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Role of pre-operative percutaneous embolization in orbital alveolar soft part sarcoma – An experience from a tertiary eye-care center

Kirthi Koka, Parinita Singh, Sonam Poonam Nisar, Md. Shahid Alam[1], Varsha Backiavathy, Julius Xavier Scott[2], Subramanian Krishnakumar[3], Bipasha Mukherjee

Purpose: To describe the clinic-radiological, pathological profile, and management outcomes of primary alveolar soft-part sarcoma (ASPS) of the orbit. **Methods:** A retrospective analysis of all histopathologically proven cases of orbital ASPS that presented between May 2016 and September 2019 was done. Data collected included demographics, clinical features, imaging characteristics, metastatic workup, management, and follow-up. **Results:** Five patients, of which four were males, presented to us during the study period. The mean age of presentation was 12.6 years (range 3–22 years). The most common presenting features were abaxial proptosis (n = 4) and diminished vision (n = 4). Imaging showed a well-defined orbital mass in all patients with internal flow voids in three. Preoperative percutaneous embolization with cyanoacrylate glue was done in these three patients owing to high vascularity. Four patients underwent complete tumor excision. One patient underwent exenteration. Histopathology showed polygonal tumor cells arranged in a pseudo-alveolar pattern and Periodic Acid-Schiff (PAS) positive crystals in the cytoplasm in all patients. One patient had systemic metastasis at presentation and developed a local recurrence after 3 months. No recurrence or metastasis was noted in the remaining four patients at a mean final follow-up of 11.2 months (range 5–15 months). **Conclusion:** ASPS is a rare orbital neoplasm that poses a diagnostic and therapeutic challenge. Imaging might show a soft-tissue tumor with high vascularity. Multidisciplinary management with interventional radiologists for preoperative embolization of vascular lesions helps minimize intraoperative bleeding and aids in complete tumor resection. A localized orbital disease carries a better prognosis.

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Alveolar soft-part sarcoma (ASPS) is a rare tumor that accounts for approximately 0.5–1% of all soft-tissue sarcomas.[1,2] It was first described in 1952 by Christopherson *et al*.[3] in a series of 12 cases that shared a common histological pattern. Postulated to occur due to an unbalanced chromosomal translocation between chromosomes 17q25 and Xp11, it mainly affects children and young adults.[4] ASPS most often involves the extremities with head and neck involvement occurring more frequently in children. Orbital ASPS has a better prognosis as compared to other areas due to early presentation, indolent growth, and smaller size.[5] ASPS shares morphological features with granular cell tumor, non-chromaffin paraganglioma, alveolar rhabdomyosarcoma, angiosarcoma, malignant renal cell carcinoma, and malignant melanoma with an alveolar pattern and it lacks a clear management protocol.[6] The management is essentially surgical with complete tumor excision achieving a cure in most of the cases, however, a complete removal is challenging for orbital cases. A recent trend toward conservative globe salvage surgery has been reported in 47 (63.5%) out of 74 cases in the literature.[1,2,5,7-9]

We herewith describe the clinical profile and management of five cases of orbital ASPS; preoperative embolization was utilized in three and globe salvage was possible in four of these cases. Preoperative embolization for orbital ASPS has not been reported very frequently in the literature and the present article sheds some light on this aspect of management.

Methods

We retrospectively analyzed five histopathologically proven cases of ASPS diagnosed between May 2016 and September 2019 at a tertiary care center in South India. The study adhered to the tenets of the Declaration of Helsinki and institutional review board approval was obtained to conduct the study. Written informed consent was taken from all the patients or parents for publication of photographs and clinical details. This was a retrospective study, hence was exempted from ethics approval as per our institution policy.

