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ORIGINAL CONTRIBUTION

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Safety and feasibility of endoscopic sinus surgery as an office-based procedure*

Sebastian Abrahamsson[1,2], Terhi Kolari[3], Jura Numminen[4], Heikki Irjala[1]

[1] Department of Otorhinolaryngology – Head and Neck Surgery, Turku University Hospital and University of Turku, Finland

[2] Department of Otorhinolaryngology, Seinäjoki Central Hospital, Finland

[3] Department of Biostatistics, University of Turku, Turku, Finland

[4] Department of Otorhinolaryngology - Head and Neck Surgery, Tampere University Hospital, Wellbeing Services County of Pirkanmaa and Faculty of Medicine and Health Technology, Tampere University, Finland

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Abstract

Background: The purpose of this study was to evaluate whether office-based endoscopic sinus surgery (ESS) is as safe as traditional outpatient surgery and whether there are differences in the operation results, patient recovery data, or complication and revision surgery rates.

Methods: The study involved 164 subjects and data was collected retrospectively from Seinäjoki Central Hospital patient records. The office-based group included 92 patients who had undergone ESS under local anaesthesia in an office-based setting between April 2014 and December 2017, and the outpatient group 72 patients who had done so in an outpatient setting between January 2010 and December 2014. Patients were divided into two groups based on presence (wNPs, n=57) or absence (sNPs, n=107) of nasal polyps.

Results: We found statistically significant differences in intraoperative medication in terms of amounts of drugs administrated. Sick leave was on average 2.1 days longer in the outpatient sNPs group and 2.4 days longer in the outpatient wNPs group than in the respective office groups. There were no statistically significant differences between methods in terms of complications. Revision rates for sNPs were 5.6% and 13.9% for the office and outpatient groups, respectively, and for wNPs 4.8% and 19.4%, respectively.

Conclusion: Office-based ESS with careful patient selection seems safe, effective, and well tolerated by patients. Office-based intervention may lead to shorter sick leave durations and can reduce the overall use of sedative drugs during the operation.

Key words: office-based, outpatient, endoscopic sinus surgery, sick leave

Introduction

Outpatient or day surgery is the gold standard for many surgical procedures in rhinology. Recent technical developments and growing economic interests have raised the issue of whether it would be safe and more efficient to perform at least some of these operations in the office. Office-based surgery means that the planned surgical procedure is performed by the surgeon in an office-based setting. In this study, outpatient surgery refers to traditional day surgery or ambulatory surgery done in operating room (OR) and the patient being discharged the same day. Office-based surgery here refers to surgery done in an office-based setting by an otorhinolaryngologist and two assisting nurses without an anaesthesiologist. Office-based patients are discharged after the operation and a predetermined monitoring time.

Chronic rhinosinusitis (CRS) is one of the most common chronic inflammatory diseases, and the financial burden on society is significant compared to that imposed by patients without CRS [1–5]. In a large European study, CRS prevalence rates varied between 6.9% and 27.1%, averaging 10.9%. In the same material, the prevalence rate in Helsinki, Finland, was 7.7% [5]. Using the European position paper on rhinosinusitis and nasal polyps (EPOS) criteria to determine the average prevalence rate in the U.S., this is estimated to be around 11.9% [1,6]. Clearly, the burden that CRS imposes on the public economy is substantial, thus it is

