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Post-operative treatment patterns after functional endoscopic sinus surgery: A survey of the American Rhinologic Society☆

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1. Introduction

Chronic Rhinosinusitis (CRS) is a disabling condition with profound health and financial implications. Standardizing the medical, perioperative and post-operative care of CRS is especially helpful in an era where the societal cost of CRS ranges from $6.9 to $9.9 billion yearly [1]. Consensus guidelines are currently available that establish norms and standards after sinus surgery and more broadly in the overall management of sinus disease [2–4]. Our study reinforces and builds upon existing data concerning post-operative trends and strategies after sinus surgery generally and for patients with CRS with (CRSwNP) and without (CRSsNP) nasal polyposis.

2. Methods

A 31-item electronic survey was designed with Survey Monkey (San Mateo, CA) (Supplemental 1). 1270 ARS members were electronically sent the survey. Two emails were sent over one week to request survey completion. All responses were recorded anonymously with no identifying information collected. Demographic information collected from each respondent included clinical practice type (private practice, academic institution, public hospital/clinic, or mixed practice), practice duration, and geographic location. Practice volume was assessed by ascertaining the number of FESS's performed monthly by each respondent.

Post-operative prescription use patterns were assessed by examining whether or not practitioners used oral antibiotics, antibiotic irrigations, oral steroids, and topical steroids in the post-operative setting. For each category, the specific antibiotics or steroids used were elucidated. Respondents were able to select more than one prescription type per category. Length of prescribed antibiotic or steroid course was also assessed. In addition, prescription practices in the setting of CRS with polyps (CRSwP) and CRS without polyps (CRSsP) were examined. Practitioners were asked whether they used topical saline rinses, topical steroid sprays or rinses, topical antibiotic rinses, oral antibiotics, oral steroids, and drug-eluting or non-drug eluting spacers in either setting. Respondents additionally had the option of writing in their response, which was incorporated into the analyses when appropriate.

Complete surveys only were included in our analysis. Data were analyzed using SPSS (Version 21.0.0.0). Practice length, case volume, and practice type responses were dichotomized into early career surgeons (practice length 0–5 years) vs. experienced surgeons (> 5 years), low volume (0–12 FESS/month) vs. high volume surgeons (> 12 FESS/month, and private practice vs. academic/public practice surgeons, respectively. Descriptive statistics were calculated to present overall use patterns, as well as those for practice length, case volume and practice type categories described above. Fisher's exact test was conducted to test for statistical significance between groups. A p-value of < 0.05 was considered statistically significant.

3. Results

3.1. Demographics

Demographic data was collated. 104 ARS members responded to the questionnaire, comprising 8.2% of emailed members. The majority of respondents were in private practice (56.7%), 45.2% were in practice for > 20 years at the time of the survey, 77.9% performed more than five sinus surgeries monthly with 31.7% performing > 12 sinus surgeries monthly. Geographic data was evenly split between the US regions as well as 12.5% international members (Table 1).

3.2. Post-operative prescribing practices for CRS without polyps.

For CRSsNP, 69.2% of surgeons as an aggregate prescribed topical saline rinses after sinus surgery. Relatively more of the early career surgeons prescribed topical steroid rinses compared with their more experienced peers. Higher volume surgeons more frequently prescribed

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Table 1
Respondent demographics.

	(%)
Practice duration	
0–5 years	15.4%
5+ years	84.6%
5–10 years	13.5%
10–20 years	26.0%
20+ years	45.2%
FESS monthly	
0–12/month	68.3%
12+/month	31.7%
Geographic location	
Northeast	26.9%
South	23.1%
Midwest	16.3%
West	21.2%
Other	12.5%

topical steroid *rinses* and compared with lower volume surgeons who more often prescribed topical steroid *sprays*. Higher volume surgeons more often used a non-drug eluting spacer compared with lower volume surgeons, but overall the frequency of use was very low. Academic surgeons more frequently prescribed topical steroid rinses, less frequently prescribed oral antibiotics and oral steroids, and less often used drug- and non-drug eluting spacers than their private-practice peers. Early career surgeons more often prescribe topical steroid rinses (43.8% versus 14.8%, p = 0.018). Additionally, private practice surgeons were more likely to prescribe oral steroids in post-FESS CRS patients without polyposis (30.5% versus 11.1%, p = 0.034) (Table 2). 47% of surgeons did not placed drug-eluting stents in CRSsNP.

