ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

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Medical and Surgical Treatment in Cases of Subperiosteal Orbital Abscess: Retrospective Descriptive Study

Subperiosteal Orbital Apse Olgularında Medikal ve Cerrahi Tedavi: Retrospektif Tanımlayıcı Araştırma

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ABSTRACT Objective: We aimed to characterize the demographic characteristics of patients presenting with subperiosteal orbital abscess (SPOA) and determine their outcomes according to the type of medical and/or surgical interventions applied. **Material and Methods:** The data were retrospectively examined for all patient applications who applied to the oculoplastic surgery clinic due to SPOA and were treated as inpatients from November 2021 to October 2023. Demographic information of the patients, radiographic and clinical evidence of SPOA, surgical interventions performed, presence of concomitant sinusitis and length of hospital stay were recorded. **Results:** The average age of 19 SPOA patients included in the study was 18.42±20.21 years. Twelve (63.2%) of the patients with SPOA had pansinusitis. The location of the SPOA was medial in 9 patients (47.4%), superolateral in 5 patients (21.1%), and superomedial in 4 patients (21.1%). In statistical comparison, the medial SPOA rate was significantly higher in the group under 10 years of age than in the group over 10 years of age (p=0.005). Endoscopic sinus surgery (ESS) was applied to 15(78.9%) of the patients and medical treatment was applied to 4 (21.1%). External SPOA drainage was performed simultaneously with ESS in 6 (31.6%) patients with superolaterally located SPOA. Intracranial abscess developed in 2 (22.2%) of the patients with SPOA with a superior component. **Conclusion:** Patients with medial, small-volume SPOA can be successfully treated with a conservative approach. While medially located large volume SPOA requires ESS with ESS alone, superiolaterally located SPOA requires external surgical abscess drainage in addition to ESS.

Keywords: Acute sinusitis; endoscopic sinus surgery; subperiosteal orbital abscess; intracranial abscess

ÖZET Amaç: Subperiosteal orbital apse (SPOA) ile prezente olan hastaların demografik özelliklerini karakterize etmeyi ve uygulanan medikal ve/veya cerrahi müdahalelerin türüne göre sonuçlarını belirlemeyi amaçladık. **Gereç ve Yöntemler:** Veriler, Kasım 2021 yılından Ekim 2023 yılına kadar SPOA nedeniyle oküloplastik cerrahi kliniğine başvuran ve yatarak tedavi edilen tüm hasta başvuruları retrospektif olarak incelendi. Hastaların demografik bilgileri, SPOA radyografik ve klinik kanıtları, yapılan müdahaleler (cerrahi ve medikal), eş zamanlı sinüzit varlığı ve hastaneye yatış süresi kaydedildi. **Bulgular:** Çalışmaya dâhil edilen 19 SPOA'lı hastasının yaş ortalaması 18,42±20,21 yıldı. SPOA'lı hastaların 12'sinde (%63,2) pansinüzit vardı. SPOA'ların yerleşimi hastaların 9'unda (%47,4) mediyalde, 5'inde (%21,1) süperolateralde, 4'ünde (%21,1) süperomediyaldeydi. İstatistiksel karşılaştırmada mediyal SPOA oranı 10 yaş altı grupta 10 yaş üstü gruba göre anlamlı derecede daha yüksekti (p=0,005). Hastaların 15'ine (%78,9) endoskopik sinüs drenajı, 4'üne (%21,1) medikal tedavi uygulanmıştı. Süperolateral yerleşimli SPOA olan 6 (%31,6) hastaya endoskopik sinüs drenajı ile eş zamanlı eksternal (transkutanöz) SPOA drenajı uygulandı. Superior kompanenti olan SPOA'lı 2 (%22,2) hastada intrakraniyal apse gelişmişti. **Sonuç:** SPOA mediyal yerleşimli ve küçük hacimli ise konservatif yaklaşımla başarılı bir şekilde tedavi edilebilir. SPOA mediyal yerleşimli ve büyük hacimli ise endoskopik sinüs drenajı ile endoskopik apse drenajı yeterli olurken, superiolateral lokasyonlu SPOA, endoskopik sinüs drenajına ilave eksternal cerrahi apse drenajını gerektirmektedir.