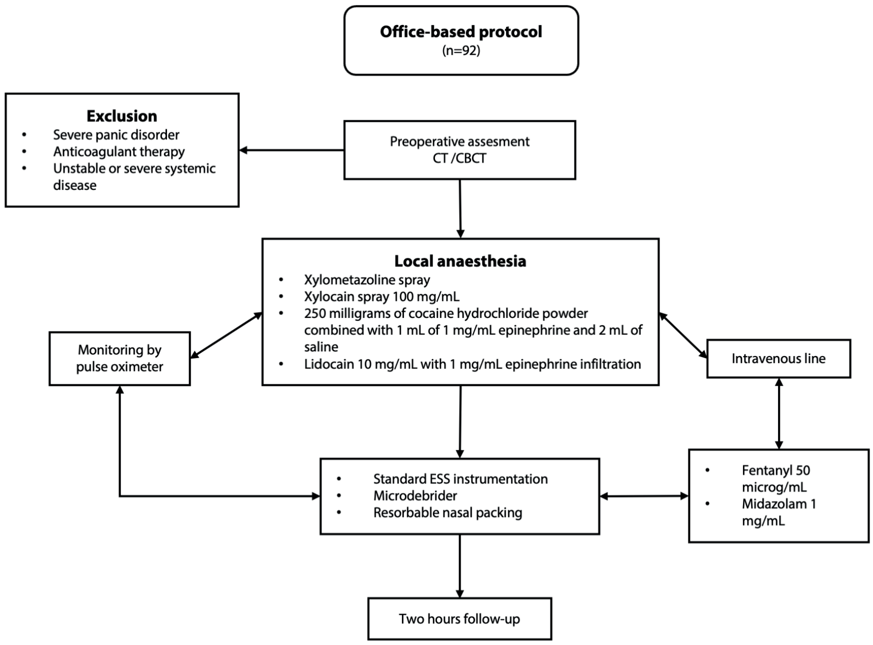

Figure 1. Office-based protocol. In most cases patients were lightly sedated with fentanyl 50 microg/mL (Office sNPs 80.3%, office wNPs 95.2%), the most common dose being 50 microg or less (50 microg; office sNPs 66.2%, office wNPs 61.9%). In most cases midazolam 1 mg/mL (office sNPs 90.1%, office wNPs 100%) was also used, the typical dose being 1.0 mg or less (office sNPs 80.3%, office wNPs 90.5%). Only in two cases (2.8%) in the group office sNPs was a larger amount of 100 microg fentanyl and 1.5 mg midazolam used.

very important in what manner and how efficiently we organize treatment for this group of patients. Just as important as finding more efficient treatments is being able to do so without compromising on their quality [3].

According to a large nationwide study, a total of 9640 ESS operations were conducted in Finland between 2013 and 2015, with a mean rate of 0.71 procedures per 1000 inhabitants. Of all the procedures, 87% were performed by the public health care system and 79% in outpatient setting [7]. Office-based ESS under local anaesthesia has been performed in Finland in its current form since April 2014. The purpose of this study was to compare the safety and efficiency of office-based ESS with traditional outpatient ESS outcomes.

Patients and methods

This retrospective study was carried out at the Department of Otorhinolaryngology of Seinäjoki Central Hospital between 2010 and 2017. The data covers two groups of patients: an office-based group (office) comprising those who had undergone ESS under local anaesthesia in an office-based setting between April 2014 and December 2017, and an outpatient group (outpatient) of patients who had undergone ESS under local anaesthesia in an outpatient setting between January 2010 and December 2014. Altogether 164 subjects were included in the study: 92 in the office-based group and 72 in the outpatient group. The patients in each group were further divided in two groups based on presence (wNPs) or absence (sNPs) of nasal polyps. Surgery was performed by a senior otorhinolaryngologist. Regarding chronic systemic diseases, we collected data posing potential risks during surgery under local anaesthesia and/or possible effects of the disease on the outcome. Other medical conditions were omitted from the analysis. For the original indication for surgery, we used the ICD-10 coding to determine whether rhinosinusitis was recurrent acute rhinosinusitis (RARS), CRS, or allergic fungal rhinosinusitis (AFRS) and if polyposis was present. While collecting the data concerning preoperative diagnosis, we noticed that in some cases patient´s with polyposis were given only CRS diagnosis while patient records indicate polyposis to be present. Some patients also had more than one preoperative diagnosis. This explains the slight imbalance in total diagnosis count in Table 1. Regarding complications we registered all cases of postoperative bleeding that needed some level of treatment by a physician, any adhesion leading to later revision, fever during the first postoperative days, and clinically confirmed postoperative infections. We also noted any problems leading to inpatient care. Some patients in both groups were not prescribed any sick leave because of retiree or student status. They were excluded from the analysis to determine realistic sick leave rates prescribed by physicians.

Inclusion criteria were all patients aged over 15 years at the time of surgery and a minimum follow-up period of 12 months. The shortest follow-up period in our material was 1 year and 5 months and the longest 8 years and 4 months. Balloon sinuplasty patients were excluded.

