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Case Report

A case of retroperitoneal tumor displaying epithelial differentiation, prominent myxoid stroma and loss of INI1/SMARCB1

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Summary

The clinicopathological spectrum of INI1 deficient tumors is expanding. Epithelioid sarcoma (ES) is a rare sarcoma of uncertain differentiation, more often occurring in the extremities and uncommonly in the deep soft tissues. Histopathologically, it manifests in the form of classical, proximal, or hybrid types, the latter two characterized by rhabdoid cytomorphology. Immunohistochemically, ESs display loss of INI1/SMARCB1 and genetically associated with high percentage of *SMARCB1* deletions

We report an extremely uncommon case of a retroperitoneal tumor in a 42-year-old male, who presented with abdominal discomfort. Radiologic imaging disclosed a 12 cm-sized retroperitoneal mass without involvement of any organ parenchyma. The patient underwent tumor excision with left-sided nephrectomy at another hospital. A review of the paraffin-embedded tissue sections revealed a multinodular tumor, composed of dyscohesive epithelioid tumor cells and focally arranged in cords, containing moderate to abundant, eosinophilic cytoplasm, vesicular nuclei, containing prominent nucleoli, including cells with rhabdoid cytomorphology, in a conspicuous myxoid stroma. A focal tumor area resembled proximal-type of ES. Immunohistochemically, tumor cells displayed positivity for pan cytokeratin (AE1/AE3), epithelial membrane antigen (EMA), vimentin and focally for CA125, while these were negative for CD34, S100 protein, CKIT, DOG1, and INI1/SMARCB1.

To the best of our knowledge, this constitutes the first case of a malignant tumor with epithelioid morphology, displaying myxoid matrix and loss of INI1/SMARCB1, resembling a myxoid variant of an epithelioid sarcoma and myoepithelioma-like tumor of the vulvar tumor, occurring in the retroperitoneum. A review of similar cases, differential diagnosis and treatment-associated implications are presented.

Key words: retroperitoneal sarcoma, myxoid tumors, epithelioid sarcoma, INI1/SMARCB1, rare tumor

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Conflict of interest
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Introduction

The spectrum of tumors characterized by loss of INI1/SMARCB1 is increasing, which includes classical examples of epithelioid sarcoma and malignant rhabdoid tumors, to name but a few [1]. Epithelioid sarcoma (ES) is a rare malignant mesenchymal tumor with an uncertain differentiation, accounts for less than 1% of all adult soft tissue sarcomas, and histologically, as well as immunohistochemically displays partial or complete epithelioid differentiation, including diffuse loss of INI1 in most cases, as a result of biallelic inactivation of *SMARCB1*/*INI1* gene [2].

ES is mainly seen in young adults, with an age-range of 10 to 35 years (median = 26) and shows male preponderance (M: F- 2:1). It predominantly occurs in the extremities, uncommonly in the trunk, head and neck region, perineum and genital sites and rarely in the mediastinum

and bone [2-7]. Unlike most other soft tissue sarcomas, ES shows lymphatic spread to lymph nodes, noncontiguous skin, deep soft tissues and bone, rather than hematogenous spread [3,8].

Histopathologically, ES appears in the form of classic, proximal or hybrid subtypes. The former subtype displays cellular nodules of epithelioid and spindle-shaped tumor cells with central necrosis, while the proximal-type is composed of sheet-like arrangement of epithelioid cells, mostly containing abundant eosinophilic cytoplasm with prominent nucleoli, reminiscent of rhabdoid cytomorphology. Rare cases with hybrid histology show combined features of classic and proximal ES [9]. Immunohistochemically, tumor cells display positive immunostaining for cytokeratins and EMA, along with a consistent loss of INI1/SMARCB1 [2,6,7,9]. Very few cases of ES with a prominent myxoid stroma have been reported, including none in the retroperitoneum [10,11]. Lately, a myoepithelioma-like tumor has been reported in the vulvar region, with overlapping features of an ES, displaying prominent myxoid stroma [12,13].

Here, we report an unusual case of a large retroperitoneal mass in an adult male.

Case report

A 42-year-old male presented with complaints of abdominal discomfort along with back ache of 2 months duration. Clinically, there was no palpable mass felt. His vitals were stable and within normal limits.

Computed tomogram (CT) scan revealed a well-defined soft tissue mass, measuring 12 cm x 9.4 cm x 9.2 cm in the left paravertebral region of the retroperitoneal compartment, involving the D1, L1 an L2 levels of the spine. The tumor was seen infiltrating the perirenal fat (Fig. 1).

Positron emission tomogram (PET) scan showed a large, heterogeneous hypermetabolic activity within the tumor mass (SUV max = 5.1), along with para aortic nodular lesions, largest measuring 1.7 cm x 1.4 cm, below the main tumor (SUV max = 4.6). There was no other clinicoradiologically significant lesion, especially in his abdominal organs or elsewhere in his body.

