www.clinicalimagingscience.org

ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

Journal of Clinical Imaging Science

Case Report

Malignant Rhabdoid Tumor of the Mediastinum: A Case Report and Literature Review

Wing Ki Ng, Boon Ping Toe, Hin Yue Lau

Department of Radiology, Tuen Mun Hospital, Tuen Mun, Hong Kong.

***Corresponding author:**
Dr. Wing Ki Ng,
Department of Radiology, Tuen Mun Hospital, 23 Tsing Chung Koon Road, Tuen Mun, New Territories, Hong Kong.

wingki.ng712@gmail.com

Received : 16 September 18
Accepted : 15 November 18
Published : 28 March 19

DOI
10.25259/JCIS-9-7

Quick Response Code:

ABSTRACT

Malignant rhabdoid tumor (MRT) of the mediastinum is an aggressive tumor that is extremely rare. To date, only 24 cases of the mediastinal MRT have been reported in adults and 9 cases in the pediatric age group under the age of 18 years. We report a rare case of such tumor and review the literature on its clinical and imaging features as well as its treatment and prognostic outcomes.

Keywords: Extra-renal rhabdoid tumor, Malignant rhabdoid tumor, mediastinum

INTRODUCTION

The rhabdoid tumor (RT) was originally described by Beckwith and Palmer in 1978.[1] It is one of the most aggressive childhood neoplasms associated with high mortality, commonly arising in kidneys of young children before the age of 1 year.[2] The most common site of tumor outside the kidney is the central nervous system, which are called the atypical teratoid/rhabdoid tumors is (AT/RT).[3,4] Other extrarenal malignant RTs (MRTs) are relatively rare and have been described in locations such as the head and neck region, thorax and mediastinum, liver, ileum, adrenal gland, spine, genitourinary tract, retroperitoneum, trunk, and extremities.[5-21] They occur predominantly in the pediatric population. Here, we describe a case of MRT of the anterior mediastinum in a young adult.

CASE REPORT

A 35-year-old male patient presented to the accident and emergency department with worsening central chest pain for 1 day. He experienced chest pain that was not related to exertion for 1 month, associated with night sweats. There was no history of fever, palpitations, or weight loss. He was a chronic smoker and had a history of childhood asthma. On admission, the patient was in respiratory distress, however, was hemodynamically stable.

The initial chest radiograph [Figure 1] revealed a large soft-tissue opacity over the medial aspect of the left upper zone. In view of the clinical possibility of acute aortic dissection, urgent computed tomography (CT) angiography was performed. CT showed no evidence of dissection or an aneurysm in the thoracic aorta. There was, however, a lobulated heterogeneously enhancing soft-tissue mass seen in the anterior mediastinum, partially encasing the aortic arch, almost completely encasing the left common carotid artery and fully encasing the left subclavian artery [Figure 2]. No calcifications or fat densities were noted within the mass. The mass displaced the left upper lobe pulmonary artery laterally. No thrombus was

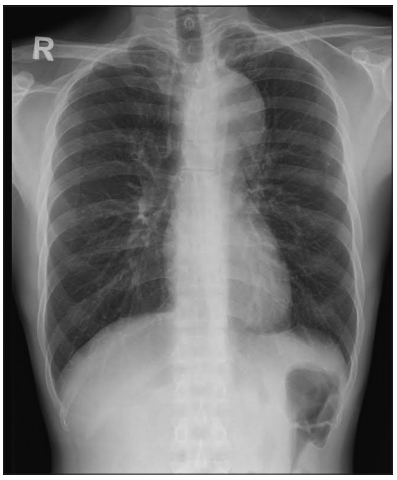

Figure 1: Chest X-ray revealed a large soft-tissue opacity over the medial aspect of the left upper zone.