Orbit, Oculoplasty, Reconstructive and Aesthetic Services, Medical Research Foundation, Sankara Nethralaya, Chennai, [1]Orbit, Oculoplasty, Reconstructive and Aesthetic Services, Aditya Birla Sankara Nethralaya, Kolkata, West Bengal, [2]L and T Department of Ophthalmic Pathology, Vision Research Foundation, Sankara Nethralaya, Chennai, [3]Division of Pediatric HematoOncology, Sri Ramachandra University, Porur, Chennai, Tamil Nadu, India

Correspondence to: Dr. Kirthi Koka, Orbit, Oculoplasty, Reconstructive and Aesthetic Services, Medical Research Foundation, Sankara Nethralaya, Chennai, Tamil Nadu, India. E-mail: drkka@snmail.org

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The demographic details, presenting features, imaging characteristics, histopathology, and immunohistochemistry (IHC) findings were noted. Tumor, Node, Metastasis (TNM) staging was done according to the eighth edition of the American Joint Committee for Cancer Classification (AJCC).[10] Magnetic resonance imaging (MRI) was done for all patients. In three patients, the tumor was found to be vascular, and a Digital Subtraction Angiography (DSA) was done to further delineate the tumor vasculature. A percutaneous embolization was done for such lesions by an intervention radiologist using 25% *n*-butyl-cyanoacrylate glue under fluoroscopic guidance under general anesthesia. A percutaneous route was chosen over a transarterial, to minimize the chances of vision loss. The transarterial route involves the passage of a guidewire through the ophthalmic artery to approach the tumor and thus a greater risk of spillage of the embolizing agent into the central retinal artery and vision loss. The transcutaneous route also requires lesser instrumentation and is thus more economical for the patient. However, even the transcutaneous approach carries a risk of vision loss and all patients were clearly informed regarding the possibility of visual loss post-embolization. The post-procedure visual acuity was recorded in all patients. All patients underwent tumor excision within 1 week following embolization.

The cytomorphology, Periodic Acid-Schiff (PAS) staining, and the status of tumor margins were studied on hematoxylineosin-stained sections. A panel of relevant immunohistochemical markers was done, and after confirmation of the diagnosis, the patients were referred to an oncologist. A metastatic workup was requested, and a further course of treatment was decided. Response to treatment was assessed as per the Response Evaluation Criteria for Solid Tumors (RECIST) and patients were categorized as having a complete response, partial response, stable disease, or progressive disease.[11] The follow-up was calculated from the time of diagnosis to the last follow-up in months.

Results

Five patients were included in the study [Table 1]. The mean age at presentation was 12.6 years (range 3–22 years). The male: female ratio was 4:1. The left eye was more frequently involved (*n* = 3). Three out of five patients complained of prominence of the eye, one each of lid swelling and a large mass, respectively. One patient gave a previous history of an excision biopsy done elsewhere 10 months back. His lesion was reported as an orbital hemangioma. All except one patient had associated diminished vision (*n* = 4). The visual acuity at presentation ranged from 20/20 to no perception of light (NPL). The mean duration of the symptoms was 40.8 months (2–120 months).

On examination, abaxial proptosis was present in four patients [Figs. 1-4a]. Two patients had a palpable mass, one of which was extending to the temporal fossa. A relative afferent pupillary defect (RAPD) was present in three and optic disk edema was present in two patients. MRI showed a well-circumscribed mass in three patients [Figs. 2-4b]. The lesion was extraconal in two patients [Figs. 1c and 4b], intraconal in 1 [Fig. 3b], and both intraconal as well as extraconal in two patients [Fig. 2b]. The mass displayed iso to hyperintense

Table 1: Clinical features and management outcomes

Case	Age (years)/ sex/ laterality	Presentation	Visual acuity		Imaging (location)	Immunohistochemistry		Management	Status as per RECIST at last follow-up (months)
			Preoperative	Last follow-up		Positive	Negative		
1	3/M/OS	Inferior dystopia, ptosis	PL	20/200	Superior extraconal	Desmin, vimentin	CD 34, S-100, PAX8	Incision biopsy + complete excision	14/CR/NED
2	13/M/OS	Proptosis, diminished vision	20/80	NPL	Medial extraconal and intraconal	TFE 3	SMA, PAN CK, myogenin, vimentin	Embolization + complete excision + EBRT	15/CR/NED
3	8/F/OD	Proptosis, diminished vision	20/63	NPL	Intraconal	Desmin, SMA	CD34, CK, S100, synaptophysin	Embolization + complete excision + Chemotherapy (VAC)	12/CR/NED
4	17/M/OS	Lower lid swelling, superior dystopia, diplopia	20/20	20/20	Inferolateral extraconal	TFE 3, vimentin	Myogenin, desmin, SOX 10	Embolization + complete excision + EBRT	10/CR/NED
5	22/M/OD	Orbital mass with extra-orbital extension, loss of vision	NPL	NPL	Orbital mass with extra-orbital extension	Vimentin, CD 34, SMA	Desmin, S100, CK, CD 31, synaptophysin	Exenteration + SSG + EBRT + Chemotherapy (Sorafenib)	5/PD/DOD