Her pre-operative serum alpha-fetoprotein levels were 3.8 ng/ml (normal range = 0-15), lactate dehydrogenase (LDH) levels were 293 U/L (normal range = 100-190) and beta human chorionic gonadotrophin (B-HCG) levels were 2 mIU/mL (normal range = 0-2).

The patient underwent resection of the retroperitoneal mass along with left-sided nephrectomy, para aortic lymph node dissection and excision of a diaphragmatic nodule at another hospital.

A soft tissue mass with nephrectomy specimen was received, together measuring 20 cm x 13 cm x 6 cm. On serial sectioning, an ill-defined gelatinous tumor with a variegated appearance was identified over the upper pole of the kidney, measuring 12 cm x 14 cm x 6 cm. The tumor was seen encasing the kidney, but not

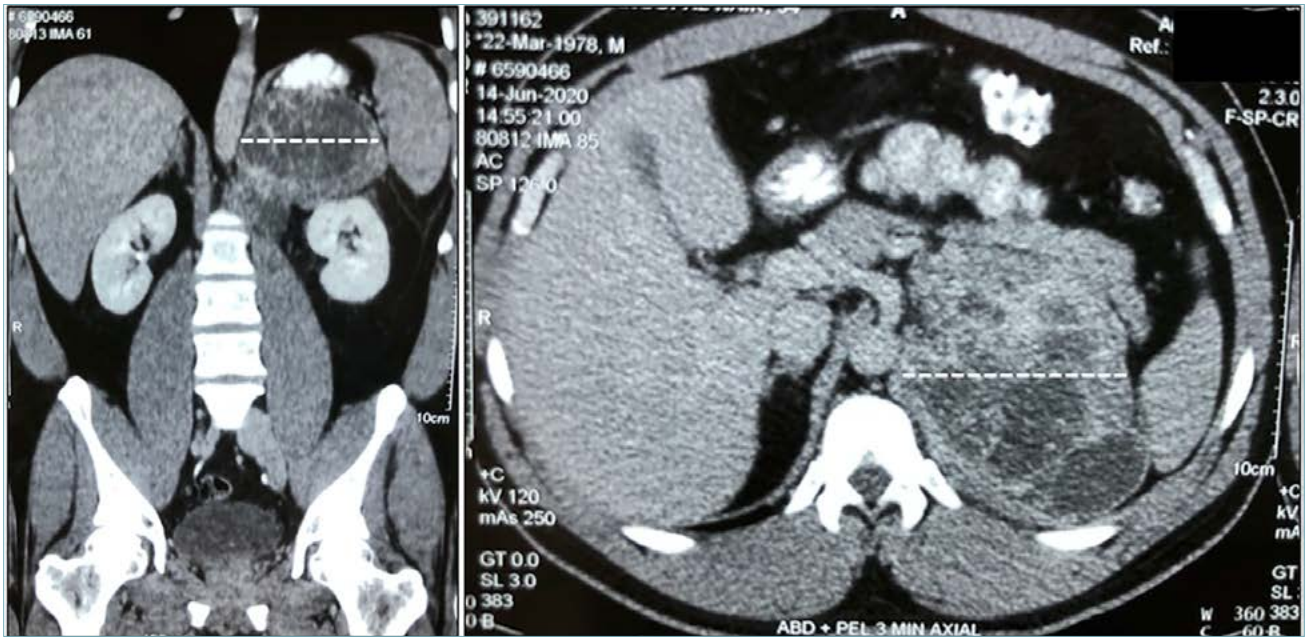

Figure 1. Computed tomogram (CT) scan showing a well-defined, large, heterogeneous soft tissue mass (dotted lines) in the left paravertebral region of the retroperitoneum.

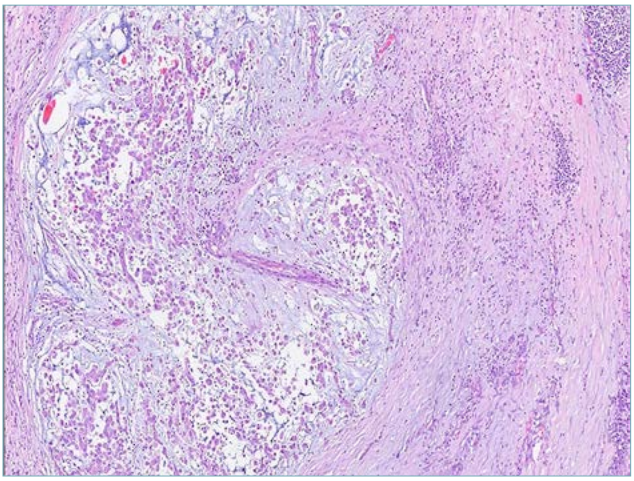

Figure 2. Microscopic appearance. Multiple ill-defined nodules of tumor cells embedded in a prominent myxoid stroma and surrounded by lymphoid aggregates. H and E, x 100.