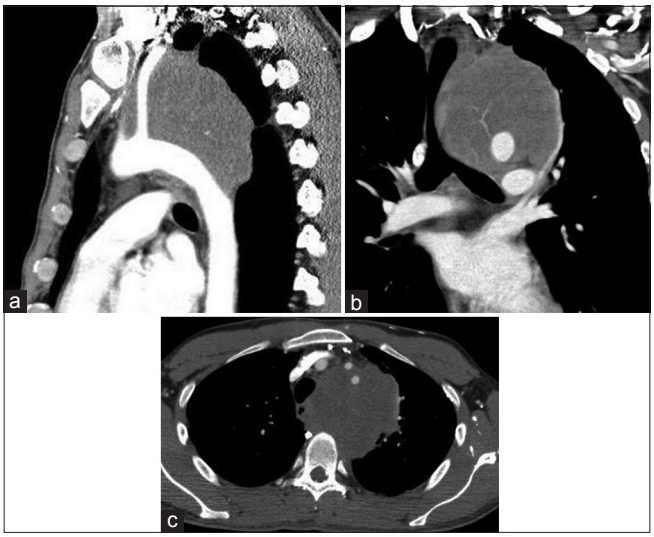

Figure 2: Sagittal (a), coronal (b), and axial (c) computed tomography images showed a lobulated heterogeneously enhancing soft-tissue mass in the anterior mediastinum in the left upper hemithorax, partially encasing the arch of the aorta, almost completely encasing the left common carotid artery and fully encasing the left subclavian artery. This mass also displaced the trachea and esophagus to the right. No calcification or fat densities were noted within the mass.

seen within the pulmonary artery. This mass also displaced the trachea and esophagus to the right [Figure 2b and c]. Blood tests including tumor markers were all unremarkable. Radiological differential diagnoses of anterior mediastinal mass including lymphoma, germ cell tumor, and invasive thymoma were made. Subsequently, an ^{18}F-fluorodeoxyglucose (FDG) positron emission tomography (PET)/CT scan was performed, showing the anterior mediastinal mass to be hypermetabolic with maximum standardized uptake values measuring 19.8 [Figure 3a]. A hypermetabolic left cervical lymph node metastasis was also detected [Figure 3b].

The mediastinal tumor was considered unresectable since it encased the aorta and its branches. The patient underwent video-assisted thoracoscopic surgery and biopsy of the mediastinal mass was taken. Histopathological examination [Figure 4] revealed sheets of tumor cells composed of large, eccentric nuclei with abundant eosinophilic cytoplasmic inclusion. The evidence of tumor necrosis was noted. On immunohistochemistry, the tumor cells showed strong and diffuse staining for CD34, and negative for MNF 116, synaptophysin, leukocyte common antigen, and desmin. The tumor cells also showed a lack of INI-1 protein expression. The final diagnosis of an extra-renal MRT was made.

The patient was started on chemotherapy with vincristine, dactinomycin, and cyclophosphamide. After completion of one course of chemotherapy, follow-up PET/CT scan showed persistent avid FDG uptake of the tumor mass as well as multiple new hypermetabolic bilateral cervical, supraclavicular, and mediastinal lymph nodes and new pleural metastases [Figure 3c and d], suggestive of disease progression. The patient's condition deteriorated despite aggressive chemotherapy, and he succumbed 4 months after diagnosis.

DISCUSSION

RT was originally described in the kidneys by Beckwith and Palmer and was thought to be a sarcomatous variant of classical renal Wilms tumor.[1] Later, it was regarded as a separate clinicopathological entity.[22] MRT of the mediastinum are rare; to the best of our knowledge, only 33 cases have been reported in the literature [Table 1].[6,12-18,23-25] The previously available literature is mainly case reports and small series of 1–3 patients, except for the retrospective review by Sauter *et al*.,[24] which included 18 patients with mediastinal RT. However, in their review, detailed information was only available for the seven patients with BRG1 (SMARCA4)-deficient tumors, which is a distinct subset of the tumor with undifferentiated rhabdoid morphology that shows aggressive behavior and poor prognosis.

