Alveolar Soft Part Sarcoma

Clinical Course and Patterns of Metastasis in 70 Patients Treated at a Single Institution

Charles A. Portera, Jr., M.D.
Viet Ho, M.S.
Shreyaskumar R. Patel, M.D.
Kelly K. Hunt, M.D.
Barry W. Feig, M.D.
Paula M. Respondek, PA-C
Alan W. Yasko, M.D.
Robert S. Benjamin, M.D.
Raphael E. Pollock, M.D., Ph.D.
Peter W. T. Pisters, M.D.

The University of Texas M. D. Anderson Cancer Center Multidisciplinary Sarcoma Center, Houston, Texas.

Presented in part at The Society of Surgical Oncology Annual Meeting, Orlando, Florida, March 4–7, 1999.

The authors gratefully acknowledge the assistance of Vivian Z. Garcia and Melissa Burkett in the preparation of this article.

Address for reprints: Peter W. T. Pisters, M.D., Department of Surgical Oncology, Box 444, The University of Texas M. D. Anderson Cancer Center, 1515 Holcombe Blvd., Houston, TX 77030-4009; Fax: (713) 792-7829; E-mail: ppisters@mdanderson.org

Received May 9, 2000; revision received September 19, 2000; accepted September 19, 2000.

BACKGROUND. Alveolar soft part sarcoma (ASPS) is a rare form of soft tissue sarcoma. Brain metastases have been reported to be a common feature of Stage IV ASPS, and recent practice guidelines recommend routine intracranial imaging as part of the staging evaluation in all patients who present with ASPS.

METHODS. The authors performed a comprehensive retrospective review of the clinical presentation, treatment, outcome, and patterns of failure in a consecutive series of patients with localized (American Joint Committee on Cancer [AJCC] Stages II/III) or metastatic (AJCC Stage IV) ASPS who presented to a tertiary care cancer center between 1959 and 1998.

RESULTS. Seventy-four patients were identified from the database searches. The anatomic distribution of their primary tumors included: extremities, 44 patients (60%); trunk, 15 patients (20%); head and neck, 9 patients (12%); and retroperitoneum, 6 patients (8%). The median tumor size was 6.5 cm (range, 1.2–24 cm). The AJCC stage at presentation was Stage II or III in 35% of the patients and Stage IV in 65% of the patients. The 5-year actuarial local recurrence free, distant recurrence free, disease free, and overall survival rates among the 22 patients with localized ASPS were 88%, 84%, 71%%, and 87%, respectively. At a median follow-up of 9 years, 2 of 22 patients with localized disease had developed local recurrences and 3 had developed metastatic disease (all to the lung only). Brain metastases were noted in 9 of 48 patients who presented with Stage IV (M1) disease (19%) and always were noted in association with metastasis to other sites. The median survival of patients with M1 disease was 40 months, with a 5-year survival rate of 20%.

CONCLUSIONS. Long term follow-up of patients with localized ASPS reveals a relatively indolent clinical course with relatively low rates of local and distant recurrence. In patients with Stage IV ASPS, brain metastases were observed only as part of more disseminated disease. The observations of the current study do not support current practice guidelines for the staging of patients with ASPS and suggest that selective rather than routine intracranial imaging should be used in patients presenting with ASPS. ***Cancer* 2001;91:585–91.**

KEYWORDS: alveolar soft part sarcoma, soft tissue sarcoma, local recurrence, distant recurrence, long term survival, disease stage.

Alveolar soft part sarcoma (ASPS) is a rare soft tissue tumor that accounts for approximately 0.5–1% of soft tissue sarcomas.[1] The disease affects primarily younger patients, with the median age at diagnosis significantly lower than for other forms of soft tissue sarcoma; the peak age incidence is between 15 and 35 years.[1] ASPS also is characterized by unusual patterns of metastatic spread. For example, brain metastases have been described as a common feature of

metastatic ASPS,[2-7] whereas they are reported to be relatively unusual with other high grade sarcomas. Indeed, this pattern of metastasis is the basis for the current practice guidelines of the Society of Surgical Oncology (SSO), which recommend intracranial imaging for all patients who present with ASPS.[8]