3.3. Post-operative prescribing practices for CRS with polyps

For CRSwNP, 66.3% of respondents provided their patients with topical steroid rinses, 58.7% offered this cohort oral steroids, 52.9% of surgeons used a drug-eluting spacer, and approximately half sent their patients home with topical saline rinses. Early career surgeons more frequently sent their patients home on intranasal steroid irrigations and topical saline rinses compared to more experienced peers. Lower volume and high volume surgeons frequently sent their patients home on topical steroid rinses, oral steroids, and a little over half in each groups used drug eluting spacer intra-operatively. There was concordance by and large when comparing private versus academic surgeons, with some differences including a higher degree of private surgeons prescribing oral antibiotics, and using drug-eluting spacers (Table 3). 27% of respondents reported using a drug eluting stent during 75% of cases involving nasal polyps. In both CRSsNP and CRSwNP, when stents were placed, the majority were inserted into the frontal and ethmoid sinuses (42%), followed by placing into the frontal sinuses only (18%), and ethmoid sinuses only (14%) (data not shown).

3.4. Post-operative antibiotic prescribing practices

76.9% of all respondents prescribed an antibiotic of some form, with 37.5% prescribing their patients a course of augmentin. Early career surgeons more often prescribed augmentin and doxycycline, 76.1% of lower volume and 78.8% of higher volume surgeons prescribed any antibiotic after surgery, and there were minimal differences between practice type and antibiotic prescription patterns. 50% of surgeons provided oral antibiotics for a duration of 7–14 days. Early career surgeons more often prescribed augmentin (63.5% versus 33.0%, p = 0.049) and Doxycycline relative to more experienced peers (43.8% versus 4.5%, p < 0.001). High volume surgeons were also more likely to prescribe doxycycline (21.2% versus 5.6%, p = 0.039) (Table 4).

3.5. Antibiotic irrigations

47 respondents reported using post-operative antibiotic irrigations (Table 3). Less than half of early career and experienced sinus surgeons prescribed antibiotic irrigations. Aminoglycoside and mupirocin irrigations were the most commonly prescribed topical agents. A similar prescribing trend was noted among high versus lower volume surgeons. 54.2% of Private surgeons prescribed an antibiotic irrigation compared with 33.3% of their academic peers (p = 0.047). A few respondents incorporated several antibiotics into their irrigation regiments, but this was infrequent. These included mixtures of an aminoglycoside with bacitracin, clindamycin, a fluoroquinolone, mupirocin, a cephalosporin, or some combination therein. The decision to prescribe varied, with many respondents citing culture results (68.0%), an infected surgical field (38.2%), recalcitrant infection or treatment failures (6.38%), or use in patients who cannot tolerate antibiotics (6.38%). Duration of irrigations varied, with most respondents utilizing a > 21 day course (45.7%), followed by a 14–21 day course (31.4%) (Table 5).

3.6. Oral steroids

77.9% of respondents used a post-operative steroid. 66.3% selected prednisone as their agent of choice, followed by methylprednisolone (12.5%). Early career surgeons were more likely to prescribe prednisone (93.8% versus 61.4%, p = 0.01), high volume surgeons were more likely to prescribe any steroid (93.9% versus 70.4%, p = 0.032), and academic surgeons relative to their private peers were more likely to prescribe any steroid (88.9% versus 69.5%, p = 0.037) and prednisone (77.8% versus 57.6%, p = 0.03). Indications for steroid use

Table 2
Post-operative prescribing practices for CRS without polyps.