Anahtar Kelimeler: Akut sinüzit; endoskopik sinüs cerrahisi; subperiosteal orbital apse; intrakraniyal apse

Subperiosteal orbital abscesses (SPOA) are a serious complication of acute rhinosinusitis (ARS), which can occur at any age, although it is more common in children.[1] This orbital complication of ARS is a condition that can worsen if not treated promptly and appropriately, progressing to permanent vision loss, cavernous sinus thrombosis, meningitis and intracranial abscess, resulting in death.[2] SPOA clini-

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cally presents with proptosis due to increased orbital volume and infection, impaired ocular mobility due to involvement of extraocular muscles, and decreased vision due to optic nerve compression. In these patients, computed tomography (CT) and/or magnetic resonance imaging (MRI) are very important for diagnosis and preoperative planning. The classifications made by Chandler et al. or Moloney et al. are used by some clinicians in staging secondary orbital complications of ARS.[3,4] Although surgical drainage has been recommended as the traditional treatment for SPOA secondary to ARS, current studies recommend more conservative treatment in young children, consisting of intravenous (i.v.) antibiotics and close monitoring of visual status.[5,6] However, the characteristics of the abscess that affect the management of surgical drainage in SPOA, the relationship of treatment with poor clinical outcomes, and many other aspects have not yet been fully clarified. In this study, we evaluate the patients who were followed up and treated for SPOA in our clinic and report their results in detail in order to shed light on these variables.

MATERIAL AND METHODS

The study was conducted in accordance with the principles of the Helsinki Declaration. Approval was received from the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (date: October 23, 2023; no: 96317027-514.10-226974439). Signed informed consent was obtained from all participants for the investigation and publication of images. Of the 40 patients who applied to our oculoplastic surgery clinic due to periorbital infection and abscess from November 2021 to October 2023, 19 patients with radiographically proven SPOA were included in the study. The remaining patients were patients with orbital abscess caused by reasons other than ARS (diseases such as dental abscess, dacryocystitis, herpes zoster infection) and patients with orbital and preseptal cellulitis not accompanied by SPOA. All these patients were excluded from the study.

One of the patients had a history of chronic sinusitis and one had a history of maxillofacial trauma. None of the patients had any predisposing conditions such as HIV or other immune system weakness. Demographic and clinical data, presence of sinusitis in radiographic images, presence of SPOA, interventions performed, bacterial culture taken, types of i.v. antibiotics used and duration of hospitalization were examined in detail for each patient. Patients with SPOA had CT and/or MRI available before the intervention.

CT scans were reevaluated by one of the authors (F.S.). Sinuses involved in ARS, SPOA location (medial, lateral, superior, inferior), abscess measurements, abscess volume (according to the formula $4/3\pi r1\ r2\ r3$, (r = radius of the ellipsoid in axial, sagittal and coronal axes, respectively) were calculated from CT images (Figure 1).[7] When ocular examinations were possible, best corrected visual acuity (BCVA) (with Snellen chart), eye movements, light reaction, periorbital edema, chemosis, proptosis, intraocular pressure and retina examinations were performed. Surgical approach, results and complications were recorded in surgically treated patients. The ophthalmologist (F.S.) and the otolaryngologist entered the surgical procedure simultaneously.