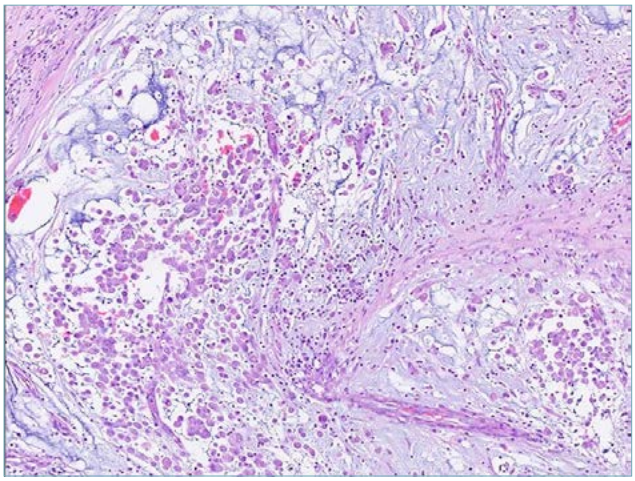

Figure 3. Loosely cohesive tumor cells arranged in cords and singly dispersed in an abundant myxoid stroma with interspersed lymphocytes and few thin-walled blood vessels. H and E, x 200.

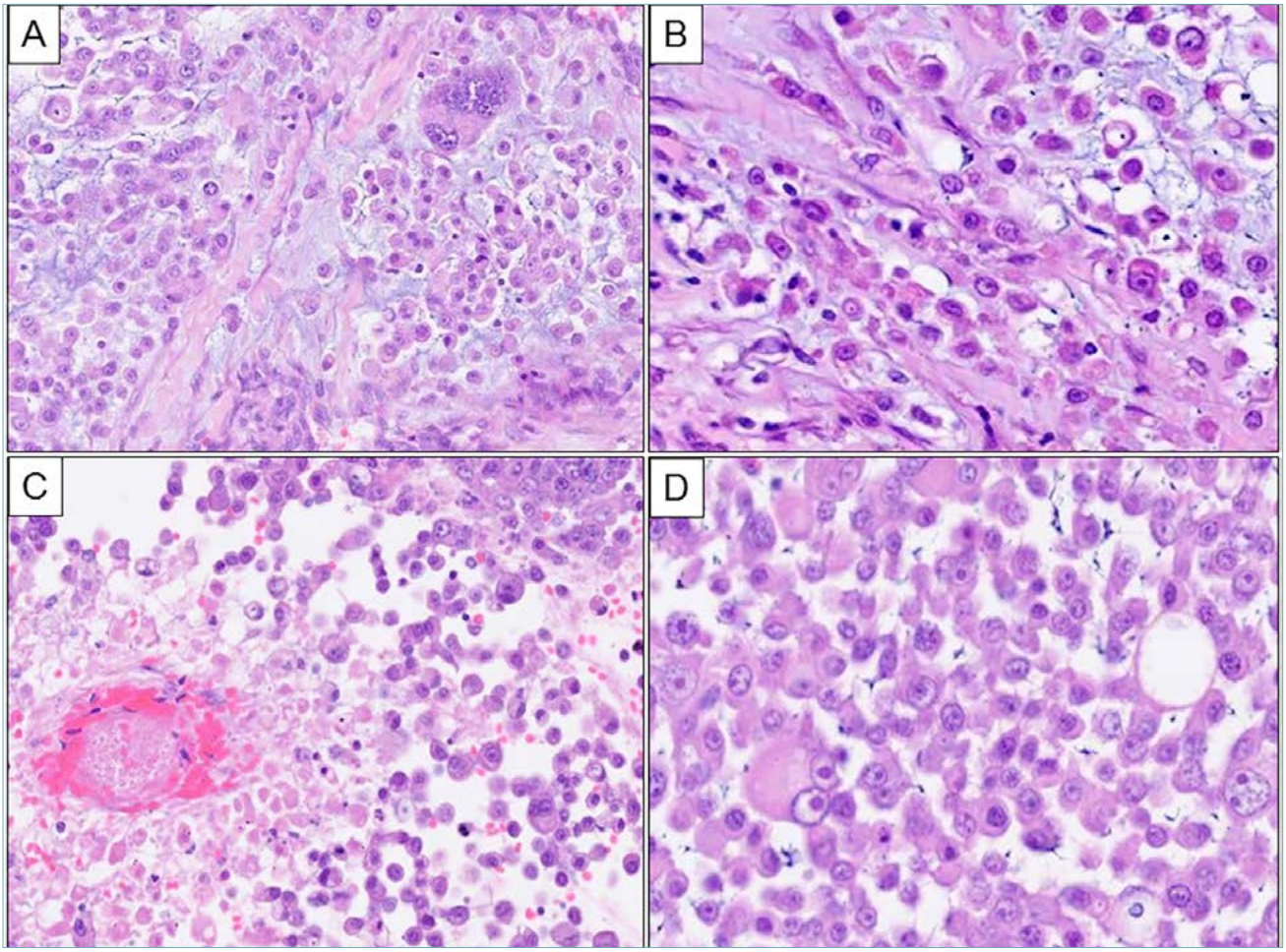

Figure 4. (A) Predominant polygonal-shaped cells with few interspersed multinucleate sarcomatous giant cells. H and E, x200. (B) Higher magnification showing cells with abundant eosinophilic cytoplasm and prominent nucleoli, arranged in cords in a myxoid stroma, focally surrounded by empty spaces, causing a pseudochondroid appearance. H and E, x 400. (C) Focal area of tumor necrosis. H and E, x 200. (D) Focal area displaying tumor cells with rhabdoid appearance, reminiscent of proximal-type epithelioid sarcoma. H and E, x 400.

