

GANGLIONEUROMA OF POSTERIOR MEDIASTINUM IN A 6-YEAR-OLD GIRL: IMAGING FOR PEDIATRIC INTRATHORACIC INCIDENTALOMA

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Intrathoracic tumor is a rare entity in the pediatric population and neurogenic tumors account for 40–50% of childhood intrathoracic tumors. They can cause severe symptoms, such as respiratory distress, neurological dysfunction and metabolic disturbances. Posterior mediastinal ganglioneuroma (GN) usually occurs in children and can be found accidentally. Precise preoperative diagnosis is very difficult and has a great influence on surgical intervention. Here, we report a 6-year-old girl with a posterior mediastinal GN that was found incidentally on chest radiography. Computed tomography and magnetic resonance imaging demonstrated a right paraspinal tumor with punctuate calcification and intraspinal extension. ¹⁸F-fluorodeoxyglucose positron emission tomography revealed low-grade fluorodeoxyglucose avidity of this tumor. Computed tomography and magnetic resonance imaging can characterize GN and positron emission tomography is helpful for differentiating benign or malignant lesions.

Key Words: child, ganglioneuroma, intrathoracic tumor, positron emission tomography
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Ganglioneuroma (GN) is a rare neurogenic tumor that originates from the sympathetic nerve ganglia or the adrenal medulla. It is a form of peripheral neuroblastic tumor along with neuroblastoma and ganglioneuroblastoma. Histologically, GN is a benign tumor that is composed of mature or immature ganglion cells and neurites, accompanied by Schwann cells and fibrous tissues. Immature elements such as neuroblasts, intermediate cells, and mitotic figures are not part of GN

[1–3]. GN can be either a primary tumor or a spontaneous or treatment-induced differentiating neuroblastoma or ganglioneuroblastomas [4]. Most patients are asymptomatic; therefore, GN has been called incidentaloma of childhood, and is usually incidentally discovered by conventional radiography or sonographic examination [5]. The main locations include the posterior mediastinum and abdomen. Intrathoracic GN can grow expansively, spread into the neural foramina, and cause spinal cord damage [6]. Surgical removal is the main treatment strategy and other options, including chemotherapy and radiotherapy, are reserved for more advanced disease or unresectable tumors. We report a 6-year-old girl with a large posterior mediastinal tumor that proved to be GN after surgical excision.



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CASE PRESENTATION

A 6-year-old girl was transferred from a local hospital to the regional teaching hospital (Kaohsiung Medical University Hospital, Taiwan) in February 2007 because of a right paraspinal mass that was found on plain chest radiography (Figure 1). No specific symptoms such as dyspnea, pain, hypertension or diarrhea were complained of, except for a productive cough. Laboratory data were unremarkable. Chest computed tomography (CT) revealed a posterior mediastinal mass with punctuate calcification at the right paraspinal region of T9–12 (Figure 2). Flexible bronchoscopy was performed, and no compressive lesion was noted on the tracheobronchial tree. Magnetic resonance



Figure 1. Chest X-ray revealed a right paraspinal mass at T9–12 level (arrows).

imaging (MRI) of the tumor showed isointensity in the muscle on T1-weighted images, slight hyperintensity on T2-weighted images, and intense enhancement on post-contrast images (Figure 3). The tumor extended to the right T9–10, T10–11 and T11–12 neural foramina, with widening of the T10–11 neural foramen. Neurological examination showed no deficit. Plasma ferritin and urine vanillylmandelic acid levels were within normal ranges. For further evaluation, fused ^{18}F -fluorodeoxyglucose positron emission tomography (FDG-PET)/CT discovered low-grade FDG avidity in the tumor, with a washout pattern (Figure 4). An intrathoracic neurogenic tumor was suspected and excisional biopsy was arranged for histological confirmation.

Thoracotomy with near-total tumor removal was performed under general anesthesia. Grossly, the tumor was firm and capsulated. It had a whitish color on the cut surface (Figure 5A). Microscopically, the tumor was composed predominantly of ganglioneuromatous stroma with scattered collections of maturing ganglion cells. Calcification and aggregated lymphocytes were also seen (Figure 5B). No conspicuous neuroblastic element was identified in any section of the removed tumor. Neither mitotic figures nor amplification of *MYCN* gene were found.

^{99}Tc whole-body bone scan was arranged and no bone metastasis was noted. Bone marrow biopsy and aspiration showed normal bone marrow elements without tumor cell infiltration. According to the International Neuroblastoma Staging System, the tumor was classified as stage 2A. After surgery, the patient