Table 1. Summary of preoperative indications.

	sNPs		wNPs	
	Office n (%)	Outpatient n (%)	Office n (%)	Outpatient n (%)
CRS	48 (67.6)	19 (52.8)	8 (38.1)	11 (30.6)
RARS	19 (26.8)	8 (22.2)	0	0
AFRS	3 (4.2)	3 (8.3)	0	1 (2.8)
Polyposis	0	0	17 (90)	21 (58.3)
Turbinate hypertrophy	5 (7.0)	0	1 (4.8)	1 (2.8)
Deviated nasal septum	4 (5.6)	1 (2.8)	1 (4.8)	1 (2.8)
Maxillary sinus cyst	1 (1.41)	5 (13.9)	0	2 (5.6)

Table 2. Operation demographics.

	sNPs			wNPs		
	Office n (%)	Outpatient n (%)	p-value	Office n (%)	Outpatient n (%)	p-value
ESS	71	36		21	36	
Primary ESS	60 (84.5)	30 (83.3)	1.0	13 (61.9)	26 (72.2)	0.56
Revision ESS	11 (15.5)	6 (16.7)		8 (38.1)	10 (27.8)	
ESS + septoplasty	5 (7.0)	1 (2.8)	0.66	0	1 (2.8)	1.0
ESS + lower turbinate radiofrequency tissue ablation	0	2 (5.6)	0.11	0	0	

Surgical technique

ESS was performed under local anaesthesia. There were both primary and revision operations, and in some cases also additional septoplasties and lower turbinate radiofrequency tissue ablations (Table 2). In general, the operations included middle meatal antrostomies with or without anterior ethmoidectomy and in case of nasal polyps also polypectomy was included as a natural part of the operation. There were also some revision cases where only polypectomy was done. These patients had however beforehand been more widely operated. The main reason to do revision surgery was remerging nasal polyps. In some cases, there were adhesion in the middle meatus and the patients' complaints about pressure and poor airflow.

The office-based protocol (Figure 1) included a preoperative assessment by an otorhinolaryngologist, during which patient-related factors and possible surgical risks to the patient were considered. Computer tomography (CT) or cone beam computer tomography (CBCT) scans were performed together with an endoscopic examination. If the operation criteria were met and there were no contraindications for operating under local anaesthesia, such as severe panic disorder, anticoagulant therapy, or unstable or severe systemic disease, the patient was scheduled for surgery in an office-based setting. The process was designed to minimize patient waiting time in the hospital prior to the operation. Operating personnel consisted only of an otorhinolaryngologist and two assisting nurses. In the outpatient department a separate large office room was used for operating. Standard ESS instrumentation and a microdebrider were used and in most cases resorbable nasal packing was inserted to minimize postoperative bleeding. Patients were monitored with a pulse oximeter. After surgery the patients were monitored in the recovery room by a third nurse for 2 hours before discharge. The general protocol for outpatient surgery was similar to that for the office-based setting, but surgery was performed in an OR equipped with full anaesthesia machinery and monitoring capability. In the outpatient protocol more personnel were involved and included an otorhinolaryngologist, an anaesthesiologist, three assisting nurses, and a fourth nurse in the recovery room.

Statistical methods

Continuous variables were expressed as means and standard deviations and categorical variables as counts (n) and percentages. Associations between categorical data were analysed with Fisher's exact test. Comparisons of continuous variables were performed with one-way analysis of variance (ANOVA).
The Cochran-Armitage trend test was used to evaluate intraoperative medication.
Differences between methods and other possible risk factors for complications were analysed using binomial logistic regression.