OD/OS - Right eye/left eye, M/F - Male/Female, PL - Perception of light, NPL - No perception of light, EBRT - External beam radiotherapy, VAC - Vincristine/Adriamycin/cyclophosphamide, SSG - Split thickness skin graft, NED - No evidence of disease, DOD - Died of disease, CR - Complete response, PD - Progressive disease

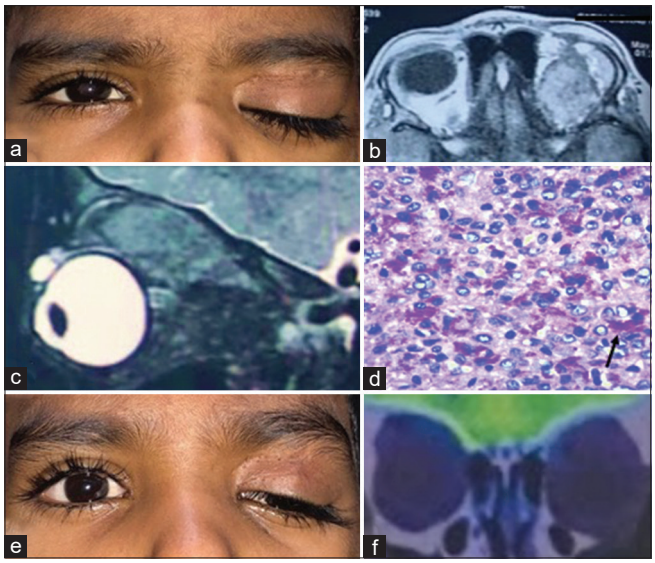

Figure 1: (a) External color photograph of a 3-year-old boy showing severe ptosis and inferior dystopia (b) MRI axial cut showing a mixed signal on T1W image (c) Sagittal cuts show a superior orbital mass that displays an isointense signal on T2W image (d) Microphotograph Hematoxylin and Eosin stain (H and E) with 40X magnification showing PAS-positive granules (arrow) (e) External photograph at 6 months follow-up showing resolution of dystopia with residual ptosis. (f) Follow-up PET-CT showing no metabolically active disease

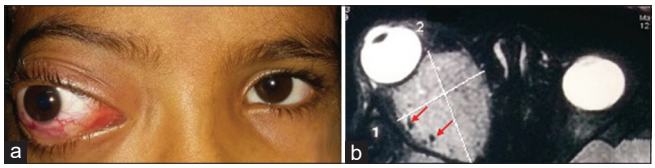

Figure 3: (a) An 8-year-old girl who presented with superotemporal dystopia (b) T2-weighted MRI axial cut showing a retrobulbar mass displaying intermediate signal in T2W1 with flow voids (arrows)

signals on T1- and T2-weighted sequences. Recti muscles could not be identified separately in two and optic nerve compression was noted in three patients. Flow voids, suggestive of increased vascularity [Figs. 3 and 4b] were seen in three patients. Digital Subtraction Angiography (DSA) confirmed a vascular mass supplied solely by an enlarged ophthalmic artery [Fig. 2c] in two cases while it was from ophthalmic and internal maxillary artery in one. In all three cases, the tumor was successfully embolized (85–100% reduction in vascularity) under fluoroscopic guidance [Fig. 2d] with *N*-butyl cyanoacrylate glue via a percutaneous route. Despite all precautions, one of the patients developed a cilioretinal artery occlusion following embolization leading to a further decrease in vision.

