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CASE REPORT

Askin tumor: four case reports and a review of the literature

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Abstract

Askin tumor is an uncommon malignant neoplasm in the thoracopulmonary region mainly occurring in children and adolescents. Four young patients with histologically proven Askin tumors were treated in our hospital. In all patients, chest computed tomography imaging demonstrated a chest wall mass with or without destruction of ribs. All patients underwent radical mass resection and postoperative chemotherapy. By the time this article was completed, two of the patients had died with local chest wall recurrences. Here we focus on the imaging features, differential diagnosis, pathology and prognosis of this rare disease.

Keywords: *Askin tumor; histologic examination; immunohistochemical examination; diagnostic imaging differences; differential diagnosis.*

Introduction

Primitive neuroectodermal tumors (PNETs) are rare malignant small round cell tumors of the central nervous system that mainly occur in children and adolescents. PNETs arise from the primitive nerve cells of the nervous system, but they can also occur outside the central nervous system (peripheral PNETs) in the chest wall, pelvis, extremities and so on.

PNETs of the chest wall were originally reported by Askin et al. in 1979[1]. Since then, PNETs within the thoracopulmonary region have been termed Askin tumors. Askin tumors are highly aggressive and metastasize rapidly with poor prognosis. Between June 2009 and December 2010, 4 cases of Askin tumors were treated at our institution. During this time, thoracic malignancies were reported in 1440 patients and only 4 (0.3%) were histologically diagnosed as Askin tumor. All the patients presented with a unilateral chest wall mass. After surgery, immunohistochemistry established the diagnosis of Askin tumor. The important clinical data of the 4 young patients are presented in Table 1. Here we focus on the radiology, pathology and prognosis of this tumor and make a short review of the literature.

Case report

Case 1

A 12-year-old girl presented with a 7-day history of left side chest pain and 10 days of intermittent fever. It was associated with cough and significant loss of weight. Physical examination revealed decreased breath sound in the left lung and dull percussion note of the left hemithorax. A chest computed tomography (CT) scan showed an irregular soft tissue density mass locating in the left hemithorax. The large mass extended into the adjacent pleura and soft tissue with partial destruction of the fourth rib. The left lung was compressed. The signs of a large left-sided pleural effusion were also present. Enhanced CT showed the mass obviously enhanced with heterogeneous density and obscure boundary. Open biopsy revealed a large friable bloody tumor with central necrosis. It was histologically composed of small round cells with scanty cytoplasm and was immunohistochemically positive for neuron-specific enolase (NSE), chromogranin A (CgA), and synaptophysin (Syn) (Fig. 1). These findings established the diagnosis of Askin tumor. The patient underwent surgery. After less

Table 1 Clinical data

Case no.	Age (years)	Sex	Primary tumor: involved rib/side	Treatment	Recurrence	Outcome (month after first diagnosis)
1	12	Female	4th/left	Surgery+chemotherapy	Yes	Dead (3)
2	21	Male	None	Surgery+chemotherapy+local irradiation	Yes	Dead (14)
3	23	Female	8th, 9th/right	Surgery+chemotherapy	Yes	Alive (5)
4	22	Male	1st/left	Surgery	No	Alive (1)

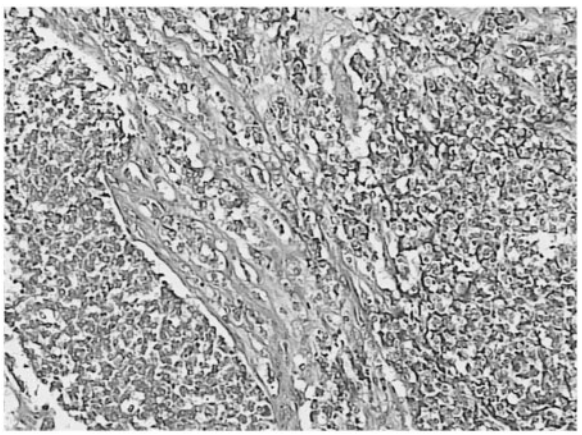

Figure 1 **Case 1. A 12-year-old girl presented with a history of left side chest pain and intermittent fever. Open biopsy revealed a tumor consisting of small round cells on microscopy (× 100).**

than 2 months, a chest CT revealed a local soft tissue mass and non-uniform thickening of the pleura demonstrating local recurrences. Lymph node metastases to the mediastinum and left axilla were also found. Adjuvant chemotherapy was then administered but did not prevent the progression of the disease because the local mass enlarged for 2 weeks. The patient's mental status and physical status worsened day by day. About 3 months after the surgical resection the patient died.