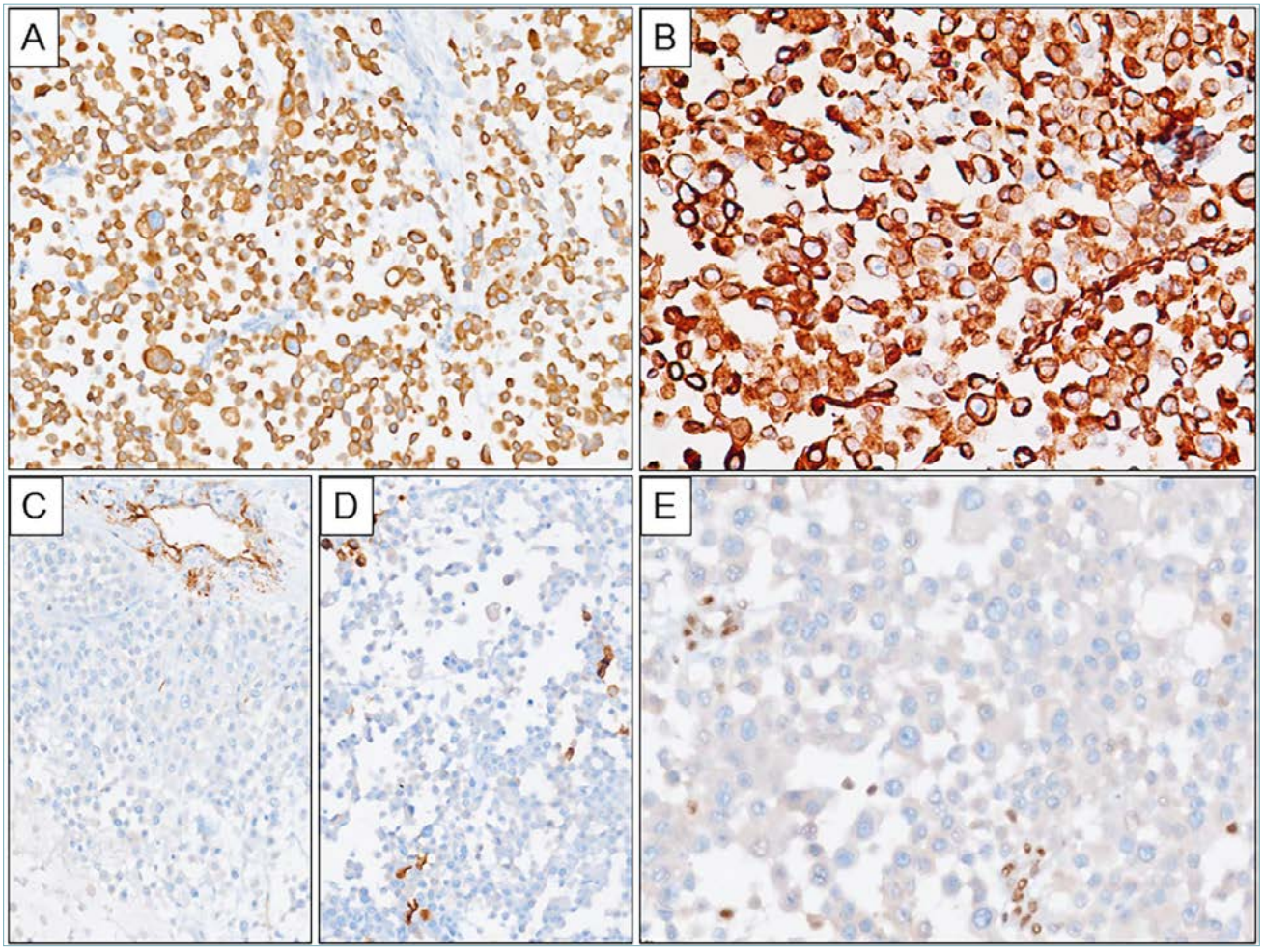

Figure 5. Immunohistochemical results. (A) Diffuse AE1/AE3 positivity. DAB, x 400. (B) Diffuse vimentin positivity. DAB, x 400. (C) CD34 negativity. DAB, x 400. (D) Focal CA125 positivity. DAB, x 400. (E) Tumor cells displaying diffuse loss of INI1/SMARCB1. DAB, x 400.

infiltrating it. The para aortic nodal mass measured 5 cm x 3 cm x 2 cm and revealed a grayish-white cut surface. The diaphragmatic nodules measured 6 cm x 5 cm x 2 cm and had a whitish cut surface.

