anesthesia. The aim was to characterize CRSsNP and CRSwNP patients who had undergone ESS in local anesthesia.

Methods

Subjects

This study retrospectively analyzed data of a random selection of CRSsNP and CRSwNP patients who had undergone sinus computed tomography (CT) scans during their visit at the Otorhinolaryngology Departments at Tampere, Kuopio, and Helsinki University Hospitals, and Päijät-Häme Central Hospital, during the period 2002-2017. Ethical approval for the study (number 31/13/03/00/2015) was granted by the relevant Hospital Districts' ethical committee, with a waiver for written informed consent.

Inclusion criteria were ESS performed within one year of initial consultation with baseline sinus CT scans. We defined "baseline" = ESS performed within one year from the date of CT scan; "revision" = ESS performed over a year after the date of the CT scan. Exclusion criteria were lack of data concerning endoscopic nasal polyps or anesthesia method, as well as a history of eosinophilic granulomatosis with polyangiitis, primary ciliary dyskinesia, cystic fibrosis, acute fungal rhinosinusitis, or severe systemic diseases such as active cancer. Data from 213 CRSwNP and 164 CRSsNP patients meeting these criteria were analyzed.

Variables

The factors of interest were selected based on the literature and data available. Patient characteristics included age, gender, smoking habit (current/no or missing), asthma (yes/no or missing), NERD (yes/no or missing), previous ESS (yes/no) and preoperative LM score of CT scan (<14 or ≥ 14). Surgery characteristics included extent of ESS (polypectomy/middle meatal antrostomy/frontal recess surgery/sphenotomy), anesthesia method (local/general), surgeon's experience ear nose throat (ENT) resident/ENT specialist), hospital center location and complications (severe complications, what; bleeding; infection; adhesions; other, what). The data for the follow-up period was collected manually in 2017-18.

Definitions

CRSwNP and CRSsNP diagnoses were established according to EPOS 2012 guidelines, with CRS requiring symptoms for at least 12 weeks with typical endoscopic signs, and CRSwNP additionally requiring nasal endoscopic evidence of nasal polyps [17]. Asthma and NERD were diagnosed based on self-reported, doctor-confirmed diseases. Asthma diagnoses depended on lung-function test results and met the Finnish national drug reimbursement criteria [18]. NERD diagnosis was based on a confirmed history of symptoms such as wheezing, coughing, or nasal and eye irritation after NSAID consumption. The diagnosis of NERD was based on typical symptoms following NSAID intake.

Characteristics of anesthesia

The local anesthesia for ESS was performed by placing cotton sticks of cocaine or lidocaine with adrenaline solution close to the nasal branches of the sphenopalatine and anterior ethmoidal nerves. In addition, local infiltration blocks with lidocaine-adrenaline solution were administered to the surgical area. The local anesthesia was completed by intravenous (peripheral and/or central) analgesics and sedatives if needed. General anesthesia was performed by either inhalational agents such as sevoflurane or total intravenous anesthesia with propofol. Unfortunately, the exact data of this methodology was lacking for these patients.

Statistical methods

Statistical analysis was carried out by the SPSS Base 15.0 Statistical Software Package (SPSS Inc., Chicago, IL, USA). Associations were assessed by Fisher's exact test (dichotomous) and Kruskal-Wallis and Mann Whitney U tests (continuous). Univariate and multivariable Logistic regression models were used to evaluate the odds ratio (OR) of general anesthesia. Multivariable Cox's proportional hazards models were used to evaluate the hazard ratio (HR) of revision ESS rate. Two-tailed P-values of < 0.05 were considered statistically significant in all models.

Results

Characterization of CRSsNP patients undergoing ESS in local and general anesthesia

The patient characteristics are shown in Table 1. In the CRSsNP group, local anesthesia was performed in 117 (71%) patients and general anesthesia in 47 (29%) patients. Local anesthesia was more frequent in the hospitals located in Southern Finland and in older patients. The CRSsNP group included five pediatric patients (aged 12-17 years). Of them four patients (aged 12, 12, 15, 16 years) underwent ESS under general anesthesia and one (aged 17 years) under local anesthesia. When excluded the pediatric patients from the analysis the result remained similar: ESS under general anesthesia was more likely in younger patients ($P=0.006$). In all CRSsNP patients age was the only variable that was significantly associated with ESS in local anesthesia after Bonferroni correction (Table 1). The local and general anesthesia groups did not differ statistically ($p > 0.05$) in the following

Table 1. Comparison of endoscopic sinus surgery (ESS) under local and general anesthesia in patients with chronic rhinosinusitis without nasal polyps (CRSsNP).