		Topical saline rinses	Topical steroid sprays	Topical steroid rinses	Oral steroids	Oral antibiotics	Topical antibiotic rinses	Non-drug eluting spacer	Drug- eluting spacer
	n	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Total	104	72 (69.2)	48 (46.2)	20 (19.2)	23 (22.1)	40 (38.5)	4 (3.8)	10 (9.6)	12 (11.5)
Experience									
Early career (0–5)	16	12 (75.0)	9 (56.2)	7 (43.8)*	4 (25.0)	6 (37.5)	1 (6.2)	0 (0.0)	2 (12.5)
Experienced (5+)	88	60 (68.2)	39 (44.3)	13 (14.8)	19 (21.6)	34 (38.6)	3 (3.4)	10 (11.4)	10 (11.4)
FESS									
0–12	71	50 (70.4)	37 (52.1	10 (14.1)	16 (22.5)	25 (35.2)	2 (2.8)	4 (5.6)	7 (9.9)
12+	33	22 (66.7)	11 (33.3)	10 (30.3)	7 (21.2)	15 (45.5)	2 (6.1)	6 (18.2)	5 (15.2)
Practice type									
Academic/public	45	33 (73.3)	21 (46.7)	11 (24.4)	5 (11.1)	13 (28.9)	1 (2.2)	3 (6.7)	4 (8.9)
Private	59	39 (66.1)	27 (45.8)	9 (15.3)	18 (30.5)**	27 (45.8)	3 (5.1)	7 (11.9)	8 (13.6)

* p = 0.018.
** p = 0.034.

Table 3
Post-operative prescribing practices for CRS with polyps.

		Topical saline rinses	Topical steroid sprays	Topical steroid rinses	Oral steroids	Oral antibiotics	Topical antibiotic rinses	Non-drug eluting spacer	Drug- eluting spacer
	n	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Total	104	51 (49.0)	43 (41.3)	69 (66.3)	61 (58.7)	38 (36.5)	10 (9.6)	7 (6.7)	55 (52.9)
Experience									
Early career (0–5)	16	11 (68.8)	5 (31.2)	14 (87.5)	13 (81.2)	5 (31.2)	1 (6.2)	0 (0.0)	8 (50.0)
Experienced (5+)	88	40 (45.5)	38 (43.2)	55 (62.5)	48 (54.5)	33 (37.5)	9 (10.2)	7 (8.0)	47 (53.4)
FESS									
0–12	71	35 (49.3)	31 (43.7)	44 (62.0)	38 (53.5)	25 (35.2)	7 (9.9)	2 (2.8)	36 (50.7)
12+	33	16 (48.5)	12 (36.4)	25 (75.8)	23 (69.7)	13 (39.4)	3 (9.1)	5 (15.2)*	19 (57.6)
Practice type									
Academic/public	45	25 (55.6)	18 (40.0)	29 (64.4)	29 (64.4)	13 (28.9)	3 (6.7)	3 (6.7)	20 (44.4)
Private	59	26 (44.1)	25 (42.4)	40 (67.8)	32 (54.2)	25 (42.4)	7 (11.9)	4 (6.8)	35 (59.3)

* $p = 0.055$.

Table 4
Post-operative oral antibiotic prescribing practices.

		Any antibiotic	Amoxicillin	Augmentin	Azithromycin	Cephalexin	Doxycycline
	n	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Total	104	80 (76.9)	5 (4.8)	39 (37.5)	2 (1.9)	13 (12.5)	11 (10.6)
Duration							
Novice (0–5)	16	14 (87.5)	0 (0.0)	10 (62.5)*	1 (6.2)	1 (6.2)	7 (43.8)**
Experienced (> 5)	88	66 (75.0)	5 (5.7)	29 (33.0)	1 (1.1)	12 (13.6)	4 (4.5)
FESS							
0–12	71	54 (76.1)	4 (5.6)	26 (36.6)	0 (0.0)	12 (16.9)	4 (5.6)
12+	33	26 (78.8)	1 (3.0)	13 (39.4)	2 (6.1)	1 (3.0)	7 (21.2)***
Practice type							
Academic/public	45	33 (73.3)	0 (0.0)	19 (42.2)	1 (2.2)	5 (11.1)	5 (11.1)
Full-time private	59	47 (79.7)	5 (8.5)	20 (33.9)	1 (1.7)	8 (13.6)	6 (10.2)

* $p = 0.049$.
** $p < 0.001$.
*** $p = 0.039$.

varied markedly, with the majority basing their prescription pattern on intraoperative findings (60.6%). Most practitioners opted for a 14-day steroid taper (29.8%), followed by a six to seven day taper (27.9%) (Table 6).