Four patients underwent complete excision. The recti needed to be sacrificed in two cases because of their close proximity to the tumor. One patient underwent a lid-sparing total exenteration.

Histopathology showed solid areas of slightly discohesive tumor cells separated by fibrovascular septae or a pseudo-alveolar pattern [Figs. 2e and 4c]. The individual tumor cells were polygonal with a distinct border and granular eosinophilic cytoplasm exhibiting PAS-positive diastase-resistant crystals [Fig. 1d]. The nucleus contained

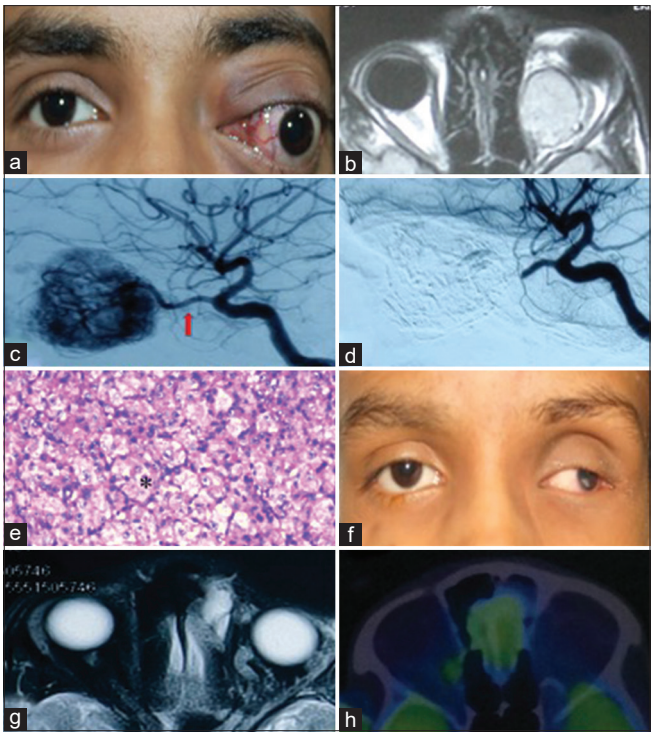

Figure 2: (a) A 13-year-old boy who presented with prominence and diminished vision in the left eye for 5 years (b) MRI axial cut showing a well-circumscribed, isointense medial orbital mass on T1W image (c) Digital subtraction angiogram, arterial phase shows a highly vascular tumor supplied by enlarged ophthalmic artery (arrow), (d) DSA post-embolization showing completely embolized tumor (e) Micrograph (H and E; 20X) showing polygonal tumor cells arranged in an alveolar pattern (asterisk) (f) At a 7-month follow-up, the child has enophthalmos and hypotropia (g) MRI axial cut showing postoperative changes and (h) PET-CT shows nil recurrence

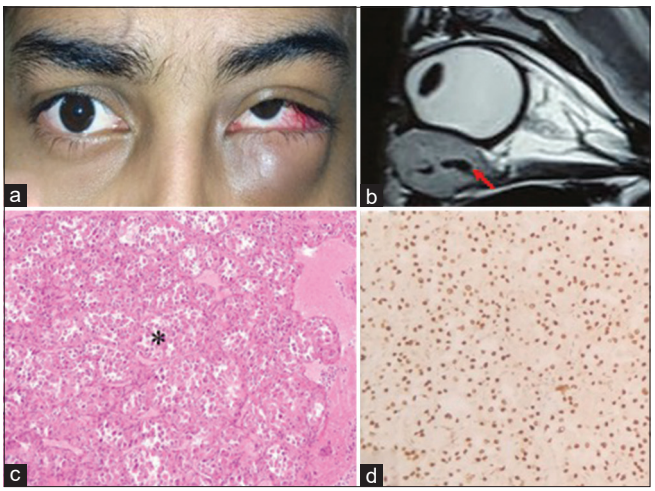

Figure 4: (a) A 17-year-old boy presented with left lower eyelid swelling (b) MRI sagittal cut showing an inferior orbital mass displaying isointense signal in T2W1 and flow voids (arrow) (c) Micrograph (H and E; 10X) shows a classic alveolar arrangement of tumor cells (asterisk). (d) IHC shows nuclear positivity for TFE3

vesicular chromatin and prominent nucleoli. The mitotic activity was low. Two patients showed capsular invasion. Immunohistochemistry (IHC) was positive for vimentin in

three, desmin in two, smooth muscle actin (SMA) in two, and CD 34 in one patient [Table 1]. Transcription factor binding to immunoglobulin heavy-chain enhancer 3 (TFE3) could be done in two patients and was positive in both [Fig. 4d].