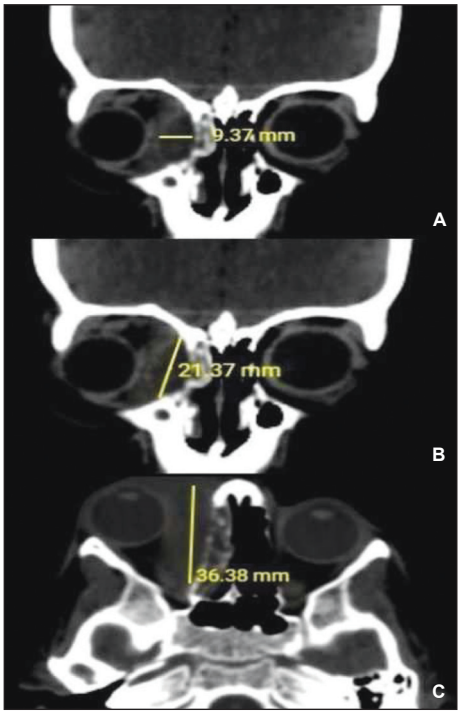

FIGURE 1: Measurement images of the right medial SPOA in CT slices, **A)** Measurement of the width of the right medial SPOA in coronal section CT, **B)** Measurement of its height in coronal section CT, **C)** Measurement of the length of the SPOA in axial section CT.
SPOA: Subperiosteal orbital abscess; CT: Computed tomography.

All surgical procedures were performed under general anesthesia. All patients who underwent surgical treatment underwent sinus drainage with endonasal endoscopic sinus surgery (ESS). Medial SPOA was drained endoscopically. For SPOA that could not be drained endoscopically, external SPOA drainage (ExAD) was performed by the ophthalmologist through an incision made at the eyelid crease or above the eyebrow, depending on the location of the abscess. No patient underwent SPOA drainage alone.

All patients were treated with broad-spectrum i.v. antibiotics as recommended by infectious diseases consultants at the time of admission to the clinic. In patients who underwent surgery, samples were taken for microbiological analysis from both the sinuses and the SPOA. In patients with growth in culture, postoperative i.v. antibiotics were changed according to the antibiogram result of the isolated microbiological agent. In patients with no growth in culture, i.v. antibiotic treatment was continued until discharge, depending on the patient's clinical condition (decrease in periorbital edema and hyperemia, decrease in eye movement limitation).

STATISTICAL ANALYSIS

Mean, standard deviation, median, minimum, maximum value frequency and percentage were used for descriptive statistics. The distribution of variables was checked with Kolmogorov-Smirnov test. Mann-Whitney U test was used for the comparison of quantitative data. Chi-square test (Fischer exact) was used for the comparison of the comparison of qualitative data. SPSS software (IBM SPSS Statistics for Windows, Version 28.0; Armonk, NY, IBM Corp.) was used for statistical analyses.

RESULTS

The mean age of patients with SPOA in this cohort was 18.42±20.21 (2-77 years); there were 8 (42.1%) patients under 10 years of age and 11 (57.9%) patients over 10 years of age. Mean BCVA was 0.61±0.35 (minimum-maximum, 0.1-1.0). The demographic and clinical data of the patients are summarized in Table 1. However, distribution was bimodal; the average age under 10 years of age was 5.25±3.15 years, and the average age over 10 years was 28.00±22.10 years.

There was a strong male dominance; 15(78.9%) of the patients were men and 4 (21.1%) were women. The male gender ratio in patients over 10 years of age was significantly higher than in patients under 10 years of age (p=0.018) (Table 2).

All patients with SPOA had concurrent sinusitis; 2 sinuses were involved in 7 (36.8%) patients, and 12 (63.2%) patients had pansinusitis (3 or more sinuses involved). Two patients (10.6%) had brain abscess accompanying SPOA. The location of the SPOAs was medial in 9 (47.4%) patients, superolateral in 5 (21.1%) patients, superomedial in 4 (21.1%) patients, superior in 1 (5.3%) patient, and inferior in 1 (5.3%) patient (Table 3). The mean volume of the SPOA was 3374±2766 mm^3 (121-11290 mm^3). In statistical comparison, the rate of medial SPOA in the group under 10 years of age was significantly higher than in the group over 10 years of age (p=0.005).