3.7. Topical steroids

A majority of surgeons (81.7%) prescribed topical steroid rinses, with preferences centering on budesonide irrigations (74%). The trend towards budesonide was largely ubiquitous, with the majority of surgeons in all cohorts prescribing a budesonide irrigation. Despite these trends, none reached statistical significance. In prescribers, the decision to provide post-operative steroids was predominantly based on intraoperative findings, including sinonasal polyps (67.3%). Most respondents initiated their intranasal steroids seven days post-operatively (34%). (Table 7).

3.8. Post-operative counseling

81.7% of respondents discuss post-operative use of antibiotics and steroids during the pre-operative office visit, 38% of respondents report discussing antibiotic and steroid care immediately before surgery. In the immediate post-operative period, 62.5% of respondents, antibiotic and steroid care is communicated with a verbal discussion only, while 25% discuss post-operative care via a pamphlet only. 48.1% of respondents spent 0–10 min of their pre-surgical consultation devoted to

Table 5
Topical Antibiotic Rinses.

		Any antibiotic	Aminoglycosides	Muciprocin	Bacitracin	Cephalosporins	Clindamycin	Fluoroquinolone
	n	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Total	104	47 (45.2)	17 (16.3)	4 (3.8)	3 (2.9)	1 (1.0)	2 (1.9)	0 (0.0)
Experience								
Early career (0–5)	16	7 (43.8)	4 (25.0)	6 (37.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.2)
Experienced (5+)	88	40 (45.5)	13 (14.8)	25 (28.4)	3 (3.4)	1 (1.1)	2 (2.3)	3 (3.4)
FESS								
0–12	71	28 (39.4)	9 (12.7)	17 (23.9)	3 (4.2)	1 (1.4)	2 (2.8)	2 (2.8)
12+	33	19 (57.6)	8 (24.2)	14 (42.4)	0 (0.0)	0 (0.0)	0 (0.0)	2 (6.1)
Practice type								
Academic/public	45	15 (33.3)	5 (11.1)	9 (20.0)	2 (4.4)	0 (0.0)	1 (2.2)	3 (6.7)
Private	59	32 (54.2)*	12 (20.3)	22 (37.3)	1 (1.7)	1 (1.7)	1 (1.7)	1 (1.7)

* $p = 0.047$.

Table 6
Oral Steroids.

		Any steroid	Prednisone	Methylprednisolone	Decadron
	n	n (%)	n (%)	n (%)	n (%)
Total	104	81 (77.9)	69 (66.3)	13 (12.5)	1 (1.0)
Experience					
Early career (0–5)	16	15 (93.8)	15 (93.8)*	2 (12.5)	0 (0.0)
Experienced (5+)	88	66 (75.0)	54 (61.4)	11 (12.5)	1 (1.1)
FESS					
0–12	71	50 (70.4)	44 (62.0)	7 (9.9)	1 (1.4)
12+	33	31 (93.9)**	25 (75.8)	6 (18.2)	0 (0.0)
Practice type					
Academic/public	45	40 (88.9)***	35 (77.8)****	4 (8.9)	1 (2.2)
Private	59	41 (69.5)	34 (57.6)	9 (15.3)	0 (0.0)

* $p = 0.01$.
** $p = 0.032$.
*** $p = 0.037$.
**** $p = 0.03$.

Table 7
Topical Steroid Rinses.