A positron emission tomography-computed tomography (PET-CT) scan was done in all the patients and it showed metastasis to the humerus, vertebrae, rib, and iliac bone in one (case 5). The TNM staging as per the eighth AJCC staging system for orbital sarcomas at the time of diagnosis was T2N0M0 in three, T3N0M0 in one, and T4N0M1 in one patient.

Post-operatively two patients received external beam radiotherapy (EBRT), one was given chemotherapy, while one received both chemo and radiotherapy. Radiotherapy was deferred in the 3-year-old patient (case 1) who underwent complete excision and was kept under close follow-up. The mean dosage of EBRT was 44.6 Gy (range 30–60 Gy) in 10–30 fractions over 1–6 weeks. Three months following radiotherapy local recurrence occurred in the patient who had metastasis at presentation. He was additionally given a course of 15 Gy EBRT and chemotherapy (Sorafenib 200 mg twice daily). He, however, responded poorly and succumbed to the disease. The adjuvant chemotherapy regime in case 3 comprised of eight cycles of vincristine, adriamycin, and cyclophosphamide. There was no local recurrence [Figs. 1e, f, and 2f-h] or systemic metastasis in the remaining four patients with all having a complete response as per RECIST guidelines at a mean follow-up of 11.2 months (range 5–15 months). The postoperative vision improved in one, reduced in two, and remained stable in two patients. All four patients were alive with no evidence of the disease at the last follow-up.

Discussion

To date, 25 out of 74 total reported cases in the literature have been reported from the Indian subcontinent. The present study adds another five patients to the existing literature of this rare tumor [Table 2]. Three of our patients were treated with preoperative embolization followed by excision. ASPS most commonly affects children and adolescents. The mean age of presentation in our series was 12.6 years (range 3–22 years). Out of the 74 cases of orbital ASPS reported to date, 35 cases belonged to the pediatric age group. There were 39 males and 45 females.[1,2,5,7-9] Our series showed a male: female ratio of 4:1, contrary to that reported in a majority of the studies. The most common signs were reduced visual acuity, an abaxial proptosis, and restricted extraocular movements.[5,7,12] The visual acuity was impaired in only one out of nine patients reported by Mulay *et al*.[12] However, in our study, three patients had optic nerve compression noted on imaging and another patient had extensive mass leading to a total loss of vision in the affected eye.

On MRI, ASPS appears as a well-defined soft-tissue mass that shows isointense to slightly hyperintense signal on T1 and hyperintense signal on T2-weighted sequences. Contrast enhancement varies from intense to peripheral rim enhancement. CT usually demonstrates a homogeneous, well-defined, iso-dense soft-tissue mass with moderate to intense contrast enhancement.[5,13] Radiologically, ASPS may appear similar to solitary fibrous tumor (SFT), rhabdomyosarcoma, and capillary hemangioma.[1] Numerous case reports have shown that ASPS is a highly vascular tumor, as seen in three of our cases.[5,8] This is seen as flow voids on MRI, and in such cases, a preoperative DSA can delineate the vascular supply and major feeder vessels of the tumor. It also guides in planning preoperative embolization to reduce vascularity and intraoperative bleeding, which facilitates a smooth and complete tumor excision.