	Local anesthesia n = 117	General anesthesia n = 47	p value
Gender, n (%)			
Female	80 (68.4)	30 (63.8)	0.59
Male	37 (31.6)	17 (36.2)	
Age, median (min-max)	43.6 (17-80)	37.4 (12-71)	**<0.001**
Q1-Q3	35.0-57.6	22.4-43.5	
mean (standard deviation)	46.4 (15.7)	36.2 (14.5)	
Surgeon			
Otorhinolaryngology specialist	100 (85.5)	40 (85.1)	1.0
Resident	17 (14.5)	7 (14.9)	
Center			
Hospital District of Helsinki and Uusimaa	64 (54.7)	18 (38.3)	
Tampere University Hospital	15 (12.8)	14 (29.8)	**0.026**
Kuopio University Hospital	14 (12.0)	9 (19.1)	
Päijät-Häme Central Hospital	24 (20.5)	6 (12.8)	
Smoking			
No	49 (73.1)	20 (66.7)	0.63
Current	18 (26.9)	10 (33.3)	
NERD			
No	115 (99.1)	46 (97.9)	0.50
Yes	1 (0.1)	1 (2.1)	
≥ 1 peroral corticosteroid course / year			
No	116 (99.1)	46 (97.9)	0.49
Yes	1 (0.9)	1 (2.1)	
Baseline sinus CT scan			
LM score < 14	104 (88.9)	43 (91.5)	0.78
LM score ≥ 14	13 (11.1)	4 (8.5)	
Revision CRS-surgery during 5-year follow-up			
No	99 (84.6)	44 (93.6)	0.19
Yes	18 (14.4)	3 (6.4)	
Complications			
No	102 (87.2)	40 (85.1)	
Minor bleeding	3 (2.6)	2 (4.3)	
Minor infection	6 (5.1)	3 (6.4)	0.65
Minor bleeding and infection	1 (0.9)	0 (0)	
Adhesion	4 (3.4)	1 (2.1)	
Other major	1 (0.9)	1 (2.1)	

NERD = patient-reported NSAID exacerbated respiratory disease; CRS = chronic rhinosinusitis; CT = computed tomography; LM = Lund-Mackay. P-values by Fisher´s exact test (dichotomous variables). P-values by Fisher´s exact test (dichotomous variables) and Mann Whitney U test (continuous variables). Bold text indicates a statistically significant difference with a p value less than 0.05. Bold and Italic text indicates a statistically significant difference after Bonferroni correction with a p value less than 0.005. Q1 and Q3 = 25th and 75th percentiles, respectively.

factors: gender, surgeon's experience, smoking habits, asthma, NERD, OCS-course, LM-score, revision ESS or complications (Table 1).

In univariate logistic regression models general anesthesia was significantly associated with the following variables: age and hospital center. Age protected from selecting general anesthesia method [OR 0.955, 95% confidence interval (CI) 0.93–0.98, p <0.001]. ESS performed under general anesthesia was significantly associated with Tampere University Hospital, when uing Helsinki University Hospital as the reference (OR 3.3.2, 1.35–8.14, p = 0.009). When added both age and center into the same multivariable model, the result remained similar for both: age (OR 0.96, 0.93-0.98, p < 0.001) and Tampere University Hospital (OR 2.64, 1.04-6.69, p = 0.041). The result remained similar when adding sex into this model: age (OR 0.96, 0.93-0.98, p < 0.001) and Tampere University Hospital (OR 2.62, 1.03-6.64, p = 0.041).

Characterizing of CRSwNP patients undergoing ESS in local and general anesthesia

The patient characteristics are shown in Table 2. In the CRSwNP group, ESS was performed under local anesthesia in 121 (57%)

Table 2. Comparison of endoscopic sinus surgery (ESS) under local and general anesthesia in patients with chronic rhinosinusitis with nasal polyps (CRSwNP).