In the group under 10 years old and the group over 10 years old, the superolateral, superomedial, inferior and superior SPOA rates did not differ significantly (p=0.103, p=0.602, p=1.000, p=1.000, respectively). Four patients (21.1%) were treated with i.v. antibiotics only. Emergency surgical intervention was performed on patients who did not show clinical improvement despite systemic empiric i.v. antibiotic treatment within 48 hours after admission. ESS was performed in 15 (78.9%) of the patients.

Endoscopic SPOA (EAD) drainage along with ESS was performed in 8 (42.1%) patients with medially located SPOA. External (transcutaneous) SPOA drainage was performed simultaneously with ESS in 6 (31.6%) patients with superolaterally located SPOA (Figure 2). Spontaneous ExAD was observed in 1 (5.3%) patient with superomedial SPOA. In 1 (5.3%) patient with superomedial SPOA who had a history of maxillofacial trauma, external frontal sinus drainage was performed as a second surgical intervention because there was no regression despite simultaneous external abscess drainage with ESS and the frontal sinus could not be reached endoscopically. While i.v. antibiotic treatment alone was sufficient in 3 (33%) of 9 patients with medial SPOA, no additional surgical intervention was required in any of these patients. ESS and EAD drainage were sufficient

TABLE 1: Demographic and clinical characteristics of patients with subperiosteal orbital abscess.

		Minimum-maximum	Median	X̄±SD/n-%	
Age (year)		2.00-77.00	14.00	18.42±20.21	
Age	≤10			8	42.1
	>10			11	57.9
Sex	Female			4	21.1
	Male			15	78.9
Application month	January			1	5.3
	February			3	15.8
	March			1	5.3
	April			2	10.5
	May			1	5.3
	June			1	5.3
	July			1	5.3
	September			3	15.8
	November			5	26.3
	December			1	5.3
Application season	Winter			6	31.6
	Autumn			7	36.8
	Spring			4	21.1
	Summer			2	10.5
BCVA		0.10-1.00	0.70	0.61±0.35	
Lateralization	Left			12	63.2
	Right			7	36.8
Abscess location	Medial			9	47.4
	Superolateral			4	21.1
	Superomedial			4	21.1
	Inferior			1	5.3
	Superior			1	5.3
Medial-lateral dimension		4.40-25.02	9.48	12.46±7.12	
Superior-inferior dimension		4.10-33.33	17.50	18.59±6.37	
Anterior-posterior dimension		11.25-35.66	25.38	24.48±7.99	
Abscess volume (mm^3)		121-11290	2919	3374±2766	

SD: Standard deviation; BCVA: Best corrected visual acuity.

for medial SPOA that did not extend superiorly. Frontal sinus involvement was present in all (n=9) cases of SPOA, which has a superior component. Intracranial abscess developed in 2 (22.2%) of these patients (Figure 3).

All patients were treated with broad-spectrum i.v. antibiotics as recommended by infectious disease consultants. Although data are variable, patients generally receive vancomycin (n=16) in the i.v. antibiotic combination, followed by clindamycin (n=9), meropenem (n=8), ceftriaxone (n=6), cefotaxime (n=3), metronidazole (n=2), cefazolin (n=1), ampicillin/sulbactam (n=1) and tazobactam-piperacillin (n=1). Culture positivity was obtained in only 3 (15.9%) patients. The average hospital stay for all admissions was 17.47±9.82 days.

Patients with SPOA were most frequently admitted to the hospital in autumn (n=7, 36.8%) and winter (n=6, 31.6%). All patients experienced improvement in their ophthalmological symptoms (decrease in periorbital edema and hyperemia, decrease in eye movement limitation) before being discharged from the hospital and were subsequently transferred to oral antibiotics and discharged.

TABLE 2: Involved sinus and treatment methods applied in patients with subperiosteal orbital abscess.