The exact tissue of origin of ASPS is not clear, however, a few studies suggest that the tumor arises from the extraocular muscles, pointing toward a myogenic origin.[5,9,12] In our series, the recti muscles were found to be involved in two patients. The histopathology is characterized by a pseudo-alveolar pattern consisting of round to polygonal tumor cells having distinct borders and epithelioid appearance separated by delicate fibrovascular septae. Certain cases show prominent hemangiopericytoma-like vasculature.[5,14] PAS-positive, diastase-resistant intracytoplasmic crystals and granules are characteristic and are present in 80% of the cases.[12]

Paraganglioncytoma, granular cell tumor, amelanotic melanoma, alveolar rhabdomyosarcoma, and metastatic renal cell carcinoma are a few tumors that appear morphologically similar to ASPS.[1,5] Immunohistochemistry markers may not be pathognomonic but are supportive in making a diagnosis and differentiating it from a morphologically similar tumor. Out of 47 cases analyzed by Rekhi *et al*.,[14] the tumors were focally positive for desmin, SMA, and vimentin in 16.1, 20, and 11.1% of the cases respectively, while 90.9% of the tumors were positive for TFE3. Mitotic activity and the Ki-67 proliferation index are typically low, consistent with the slow-growing nature of the tumor.

Nuclear expression and detection of TFE3 protein by IHC is highly specific and diagnostic, especially in cases that do not show typical histopathological features. The nuclear expression of this marker is considered diagnostic as cytoplasmic positivity may be present in other tumors also.[4] Two patients in our series showed nuclear positivity for TFE3. The remaining three patients were diagnosed based on their typical histopathology features.

The treatment of choice for ASPS is complete surgical resection with tumor-free margins. However, a negative tumor-free margin cannot be assured in orbital tumors due to the inherent anatomical limitations. Exenteration, a radical surgery that at times is unavoidable was done for 20 (27%) out of the 74 cases reported.[1,2,5,7-9] Embolization before exenteration was done for one patient owing to significant bleeding encountered during an incisional biopsy by Kim *et al*.[15] In our series, all three patients who underwent embolization had successful removal of the entire tumor with very minimal intraoperative bleeding. Preoperative embolization followed by excision could be a promising modality of treatment that can help salvage the globe. The route of embolization can be either percutaneous or transarterial. Since the ophthalmic artery was a feeder to the tumor, a percutaneous route was preferred vis-à-vis a transarterial one to reduce the chances of post-embolization vision loss.[16] Despite all the precautions, there is still a chance of retinal artery occlusion due to the embolic material which occurred in one of our patients.

The reported recurrence rate for orbital ASPS varies from 18.6 to 47.7%.[7] The adjuvant radiotherapy in a dose of 50–64 Gy

Table 2: Review of literature of alveolar soft-part sarcoma cases presenting in the Indian subcontinent

Author, year	No. of cases	Mean age (years)/ sex	Presentation	Immunohistochemistry (Positive)	Management	Follow-up (months)/status at follow-up
Our study	5	12.6/4 M, 1 F	Proptosis, diminished vision	2 - TFE3 + 2 - Desmin + 3 - Vimentin +	1 B+CE 2 Em+CE+RT 1 Em+CE+CH 1 Ex+EBRT+CH	11.2/ 4- NED, 1- DOD
Rangarajan *et al*., 2020	1	12/F	Proptosis	NA	CE	6/NED
Chaudhari *et al*., 2019	1	22/M	Proptosis, loss of vision	NA	Ex+RT	6/NED
Kumar *et al*., 2016	1	7/F	Orbital mass, loss of vision	TFE3, CD 34, CD 31 +	B+Ex	NA
Mulay K *et al*., 2016	1	7/M	Eyelid swelling	NA	CE+RT	NA
Mulay K *et al*., 2014	9	6/ 2M, 7F	Proptosis, lid swelling	7 - myo D1, NSE, S-100+	7 CE+RT 2 CE+RT+CH	1-126/NED
Majumdar *et al*., 2013	1	25/M	Proptosis	NA	CE+CH	6/NED
Rekhi *et al*., 2012	2	25/2 M	NA	1 - TFE3 +	CE	39/AWD 1- LTFU
Kanhere *et al*., 2005	2	16.5/ 1M, 1F	Slowly growing mass	NA	Ex+RT, CE+RT+CH	102/1-NED, 1-LTFU
Kashyap *et al*., 2004	3	13/ 2F, 1M	Proptosis	2 -Desmin+1- NSE +	1B+Ex+RT+CH 2 CE	24/1-NED, 1- Recurrence, 1- LTFU
Chodankar *et al*., 1986	1	15/M	Eyelid swelling	NA	CE	9/NED
Mukherjee and Agrawal, 1979	1	30/M	Proptosis, diminished vision	NA	Ex	LTFU
Varghese *et al*., 1968	1	13/F	Proptosis	NA	Ex	Few months, Recurrence
Nirankari *et al*., 1963	1	38, M	Proptosis, diminished vision	NA	E+Ex+RT	12, Recurrence, LTFU