	Local anesthesia n = 121	General anesthesia n = 92	p value
Gender, n (%)			
Female	62 (51.2)	56 (60.9)	0.17
Male	59 (48.8)	36 (39.1)	
Age, median (min-max)	43.9 (18-77)	43.7 (10.3-71.1)	0.47
Q1-Q3	35.9-55.7	35.2-52.4	
mean (standard deviation)	45.6 (13.7)	43.6 (12.4)	
Surgeon			
Otorhinolaryngology specialist	14 (11.6)	7 (7.6)	0.37
Resident	107 (88.4)	85 (92.4)	
Baseline endoscopic sinus surgery			
Polypectomy (PE) ± septoplasty (SP)	14 (22.6)	25 (41.7)	
PE ± SP + middle meatal antrostomy (MMA) ± inferior meatal antrostomy	47 (75.8)	24 (40.0)	**< 0.001**
PE ± SP ± MMA + frontal recess surgery (FRS)	1 (1.6)	3 (5.0)	
PE ± SP ± MMA ± FRS + sphenotomy	0 (0)	8 (13.3)	
Center			
Hospital District of Helsinki and Uusimaa	88 (72.7)	59 (64.1)	
Tampere University Hospital	5 (4.1)	14 (15.2)	**0.013**
Kuopio University Hospital	19 (15.7)	17 (18.5)	
Päijät-Häme Central Hospital	9 (7.4)	2 (2.2)	
Smoking			
No	66 (80.5)	65 (83.3)	0.69
Current	16 (19.5)	13 (16.7)	
Asthma			
No	45 (38.8)	8 (8.7)	**< 0.001**
Yes	71 (61.2)	84 (91.3)	
NERD			
No	71 (61.2)	22 (24.7)	**< 0.001**
Yes	45 (38.8)	67 (75.3)	
≥ 1 peroral corticosteroid course / year			
No	89 (73.6)	56 (60.9)	0.06
Yes	32 (26.4)	36 (39.1)	
A history of previous ESS			
No	48 (77.4)	30 (61.2)	0.09
Yes	14 (22.6)	19 (38.8)	
Baseline sinus CT scan			
LM score < 14	41 (34.5)	19 (21.1)	**0.044**
LM score ≥ 14	78 (65.5)	71 (78.9)	
Revision CRS-surgery during 5-year follow-up			
No	77 (68.8)	40 (48.2)	**0.005**
Yes	35 (31.2)	43 (51.8)	
Complications			
No	99 (86.1)	68 (79.1)	
Minor bleeding	6 (5.2)	8 (9.3)	
Minor infection	0 (0)	1 (1.2)	0.37
Minor bleeding and infection	6 5.2)	8 (9.3)	
Adhesion	1 (0.9)	0 (0)	
Other major	3 (2.6)	1 (1.2)	

NERD = patient-reported NSAID exacerbated respiratory disease; CRS = chronic rhinosinusitis; CT = computed tomography; LM = Lund-Mackay. P-values by Fisher´s exact test (dichotomous variables). P-values by Fisher´s exact test (dichotomous variables) and Mann Whitney U test (continuous variables). Bold text indicates a statistically significant difference with a p value less than 0.05. Bold and Italic text indicates a statistically significant difference after Bonferroni correction with a p value less than 0.003. Q1 and Q3 = 25th and 75th percentiles, respectively.

patients and under general anesthesia in 92 (43%) patients. Local anesthesia was more frequent ($p < 0.05$) in limited surgery group and in patients without co-morbid asthma or NERD. The anesthesia method was also dependent on the hospital,

with the southernmost centers, Helsinki University Hospital and Päijät-Häme Central Hospital, performing more operations under local anesthesia. Patients who underwent ESS with local anesthesia were less likely to need revision surgery in the five-year follow-up period. The following variables were significantly associated with ESS in local anesthesia after Bonferroni correction: limited surgical procedure, no asthma and no NERD (Table 2). No complete ESS was performed in local anesthesia (Table 2). The local and general anesthesia groups did not differ statistically ($p > 0.05$) in the following factors: gender, age, surgeon's experience, smoking habits, oral corticosteroid course, history of previous ESS, LM-score or complications (Table 2).

In univariate logistic regression models, general anesthesia was significantly associated with the following variables: Lund-Mackay score between 13 and 24 (LM 13-24) of baseline CT scans (OR 1.96, 1.04–3.70, $p = 0.036$); Tampere University Hospital, when using Helsinki University Hospital as the reference (OR 4.18, 1.43–12.21, $p = 0.009$) and, presence of co-morbid asthma and/or NERD (OR 10.1, 4.09–24.91, $p < 0.001$). When all three variables were added to the same multivariable model, the following variables were significantly associated with the general anesthesia: the presence asthma/NERD (OR 8.83, 3.43-22.74, $p < 0.001$) and the center (Tampere University Hospital) (OR 3.54, 1.12-11.25, $p = 0.032$). When age and sex were added into this multivariable model the result remained significant; the presence asthma/NERD (OR 8.94, 3.36-23.78, $p < 0.001$) and Tampere University Hospital (OR 3.66, 1.17-11.47, $p = 0.026$).