The representative paraffin blocks of the resected specimen were submitted to us for a review.

Microscopic examination revealed a multinodular tumor composed of loosely cohesive/dyscohesive polygonal/epithelioid malignant cells, at places arranged in cords, as well as singly dispersed, containing moderate to abundant eosinophilic cytoplasm and prominent to eosinophilic nucleoli, embedded in a prominent myxoid stroma, along with focal areas of necrosis and hemorrhage. Interspersed were cells with rhabdoid appearance and few multinucleate sarcomatous giant cells, along with lymphocytes, including aggregates at the periphery of the tumor nodules (Figs. 2, 3, 4A-C). A small tumor area (nearly 10%) distinctly revealed features reminiscent of proximal-type ES (Fig. 4D). There was no area exhibiting tubule acinar/glandular or papillary differentiation. There were no cells with vacuolated cytoplasm. There was no adrenal tissue identified on extensive tissue sampling.

The tumor was seen infiltrating the renal capsule, but sparing the renal parenchyma, including the hilum and the medulla. Additionally, the sub diaphragmatic nodule, as well as the excised para aortic nodes showed tumor deposits. Adrenal tissue was not identified in any of the sections, prepared after extensive sectioning.

By immunohistochemistry, the tumor cells were diffusely positive for pan cytokeratin (AE1/AE3), epithelial membrane antigen (EMA), vimentin; focally for cytokeratin (CK)7 and CA125, while negative for CK20, CDX2,

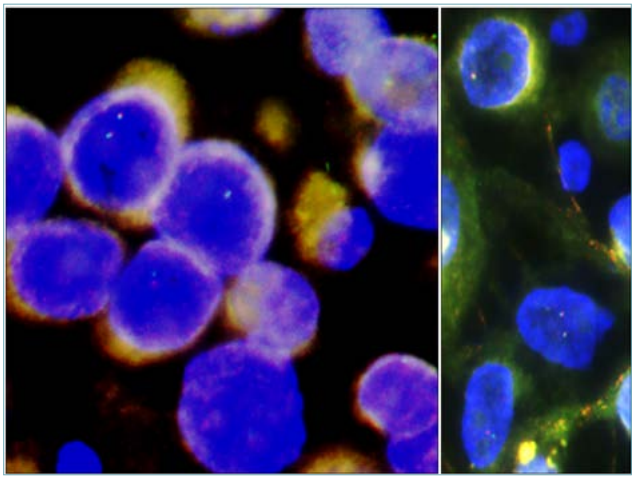

Figure 6. *EWSR1* gene rearrangement by fluorescence in-situ hybridization. Most tumor cell nuclei show double fused or single red green fused signals, indicative of lack of *EWSR1* gene rearrangement. DAPI, x 1000.

SATB2, CD34, S100 protein, glial fibrillary acid protein (GFAP), MUC5AC, CK19, p63, CKIT, DOG1, brachyury, WT1(6F-H2 clone), inhibin, calretinin, synaptophysin, CD30, SOX10, Melan A and HMB45 (Figs. 5A-D). In addition, the tumor cells showed diffuse loss of INI1/SMARCB1 (Fig. 5E). Diagnosis of a malignant tumor epithelioid with myxoid matrix, closely resembling ES, proximal-type, was finally rendered. Furthermore, the tumor was tested for *EWSR1* gene rearrangement using LSI break apart, dual color EWSR1 probe (Zytolight SPEC EWSR1 dual color break-apart probe) was performed on 4 µm thick paraffin-embedded tissue sections of all cases. The processed tissue sections were finally stained with 4′-6-diamidino-2-phenylindole (DAPI) and examined under a fluorescent microscope (Carl Zeiss, Axio Imager Z1, Germany), using AxioCam MRc5 camera and Axio vision Rel 4.5 software.

Most of the tumor cells displayed double or single fused red-green signals. There were no split signals, ruling our *EWSR1* gene rearrangement or deletion (Fig. 6).

Post-operatively, the patient completed 6 cycles of adjuvant chemotherapy, including ifosfamide and adriamycin and radiotherapy. The post treatment PET showed evidence of residual disease.

Discussion

Unlike classic ES, proximal subtype more frequently involves the axial locations, such as pelvis, perineum and the genital tract [1,3,5,6]. Rare documented sites of ES include mediastinum, bone and the abdominal wall[6,7,11]. There is a single documentation of a retroperitoneal ES, but without INI1 test result [14].