Bimodal age distribution of the mediastinal MRT is observed in our review, having the first peak during childhood and the second peak between the 4th and 5th decades. It is more common in male patients, as observed in 16 out of 22 of the patients in this review [Table 1].[6,12-18,23-25] Indeed, for the pediatric patients <10-year-old, all were male patients.[6,14,16-18]

Mediastinal MRT usually presents with chest pain, dyspnea, cough, and respiratory distress,[12,13,15,18,23,24] which are nonspecific but are likely due to the mass effect of the tumor. However, some patients also had constitutional symptoms such as fever, loss of weight, loss of appetite, joint pain, and generalized weakness.[13,15,24] Our patient experienced chest pain and respiratory distress with the constitutional symptom of night sweats.

Radiologically, MRT of the mediastinum usually shows large masses with heterogeneous contrast enhancement on CT and magnetic resonance imaging,[6,18,23,24] similar to MRT in other locations.[2,7,26] They cause compressive mass effects to the heart

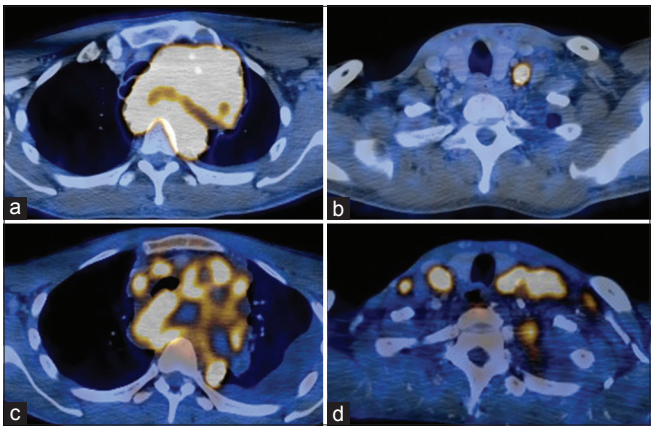

Figure 3: Pre- (a and b) and post-chemotherapy (c and d) positron emission tomography/computed tomography images of the mediastinal mass and left cervical lymph node metastasis, showing persistent high grade ^{18}F-fluorodeoxyglucose uptake of the tumor mass, as well as multiple new hypermetabolic bilateral cervical, supraclavicular and mediastinal lymph nodes metastases, suggestive of disease progression.

and other mediastinal structures and can cause severe midline shift.[18,23,24] However, unique to the mediastinal compartment, these tumors may demonstrate infiltrative features encasing the great vessels, trachea, and bronchus.[18,24] One of the cases reported by Sauter *et al*.,[24] showed left jugular vein thrombosis. These tumors are hypermetabolic on ^{18}F-FDG PET/CT scan. Our patient demonstrated both compressive and infiltrative features, showing displacement of the trachea and esophagus as well as encasement of the great vessels and PET/CT avid.

The discovery of a solid anterior mediastinal mass usually raises the suspicion of a lymphoma, germ cell tumor or invasive thymoma. It may be very difficult to differentiate one from the other radiologically. The definitive diagnosis can only be made on histopathological examination. Although imaging features of MRT of the mediastinum are not specific, radiologists should include MRT in the differential diagnosis when dealing with aggressive anterior mediastinal masses with both compressive and infiltrative features, especially in children and young adults.

Microscopic analysis of RTs usually reveals the presence of eosinophilic cytoplasmic inclusions and large vesicular nuclei as well as prominent nucleoli.[6] Immunohistochemically, they show positivity for vimentin and often for keratin and epithelial membrane antigen, but generally not for skeletal muscle markers or S-100 protein.[6] Molecular analysis reveals mutation or alteration in the SMARB1/INI gene in most RTs, which results in loss of INI-1 expression.[6] Thus, lack of INI-1 protein expression on immunostaining seen in our patient, together with the morphological features on histology lead us to the diagnosis of MRT.