Risk of revision ESS among CRSwNP patients

Revision ESS was performed on 86/212 (40.4 %) CRSwNP patients on average (min-max) 5.9 (0-15) years after the time of performing the baseline ESS. In univariate Cox´s hazards models, when compared to non-revised patients, revision ESS was significantly associated with the following variables; LM 13-24 value of baseline CT scans (HR 1.97, 1.14–3.41, $p = 0.015$); general anesthesia (HR 1.84, 1.20–2.83, $p = 0.005$) and presence of co-morbid asthma and/or NERD (HR 3.47, 1.83–6.59, $p < 0.001$). When all three variables were added to the same multivariable model, only the presence asthma/NERD was significantly associated with the revision ESS (HR 2.68, 1.34-5.38, $p = 0.005$); p value for interaction asthma/NERD*anesthesia was 0.51, and asthma/NERD*LM 13-24 was 0.50. When added the Hospital center as the fourth variable of this multivariable model, the presence of asthma/NERD was significantly associated with the revision ESS (HR 2.77, 1.40-5.50, $p = 0.004$), whereas the anesthesia method or LM score were not.

Discussion

This retrospective cohort study was performed to characterize CRSsNP and CRSwNP patients who underwent ESS under local anesthesia. Overall, both CRS patient groups had ESS under local anesthesia more frequently than under general anesthesia: 57% in CRSwNP and 71% in CRSsNP.

The present study showed that in the CRSwNP group, less extensive ESS is performed under local anesthesia while more extensive ESS is performed under general anesthesia. This is in line with our prediction. General anesthesia is more likely preferred in more extensive and thus more time-consuming surgeries due to easier pain management and less patient co-operation required. A 2002 study of 1460 patients who underwent ESS between 1987-2001 concluded that local anesthesia is preferred in minor surgery while general anesthesia is preferred in most cases [19]. General anesthesia allows administration of hypotension inducing medications, such as dexmedetomidine, which provides less blood loss and improves surgical field during ESS1, which is beneficial in more extensive cases.

Our study interestingly found that there is a difference on the frequency of ESS performed under local anesthesia across centers in Finland. In the CRSwNP group, Tampere University Hospital preferred general anesthesia over local anesthesia (73.7% vs 26.3%), the southernmost hospitals preferred local anesthesia. This finding remained significant in multivariable models both in CRSsNP and CRSwNP groups. We have previously shown regional differences in ESS rate in Finland [20]. Hence, it seems that also regional variation extends to the anesthesia procedure. Center and geographical differences in anesthesia method could be explained by local hospital policies, allocation of resources or patient population.

Patients without asthma or NERD in the CRSwNP group were more frequently operated under local anesthesia. In our study, 91.3% of CRSwNP patients who had ESS under general anesthesia also had asthma. This finding also corresponds with our finding that CRSwNP patients who had ESS under local anesthesia were more unlikely to need revision surgery in the follow-up. Patients selected for local anesthesia might have more localised disease and less severe CRS without co-morbidities, which could naturally decrease the need for revision surgery. Patient feedback during local anesthesia may guide the surgeon to be more cautious and cause less mucosal trauma and scarring.

Studies comparing revision rates between local and general anesthesia are limited. A 2014 multicenter, randomized trial study compared in-office balloon dilation of the maxillary ostium and ethmoid infundibulum under local anesthesia with conventional ESS mostly under general anesthesia. It concluded a revision rate of 2.1% and 2.4% respectively, in a 1-year period [21]. Among the CRSwNP group of the current study, multivariable models showed that anesthesia form was not associated with revision ESS, whereas asthma/NERD was. This is in line with our previous findings that asthma/NERD increase the most the revision ESS

risk among CRSwNP patients [22]. CRSwNP patients with asthma often require repeated surgeries as shown by Chen et al. [23]. They followed 25 asthmatic patients for 3 years and concluded a revision ESS rate of 25%. Similarly, a systematic review by Adelman et al. [24] of patients with NERD in 18 studies (686 patients) concluded that 59.4% had had revision surgery. EPOS 2020 recommends extensive endoscopic sinus surgery (EESS) or radical sinus surgery for refractory CRS. It is then reasonable that patients with asthma or NERD have more extensive surgeries, due to the difficult-to-treat nature of disease, which would call for general rather than local anesthesia.