Histopathologically, apart from the classic, proximal and hybrid forms of ES, osteoclastic giant cell-rich subtype of proximal ES and fibroma-like ES are also described [15,16]. Microscopically, proximal-type ES shows predominantly, large, epithelioid cells with enlarged monomorphic nuclei, vesicular chromatin and prominent nucleoli, reminiscent of rhabdoid features [2,6]. Very few cases of ES, characterized by a conspicuous myxoid stroma, the latter ranging from 50-90% (median = 75%) of the tumor component, have been described [10,11].

The present case constitutes the first case of a malignant tumor, in the retroperitoneal location histopathologically characterized by a prominent myxoid stroma, epithelial differentiation, prominent myxoid matrix and immunohistochemically, by loss of INI1. Presence of epithelioid cells and myxoid stroma, along with para aortic lymph node deposits led to a consideration of various differential diagnoses, such as metastatic carcinoma, myoepithelial carcinoma, extraskeletal myxoid chondrosarcoma and epithelioid gastrointestinal stromal tumor. Lack of any other lesion elsewhere in the body, as per radiological imaging, made this possibility less likely. Epithelioid morphology mirrored with immunohistochemical expression of cytokeratin and EMA. Diffuse loss of INI1 further reduced the possibility of a metastatic carcinoma, particularly in this location. There have been rare documentations of adrenal carcinoma with rhabdoid features. However, those tumors displayed rhabdoid cells, in addition to areas reminiscent of adrenocortical carcinoma and adrenal tissue (2/3 cases), unlike the present tumor. Immunohistochemically, those tumors have been reported to express inhibin, calretinin, melan A, synaptophysin, along with retained immunoexpression of INI1. These features were contrasting to the present tumor, thereby ruling out this possibility [17]. Lack of glandular and or papillary growth patterns, as well cells with intracytoplasmic vacuolization were less favorable features for considering a possibility of an adenocarcinoma, which was a close differential diagnosis. There are rare reports of pancreatic undifferentiated rhabdoid carcinomas; including certain tumors lacking INI1 [18]. Negative immunostaining for CK19 and MUC5AC further helped in ruling out a pancreatic adenocarcinoma [19]. The pancreas was unremarkable on radioimaging. Lack of S100 protein, melan A and HMB4 ruled out a melanoma that can rarely display aberrant immunostaining for epithelial markers.

In view of prominent myxoid stroma, myoepithelial carcinoma was another close differential diagnosis. Negative immunostaining for S100P, GFAP and p63

ruled out a myoepithelial carcinoma [20]. Lack of CKIT and DOG1 immunostaining along with loss of INI1/SMARCB1 ruled out an epithelioid GIST, with prominent myxoid stroma [21]. Despite positive immunostaining for epithelial markers, loss of INI1 and brachyury ruled out a possibility of an extra axial chordoma, which was the diagnosis offered at the referring hospital. Likewise, a germ cell tumor was also ruled out, based on unremarkable serum tumor marker levels and immunohistochemical loss of INI1. Diffuse immunostaining for AE1/AE3, along with negative immunostaining for S100 protein and loss of INI1 are unusual features of an extraskeletal myxoid chondrosarcoma, including its rhabdoid variant that was another possibility [22]. Furthermore, lack of *EWSR1* gene rearrangement made diagnosis of a myoepithelial carcinoma and EMC, as less likely, to a reasonable extent [23].

Despite AE1/AE3 positivity and loss of INI1, epithelioid MPNST was ruled out in view of complete absence of S100 protein immunoexpression. In view of a small tumor area resembling proximal-type ES, this tumor was considered as a myxoid variant of ES, as earlier described by Flucke et al. [11]. Similar to 2/3 cases in that study, there was nodal metastasis in the present case. Likewise CD34 negativity was seen in most of those cases [11]. A similar tumor, designated as myoepithelioma-like tumor of the vulvar region has been reported by Yoshida et al. [12], in a series of 9 cases. Although most of the histopathological features and immunohistochemical features of the present tumor were overlapping, diffuse immunostaining for AE1/AE3, as noted in the present case, was not observed in any of the cases reported by Yoshida et al. [12] and neither in subsequently, other such documented cases [13,24]. Another case of myoepithelioma-like tumor in the vulvar region was reported with ERG and Fli1 immunoexpression [13]. Apparently, these two markers, especially ERG (antibody against N-terminus) have been reported to be positive in a significant number of epithelioid sarcomas, mostly conventional type, unlike the present tumor [25]. Despite the lack of ERG and CD34 immunostaining in the present case, in view of presence of a distinct tumor focus, resembling proximal-type ES, along with diffuse vimentin expression, we believe the present case as a myxoid-rich variant of ES or a myoepithelioma-like tumor. Additionally, we observed positive immunostaining for CA125, although focal. A strong CA125 immunoexpression has been previously reported in certain cases of ES [26]. Despite rhabdoid morphology, in view of age of the patient, an extrarenal rhabdoid tumor was ruled out.