Due to its rarity, no standard or consistently effective chemotherapy or radiotherapy regimen for mediastinal MRT has been established.

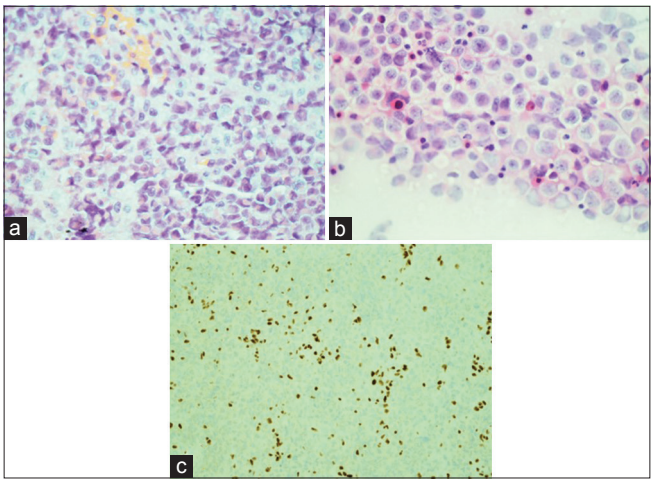

Figure 4: Pathological examination: (a) hematoxylin and eosin stained section revealed tumor cells arranged in sheets and were large, round to oval with eccentric nuclei and deep eosinophilic cytoplasm concordant with rhabdoid morphology. The tumor cells also demonstrated malignant cytological features of pleomorphic hyperchromatic nuclei and brisk mitosis. (b) Similar features were demonstrated in the cytological imprint of H and E section. (c) On immunohistochemistry, the tumor cells showed loss of INI-1 immunostaining; the stained cells were normal cells mixed within blood vessels or inflammatory cells.

Mediastinal MRT usually presents at an advanced stage and is rendered unresectable. For renal and gluteal MRT, a few cases with the successful outcome of surgery and chemotherapy have been reported.[27-29] However, to date, only a few studies have been published featuring the efficacy of different treatment modalities for extracranial MRT.[8,10,12,16] The beneficial role of radiotherapy in MRT have been reported in a few studies.[16,30] However, its delivery is often limited by a young age at presentation. Although the outcomes are generally poor, Venkatramani *et al*. suggested treatment with high dose alkylator therapy followed by consolidation with high-dose chemotherapy and autologous bone marrow transplant for patients in radiographic remission. This appears to have a beneficial effect on survival.[10] Most patients in our review underwent chemotherapy[12,13,15,16,18,23,24] with some undergoing adjuvant radiotherapy.[13,15,24] A few new targeted strategies have been suggested to treat MRT, and the results seem promising.[31-33]

The prognosis of patients with MRT is generally very poor, and the clinical course is extremely aggressive. In a series of 100 children diagnosed with extracranial MRT from 2005 to 2014, 3-year overall survival was only 38.4%.[8] In a single-institution series of 14 cases of extracranial MRT diagnosed over a 20-year period, the median time to progression was only 2 months.[9] Similarly, a dismal outcome for mediastinal MRT was seen in our review in which the available data showed 17 out of 18 patients died of the disease on follow-up. Our patient showed disease progression despite chemotherapy and died of the disease 4 months after diagnosis.

Table 1: Summary of reported cases of mediastinal rhabdoid tumor.