As a consequence of the rarity of the disease, the majority of reports concerning ASPS are in the form of case reports and small collective series.[6,9,10] To our knowledge there is only one large series reported in the literature to date, a report of 102 patients from Memorial Sloan-Kettering Cancer Center that summarized 50 years of experience with the disease.[11] As such, the literature base for clinical decision-making for patients with ASPS is quite limited. Therefore we performed a retrospective study to evaluate the clinicopathologic features, treatment, outcome, and patterns of failure in a consecutive cohort of patients with ASPS who presented to The University of Texas M. D. Anderson Cancer Center. In addition, we evaluated whether the distribution of metastases supported the existing staging guidelines of the SSO.[8]

MATERIALS AND METHODS

We searched The University of Texas M. D. Anderson Cancer Center Tumor Registry and the M. D. Anderson Prospective Sarcoma Database for patients with ASPS who were evaluated at the M. D. Anderson Cancer Center between 1959–1998. Seventy-four consecutive patients with ASPS who were evaluated between April 1959 and March 1998 were identified. A comprehensive retrospective review of the medical records of the subset of patients who received the majority of their care and follow-up evaluation (n = 70) at M. D. Anderson was performed. Data regarding clinicopathologic factors, treatment, outcome, patterns of failure, and sites of metastatic disease were recorded. The diagnosis of ASPS was confirmed by a review of the pathology slides at the M. D. Anderson Cancer Center.

The following definitions were used. The anatomic depth of the tumor was characterized as either superficial or deep relative to the investing muscular fascia. Tumor size was defined as the maximum dimension described by pathologic evaluation, pretreatment imaging (computed tomography [CT], magnetic resonance imaging [MRI], or ultrasonography), or physical examination. The tumor was considered to be in the upper extremity if it was at or beyond the shoulder joint and in the lower extremity if the tumor was in the groin or the leg. An iliac fossa tumor was classified as being located in the retroperitoneum. All patients were staged retrospectively according to the American Joint Committee on Cancer (AJCC) staging system.[12] A tumor was described as being localized if there was no evidence of distant disease after clinical and radiographic staging. Locally recurrent disease was defined as tumor occurrence at a site previously treated for ASPS.

Summary statistics were obtained using established methods. The rates of recurrence and survival were estimated using the Kaplan–Meier method.[13] The time to recurrence or death was measured from the time of surgery (for patients who underwent surgical resection with curative intent) or initial presentation (for patients who presented to the M. D. Anderson Cancer Center with AJCC Stage IV disease). The endpoints for actuarial analysis were local recurrence free survival, distant recurrence free survival, disease free survival, and overall survival. Univariate comparisons were performed by log rank analysis.

RESULTS

The distribution of clinicopathologic characteristics for the entire cohort of 74 patients is outlined in Table 1. The median age of the patients presenting to M. D. Anderson with ASPS was 26 years (range, 3–68 years). There were 36 male patients (49%) and 38 female patients (51%). Among the 43 patients age < 30 years, there was a slight female preponderance (25 female patients [58%]). In contrast, a slight male preponderance was noted among the 31 patients who were age ≥ 30 years (18 male patients [58%]). The majority of patients (65%) presented with Stage IV disease. The majority of the primary tumors (82%) were located deep relative to the investing fascia of the extremity or trunk.

The anatomic regions and subsites of ASPS in the overall cohort of 74 patients are summarized in Table 2. Forty-four patients (60%) had ASPS arising in the upper or lower extremity. The most common anatomic subsite was the thigh, which accounted for 30 cases (41%). The next most frequent anatomic subsite was the pelvis/iliac fossa (7 patients; 10%).

The clinicopathologic characteristics and event free outcomes for the cohorts of patients with localized (AJCC Stage II or III) and advanced (AJCC Stage IV) disease were considered separately.

Patients with Localized ASPS

Table 1 outlines the distribution of clinicopathologic factors in the subset of 22 patients with localized ASPS. The median age of the patients with localized disease was 22 years (range, 5–56 years). There were 8 males (36%) and 14 females (64%). The majority of the tumors were located deep to the fascia (77%), and the majority of patients presented with Stage IIB disease (68%), followed by Stage III disease (27%). The most common sites at presentation were the trunk (n = 6

TABLE 1
Distribution of Clinicopathologic Factors among All Patients Presenting to The University of Texas M. D. Anderson Cancer Center with ASPS and among the Subset with Localized Disease