Table 3. Patient demographics.

	sNPs			wNPs		
	Office n (%)	Outpatient n (%)	p-value	Office n (%)	Outpatient n (%)	p-value
Sex						
Male	27 (38)	17 (47)		12 (57)	23 (64)	
Female	44 (62)	19 (53)		9 (43)	13 (36)	
Age, median (range)	41.9 (21.5–75.2)	42.2 (19.0–65.5)	0.51	47.9 (25.4–67.6)	49.4 (16.1–71.6)	0.45
Smoking	6 (8.5)	8 (22.2)	0.21	1 (4.8)	7 (19.4)	0.86
Allergy						
Pollen	15 (21.1)	7 (19.4)	1.0	8 (38.1)	4 (11.1)	0.02
ASA	0	2 (5.6)	0.11	1 (4.8)	7 (19.4)	0.24
Coronal disease	0	0		1 (4.8)	0	0.37
Arterial hypertension	8 (11.3)	7 (19.4)	0.26	3 (14.3)	3 (8.3)	0.66
Atrial fibrillation	0	0		1 (4.8)	0	0.37
Asthma	4 (5.6)	5 (13.9)	0.16	1 (4.8)	16 (44.4)	0.002
Eosinophilia	0	0		1 (4.8)	1 (2.8)	1.0
Chronic rhinitis	1 (1.4)	0	1.0	1 (4.8)	0	0.37
Work related allergic rhinitis	0	1 (2.8)	0.34	1 (4.8)	1 (2.8)	1.0
Allergic rhinitis	2 (2.8)	1 (2.8)	1.0	1 (4.8)	2 (5.6)	1.0
Sleep apnoea with CPAP	0	0		1 (4.8)	0	0.37
Diabetes						
Type I	0	0		0	0	
Type II	3 (4.2)	0		1 (4.8)	2 (5.6)	1.0
Panic disorder	2 (2.8)	0	0.55	0	0	
Depression	3 (4.2)	1 (2.8)	1.0	0	0	
Mucosal obstruction on CT imaging						
Maxillary sinuses	15 (21.1)	18 (50.0)	0.0037	9 (42.9)	13 (36.1)	0.78
Ethmoid cells	8 (11.3)	11 (30.6)	0.0177	6 (28.6)	12 (33.3)	0.77
Mucosal obstruction on CBCT imaging						
Maxillary sinuses	9 (12.7)	8 (22.2)	0.26	4 (19.1)	9 (25.0)	0.75
Ethmoid cells	3 (4.2)	5 (13.9)	0.12	4 (19.1)	9 (25.0)	0.75

Odds ratios (ORs) with 95% confidence intervals were reported. First a univariate analysis was performed, then each factor was added to the model including the method and interaction between factor and method. When only non-significant factors were found, no other multivariate model was constructed.
All tests were performed as two-sided with a significance level set at 0.05. The analyses were carried out using the SAS System, version 9.4, for Windows (SAS Institute Inc., Cary, NC, US).

Ethical considerations

This study was approved by the institutional Research Ethics Board of Turku University Hospital (record number: 2/1801/2018). In addition, an institutional research permission was granted by the Hospital District of South Ostrobothnia (§183).

Results

The patient characteristics are shown in Table 3. The groups did not differ statistically significantly regarding smoking or chronic systemic diseases, except for a higher prevalence of asthma in the outpatient wNPs. There was also a higher prevalence of pollen allergy in office wNPs. When comparing the imaging results, we registered possible mucosal thickening and obstruction in the paranasal sinuses on CT or CBCT scans to determine if the patient had clinical signs of rhinosinusitis. We found a higher prevalence of mucosal obstruction in both the maxillary and ethmoidal sinuses in the outpatient sNPs group compared to respective office sNPs group. In terms of preoperative Lund-Mackay scores there was 1.9 scores (95% CI 0.2, 3.6) difference between the groups (p=0.028). The outpatient's mean was 9.5 (95 % CI 8.3, 10.8) and the office's mean was 7.6 (95% CI 4.5, 8.8). We found statistically significant differences in the intra- and perioperative medication concerning amounts of drugs admi-

Table 4. Intraoperative medication.