		Age≤10		Age>10		
		X̄±SD/n-%	Median	X̄±SD/n-%	Median	p value
Age (year)		5.25±3.15	4.00	28.00 ± 22.10	16.00	
Sex	Female	4 50.0		0	0.0	0.018$^{\chi 2}$
	Male	4 50.0		11	100	
Medial-lateral dimension		8.25±2.70	8.48	15.52±7.85	18.67	0.082^{m}
Superior-inferior dimension		19.25±7.27	20.92	18.11±5.95	17.26	0.321^{m}
Anterior-posterior dimension		25.87±7.15	27.26	23.46±8.75	21.12	0.591^{m}
Abscess volume (mm^3)		2541±1623	2789	3981±3312	2919	0.364^{m}
BCVA		0.90±0.14	0.90	0.55±0.35	0.40	0.228^{m}
Lateralization	Left	4 50.0		8 72.7		0.311$^{\chi 2}$
	Right	4 50.0		3 27.3		
Abscess location						
Medial		7 87.5		2 18.2		0.005$^{\chi 2}$
Superolateral		0 0.0		4 36.4		0.103$^{\chi 2}$
Superomedial		1 12.5		3 27.3		0.602$^{\chi 2}$
Inferior		0 0.0		1 9.1		1.000$^{\chi 2}$
Superior		0 0.0		1 9.1		1.000$^{\chi 2}$
Treatment						
ESS/EAD		5 62.5		3 27.3		0.262$^{\chi 2}$
ESS/ExAD		0 0.0		7 63.6		
Only medical		3 37.5		1 9.1		
Application season						
Winter		4 50.0		2 18.2		1.000$^{\chi 2}$
Autumn		2 25.0		5 45.5		
Spring		1 12.5		3 27.3		
Summer		1 12.5		1 9.1		
Hospitalization (days)		20.25±10.50	16.00	15.45±9.27	11.00	0.262^{m}

^{m}Mann-Whitney U test; ^{w}Wilcoxon test; SD: Standard deviation; BCVA: Best corrected visual acuity; ESS: Endoscopic sinus surgery; EAD: Endoscopic subperiosteal orbital abscesses drainage; ExAD: External subperiosteal orbital abscesses drainage.

DISCUSSION

SPOA is a complication of ARS characterized by the collection of purulent material between the orbital bone wall and the periosteum covering it. SPOA requires urgent systemic antibiotics and possible surgical intervention due to its aggressive course.[4] Current studies recommend that medical treatment should be initiated first for SPOA and that surgical drainage should be performed in cases where clinical improvement cannot be achieved or visual impairment is suspected within 48 hours after starting medical treatment.[8-11] These studies have presented some criteria for SPOAs that can only be treated with medical treatment.[8-11] Later, these criteria were analyzed in many studies and a general consensus was tried to be reached that abscesses meeting these criteria could be treated with i.v. antibiotics alone.[12-16] The criteria suggested by Garcia and Harris for patients who can only be treated with conservative treatment are; there is no suspicion of anaerobic or odontogenic infection, there is no chronic sinusitis, there is no frontal sinusitis, there is no previous drainage or compressive optic neuropathy, there is a medially located small volume abscess, and the patient is younger than 9 years of age.[10] Gavriel et al. drew attention to abscess volume and size in their study analyzing SPOAs in children.[7] In their study, they emphasized that surgical drainage should be strongly considered in children who present with significant or progressive

TABLE 3: Statistical comparison results of the clinical features of subperiosteal orbital abscess in patients under 10 years of age and over 10 years of age.