Author	*n*	Age (years)	Sex	Clinical findings	Imaging features	Treatment	Metastasis/ local invasion	Clinical outcome
Gururangan *et al.*, 1993[12]	1	13	Female	Chest pain, Horner syndrome	NR	B, C	Lungs	DOD, 12 months
Parham *et al.*, 1994[17]	3	0.8-13	Male=3	NR	NR	NR	Posterior auricular region	DOD=1, 7 years NR=2
Perlman *et al.*, 1998[18]	1	Newborn	Male	Hydrops and respiratory distress	Pericardial effusion and cardiac compression, mass encasing great vessels focally involved the right atrial free wall	C	NR	DOD, 2 months
Falconieri *et al.*, 2005[13]	2	40 and 46	Male=2	Chest pain, fever, vomiting, joint pain, prostration	Mass	B, C, R=1 S, C, R=1	NR	DOD=1, 8 months AWD=1, ? duration
Garcés-Iñigo *et al.*, 2009[6]	3	0.4-0.8	Male=3	Chest wall mass	CT: Heterogeneous enhancement MRI: T1W hypointense, T2W heterogeneous hyperintense, Gd: Heterogeneous enhancement US: Heterogeneous mass	NR	Skull	DOD, 4-62 months
Oh KJ *et al.*, 2009[15] Report in Korean language	1	35	Female	Cough, loss of weight, loss of appetite, generalized weakness	Mass	B, C, R	Supraclavicular LN, muscles, ribs	DOD, 3 months
Thomson *et al.*, 2011[14]	2	7.5 and 26	Male=1 Female=1	NR	NR	FNA, B=1 FNA=1	Infraumbilical, back	DOD, 3 and 9 months
Le Loarer *et al.*, 2015[25]	1	48	Male	NR	NR	NR	NR	DOD, 7 months
Kuwamoto *et al.*, 2017[23]	1	30s	Female	Chest pain	Slight enhancing compressive mass on CT marked FDG uptake on PET	B, C	Left axillary LN	NR
Farber *et al.*, 2017[16]	1	3.9	Male	NR	NR	B, C	Lung	DOD, 10 months
Sauter *et al.*, 2017[24]	18^	44-69	Male=5 Female=2	Dyspnea, weight loss, fatigue, reflux, chest pain, metastatic bony pain	Mass, encasing major vessels, trachea and bronchus, severe midline shift, jugular vein thrombosis, lymphadenopathy, echogenic area in pericardium, PET avid	B, C=2 S, C=3 S, C, R=1 NA=1	Brain, bone, lungs, axilla	DOD=6, 1-4 months NR=1
Ng *et al.*,* 2018	1	35	Male	Chest pain, night sweat, respiratory distress	Lobulated enhancing mass, encasing major vessels, displaces trachea and esophagus, PET avid	B, S, C	Cervical and mediastinal LN, pleural metastasis	DOD, 4 months

^Seven patients with BRG1-deficient tumors and 11 patients with BRG1-retained tumors. Information was only available for the seven patients with BRG1-deficient tumors, *Present case. NR: Not reported, S: Surgery, R: Radiation therapy, C: Chemotherapy, FNA: Fine-needle aspiration, B: Biopsy only, LN: Lymph nodes, DOD: Died of disease, CT: Computed tomography, PET: Positron emission tomography, FDG: ^{18}F-fluorodeoxyglucose, MRI: Magnetic resonance imaging, US: Ultrasonography, AWD: Alive with disease, ? duration: unsure of duration

CONCLUSION

Mediastinal MRT is a rare tumor with aggressive features and a grave prognosis. Although no specific imaging features were found in our review, a tendency toward a large mediastinal mass with both compressive and infiltrative features is described and should be considered in the differential diagnosis in young patients. A biopsy is required to establish the final diagnosis, providing

histologic, and immunohistochemistry characterization and further potential targeted therapy.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Acknowledgment