Older CRSsNP patients underwent ESS under general anesthesia more frequently. Older patients might be more likely to co-operate with the surgeon during local anesthesia. Also, local anesthesia could be safer in older patients and reduce nausea and post-surgery delirium [25]. It is also possible that elderly patients have more extensive disease, which would warrant local anesthesia, although there is little research on this topic. One explanation is that paediatric patients require more often general anesthesia due to challenges in cooperation. Yet this does not fully explain the difference between anesthesia method as the effect of age remained similarly significant when we observed only the CRSsNP group aged ≥ 18 years.

A 2019 study by Yancey et al. retrospectively analysed 403 CRS patients who underwent ESS and concluded that elderly patients (age ≥60) had lower postoperative SNOT-22 score improvements than young (age 18-39) or middle-aged (40-59) patients [26]. They also reported that prior ESS was more common in middle-aged and elderly patients.

As the study group hypothesised, there was no remarkable difference in other patient characteristics. Complication rate between local and general anesthesia did not differ statistically. However, our study does not recognize anesthesia complications such as nausea, emesis or analgesic requirements. There was no difference in local anesthesia rates between ENT residents or specialists. Literature emphasises that ESS with local anesthesia is beneficial to resident training, as it provides an extra level of safety operating on an alert patient [19,27], however, our results do not show this trend.

Hale et al. have emphasized the importance of combining decongestants with topical anesthetics [28]. This combination not only provides effective mucosal anesthesia but also reduces mucosal swelling, enhancing procedural visibility. Agents like lidocaine and tetracaine are often combined with decongestants such as oxymetazoline or phenylephrine to achieve optimal results. Unfortunately, data of this dual approach was not available in our study.

This study has several limitations. The sample size was small for clinically relevant conclusions. There might have been limitations in the variables collected from patient records. We acknowledge that lack of Sino-Nasal Outcome Test-22 (SNOT-22), olfaction tests and doses of medication limits the interpretation of the findings. A study from another group has shown that CRSwNP patients have a long-term 12-year postoperative improvement in nasal symptoms, polyp size, computed tomography, and olfaction [29]. Our analysis of revision surgery may have been influenced by several factors unrelated to recurrence of CRS, including waiting times for surgery and patients' preferences to delay surgery for personal reasons. Other factors that can also affect the timing of revision surgery include the patient's tolerance of recurrent sinusitis symptoms, the operative technique used at the time of the initial surgery, and the surgeon's opinion as to when revision surgery is clinically warranted. Additionally, an unknown number of patients who developed recurrence or exacerbations undoubtedly sought treatment elsewhere and/or were lacking electronic prescription data. It is assumed that these patients lost to follow-up were spread equally across demographic cohorts, although this assumption may be flawed.

Conclusions

Our study indicates a clear preference for local anesthesia in ESS among patients with CRSwNP and CRSsNP, with local anesthesia being preferred over general anesthesia in less extensive surgery, older patient groups and CRSwNP without co-morbidities. Regional differences were significant, hence indicating a need to unify practices in Finland. As there is little literature comparing patient characteristics and anesthesia method, further research is warranted.

Abbreviations

CT = Computed tomography; CRS = Chronic rhinosinusitis; ENT = ear nose and throat; ESS= endoscopic sinus surgery; LM= Lund-Mackay; NSAID= non-steroidal anti-inflammatory drug; NERD= NSAID exacerbated respiratory disease; OMC= Ostiomeatal complex; CRSsNP = Chronic rhinosinusitis without nasal polyps; CRSwNP = Chronic rhinosinusitis with nasal polyps.

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Authorship contribution

All authors participated in the planning and conception of the study and the analytical strategy and/or collection of data. ST-S and TK performed the data analyses and wrote the manuscript together with HK and JSA. All authors have assisted in data management, analyses and critical review of the manuscript.

Ethics approval and consent to participate

Ethical approval for the study (number 31/13/03/00/2015) was granted by the relevant Hospital Districts' ethical committee, with a waiver for written informed consent.

Consent for publication

Not applicable.

Availability of data and material

Due to Finnish data protection legislation, confidential, health-related data, the datasets produced and/or examined during this study are not accessible to the general public. They can solely be managed by designated individuals within the study group for specific research objectives. The datasets analyzed during the current study are available from the corresponding author upon reasonable request. Data use permissions can be applied from the competent authorities.

Conflict of interest

STS reports consultancies for AstraZeneca, Clario, Novartis, Sanofi Pharma, Roche Products, and grants from GlaxoSmithKline and Sanofi. All are outside the submitted work. All other authors declare no conflicts of interest.

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