	sNPs			wNPs		
	Office n (%)	Outpatient n (%)	p-value	Office n (%)	Outpatient n (%)	p-value
Midazolam (mg)			0.08			0.009
0	7 (9.9)	20 (55.6)		0	25 (69.4)	
0.5	5 (7.0)	0		2 (9.5)	0	
1.0	57 (80.3)	9 (25.0)		19 (90.5)	5 (13.9)	
1.5	2 (2.8)	1 (2.8)		0	0	
2.0	0	5 (13.9)		0	6 (16.7)	
8.0	0	1 (2.8		0	0	
Fentanyl (microg)			<0.001			0.048
0	14 (19.7)	9 (25)		1 (4.8)	10 (27.8)	
25	8 (11.3)	0		7 (33.3)	1 (2.8)	
50	47 (66.2)	8 (22.2)		13 (61.9)	7 (19.4)	
75	0	5 (13.9)		0	6 (16.7)	
100	2 (2.8)	8 (22.2)		0	8 (22.2)	
125	0	2 (5.6)		0	2 (5.6)	
175	0	3 (8.3)		0	2 (5.6)	
200	0	1 (2.8)		0	0	
Propofol (mg)			<0.001			0.003
0	71 (100)	27 (75.0)		21 (100)	28 (77.8)	
20	0	4 (11.1)		0	1 (2.8)	
40	0	2 (5.6)		0	3 (8.3)	
60	0	1 (2.8)		0	1 (2.8)	
80	0	1 (2.8)		0	1 (2.8)	
90	0	1 (2.8)		0	1 (2.8)	
110	0	0		0	1 (2.8)	
Stesolid (mg)			<0.001			<0.001
0	71 (100)	26 (72.2)		21 (100)	27 (75.0)	
2.5	0	2 (5.6)		0	1 (2.8)	
5.0	0	4 (11.1)		0	2 (5.6)	
7.0	0	0		0	1 (2.8)	
7.5	0	2 (5.6)		0	0	
10.0	0	2 (5.6)		0	5 (13.9)	

nistrated and the variety of drugs used (p=<0.0001). Clinically the most important differences were found when comparing the groups for sedative drugs (Table 4). Whereas in the office protocol the variety of sedatives was limited to fentanyl and midazolam because of the strictly validated process, the range of drugs in the outpatient group was wider.

Comparing prescribed sick leave in terms of days, we found that sick leave was longer in both outpatient groups (Table 5). When comparing the means, we found out that sick leaves were 2.1 days longer in the outpatient sNPs (p=0.001) and 2.4 days longer in the outpatient wNPs (p=0.0009) groups compared to the respective office groups.

There were no statistically significant differences between methods in terms of complications (OR 1.13, 95% CI: 0.39, 3.28, p=0.82). Nor were nasal polyps or secondary operation associated with complications (nasal polyps OR 0.93, 95% CI: 0.30, 2.87, p=0.93; secondary operation OR 0.24, 95% CI 0.03, 1.90, p=0.18). The association with intraoperative medication was non-significant (OR 1.01, 95% CI: 0.91, 1.11, p=0.90). Complications were minor or moderate and no major complications were found (Table 6). None of the complications were perioperative. In the office group two patients were hospitalized postoperatively - one for 2 days due to postoperative bleeding and one for 4 days due to fever and nausea. No other significant signs of postoperative infection were found, and the cause of the fever remained unknown. In the outpatient group two patients were hospitalized postoperatively - one patient for 1 day due to postoperative bleeding and the other for 2 days due to a clinically verified infection. When comparing hospitalization rates, however, there were no statistically significant differences (sNPs p=0.26 and wNPs p=0.61). The revision rates between the groups were 5.6% for office sNPs and 13.9% for outpatient sNPs (p=0.16), and 4.8% for office wNPs and 19.4% for outpatient wNPs 19.4 % (p=0.24).

Discussion

In recent decades, advances in endoscopic instrumentation have led to ever growing possibilities in the field of rhinological surgery and mounting interest in office-based procedures to gain shorter waiting times and possibly economic advantage without compromising patient safety. Still, only a few studies have been done on office-based ESS under local anaesthesia including middle meatal antrostomies and anterior ethmoidecto-

5. Sick leave (days).

		n	Mean	Lower 95% CL for mean	Upper 95% CL for mean	Minimum	Maximum	p-value
sNPs	Office	62	10.6	9.8	11.3	5.0	19.0	0.001
	Outpatient	32	12.7	11.5	13.8	7.0	20.0	
wNPs	Office	15	10.9	9.4	12.5	5.0	16.0	0.0009
	Outpatient	31	13.3	12.3	14.3	7.0	17.0	