Case 2

A 21-year-old man presented with a tender swelling on the right chest wall. He had previously been in good health. There was no history of cough, fever, expectoration or dyspnea. Physical examination revealed a 4.0×5.0 cm smooth, tender mass on the right posterior chest wall. The chest plain CT scan demonstrated a well-demarcated, homogeneous soft tissue density mass on the right posterior chest wall with a small amount of pleural fluid and no rib involvement (Fig. 2). No mediastinal or axillary lymphadenectasis was found. A provisional diagnosis of benign tumor was made. Subsequently, local mass resection and partial resection of the 8th and 9th ribs were performed. Histologic examination under the light microscope showed small round cells with scanty

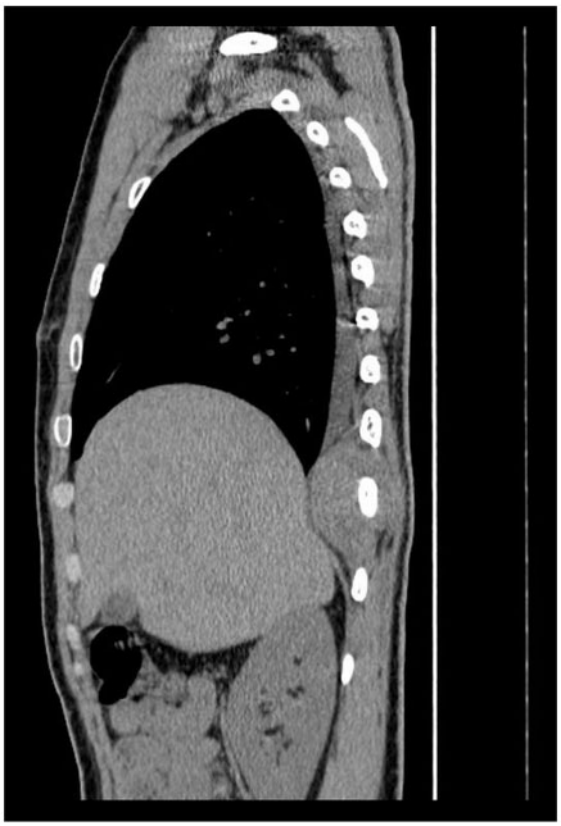

Figure 2 **Case 2. A 21-year-old man presented with a tender swelling on the right chest wall. Plain CT scan demonstrated a well-demarcated, homogeneous soft-tissue density mass on the right posterior chest wall with no rib destruction.**

cytoplasm growing as rosettes that were immunohistochemically positive for NSE and CD99. The diagnosis of Askin tumor was established. For about 3 months after the initial tumor resection, local recurrence presented with an irregular soft tissue density mass located at the field of operation. Although chemotherapy was added for disease relief, the disease progressed. The young man was paralyzed 10 months after his initial presentation. Magnetic resonance imaging (MRI) showed abnormal signal in the 12th thoracic and the 1st lumbar vertebrae, potentially indicative of bony metastases. Despite the addition of radiotherapy from that point, the patient died 4 months later.

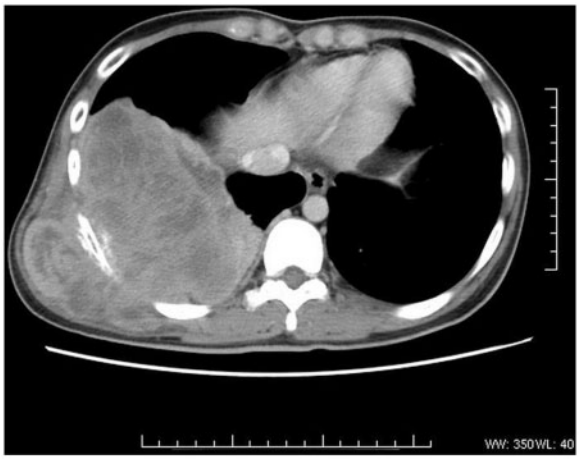

Figure 3 **Case 3. A 23-year-old woman presented with a slightly tender mass on the right chest wall. Contrast-enhanced CT imaging displayed a large, heterogeneous pleural-based mass extending into the thoracic cavity with adjacent rib destruction.**