	All patients (n = 74)		Localized ASPS (n = 22)	
Factor	No.	%	No.	%
Age (yrs)				
Median (range)	26 (3–68)		22 (5–56)	
< 30	43	58	18	82
≥ 30	31	42	4	18
Gender				
Male	36	49	8	36
Female	38	51	14	64
Presentation				
Primary	21	28	21	95
Local recurrent	1	1	1	5
Local and metastatic	24	32	—	—
Metastatic only	24	32	—	—
Neurologic symptoms	9	12	0	0
Anatomic site				
Head and neck	9	12	4	18
Trunk	23	31	6	27
Upper extremity	7	10	4	18
Lower extremity	37	50	6	27
Retroperitoneum, abdomen	6	8	2	9
Tumor size (cm)				
Median (range)	6.5 (1.2–24 cm)		3.1 (1.2–11)	
T1[a]	30	41	15	68
T2[a]	44	59	7	32
Tumor depth				
Superficial	2	3	2	9
Deep	61	82	17	77
Not evaluable	11	15	3	14
AJCC Stage[a]				
IIB	19	26	15	68
IIC	1	1	1	5
III	6	8	6	27
IV	48	65	—	—

ASPS: alveolar soft part sarcoma; AJCC: American Joint Committee on Cancer.
[a] American Joint Committee on Cancer Staging, 5th edition.[12]

TABLE 2
Anatomic Regions and Subsites of ASPS in 74 Patients

Site/subsite	No.
Head and neck region	9
Nasopharyngeal	1
Tongue	1
Retro-orbital	1
Skull	1
Neck	1
Sublingual gland	1
Scalp	1
Face	1
Infratemporal fossa	1
Trunk/retroperitoneal/abdomen	21
Shoulder	3
Subscapular	1
Back/paravertebral	2
Anterior chest wall	1
Posterior chest wall	2
Rectus abdominal muscle	1
Flank	2
Pelvis/iliac fossa	7
Buttock	2
Lower extremity	37
Groin	2
Thigh	30
Knee	1
Calf	4
Upper extremity	7
Upper arm	3
Elbow	1
Forearm	3

ASPS: alveolar soft part sarcoma.

patients; 27%) and lower extremities (n = 6 patients; 27%).

The treatment approaches utilized for patients with localized disease were comprised primarily of local therapy alone. Surgery alone and surgery plus external beam radiotherapy were used in 9 and 10 patients, respectively. Three patients were treated with preoperative doxorubicin-based chemotherapy followed by surgery (two patients) or followed by surgery plus external beam radiotherapy (one patient). No chemotherapy-induced clinical or radiographic responses were observed in these three patients.

At last follow-up, the median follow-up of the cohort of patients with localized ASPS was 108 months. Five patients had developed disease recurrence; 2 patients developed local recurrences at 26 and 32 months, respectively, after treatment and 3 patients developed distant recurrences (lung only) at 5, 10, and 24 months, respectively, after treatment. One of the two patients who developed a local recurrence had received postoperative external beam radiotherapy after an R1 resection. At the time of last follow-up, 2 patients who presented with localized ASPS had died of disease, 22 and 58 months, respectively, after treatment. The 5-year actuarial local recurrence free, distant recurrence free, disease free, and overall survival rates were 87%, 84%, 71%, and 88%, respectively. The overall survival and disease free survival plots for patients presenting with localized ASPS are shown in Figures 1 and 2, respectively.

Patients with Metastatic ASPS

The majority of patients (n = 48; 65%) presented with AJCC Stage IV disease. The distribution of metastatic (M1) disease at presentation is outlined in Table 3. The majority of Stage IV patients (71%) presented with

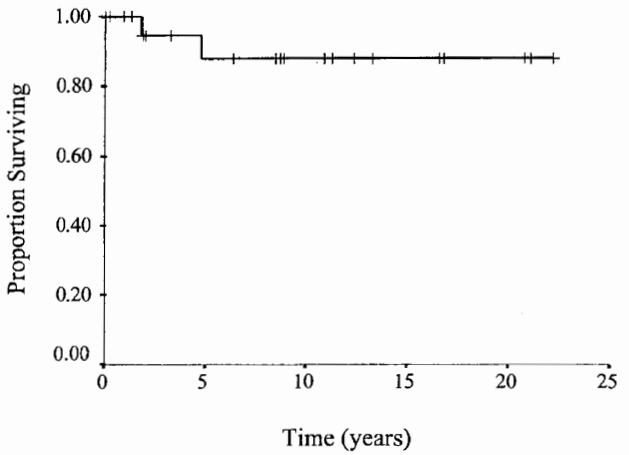

FIGURE 1. Overall survival of a cohort of 22 patients who presented with localized alveolar soft part sarcoma. The 5-year actuarial survival rate was 88%.