Table 6. Summary of postoperative complications

Type of complication	Office n (%)	Outpatient n (%)
Postoperative bleeding	4 (4.3)	1 (1.4)
Adhesion leading to revision	0	1 (1.4)
Fever	2 (2.8)	0
Infection	2 (2.8)	4 (5.6)
Pneumonia	0	1 (1.4)
Overall	8 (8.7)	7 (9.7)

mies. To date, the largest individual study is that by Scott et al. of 315 patients of whom 118 underwent ESS. The study reported a low complication rate and low revision rate in patients operated on in an office-based setting [8] but lacked a control group.
In our study we retrospectively analysed patients who had undergone ESS in both office-based and outpatient groups. Patients in the outpatient group tended to receive more sedatives during the operative process, even when the original plan was to operate under local anaesthesia. This could have to do with patient-related factors but raises the question of whether all the sedatives were strictly necessary or whether they were given somewhat automatically as part of the process. Since the use of opioids and other sedatives is a constant matter for debate and the risks and side effects are well known, every effort should be made to avoid excessive use of sedatives [9–11]. Given the nature of the office-based process, it makes sense to question whether such drugs are needed at all in this setting. In our retrospective series, however, they were generally used in small amounts in office-based setting with no perioperative complications. The operating surgeons operating in the office-based setting were familiar to use safely sedatives like fentanyl and midazolam. The amounts of these medicines were with a broad safety margin but enough to relief the pain and anxiety.
Protocols for prescribing sick leave after surgery vary widely between societies and clinics. In many centres it is common practice to prescribe standard sick leave durations for certain operations. The question arises as to what is sufficient, when some patients may need more leave and for many others the duration is far too long [12]. For any physician, evaluating a suitable duration of sick leave is demanding and variable and requires consideration of both patient and clinical factors and enough knowledge of the patient's own work assignment. Prolonged sick leave absences have a significant effect on public and private sector health care costs, as well as on patients' socioeconomic factors, and should be avoided by any means necessary [13]. Interestingly, in our study, prescribed sick leave rates were higher in both outpatient groups with no major difference between patient demographics. One factor was most likely that the outpatient cases were more severe, and surgeons assessed longer sick leaves. This still raises several questions as to whether the prescribed sick leaves were in fact necessary.
The decadelong debate on tailoring appropriate individual sick leave may have affected our patient series, since the outpatient group was mostly from the early part of the decade. It does not, however, explain the whole difference and the reason is probably far more complex. It could well be that the lighter process of operating in an office-based setting means that patients who previously were prescribed longer sick leaves coped very well with the shorter durations prescribed in this setting. It could also have cut sick leave rates in the outpatient protocol if compared with today's patients. It also appears that the easier office-based setting does not affect patients mentally as much as having them in the OR and they therefore cope better with shorter sick leaves. This is, however, speculative and further studies on patient satisfaction are needed. Nonetheless, the results do indicate that earlier sick leave durations have been unnecessarily long and that this new protocol has had some effect on shortening them generally. Patient-related factors could also partly account for the tendency to prescribe longer sick leaves in the outpatient protocol, but the same question on the possible effects of the setting remains. Since the absolute number of sick leave days plays a major role in the total costs of treatment, physicians should carefully take this into account.
There was no statistically significant difference in complications between the groups, underlining the safety of office-based surgery in relation to the more traditional approach of operating in the OR. This study shows that in this small cohort there is no significant difference in operating safety or patient recovery. Absolute patient numbers should, however, be larger before drawing final conclusions and further studies are required. Patients

in the outpatient group had somewhat stronger symptoms and more significant CT scan results, but this is the natural outcome of the protocol determining which patients were suitable for an in-office procedure. At the same time the retrospective nature of the study and the possible selection bias due to that is a matter to discuss. Mostly the fact that because of the selection process more severe cases were selected to be operated in the outpatient setting. This should be kept in mind when reading the results and making conclusions about patient safety comparability. This kept in mind in this small cohort results show that with the right patient selection, an office-based setting seems to be a safe and efficient way to treat patients with rhinosinusitis but leaves out the possibility to discuss how more difficult cases could be operated in the office.

Revision rates in both office-based groups were low compared to outpatient groups, the shortest follow-up time being 1 year and 5 months. The relatively longer follow-up time in the outpatient group and the more severe symptoms can to some extent explain the difference. Nevertheless, it is clear that operating in an office-based setting did not lead to higher revision rates. Therefore, with carefully selected patients it should be possible to offer the same level of surgery in office-based settings as in outpatient settings. This could generate not only savings in costs, but also greater efficiency in public health care if this could be extended to other types of surgery.