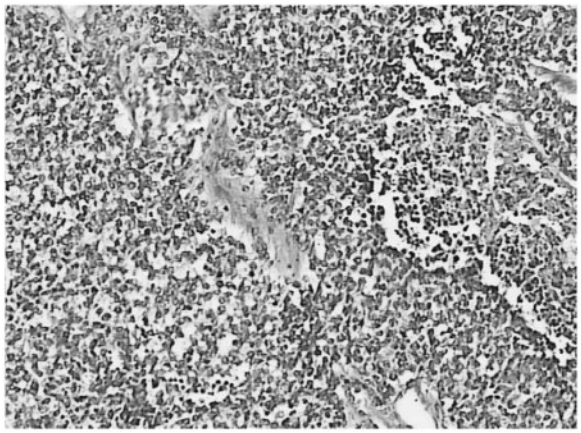

Figure 4 **Case 3. Open surgical biopsy demonstrated a tumor comprising small round blue cells arranged in cords and embedded in fibrous tissue on light microscopy (× 100).**

Case 3

A 23-year-old woman visited our hospital because of a palpable mass on the right chest wall for 2 months. She complained of vague abdominal pain lasting for 1 month. There was no history of headache, cough or fever. On physical examination, the mass was slightly tender with little movement. Admission chest CT imaging revealed a right pleural-based mass with destruction of the 8th and 9th ribs and involvement of the pectoralis muscle. The underlying lung was compressed. Contrast-enhanced CT imaging displayed a large, heterogeneous pleural-based mass with internal non-enhancing regions of necrosis, extending from the posterior right chest wall into the thoracic cavity (Fig. 3). No mediastinal lymphadenectasis was found. Open surgical biopsy found a high-grade sarcoma ($17 \times 10 \times 9$ cm) with areas of necrosis and hemorrhage. The tumor was comprised of small round blue cells arranged in cords and embedded in fibrous tissue (Fig. 4), immunohistochemically positive for CD99, CD117 and Syn. The diagnosis of Askin tumor was then established. After surgery, the patient left the hospital with symptomatic relief, without accepting chemotherapy. After 6 weeks, the patient began experiencing a severe cough and dyspnea. Chest CT discovered local recurrence. The patient then accepted chemotherapy. At the time of writing, the patient had finished the first course of treatment and was improving.

Case 4

A 22-year-old man complained of left-sided thoracic pain for about 1 month. He was previously in good health with no accompanying symptoms of cough, fever, dyspnea, abdominal pain, or diarrhea. Laboratory examinations were within normal limits. Clinical examination found

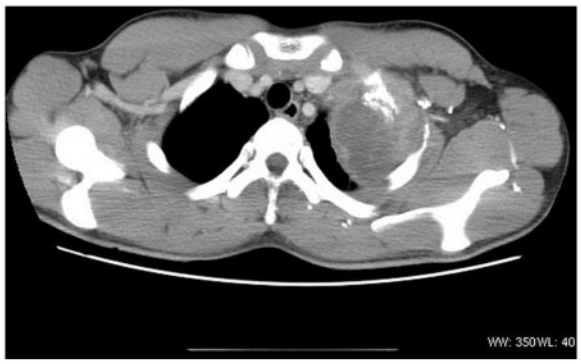

Figure 5 **Case 4. A 22-year-old man complained of left-sided thoracic pain for about 1 month. Enhanced CT demonstrated a lesion in the upper anterior chest wall with invasion to the 1st rib.**

deep breath sound and no regional lymphadenopathy. Computed tomography confirmed the presence of a lesion measuring $30 \times 40 \times 50$ mm in the upper anterior chest wall. Invasion to the ipsilateral 1st rib and pleural effusion were also observed (Fig. 5). After injection of intravenous contrast, the density of the mass was inhomogeneous with a non-enhancing area in the center, representing necrosis or cystic degeneration. No mediastinal or subaxillary lymphadenopathy was observed. The patient underwent surgery. During surgery, a lesion arising from the chest wall, infiltrating the adjacent rib was identified. Light microscopy showed small round cells with scanty cytoplasm assembling in alveolar structures. After immunohistochemical analysis, which showed positivity for CD99, vimentin and Syn, the diagnosis of PNET was made. At the time of writing, the patient is still well.