		Any steroid	Budesonide	Mometasone	Fluticasone	Dexamethasone
	n	n (%)	n (%)	n (%)	n (%)	n (%)
Total	104	85 (81.7)	77 (74.0)	5 (4.8)	4 (3.8)	1 (1.0)
Experience						
Early career (0–5)	16	14 (87.5)	13 (81.2)	2 (12.5)	0 (0.0)	0 (0.0)
Experienced (5+)	88	71 (80.7)	64 (72.7)	3 (3.4)	4 (4.5)	1 (1.1)
FESS						
0–12	71	57 (80.3)	50 (70.4)	1 (1.4)	4 (5.6)	1 (1.4)
12+	33	28 (84.8)	27 (81.8)	4 (12.1	0 (0.0)	0 (0.0)
Practice type						
Academic/public	45	37 (84.4)	33 (73.3)	3 (6.7)	1 (2.2)	1 (2.2)
Private	59	48 (81.4)	44 (74.6)	2 (3.4)	3 (5.1)	0 (0.0)

discussing post-operative antibiotics and steroids, 41.3% spent 10–20 min in pre-surgical consultation. No surgeons utilized texting to correspond with patients post-operatively, a third of surgeons (33.6%) communicated during post-operative office visits only, while 28.8% communicate via cellular and home phone calls.

4. Discussion

Our data provides a snapshot of practice patterns among private and academic ARS members. Demographic data illustrated a diverse group of respondents, with the majority in private practice (56.7%). Subgroup analysis demonstrated that the majority of respondents were in practice for > 20 years (45.2%), and performed 5–12 sinus surgeries monthly (46.2%). 29.8% of respondents described themselves as academic; 32% of current ARS members are fellowship trained.

The majority of respondents utilized antibiotics (75%; 42% penicillin derivatives; 50% chose a 7–14 day course). The efficacy of prescribing antibiotics is debated in the literature with some studies showing no improvement of post-operative infection rates and other short-term outcomes, while others demonstrate reduced nasal obstruction, drainage, and improved endoscopic scoring. [5–7] Prescribing oral antibiotics is therefore an option in the most recent Orlandi et al. 2016 consensus statement concerning post-operative management of post-FESS patients with CRS [2]. In a survey of post-operative oral antibiotic usage, Fang et al. speculated that the rationale behind divergent practice patterns in the case of preoperative antibiotic use stems from the presence of high bacterial burden (complex or revision sinus case), experience learned from training/institutional preference, the presence of active infection, and when cultures and sensitivities direct management [8]. Nonetheless, trends appear to be heading away from antibiotic usage and more towards antibiotic stewardship, especially as the efficacy of pre- and post-operative antibiotics becomes increasingly under scrutiny- particularly as a prophylaxis against toxic shock syndrome [4,9,10]. In this way, topical antibiotics may supplant the usage of oral antibiotics in managing recalcitrant sinus disease and sinonasal biofilms caused by pseudomonas and staphylococcal species. In one study, mupirocin 0.05–2% saline irrigations reduced the risk of residual staphylococcal infection in recalcitrant CRS by approximately 87% at one month after the start of irrigations [11]. Additionally, 30% of endoscopically obtained sinonasal cultures are pseudomonas; these infections are often relapsing and refractory to oral antibiotics that cannot provide adequate mucosal penetration to effectively treat the biofilm [12]. Topical tobramycin was demonstrated as effective in pseudomonas-infected rabbit maximally sinus mucosa [12]. Topical aminoglycosides have also been demonstrated as safe and effective in a daily topical application in pediatric patients with CRS [13]. Taken together, the use of oral and topical antibiotics is often case specific and should not necessarily be reflexive but should be weighed against several patient factors. Our data demonstrates a very high usage of post-operative antibiotics, however this may not necessarily be reflective of all ARS members.