	Minimum-maximum	Median	X̄±SD/n-%	
Involved sinus				
Ethmoid/frontal/sphenoid			1	5.3
Ethmoid/maxilla			7	36.8
Ethmoid/maxilla/frontal			9	47.4
Ethmoid/maxilla/frontal/sfenoid			1	5.3
Ethmoid/maxilla/frontal/sphenoid			1	5.3
Abscess location				
Inferior			1	5.3
Medial			9	47.4
Superior			1	5.3
Superolateral			3	15.8
Superolateral+intracranial			1	5.3
Superomedial			3	15.8
Superomedial+intracranial			1	5.3
Treatment				
ESS/EAD			8	42.1
ESS/ExAD			7	36.8
Only medical			4	21.1
Sinus drainage/SPOA drainage				
ESS/EAD			8	42.1
ESS/ExAD			5	26.3
ESS/ExSS/ExAD			1	5.3
ESS/Spontaneous ExAD			1	5.3
No			4	21.1
Antibiotic choice				
Ampicillin-sulbactam/clindamycin			1	5.3
Clindamycin/ceftriaxone			1	5.3
Metronidazole/ceftriaxone			1	5.3
Vancomycin/cefotaxime			1	5.3
Vancomycin/ceftriaxone			3	15.8
Vancomycin/ceftriaxone/metronidazole			1	5.3
Vancomycin/clindamycin/cefotaxime			2	10.5
Vancomycin/meropenem			2	10.5
Vancomycin/meropenem/cefazolin			1	5.3
Vancomycin/meropenem/clindamycin			5	26.3
Vancomycin/tazobactam-piperacillin			1	5.3
Microbiological result				
No			16	84.2
Polymicrobial			1	5.3
Streptococcus pyogenes (Group A)			1	5.3
Streptococcus salivarius			1	5.3
Hospitalization (days)	7.00-40.00	15.00	17.47±9.82	

SD: Standard deviation; ESS: Endoscopic sinus surgery; EAD: Endoscopic subperiosteal orbital abscesses drainage; ExAD: External subperiosteal orbital abscesses drainage; ExSS: External sinus surgery.

ocular findings or in whom improvement is not achieved after 48 hours of medical treatment and whose abscess volume is more than 0.5 mL, length is greater than 17 mm, and width is greater than 4.5 mm.[7] In our series, all our patients first received systemic i.v. antibiotics. In our study, 3 out of 4 patients

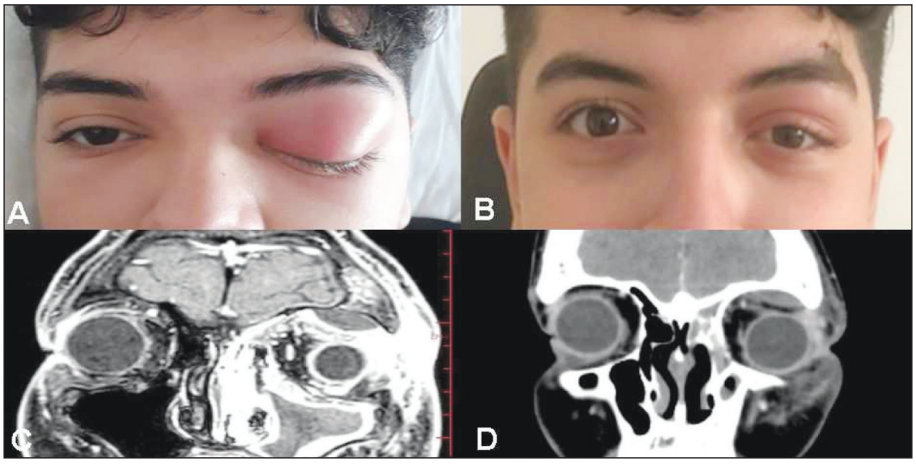

FIGURE 2: Images of a 16-year-old patient with left pansinusitis and left superior SPOA, **A)** Preoperative clinical image shows marked left periorbital edema and hyperemia, **B)** Postoperative 1st week image shows significant improvement in left clinical findings, **C)** Contrast-enhanced coronal section T1 appearance of SPOA in the left superior on MRI, D) Appearance of superior SPOA on coronal section CT.
SPOA: Subperiosteal orbital abscess; MRI: Magnetic resonance imaging; CT: Computed tomography.