The authors would like to thank Dr. KL Liu (Department of Clinical Pathology, Tuen Mun Hospital, Hong Kong) for his assistance and contribution.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Beckwith JB, Palmer NF. Histopathology and prognosis of Wilms tumors: Results from the first national Wilms' tumor study. Cancer 1978;41:1937-48.
2. Winger DI, Buyuk A, Bohrer S, Turi GK, Scimeca P, Price AP, *et al.* Radiology-pathology conference: Rhabdoid tumor of the kidney. Clin Imaging 2006;30:132-6.
3. Jakate SM, Marsden HB, Ingram L. Primary rhabdoid tumour of the brain. Virchows Arch A Pathol Anat Histopathol 1988;412:393-7.
4. Rorke LB, Packer RJ, Biegel JA. Central nervous system atypical teratoid/rhabdoid tumors of infancy and childhood: Definition of an entity. J Neurosurg 1996;85:56-65.
5. Narendra H, Ray S, Rao L, Geetha V. Malignant extrarenal rhabdoid tumor of the vulva in an adult. J Cancer Res Ther 2010;6:82-5.
6. Garcés-Iñigo EF, Leung R, Sebire NJ, McHugh K. Extrarenal rhabdoid tumours outside the central nervous system in infancy. Pediatr Radiol 2009;39:817-22.
7. Abdullah A, Patel Y, Lewis TJ, Elsamaloty H, Strobel S. Extrarenal malignant rhabdoid tumors: Radiologic findings with histopathologic correlation. Cancer Imaging 2010;10:97-101.
8. Brennan B, De Salvo GL, Orbach D, De Paoli A, Kelsey A, Mudry P, *et al.* Outcome of extracranial malignant rhabdoid tumours in children registered in the European Paediatric Soft Tissue Sarcoma Study Group non-rhabdomyosarcoma soft tissue sarcoma 2005 study-EpSSG NRSTS 2005. Eur J Cancer 2016;60:69-82.
9. Madigan CE, Armenian SH, Malogolowkin MH, Mascarenhas L. Extracranial malignant rhabdoid tumors in childhood: The childrens hospital Los Angeles experience. Cancer 2007;110:2061-6.
10. Venkatramani R, Shoureshi P, Malvar J, Zhou S, Mascarenhas L. High dose alkylator therapy for extracranial malignant rhabdoid tumors in children. Pediatr Blood Cancer 2014;61:1357-61.
11. Shim E, Yeom SK, Um JW, Kim JH, Lee SH, Cha SH, *et al.* Malignant extrarenal rhabdoid tumor in adults: Three case reports originating from the ileum, adrenal gland and uterus. J Korean Soc Radiol 2014;71:20-5.
12. Gururangan S, Bowman LC, Parham DM, Wilimas JA, Rao B, Pratt CB, *et al.* Primary extracranial rhabdoid tumors. Clinicopathologic features and response to ifosfamide. Cancer 1993;71:2653-9.
13. Falconieri G, Moran CA, Pizzolitto S, Zidar A, Angione V, Wakely PE Jr., *et al.* Intrathoracic rhabdoid carcinoma: A clinicopathological, immunohistochemical, and ultrastructural study of 6 cases. Ann Diagn Pathol 2005;9:279-83.
14. Thomson TA, Klijanienko J, Couturier J, Brisse H, Pierron G, Freneaux P, *et al.* Fine-needle aspiration of renal and extrarenal rhabdoid tumors: The experience of the institut curie regarding 20 tumors in 13 patients. Cancer Cytopathol 2011;119:49-57.
15. Oh KJ, Lee KB, Hong SW, Jung KT, Choi HK, Kim HJ, *et al*. A Case of Malignant Rhabdoid Tumor in the Anterior Mediastinum. Tuberc Respir Dis 2009;67:462-6.
16. Farber BA, Shukla N, Lim II, Murphy JM, La Quaglia MP. Prognostic factors and survival in non-central nervous system rhabdoid tumors. J Pediatr Surg 2017;52:373-6.
17. Parham DM, Weeks DA, Beckwith JB. The clinicopathologic spectrum of putative extrarenal rhabdoid tumors. An analysis of 42 cases studied with immunohistochemistry or electron microscopy. Am J Surg Pathol 1994;18:1010-29.
18. Perlman EJ, Ali SZ, Robinson R, Lindato R, Griffin CA. Infantile extrarenal rhabdoid tumor. Pediatr Dev Pathol 1998;1:149-52.
19. Brennan B, Stiller C, Bourdeaut F. Extracranial rhabdoid tumours: What we have learned so far and future directions. Lancet Oncol 2013;14:e329-36.
20. Wetzel SL, Kerpel S, Reich RF, Freedman PD. Malignant rhabdoid tumor of the floor of mouth: First reported case in the oral cavity of an adult. Head Neck Pathol 2015;9:269-72.
21. Gupta RK, Batra VV, Das MC, Sharma A, Narang P. Malignant extra-renal rhabdoid tumor with unusual presentation: A report of two cases. J Cancer Res Ther 2015;11:963-6.
22. Weeks DA, Beckwith JB, Mierau GW, Luckey DW. Rhabdoid tumor of kidney. A report of 111 cases from the National Wilms' Tumor Study Pathology Center. Am J Surg Pathol 1989;13:439-58.
23. Kuwamoto S, Matsushita M, Takeda K, Tanaka N, Endo Y, Yamasaki A, *et al.* SMARCA4-deficient thoracic sarcoma: Report of a case and insights into how to reach the diagnosis using limited samples and resources. Hum Pathol 2017;70:92-7.
24. Sauter JL, Graham RP, Larsen BT, Jenkins SM, Roden AC, Boland JM, *et al.* SMARCA4-deficient thoracic sarcoma: A distinctive clinicopathological entity with undifferentiated rhabdoid morphology and aggressive behavior. Mod Pathol 2017;30:1422-32.
25. Le Loarer F, Watson S, Pierron G, de Montpreville VT, Ballet S, Firmin N, *et al.* SMARCA4 inactivation defines a group of undifferentiated thoracic malignancies transcriptionally related to BAF-deficient sarcomas. Nat Genet 2015;47:1200-5.
26. Figarola MS, Khader SM. Pediatric case of the day. Extrarenal rhabdoid tumor of the pelvis. Radiographics 1999;19:1693-5.
27. Waldron PE, Rodgers BM, Kelly MD, Womer RB. Successful treatment of a patient with stage IV rhabdoid tumor of the kidney:

Case report and review. J Pediatr Hematol Oncol 1999;21:53-7.
28. Wagner L, Hill DA, Fuller C, Pedrosa M, Bhakta M, Perry A, *et al.* Treatment of metastatic rhabdoid tumor of the kidney. J Pediatr Hematol Oncol 2002;24:385-8.
29. Fabre A, Eyden B, Ali HH. Soft-tissue extrarenal rhabdoid tumor with a unique long-term survival. Ultrastruct Pathol 2004;28:49-52.
30. Sultan I, Qaddoumi I, Rodríguez-Galindo C, Nassan AA, Ghandour K, Al-Hussaini M, *et al.* Age, stage, and radiotherapy, but not primary tumor site, affects the outcome of patients with malignant rhabdoid tumors. Pediatr Blood Cancer 2010;54:35-40.
31. Alarcon-Vargas D, Zhang Z, Agarwal B, Challagulla K, Mani S, Kalpana GV, *et al.* Targeting cyclin D1, a downstream effector of INI1/hSNF5, in rhabdoid tumors. Oncogene 2006;25:722-34.
32. Smith ME, Cimica V, Chinni S, Challagulla K, Mani S, Kalpana GV, *et al.* Rhabdoid tumor growth is inhibited by flavopiridol. Clin Cancer Res 2008;14:523-32.
33. Watanabe M, Adachi S, Matsubara H, Imai T, Yui Y, Mizushima Y, *et al.* Induction of autophagy in malignant rhabdoid tumor cells by the histone deacetylase inhibitor FK228 through AIF translocation. Int J Cancer 2009;124:55-67.

How to cite this article: Ng WK, Toe BP, Lau HY. Malignant rhabdoid tumor of the mediastinum: A case report and literature review. J Clin Imaging Sci 2019;9:7.