Discussion

Askin tumor is a primitive neuroectodermal tumor located in the thoracopulmonary region. Most of the tumors arise from the soft tissue of the chest wall. Some tumors have also been found in the lung[2]. It is a malignant small round cell tumor of neuroectodermal origin belonging to the Ewing tumor family due to their cytogenetic appearance; both demonstrate a characteristic chromosomal translocations t(11;22)(q24;q12)[3], and are separate entities for neuroectodermal differentiation, observation in immunohistochemical examination or by electron microscopy[4].

Askin tumors are extremely aggressive. They occur predominantly in children and adolescents, but can develop at any age[4]. Sex distribution is still unclear. The patients usually present with a swelling painful mass in the chest wall. Cough, fever, dyspnea, and weight loss are common accompanying symptoms. Local recurrence and remote metastases are common. The prognosis is usually poor with 2- and 6-year survival rates of 38% and 14%, respectively[5]. After local recurrences, the mean survival rate is reduced to 11 months[6]. The prevailing treatment is an intensive combined therapy including resection, chemotherapy and radiotherapy. Preoperative chemotherapy is advocated to reduce the risk of intraoperative tumor rupture and tumor cell dissemination[7]. Neoadjuvant chemotherapy alone was reported to yield a complete clinical response, which could potentially allow radical surgical resection to be avoided[8].

The disease is diagnosed by histologic and immunohistochemical analysis. Cytologic smears of the tumor reveal small round malignant cells that contain little cytoplasm and are arranged in rows. The typical feature is the presence of Homer–Wright rosettes with various layers of cells with fibrillary material[9]. Under immunohistochemical examination, the tumor is positive for several neural markers, such as NSE, CD99, and vimentin[9,10]. The chromosomal translocation t(11;22)(q24;q12) is an additional firm diagnostic criterion[10].

Typical CT findings include a large soft tissue mass based on the signal chest wall with or without ipsilateral pleural effusion and rib destruction. Large lesions often have a heterogeneous appearance, representing hemorrhage and necrosis or cystic degeneration. Calcification within the mass and lymphadenopathy are rare. The mass tends to displace, rather than encase the adjacent organ[4]. Linear and nodular density in the subpleural fat, which may represent local perilymphatic and perineural extension, is an unfavorable prognostic sign[4]. After intravenous contrast administration, the tumors demonstrate a heterogeneous appearance with non-enhancing necrotic or cystic areas. Askin tumor is liable to recur in the vicinity of the resected tumor, commonly involving the ribs, pleura, chest wall muscles and diaphragm[10]. The typical sign is non-uniform thickening of the pleura with soft tissue density nodule. The metastasis sites include lung, mediastinal and retroperitoneal lymph nodes, extrathoracic skeleton, liver, adrenal glands, and sympathetic nerve chain[11]. According to the literature, characteristic MRI findings include hyperintensity compared with muscle on T1-weighted imaging and heterogeneously bright signal intensity on T2-weighted imaging representing hemorrhage and necrosis[10,12]. Post-contrast T1-weighted imaging can demonstrate the boundary and parenchyma of the tumor, as well as the blood supply of the mass. Nevertheless, the radiologic characteristics of Askin tumors are not specific[10,13], but imaging can be valuable for evaluating the extent of the tumor, the response to treatment and local recurrences or distant metastases. It is also useful for guiding the biopsy route and determining whether the tumor has been completely resected. MRI is more sensitive in evaluating local invasion by providing true multiplanar imaging and excellent soft tissue differentiation, but CT is better for detecting lung and remote metastases, especially bony detail[10,14]. Both methods can provide information about the vascularity of the lesion by using intravenous contrast. Positron emission tomography/CT was reported to be helpful for characterization of the metabolic activity of the tumor and for investigation of distant metastases[15].

Differential diagnosis of imaging with chest wall mass occurring in children and adolescents should include neuroblastoma, rhabdomyosarcoma, non-Hodgkin lymphoma and Langerhans cell histiocytosis. Most neuroblastomas occur before 5 years of age, and characteristically present invasion through neural foramina giving a dumbbell appearance due to their origin from sympathetic nervous tissue[14]. Open biopsy is often needed because both rhabdomyosarcoma and Askin tumor can present a soft tissue mass with bone destruction and large pleural effusion. Isolated chest wall masses are rare in non-Hodgkin lymphoma at diagnosis, which instead usually presents with pervasive nodular thickening of the pleura. It is important to exclude non-Hodgkin lymphoma as its treatment does not include surgery[14]. Imaging features of Langerhans cell histiocytosis are a bony lytic lesion with or without soft tissue masses, and multisystemic involvement such as brain, lung and abdominal organs can be found. An isotope scan should be performed as lesions may not show osteoblastic activity.