M/F - Male/Female, CE - Complete excision, Em - Embolization, Ex - Exenteration, RT - Radiotherapy, CH - Chemotherapy, B - Biopsy, NED - No evidence of disease, DOD - Died of disease, LTFU - Lost to follow-up, NA - Not available

given over 15–32 fractions helps to achieve local tumor control, thereby, reducing the chances of recurrence.[2,7] Lieberman *et al*.[17] followed up 91 patients of ASPS and reported survival of 87, 62, and 43% at 2, 5, and 10 years of follow-up, respectively. Forty-five patients developed metastases and the median survival for these patients was 2 years. deBarros reviewed 49 cases of orbital ASPS with a mean follow-up of 71 months and found that nine cases (18%) had distant metastases and six patients (12%) died of the disease.[8] The most common sites for metastasis noted by them were the lung (12%), followed by the brain (5%), and the liver (one case). Another common site of metastasis is the bone, which was seen in one of our patients.[17,18] ASPS is known to metastasize late in the course of the disease years after the initial diagnosis which mandates a long-term follow-up.[12]

Orbital involvement, younger age, and a tumor size less than 5 cm have been noted to have a better prognosis while metastasis at the time of presentation carries a poorer prognosis.[5,7] Case 5 in our study had all the poor prognostic factors at presentation—a large tumor size, more than 20 years of age, metastatic disease which explains poor survival in this patient. Although the Ki proliferation index is not proven to be a prognostic marker, it was associated with aggressive disease, local recurrence, and poor survival in one of the series.[5]

ASPS is shown to have a poor response to conventional anthracycline-based chemotherapeutic agents but adjuvant treatment with vincristine, adriamycin, and cyclophosphamide has been tried with variable results.[8,18] In comparison to other soft-tissue sarcomas, ASPS has shown high sensitivity to vascular endothelial growth factor receptor-targeted tyrosine kinase inhibitors. Pazopanib, sunitinib, sorafenib, and cediranib have shown to be effective in advanced and metastatic ASPS.[18-20] There are even instances of disease stabilization without any treatment and rare case reports of spontaneous disease regression.[19,21]

Our study was limited by its retrospective design and small sample size. The TFE3 marker which is now considered specific could not be done for all patients. Other limitations were a non-uniform treatment protocol and a short duration of follow-up. Despite all its limitations, the present study adds further insights into this rare orbital neoplasm.

Conclusion

Orbital ASPS is a relatively uncommon, slow-growing, pediatric orbital neoplasm with a high potential for metastasis. Radiologically, it may appear as a vascular soft-tissue tumor and DSA is indicated in all such cases. Preoperative embolization can be considered as an option for globe salvage. Complete surgical excision is the treatment of choice and adjuvant radiotherapy helps in preventing recurrences. A multidisciplinary approach and a specific tumor registry for ASPS might aid in better understanding and management of this rare tumor.

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Conflicts of interest

There are no conflicts of interest.