In our series, patient selection relied solely on the surgeon's experience and knowledge of the operation methods. All our patients were operated on by an experienced otorhinolaryngologist. This could be a factor leading to lower complication rates, making it important to find validated methods for helping less experienced physicians select patients appropriately. In preoperative risk evaluation both the patient's medical condition and socioeconomic factors should be carefully examined, as well as factors related to the planned procedure. The American Society of Anesthesiology comorbidity score provides some guidelines for preoperative assessment but is not alone sufficient to make the final decision whether to operate in an office-based or outpatient setting [14–17]. The day surgery risk score is easy to use and can provide some tools for less experienced physicians, but it seems not to predict whether a complication is more likely to occur [18]. The nature of office-based surgery means that it is hard to design an accurate schematic protocol for patient selection that would apply in all cases. Therefore, patient selection in our experience should always be done individually based on the patient's medical and socioeconomic factors and the physician's assessment of the patient's mental capacity to undergo the procedure. The operating process should be carefully explained to the patient, and both the surgeon and the patient should be conformable with the decision.

The main differences that emerge between office-based and outpatient protocols are more personnel, better monitoring possibilities, presence of an anaesthesiologist, and the availability of general anaesthesia in an outpatient setting. If we consider only patients operated under local anaesthesia, the selection process is similar in both settings. This does not include patients who need closer monitoring or the possibility to convert to general anaesthesia. In our series there were no significant differences in patient recovery or their ability to undergo office-based operations. Thus, the discussion as to whether EES patients who have earlier undergone outpatient procedures under local anaesthesia should in future pass to an office-based setting is entirely relevant.

While some cost analyses seem to indicate that office-based procedures would lead to substantial cost savings in hospital charges [19], more studies are needed to evaluate the total costs of these methods and reveal any hidden costs. It has been suggested that if the possible hidden costs of personnel and sick leave were considered, the office-based protocol could generate even greater savings. That has yet to be seen, and further studies are needed on the economic benefits and results of patient satisfaction. Given that a massive 79% of ESS procedures are performed in outpatient clinics in Finland [7], this is a highly relevant issue. We plan to address these factors in future studies, with a closer look at the possible cost-saving aspects of office-based operating procedures compared to the traditional outpatient process, and patient satisfaction with these two methods.

The main weaknesses of this study are its retrospective nature and small group size. Other weakness has to do with the fact that what level of surgery would be sufficient in patients with CRSwNP today. This article concentrated solely on comparing the two operating protocols and the matter how widely patients should in general be operated is outside of the article's spectrum.

Conclusions

According to this study it seems that office-based ESS with careful patient selection could be safe, effective, and well tolerated by patients. A carefully laid out office-based protocol may lead to shorter sick leave absences and reduce the overall use of sedatives during surgery. An office-based protocol offers a clear and efficient alternative to traditional day surgery and can in the future play a major role when considering the best and most efficient way to treat patients with rhinosinusitis. Absolute patient numbers should however be larger before drawing any final conclusions, and further studies are required. To our knowledge this study was the first controlled patient series of its kind to be published concerning office-based ESS.

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Authorship contribution

SA developed the idea, designed the study, performed data acquisition, and drafted the manuscript. HI, JR, and TK revised the manuscript and took part in the drafting process. Statistical evaluation was provided by TK. All the authors have read and approved the final version of the manuscript.

Ethics approval and consent to participate

This study was approved by the institutional Research Ethics Board of Turku University Hospital (record number: 2/1801/2018).

Availability of data and materials

Because of the legislation and the law on personal data protection it is not possible to openly give out the patient data even if anonymized. However, the datasets used and analysed during the current study are available from the corresponding author on request.

Conflict of interest

The authors declare that they have no competing interests.

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Sebastian Abrahamsson
Department of Otorhinolaryngology
Head and Neck Surgery
Turku University Hospital
and University of Turku
Finland

Tel. +35-823130055
E-mail:
sebastian.abrahamsson@tyks.fi