References

[1] Askin FB, Rosai J, Sibley RK, Dehner LP, McAlister WH. Malignant small cell tumor of the thoracopulmonary region in childhood. a distinctive clinico-pathologic entity of uncertain histogenesis. Cancer 1979; 43: 2438–51. doi:10.1002/1097-0142(197906)43:6<2438::AID-CNCR2820430640>3.0.CO;2-9.

[2] Verfaillie G, Hoorens A, Lamote J. Primary primitive neuro-ectodermal tumour of the lung. Acta Chir Belg 2009; 109: 381–4.

[3] Delattre O, Zucman J, Melot T, *et al.* The Ewing family of tumors-a subgroup small-round-cell tumurs defined by specific chimeric transcripts. N Engl J Med 1994; 331: 294–9. doi:10.1056/NEJM199408043310503.

[4] Hari S, Jain TP, Thulkar S, Bakhshi S. Imaging features of pefiph-eral primitive neuroectodennal tumors. Br J Radiol 2008; 8l: 975–83.

[5] Contesso G, Llombart-Bosch A, Terrier P, *et al.* Does malignant small round cell tumor of the thoracopulmonary region (Askin tumor) constitute a clinicopathologic entity? An analysis of 30 cases with immunohistochemical and electron-microscopic support treated at the Institute Gustave Roussy. Cancer 1992; 69: 1012–20. doi:10.1002/1097-0142(19920215)69:4<1012::AID-CNCR2820690431>3.0.CO;2-V.

[6] Takanami I, Imamura T, Naruke M, Kodaira S. Long-term survival after repeated resections of Askin tumor recurrences. Eur J Cardio-thorac Surg 1998; 13: 1148–51.

[7] Veronesi G, Spaggiari L, De Pas T, *et al.* Preoperative chemotherapy is essential for conservative surgery of Askin tumurs. J Thorac Cardiovasc Surg, 2003; 125: 428–9. doi:10.1067/mtc.2003.198.

[8] Mulsow J, Jeffers M, McDermott R, Geraghty J, Rothwell J. Complete Clinical Response to Neoadjuvant Chemotherapy in a 54-year-old Male with Askin Tumor. Thorac Cardiovasc Surg 2010; 58: 306–8. doi:10.1055/s-0029-1186198.

[9] Kumar PV. Fine needle aspiration cytologic findings in malignangt small cell tumor of the thoracopulmonay region (Askin tumors). Acta Cytol 1994; 38: 702–6.

[10] Sallusio G, Pirronti T, Lasorella A, Natale L, Bray A, Marano P. Diagnostic imaging of primitive neuroectodermal tumor of the chest wall (Askin tumor). Pediatr Radiol 1998; 28: 697–702. doi:10.1007/s002470050443.

[11] Fink M, Salisbury J, Gishen P. Askin tumor: three case histories and a review of the literature. Eur J Radiol 1992; 14: 178–80. doi:10.1016/0720-048X(92)90081-J.

[12] Winer-Muran HT, Kauffman WM, Gronemeyer SA, Jennings SG. Primitive neuroectodermal tumors of the chest wall (Askin tumors): CT and MR findings. AJR 1993; 161: 265–8.

[13] Schulman H, Newman-Heinman N, Kurtzbart E, Maor E, Zirkin H, Laufer L. Thoracoabdominal peripheral primitive neuroectodermal tumors in childhood: radiological features. Eur Radiol 2000; 10: 1649–52. doi:10.1007/s003300000367.

[14] Watt AJ. Chest wall lesions. Paediatr Respir Rev 2002; 3: 328–38. doi:10.1016/S1526-0542(02)00270-1.

[15] Kara Gedik G, Sari O, Altinok T, Lema T, Kaya B, Kara PO. Askin's tumor in an adult: case report and findings on 18F-FDG PET/CT. Case Report Med 2009; 2009: 517329. doi: 10.1155/2009/517329.