References

1. Kumar GK, Nemade H, Krishnamohan, Fonseca D, Rao LMCS, Rao TS. Rare case report of alveolar soft part sarcoma of the orbit. Indian J Surg Oncol 2017;8:234-9.
2. Chaudhari PB, Pathy S, Deo SSV, Chawla B, Mridha AR. Alveolar soft part sarcoma of orbit: A rare diagnosis. J Egypt Natl Canc Inst 2017;29:167-70.
3. Christopherson WM, Foote FW Jr, Stewart FW. Alveolar soft-part sarcomas; structurally characteristic tumors of uncertain histogenesis. Cancer 1952;5:100-11.
4. Folpe AL, Deyrup AT. Alveolar soft part sarcoma: A review and update. J Clin Pathol 2006;59:1127-32.
5. Hei Y, Kang L, Yang X, Wang Y, Lu X, Li Y, *et al*. Orbital alveolar soft part sarcoma: A report of 8 cases and review of the literature. Oncol Lett 2018;15:304-14.
6. Welsh RA, Bray DM 3rd, Shipkey FH, Meyer AT. Histogenesis of alveolar soft part sarcoma. Cancer 1972;29:191-204.
7. Wang Y, Du B, Yang M, He W. Paediatric orbital alveolar soft part sarcoma recurrence during long-termfollow-up: A report of 3 cases and a review of the literature. BMC Ophthalmol 2020;20:60.
8. de Barros GF, Hakim JR, Passos JP, Perron M, Odashiro AN. Orbital alveolar soft part sarcoma: Case report and literature review. Can J Ophthalmol 2019;54:e292-4.
9. Al Ghulaiga FM, Kwon M, Sa H-S. Alveolar soft part sarcoma of the lateral rectus muscle: Suture technique to prevent postoperative strabismus. Am J Ophthalmol Case Rep 2020;18:100668.
10. Huang SH, O'Sullivan B. Overview of the 8th edition TNM classification for head and neck cancer. Curr Treat Options Oncol 2017;18:40.
11. Eisenhauer EA, Therasse P, Bogaerts J, Schwartz LH, Sargent D, Ford R, *et al*. New response evaluation criteria in solid tumours: Revised RECIST guideline (version 1.1). Eur J Cancer 2009;45:228-47.
12. Mulay K, Ali MJ, Honavar SG, Reddy VA. Orbital alveolar soft-part sarcoma: Clinico-pathological profiles, management and outcomes. J Cancer Res Ther 2014;10:294-8.
13. McCarville MB, Muzzafar S, Kao SC, Coffin CM, Parham DM, Anderson JR, *et al*. Imaging features of alveolar soft-part sarcoma: A report from Children's Oncology Group Study ARST0332. AJR Am J Roentgenol 2014;203:1345-52.
14. Rekhi B, Ingle A, Agarwal M, Puri A, Laskar S, Jambhekar NA. Alveolar soft part sarcoma 'revisited': Clinicopathological review of 47 cases from a tertiary cancer referral centre, including immunohistochemical expression of TFE3 in 22 cases and 21 other tumours. Pathology 2012;44:11-7.
15. Kim HJ, Wojno T, Grossniklaus HE, Shehata BM. Alveolar soft part sarcoma of the orbit: Report of 2 cases with review of the literature. Ophthalmic Plast Reconstr Surg 2013;29:e138-42.
16. Pihlblad MS, Schaefer DP. Percutaneous embolization of an orbital hemangiopericytoma with Onyx facilitates its surgical excision. Ophthalmic Plast Reconstr Surg 2012;28:e147-9.
17. Lieberman PH, Brennan MF, Kimmel M, Erlandson RA, Garin-Chesa P, Flehinger BY. Alveolar soft-part sarcoma: A clinicopathologic study of half a century. Cancer 1989;63:1-13.
18. Paoluzzi L, Maki RG. Diagnosis, prognosis, and treatment of alveolar soft-part sarcoma: A review. JAMA Oncol 2019;5:254-60.
19. Judson I, Morden JP, Kilburn L, Leahy M, Benson C, Bhadri V, *et al*. Cediranib in patients with alveolar soft-part sarcoma (CASPS): A double-blind, placebo-controlled, randomized, phase 2 trial. Lancet Oncol 2019;20:1023-34.
20. Que Y, Liang Y, Zhao J, Ding Y, Peng R, Guan Y, *et al*. Treatment-related adverse effects with pazopanib, sorafenib and sunitinib in patients with advanced soft-tissue sarcoma: A pooled analysis. Cancer Manag Res 2018;10:2141-50.
21. BaniHani MN, Al Manasra AR. Spontaneous regression in alveolar soft part sarcoma: Case report and literature review. World J Surg Oncol 2009;7:53.