Oral steroids were prescribed by 79% of all surgeons after FESS and more frequently by academic practice surgeons. 41% of surgeons offered their patients a steroid course < 14 days in duration. Surgeons cited sinonasal polyp burden, extent of surgery, and routine use as reasons for prescribing steroids. Oral steroids have played a considerable role in the genesis of sinus surgery. Pre-treatment with systemic steroids confers a surgical advantage and improves the quality of sinonasal tissue, and reduces overall blood loss during surgery. [14–16] In a survey of the ARS, an overwhelming majority of respondents (96.64%) utilize pre-operative steroids in patients with CRS and nasal polyposis [17]. Post-operative treatment has been demonstrated to be

helpful in the short-term endoscopic appearance of sinonasal cavities and to allow for adequate irrigation and debridement, and may reduce the rate of recurrence [3,14,18]. However, post-operative steroids are not without sequelae, including sugar dyscrasias, cushings, and osteonecrosis of the hip, and should not be used in patients with diabetes or in patients with underlying immunodeficiency [19]. In a study by Dautremont et al., patients randomized to post-operative steroids versus steroid-eluting middle meatal stents had the same endoscopic grading and SNOT-22 scores [20]. Therefore oral steroids may not be necessary in patients in whom a steroid-eluting stent or spacer is placed. Drug-eluting stents have been demonstrated to reduce the need for post-operative interventions such as lysis of adhesions, degree of polyposis, and improved endoscopic grading of post-operative cavities all with a minimal risk profile [21]. Nonetheless, in our cohort a large proportion of surgeons offered their patients oral steroids with many prescribing reflexively after surgery while others based their decision on intraoperative and histologic findings. Other surgeons commented that they provide preoperative steroids, and three respondents added additional steroids resulting from post-operative patient endoscopy and symptoms after the initial steroid regimen was completed. Taken together, our data suggests that a high volume of surgeons prescribe systemic steroids, particularly in post-FESS patients with CRSwNP (58.7%).

Fewer surgeons prescribed topical steroid rinses in CRSsNP (19.2%) versus CRSwNP (66.3%). However, in the CRSsNP group, early career surgeons were more likely to provide their patients with a topical steroid rinse (43.8% versus 14.8% $p = 0.018$). This difference is not readily explained, but may be due to accumulating data on the inflammatory features of CRSsNP and the excellent safety profile of topical steroid rinses. Recent trials have demonstrated improved quality of life and symptom improvement following topical steroid rinses whereas two randomized control trials failed to demonstrate any clear benefit of steroid versus saline rinses. [22–24] This data has likely been incorporated into the teaching regimens of recent Otolaryngology graduates which could explain the difference in prescription pattern when compared to more experienced peers. Current consensus guidelines have demonstrated a low risk profile and a high degree of benefit for topical nasal steroids (Grade A evidence, strongly recommended) and saline irrigations (Grade B evidence, recommended) [2]. It was not surprising then that topical steroids were used with a high frequency in our study. Moreover, the high rate of budesonide irrigations is likely resultant from evidence suggesting improvement in symptom scores, reduced tissue inflammatory mediators, and reduced eosinophilia after topical treatment with budesonide [25].

Topical saline has a low risk profile and high degree of tolerance in conjunction with its utility in enhancing patient reported sinonasal outcomes/symptom scores, mucociliary clearance, and mechanically removing inflammatory mucin - particularly when used in higher volumes irrigations [26–28] Topical saline was frequently used among respondents in our study. However, the lower rate of topical saline use after FESS for CRSwNP compared to CRSsNP is not readily explained.

There are several limitations to our study, including a relatively low responses rate and some degree of discordance between the numbers of academic versus private practice respondents when compared to the numbers that actually comprise the ARS. Moreover, this study did not parse outpatient age, extent of and indications for surgery. Furthermore, due to the limited response options available in a survey study, there is the high risk for selection bias. Finally, there were not sections for debridements, topical decongestants, and alternative therapies. These were not included part because it was felt that the number of questions may reduce respondents and the overall power of the study and due to the strong recommendation against the use of topical decongestants and the limited data available for many of the alternative therapies.

5. Conclusion

Responses to the questionnaire highlight differences in post-operative practice patterns among ARS members. While guidelines exist regarding post-operative management of FESS patients, this data suggests that surgeon preferences are contingent on a broad range of variables that may influence treatment decisions.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjoto.2019.05.022.

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Declaration of Competing Interest

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