Adequate treatment for such a tumor, including an ES includes radical excision, along with regional lymph node dissection, as noted in the present case [12]. Even after intensive treatment, the prognosis remains grim, in view of a recurrence rate between 34% and 77% and metastases of 40% associated with this tumor. Therefore, adjuvant radiotherapy and chemotherapy is considered in such cases [4,5,27,28]. Proximal-type ES has a relatively more aggressive clinical course than classic ES [4]. In terms of chemotherapy, a moderate activity of anthracycline-based and gemcitabine-based regimens has been reported in ES [29]. With regards to outcomes, high-grade classical ES (based on increased mitoses) and proximal-type ES were reported to be associated with lower survival [30]. Lately, an oral selective EZH2 inhibitor, Tazematostat seems to show promising results in tumors, characterized by loss of INI1, including an ES [31]. Therefore, it becomes imperative to identify INI1-deficient tumors, which seem to be having a wide clinicopathological spectrum, considering the present case. However, it might take some time before this drug accessible across all regions, including lower and middle-income countries. In view of high-grade sarcoma, our patient has been planned for the currently available adjuvant chemotherapy with an aim to avoid further recurrences and metastasis.

Conclusions

The present patient constitutes the first case of a malignant tumor with epithelial and mesenchymal differentiation, in the retroperitoneum, closely resembling ES, exhibiting prominent myxoid stroma and an INI1-deficient myoepithelial tumor, displaying loss of INI1/SMARCB1. Despite a prominent myxoid stroma, epithelioid to rhabdoid cytomorphology and confirmation by immunohistochemistry, including positive immunostaining for epithelial antibody markers, along with diffuse loss of INI1/SMARCB1, led to this diagnosis. Presently, diagnosis of such tumors, including at unusual sites and morphological variants seems to have significant therapeutic implications.

References

1 Hollmann TJ, Hornick JL. INI1-deficient tumors: diagnostic features and molecular genetics. Am J Surg Pathol 2011;35:e47-63. https://doi.org/10.1097/PAS.0b013e31822b325b

2 Oda Y, Dal Cin P, Le Loarer F, Nielsen TO. Tumors of uncertain differentiation/Epithelioid sarcoma. In: World Health Organization (WHO) classification of tumours editorial board, eds. World Health Organization classification of tumours. 5th ed. Soft tissue and bone tumours. Lyon, France: IARC Press 2020, pp. 294-296.

3 Spillane AJ, Thomas JM, Fisher C. Epithelioid sarcoma: the clinicopathological complexities of this rare soft tissue sarcoma. Ann Surg Oncol 2000;7:218-225. https://doi.org/10.1007/BF02523657

4 Fisher C. Epithelioid sarcoma of Enzinger. Adv Anat Pathol 2006;13:114-121. https://doi.org/10.1097/00125480-200605000-00002

5 Rekhi B, Gorad BD, Chinoy RF. Clinicopathological features with outcomes of a series of conventional and proximal-type epithelioid sarcomas, diagnosed over a period of 10 years at a tertiary cancer hospital in India. Virchows Arch 2008;453:141-153. https://doi.org/10.1007/s00428-008-0639-0

6 Chbani L, Guillou L, Terrier P et al. Epithelioid sarcoma. A clinicopathologic and immunohistochemical analysis of 106 cases from the French Sarcoma Group. Am J Clin Pathol 2009;131:222-227. https://doi.org/10.1309/AJCPU98ABIPVJAIV

7 Rekhi B, Jambhekar NA. Immunohistochemical validation of INI1/SMARCB1 in a spectrum of musculoskeletal tumors: an experience at a Tertiary Cancer Referral Centre. Pathol Res Pract 2013;209:758-66. https://doi.org/10.1016/j.prp.2013.08.008

8 Prat J, Woodruff JM, Marcove RC. Epithelioid sarcoma: an analysis of 22 cases indicating the prognostic significance of vascular invasion and regional lymph node metastasis. Cancer 1978;41:1472-1487. https://doi.org/10.1002/1097-0142(197804)41:4<1472::aid-cncr2820410436>3.0.co;2-w

9 Hornick JL, Dal Cin P, Fletcher CD. Loss of INI1 expression is characteristic of both conventional and proximal-type epithelioid sarcoma. Am J Surg Pathol 2009;33:542-550. https://doi.org/10.1097/PAS.0b013e3181882c54

10 Fadare O. Myxoid epithelioid sarcoma: clinicopathologic analysis of 2 cases. Int J Surg Pathol 2009;17:147-152. https://doi.org/10.1177/1066896908316383

11 Flucke U, Hulsebos TJ, van Krieken JH, Mentzel T. Myxoid epithelioid sarcoma: a diagnostic challenge. A report on six cases. Histopathology 2010;57:753-759. https://doi.org/10.1111/j.1365-2559.2010.03688.x

12 Yoshida A, Yoshida H, Yoshida M, et al. Myoepithelioma-like tumors of the vulvar region: a distinctive group of SMARCB1-deficient neoplasms. Am J Surg Pathol 2015;39:1102-1113.