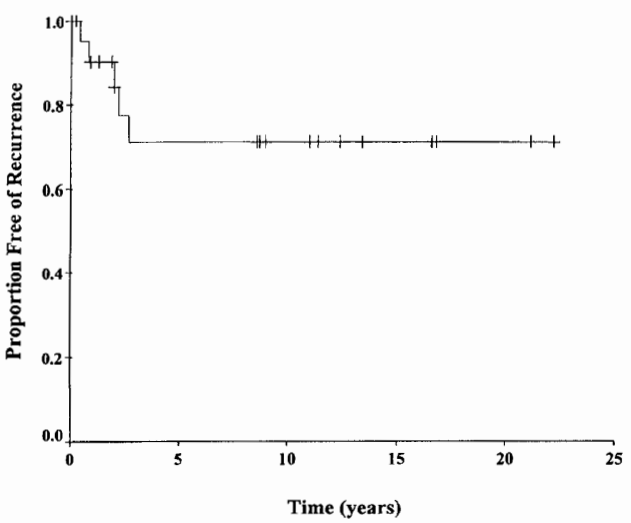

FIGURE 2. Disease free survival of a cohort of 22 patients who presented with localized alveolar soft part sarcoma. The 5-year disease free survival rate was 71%.

only 1 site of metastasis. The most common site of solitary metastasis was the lung (n = 30; 63%), followed by bone (n = 3; 6%).

Brain metastases were reported in 9 of 48 patients with Stage IV disease (19%). Intracranial metastases were observed only in the presence of extracranial metastatic disease and never in the absence of lung metastases. Of the eight patients who presented with neurologic symptoms, all were found to have cerebral metastases on brain CT scan or MRI. Brain imaging studies were performed for staging in 37 patients and did not identify any patients with asymptomatic brain metastases.

TABLE 3
Distribution of Metastases at Presentation in 48 Patients with AJCC Stage IV ASPS

Site of metastasis	No.	%
Solitary metastasis	34	71
Lung	30	63
Bone	3	6
Regional lymph nodes	1	2
Brain	0	0
Liver	0	0
Multiple metastases	14	29
Lung + other nonbrain	5	10
Lung + brain	5	10
Lung + brain + other[a]	4	8

AJCC: American Joint Committee on Cancer; ASPS: alveolar soft part sarcoma.
[a] "Other" includes the liver (one case), bone (two cases), and ovaries (one case).

Of the 48 patients who presented with AJCC Stage IV disease, 33 received definitive treatment and follow-up at the M. D. Anderson Cancer Center. Twenty-six of these 33 patients were treated with systemic chemotherapy. The chemotherapy (first-line therapy at M. D. Anderson) given prior to 1970 was comprised of nonanthracycline based-regimens, primarily regimens that included vincristine and/or cyclophosphamide. Doxorubicin-based chemotherapy was used in 17 of the 26 patients (65%) (median, 4 cycles; range, 2–8 cycles). Of the 26 patients who received systemic chemotherapy for metastatic disease, 1 patient (4%), who underwent R2 metastasectomy (with residual macroscopic pulmonary disease) for multifocal metastatic ASPS to the lung was treated with postoperative doxorubicin (60 mg/m^2 × 5 cycles), vincristine, and cyclophosphamide and achieved complete regression of the residual pulmonary disease. This patient is considered to have achieved a complete response and remained disease free 11 years after treatment. Nine patients (35%) had stable disease. The majority of patients treated with chemotherapy (n = 15; 58%) developed disease progression. No partial or minor responses were noted. One patient could not be assessed accurately for response by retrospective review of X-rays and medical records.