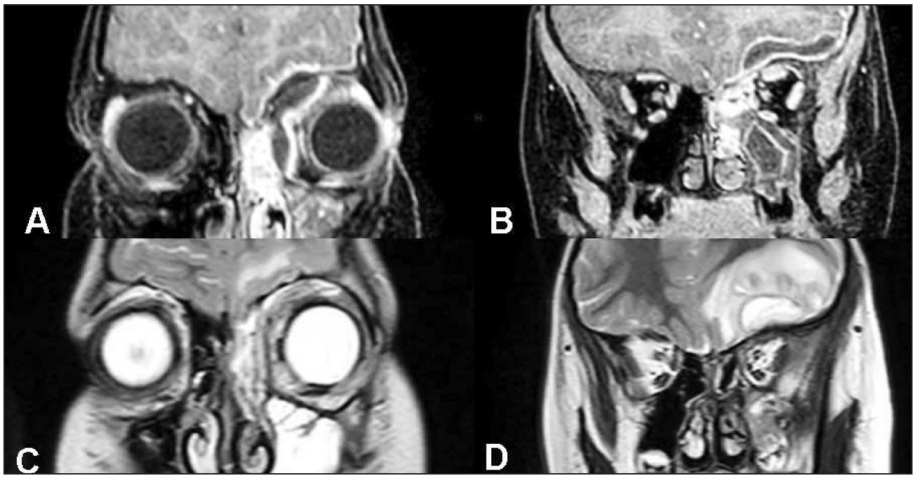

FIGURE 3: A 10-year-old male patient who developed SPOA and intracranial abscess due to left pansinusitis, **A)** Preoperative, medial and superomedial SPOA on contrast-enhanced T1 MRI coronal, involvement in the epidural distance, **B)** Preoperative, epidural abscess in contrast-enhanced T1 MRI coronal section, **C)** 5th day after endoscopic sinus and SPOA drainage, T2 MRI, coranal section, SPOA has regressed, **D)** 5th day after endoscopic sinus and SPOA drainage, T2 MRI, coranal section, epidural abscess is accompanied by inracerebral edema.
SPOA: Subperiosteal orbital abscess; MRI: Magnetic resonance imaging.

whose medical treatment was sufficient and did not require additional surgery were under the age of 10 at the time of application. The mean abscess volume of these patients was 892±864 mm^3. Only one of the patients for whom medical treatment was sufficient was over 10 years old. In this patient, the abscess was located superomedially and had a small volume (244 mm^3). Similar to previous studies, in patients who were successfully treated with medical therapy, although our number was small, the age of the patients was generally young and the abscess volume was small in these patients.

The location and size of the abscess are very important for surgical management in SPOA that require surgical drainage. It is widely accepted that pure endoscopic management of SPOA is beneficial in cases with medially located SPOA, and that an external approach is needed because endoscopic access is not possible due

to the location of superiorly located SPOA.[17,18] There are very few studies in the literature presenting successful endoscopic management and conservative treatment of a superiorly located SPOA.[19,20] In their study, Gavriel et al. successfully treated 3 of 6 patients with superomedially located SPOA with endoscopic drainage.[20] However, they reported that it is very difficult to access antero-laterally located abscesses endoscopically due to a narrow surgical field and the long distance of intraorbital dissection, and combined drainage is required in these patients. Additionally, in their study, they reported that the superior SPOA improved with medical treatment in a 9-year-old patient with a small abscess size.[20] In our study, all patients (n=7) who underwent external drainage had a superior component. Four of these patients had superolaterally located SPOA, and all of them had ExAD in addition to ESS. Our study shows that ExAD is absolutely necessary in patients with superiolaterally located SPOA. However, in our superomedially located abscesses, due to the small number of patients and the patients having different clinical characteristics, we are limited in expressing a clear opinion about the adequacy of endoscopic drainage or the necessity of external drainage in these patients.