13 Tajima S, Takahasi Y, Hikoaki M, et al. A SMARCB1-deficient vulvar neoplasm with prominent myxoid stroma: report of a case showing ERG and FLI1 expression. Int J Clin Exp Pathol 2015;8:7526-7532. https://doi.org/10.1038/modpathol.2013.161

14 Coronado JA, Chávez MÁ, Manrique MA, et al. Retroperitoneal epithelioid sarcoma: A case report. World J Gastrointest Endosc 2017;9:579-582. https://doi.org/10.4253/wjge.v9.i12.579

15 Rekhi B, Verma A, Jambhekar NA, et al. Osteoclast-rich, proximal-type epithelioid sarcoma: clinicopathological features of three unusual cases expanding the histomorphological spectrum. Ann Diagn Pathol 2016;21:39-43. https://doi.org/10.1016/j.anndiagpath.2015.12.003

16 Mirra JM, Kessler S, Bhuta S, et al. The fibroma-like variant of epithelioid sarcoma. A fibrohistiocytic/myoid cell lesion often confused with benign and malignant spindle cell tumors. Cancer 1992;69:1382-1395. doi: 10.1002/1097-0142(19920315)69:6<1382::aid-cncr2820690614>3.0.co;2-y

17 Weissferdt A, Phan A, Suster S, et al. Primary rhabdoid adrenocortical carcinoma: a clinicopathological and immunohistochemical study of three cases. Histopathology 2013;62:771-777. https://doi.org/10.1111/his.12083

18 Agaimy A, Haller F, Frohnauer J, et al. Pancreatic undifferentiated rhabdoid carcinoma: KRAS alterations and SMARCB1 expression status define two subtypes. Mod Pathol 2015;28:248-60. https://doi.org/10.1038/modpathol.2014.100

19 Zhang J, Wang Y, Zhao T, et al. Evaluation of serum MUC5AC in combination with CA19-9 for the diagnosis of pancreatic cancer. World J Surg Oncol 2020;18:31. https://doi.org/10.1186/s12957-020-1809-z

20 Hornick JL, Fletcher CD. Myoepithelial tumors of soft tissue: a clinicopathologic and immunohistochemical study of 101 cases with evaluation of prognostic parameters. Am J Surg Pathol 2003;27:1183-1196. https://doi.org/10.1097/00000478-200309000-00001

21 Rizzardi C, Marzinotto S, Avellini C, et al. A KIT-negative, DOG1-positive epithelioid GIST of the stomach harboring a novel PDGFRA exon 14 single nucleotide deletion. Anticancer Res 2012;32:1775-1778.

22 Agaram NP, Zhang L, Sung YS, et al. Extraskeletal myxoid chondrosarcoma with non-EWSR1-NR4A3 variant fusions correlate with rhabdoid phenotype and high-grade morphology. Hum Pathol 2014;45:1084-1091. https://doi.org/10.1016/j.humpath.2014.01.007

23 Fisher C. The diversity of soft tissue tumours with EWSR1 gene rearrangements: a review. Histopathology 2014;64:134-150. https://10.1111/his.12269

24 Xu Y, Gao H, Gao JL. Myoepithelioma-like tumor of the vulvar region: a case report in China and review of the literature. Diagn Pathol 2020 8;15:3.

25 Stockman DL, Hornick JL, Deavers MT, et al. ERG and FLI1 protein expression in epithelioid sarcoma. Mod Pathol 2014;27:496-501. https://doi.org/10.1038/modpathol.2013.161

26 Kato H, Hatori M, Kokubun S, et al. CA125 expression in epithelioid sarcoma. Jpn J Clin Oncol 2004;34:149-154. https://doi.org/10.1093/jjco/hyh027

27 Evans HL, Baer SC. Epithelioid sarcoma: a clinicopathologic and prognostic study of 26 cases. Semin Diagn Pathol 1993;10:286-291.

28 Baratti D, Pennacchioli E, Casali PG, et al. Epithelioid sarcoma: prognostic factors and survival in a series of patients treated at a single institution. Ann Surg Oncol 2007;14:3542-3551. https://doi.org/10.1245/s10434-007-9628-9

29 Frezza AM, Jones RL, Lo Vullo S, et al. Anthracycline, gemcitabine, and pazopanib in epithelioid sarcoma: a multi-institutional case series. JAMA Oncol 2018;4:e180219. doi: 10.1001/jamaoncol.2018.0219

30 Frezza AM, Sbaraglia M, Lo Vullo S, et al. The natural history of epithelioid sarcoma. A retrospective multicentre case-series within the Italian Sarcoma Group. Eur J Surg Oncol 2020;46:1320-1326. doi: 10.1016/j.ejso.2020.03.215

31 Gounder M, Schöffski P, Jones RL, et al. Tazemetostat in advanced epithelioid sarcoma with loss of INI1/SMARCB1: an international, open-label, phase 2 basket study. Lancet Oncol 2020;21:1423-1432. https://doi.org/10.1016/S1470-2045(20)30451-4