At the time of last follow-up, the median follow-up among surviving patients with AJCC Stage IV disease who were treated and followed at the M. D. Anderson Cancer Center was 41 months. The median survival of all patients who presented with metastatic ASPS was 40 months. The overall survival plot for patients who presented with Stage IV ASPS is shown in Figure 3. The 5-year actuarial overall survival rate was 20%, with the majority of events having occurred within the first 5 years. At last follow-up, 2 of 33

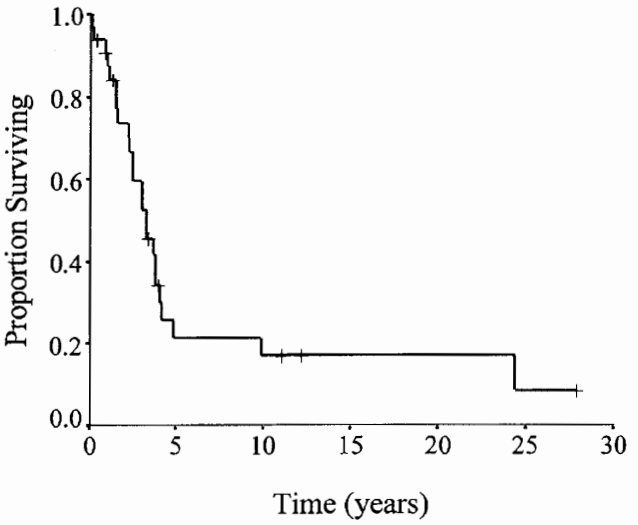

FIGURE 3. Overall survival of a cohort of 33 patients with American Joint Committee on Cancer Stage IV alveolar soft part sarcoma who were treated and followed at the University of Texas M. D. Anderson Cancer Center. The median survival was 40 months and the 5-year actuarial survival rate was 20%.

patients were alive with disease 11 years and 28 years, respectively, after the diagnosis of metastatic ASPS.

DISCUSSION

With rare exceptions,[10,11] prior reports regarding ASPS have to our knowledge been limited to small series[9] and case reports. The larger series, such as the current study and the report concerning 102 patients treated over the course of 50 years at the Memorial Sloan-Kettering Cancer Center,[11] have spanned decades. Despite the limitations of series covering such long periods, important observations regarding the demographics and presentation of patients with ASPS can be made from the current report. Of note, the median age in the current study was 26 years, with the majority of patients (56%) presenting before the age of 30 years. We also noted the age-related gender ratio inversion described by Ordòñez,[10] with a female preponderance noted in younger patients and a male preponderance noted in older patients. Although other series have documented a larger proportion of female ASPS patients,[11] the current study cohort of patients demonstrated no significant gender differences when the group was considered as a whole. However, if the patients with localized disease were considered separately, there was a definite female preponderance (64% female). The most common anatomic location was the lower extremity, which accounted for 50% of the cases at presentation. Other investigators have noted this predilection for the lower extremities.[1,10,11] The majority of patients with ASPS in the current series presented with AJCC Stage IV disease (65%). This preponderance of patients with Stage IV disease is higher than that noted in our overall soft tissue sarcoma population, in which 41% of 2487 patients seen in the past 4 years had Stage IV disease (unpublished data). This most likely reflects referral bias (to a tertiary care institution), the relatively longer clinical course of some patients with Stage IV ASPS, and the absence of therapeutic options known to be helpful in the treatment of patients with advanced disease.

Although it is difficult to make specific comments regarding the efficacy of specific therapies in the context of a study that spans several decades, our experience with doxorubicin-based chemotherapy for ASPS merits comment. Among the 26 patients with measurable Stage IV disease who received chemotherapy and the additional 3 patients with localized disease who received neoadjuvant doxorubicin-based systemic therapy prior to resection, there was only 1 patient (3%) who responded; this patient with Stage IV disease achieved a complete response to doxorubicin-based therapy. On the basis of this experience, we do not recommend routine doxorubicin-based systemic therapy for patients with localized or metastatic ASPS. However, it should be noted that only two patients received doxorubicin plus ifosfamide (a drug with promising activity in other forms of sarcoma) and thus we cannot comment meaningfully on the activity of ifosfamide against ASPS. Our current therapeutic approach for patients with Stage IV ASPS is to consider observation (to better define the pace of the disease and thereby identify the subset of patients with the indolent form of M1 disease) or Phase I or Phase II investigational therapies.