Dewan et al. reported that in patients who only performed SPOA drainage without sinus surgery, patients with SPOA whose longest dimension was greater than 2 cm tended to reaccumulate due to the failure to drain the adjacent sinus and required a second surgery.[21] However, no reaccumulation occurred in patients who underwent simultaneous drainage of SPOA with ESS. Based on this result, they underlined the importance of considering that sinus disease is the focus of infection and that sinus disease management should be taken into consideration as a part of the general treatment in cases with SPOA larger than 2 cm.[21] They also supported the accepted idea that the orbit is an "innocent bystander" in SPOA secondary to ARS.[21] In our clinic, with the opinion of the infectious diseases and otolaryngology department, we primarily recommend ESS to all SPOA patients who do not show clinical regression with medical treatment. In addition, EAD drainage was performed simultaneously with endoscopic intervention in all our patients, especially those with medially located SPOA. Therefore, external drainage was not required in any of our patients with medial SPOA.

In the literature, the risk of developing intracranial abscess secondary to ARS is reported as 3%.[22] Harris in his studies, he also mentions the increasing correlation between frontal sinusitis and intracranial infection.[23] He reported that this complication is age-related, as the frontal sinus develops later than 5 to 7 years of age. Among the 13 patients with SPOA who had intracranial abscess in their study, 11 were 15 years of age or older. The other 2 patients were 9 and 14 years old. Greenberg and Pollard reported no intracranial complications in 18 young children with medial abscess; however, 3 of 6 older children with superior SPOA and frontal sinusitis had intracranial abscess. They reported that superior SPOA secondary to frontal sinusitis may have infections that are more difficult to treat, especially in children older than 8 years of age, and are at a higher risk of intracranial complications.[12] Gavriel et al. in their 6-case superior SPOA series, one patient encountered an epidural abscess 2 weeks after treatment.[20] In our study, we encountered intracranial abscess in 2 patients, and both patients had frontal sinus involvement and superior SPOA. The patients were 10 and 13 years old and both had received antibiotic therapy at an external center. Since he had intracranial abscesses at the time of admission to our clinic, emergency surgical drainage was performed. Although endoscopic abscess drainage was performed with ESS in a 10-year-old patient with supeomedial SPOA, intracranial abscess drainage was also required during follow-up. ExAD combined with ESS was applied to a 13-year-old patient with superolateral SPOA. Intracranial abscess was treated medically.

In our study, the season during which patients with SPOA applied to our clinic was also evaluated. Patients mostly applied in autumn (n=7, 36.8%) and winter (n=6, 31.6%) and least frequently in summer (n=2, 10.5%). This distribution is expected due to sinusitis, which increases with respiratory diseases in winter and autumn. Nageswaran et al. found that 56% of pediatric patients with orbital cellulitis secondary to sinusitis were admitted from October to March, but reported that there was no significant seasonal difference.[24] In our study, applications were highest in winter and autumn with 68.4%.

One of the most important limitations of our study is the limited number of patients due to the short study period. Another limitation of ours is that since our hospital is a 3rd level health center, most of the patients are referred to us for surgical drainage. This situation limited us to determine the characteristics of abscesses that respond to medical treatment.

CONCLUSION

Our study shows that in patients with SPOA secondary to ARS, the medical and surgical treatment to be applied to the patients varies depending on the age of the patient, the location and number of involved sinuses, and the location and volume of the abscess. The management of these patients is urgent and complex, requiring frequent observation of the patients. Based on all these data, i.v. medical treatment should be given a chance by closely monitoring patients with medial SPOA, especially those under 5 years of age, where the frontal sinus is still underdeveloped. We believe that in patients over 8 or 10 years of age with developed frontal sinus, if superolateral high-volume SPOAs are not thought to respond to medical treatment, ExAD should be applied in addition to ESS, considering that it may cause intracranial extension.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Fatma Savur;* ***Design:*** *Fatma Savur, Merve Uran;* ***Control/Supervision:*** *Fatma Savur;* ***Data Collection and/or Processing:*** *Fatma Savur, Merve Uran;* ***Analysis and/or Interpretation:*** *Fatma Savur;* ***Literature Review:*** *Fatma Savur, Merve Uran;* ***Writing the Article:*** *Fatma Savur;* ***Critical Review:*** *Merve Uran;* ***References and Fundings:*** *Fatma Savur;* ***Materials:*** *Fatma Savur, Merve Uran.*

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