The role of radiation in the treatment of patients with localized ASPS is difficult to define from our experience. In the current study the ten patients who were treated with surgery plus radiotherapy received combined modality therapy on the basis of the perceived high risk nature of their tumors. This assessment was based on the usual constellation of clinicopathologic factors utilized in such risk assessment for patients with other forms of soft tissue sarcoma. Such factors included presentation with locally recurrent ASPS, microscopically positive surgical margins, anatomic location, and, to a lesser extent, tumor size. Given the small numbers of patients treated and the selection bias inherent in identifying patients for combined modality treatment, we do not believe we could comment meaningfully on the efficacy of preoperative or postoperative radiotherapy for patients with localized ASPS. In the absence of data suggesting otherwise, it appears reasonable to continue to use standard clinicopathologic criteria to identify ASPS

patients perceived to be at higher risk for local recurrence; it may be prudent to consider treatment with surgery plus radiotherapy for such patients.

The patterns of failure observed among the 48 patients who presented with metastatic disease and the additional 3 patients who developed metachronous metastases after initial local therapy are of interest. ASPS has been reported to metastasize to the brain more commonly than other forms of high grade sarcoma.[1-7,14,15] In fact, this tendency forms the basis for the current practice guidelines of the SSO, which recommend routine intracranial imaging (brain CT scan or MRI) for patients who present with ASPS.[8] However, these practice guidelines largely are consensus statements rather than completely evidence-based guidelines.[11] In the current series, we did not observe any cases of isolated brain metastases occurring in the absence of pulmonary metastases, although there are published case reports on four patients with metastatic ASPS ostensibly arising in the absence of extracranial metastatic disease.[4,14,15] In the 50-year experience with 102 patients reported from the Memorial Sloan-Kettering Cancer Center, 4 patients were reported to have brain-only metastases; however, the majority of patients were staged in the era prior to routine chest CT scan. Notwithstanding the case reports and taking into account the findings of the current study and the larger report on 102 patients from the Memorial Sloan-Kettering Cancer Center, it appears likely that although ASPS does metastasize to the brain, brain metastases occur most often as a manifestation of disseminated disease. Moreover, in the current study, there were no patients with negative findings on chest CT who underwent intracranial imaging that demonstrated clinically occult intracranial metastases. Thus, on the basis of our observations and the aggregate literature addressing the pattern of metastatic ASPS, there is little evidence to support a recommendation for routine intracranial imaging in patients who present with ASPS. The selective use of intracranial imaging would appear to be indicated when pulmonary metastases are documented or if neurologic symptoms are present.

The long term outcome of patients with localized ASPS generally is quite favorable. We observed disease free and overall survival rates of 71% and 88%, respectively. This is similar to the 60% 5-year survival rate reported for a group of 69 patients with localized ASPS at the Memorial Sloan-Kettering Cancer Center[11] and a 67% 5-year survival rate reported in a series of 20 patients by Auerbach and Brooks.[16] In the current study, local recurrence was observed in 2 of 22 patients with localized disease; 1 of these patients had received postoperative external beam radiotherapy.

The long term outcome of patients with Stage IV ASPS also merits comment. The median survival of patients with M1 disease was 40 months, which is relatively longer than one might anticipate for a chemoresistant, advanced solid tumor. There is a small subset of patients with metastatic ASPS who experience unexplained long term survival. In the current series, 3 of 33 patients with metastatic ASPS were alive $\geq$ 5 years after presentation with metastatic disease. In the series from Memorial Sloan-Kettering, 22 patients with metastatic ASPS had long term follow-up data available,[11] and at least 2 of those 22 patients survived beyond 5 years. To our knowledge the biologic explanations for prolonged survival in the setting of advanced disease are not known. Recent cytogenetic analysis has revealed chromosome rearrangements at 17q25 and Xp11.2 in ASPS,[17,18,19] and additional cytogenetic analyses and further molecular characterization of ASPS may allow for a better understanding of the biologic basis for the prolonged survival observed among some patients with advanced disease.

We believe it is difficult for us to comment meaningfully on the role of surgery in patients with isolated metastatic ASPS. In general, given the indolent course of some patients with metastatic ASPS and the absence of other effective, less toxic palliative options, metastasectomy often is considered for these patients. Not surprisingly perhaps, our experience suggest that ASPS patients may have significant symptom free palliation with metastasectomy.[15] Whether this favorable outcome in a small number of patients with a variable course of disease is because of surgical therapy or in spite of it cannot be determined from our experience. In general, our policy continues to be to evaluate patients with metastatic ASPS individually and to consider metastasectomy for patients with good performance status and medically operable tumors who have M1 disease that can be resected completely with acceptable morbidity.

The results of the current study summarize our institutional experience with ASPS. Patients who present with localized (AJCC Stage II or III) disease have a generally favorable prognosis with prolonged survival. Metastatic ASPS is resistant to conventional doxorubicin-based chemotherapy and consequently we recommend that observation or novel therapies be considered for these patients. The distribution of metastatic disease noted in ASPS patients confirms that this disease can spread to the brain. However, no cases of isolated brain metastases in the absence of pulmonary metastases were identified in the current study and thus our findings do not support the current SSO guidelines for the staging of ASPS.[8] A subset of

patients with advanced disease experiences prolonged survival. Further studies characterizing the cytogenetic abnormalities and molecular alterations in ASPS will be required to gain an increased understanding of the variable clinical behaviors of morphologically similar forms of this disease.

REFERENCES

1. Enzinger FM, Weiss SW. Malignant tumors of uncertain type. In: Enzinger FM, Weiss SW, editors. Soft tissue tumors. St. Louis: Mosby, 1995:1067–74.
2. Perry J, Bilbao JM. Metastatic alveolar soft part sarcoma presenting as a dural-based cerebral mass. *Neurosurgery* 1994;334:168–70.
3. Ogose A, Morita T, Hotta T, Kobayashi H, Otsuka H, Hirata Y, et al. Brain metastases in musculoskeletal sarcomas. *Jpn J Clin Oncol* 1999;29:245–7.
4. Salvati M, Cervoni L, Caruso R, Gagliardi FM, Delfini R. Sarcoma metastatic to the brain: a series of 15 cases. *Surg Neurol* 1998;49:441–4.
5. Lewis AJ. Sarcoma metastatic to the brain. *Cancer* 1988;61: 593–601.
6. Evans HL. Alveolar soft-part sarcoma. A study of 13 typical examples and one with a histologically atypical component. *Cancer* 1985;55:912–7.
7. Brunk JH. Ueber das sogenannte nichtchromaffine, maligne paraganglioma der Bauchwandund Oberschenkelmuskulatur (Synonym: alveolares weichteilsarkom, malignes granulares myoblastom). *Frankf Ztschft Pathology* 1957;68:643–5.
8. Pollock RE, Brennan MF, Lawrence W Jr. Soft-tissue sarcoma surgical practice guidelines. *Oncology* 1997;11:1327–32.
9. Temple HT, Scully SP, O'Keefe RJ, Rosenthal DI, Mankin HJ. Clinical presentation of alveolar soft-part sarcoma. *Clin Orthop* 1994;(300):213–8.
10. Ordòñez NG. Alveolar soft part sarcoma: a review and update. *Adv Anat Pathol* 1999;6:125–39.
11. 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.
12. Soft tissue sarcoma. In: Fleming ID, Cooper JS, Henson DE, Hutter RVP, Kennedy BJ, Murphy GP, et al., editors. American Joint Committee on Cancer staging manual. 5th edition. Philadelphia: Lippincott-Raven, 1997:149–56.
13. Kaplan E, Meier P. Nonparametric estimation from incomplete observations. *J Am Stat Assoc* 1958;53:457–81.
14. Wang CH, Lee N, Lee LS. Successful treatment for solitary brain metastasis from alveolar soft part sarcoma. *J Neurooncol* 1995;25:161–6.
15. Bindal RK, Sawaya RE, Leavens ME, Taylor SH, Guinee VF. Sarcoma metastatic to the brain: results of surgical treatment. *Neurosurgery* 1994;35(2):185–90.
16. Auerbach HE, Brooks JJ. Alveolar soft part sarcoma. A clinicopathologic and immunohistochemical study. *Cancer* 1987;60:66–73.
17. Joyama S, Ueda T, Shimizu K, Kudawara I, Mano M, Funai H, et al. Chromosome rearrangement at 17q25 and xp11.2 in alveolar soft-part sarcoma: a case report and review of the literature. *Cancer* 1999;86:1246–50.
18. Heimann P, Devalck C, Debusscher C, Sariban E, Vamos E. Alveolar soft-part sarcoma: further evidence by FISH for the involvement of chromosome band 17q25. *Genes Chromosomes Cancer* 1998;23:194–7.
19. van Echten J, van den BE, van Baarlen J, van Noort G, Vermey A, Dam A, et al. An important role for chromosome 17, band q25, in the histogenesis of alveolar soft part sarcoma. *Cancer Genet Cytogenet* 1995;82:57–61.