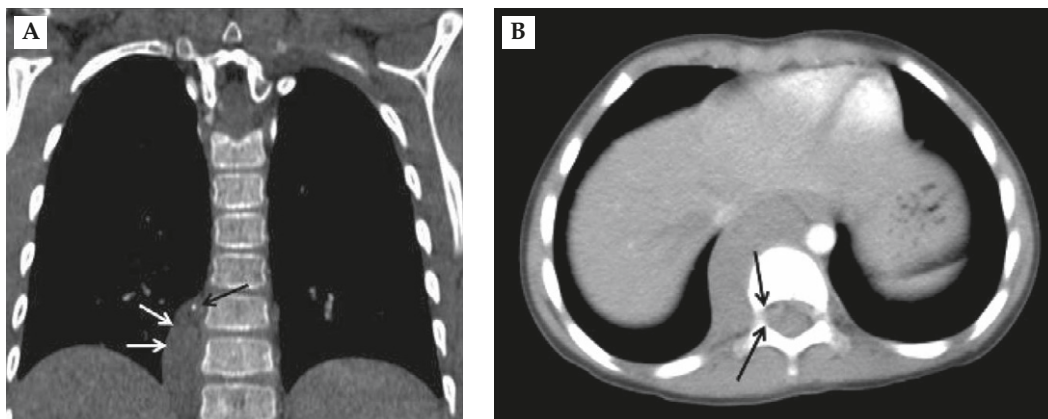


Figure 2. (A) Coronal reformatted computed tomography showed an isodense paraspinal mass (white arrows) with punctuate calcification (black arrow). (B) Post-contrast axial image demonstrated homogeneous enhancement of this tumor with intraspinal extension (black arrows).

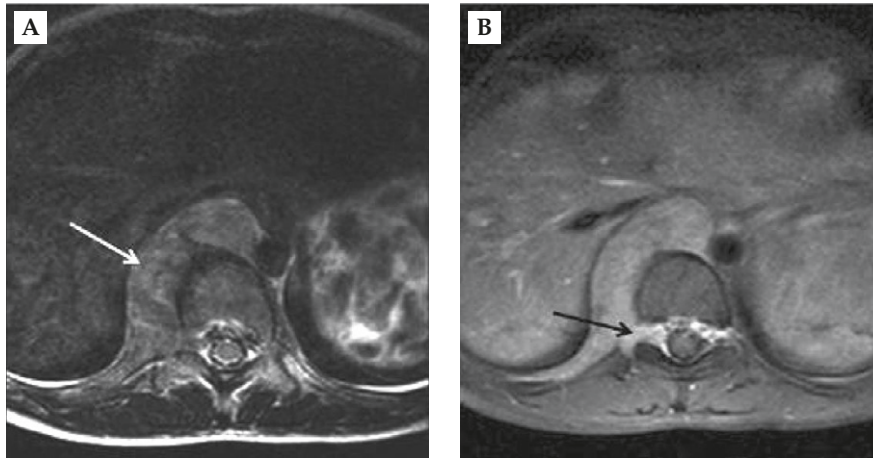


Figure 3. Magnetic resonance imaging. (A) Axial T2-weighted spin-echo image showed a slightly hyperintense paraspinous mass (white arrow). (B) Axial Gd-enhanced T1-weighted spin-echo image demonstrated enhancement of the tumor and intraspinal extension (black arrow).



Figure 4. Fused ^{18}F -fluorodeoxyglucose positron emission tomography/computed tomography image revealed low-grade fluorodeoxyglucose avidity in the tumor, with a maximal standardized uptake value of 0.8–1.0.

was observed conservatively without adjuvant chemotherapy or radiotherapy. No significant change in the residual tumor was noted after regular follow-up for 35 months.

DISCUSSION

Intrathoracic tumors are a rare entity in childhood and frequently present a problem in diagnosis and management. Tumors of neurogenic origin are most commonly encountered and represent 40–50% of intrathoracic pediatric tumors [7]. Cellular components of intrathoracic neurogenic tumors are: nerve sheath, autonomic ganglia, paraganglionic system, and peripheral neuroectoderm [6]. Tumors of sympathetic

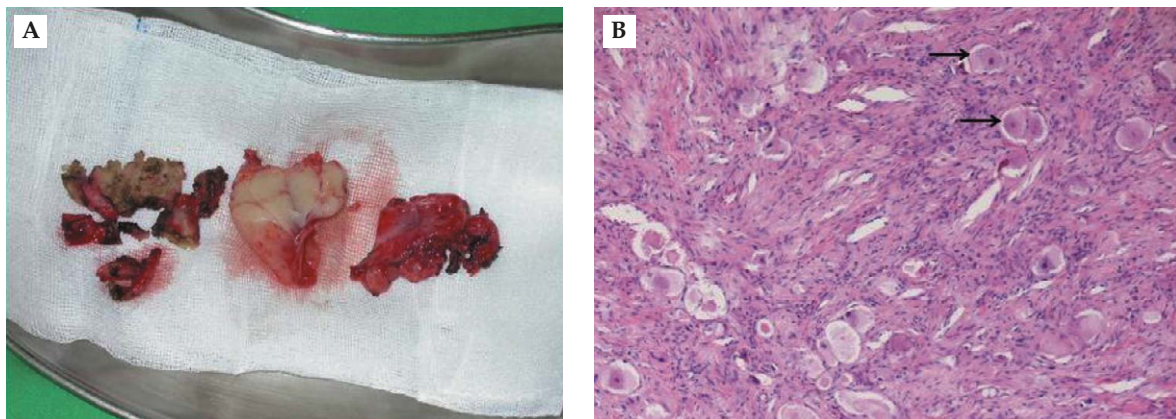


Figure 5. Surgical removal of the tumor was performed. (A) Gross appearance of the tumor revealed a capsulated mass. (B) Microscopically, maturing ganglion cells (arrows) were embedded in a Schwannian stroma. (Hematoxylin and eosin staining, original magnification, 200 \times).

ganglion origin are the most common extracranial malignant solid tumors of childhood. They originate from primitive sympathetic neuroblasts of the neural crest, which normally give rise to the adrenal medulla and the sympathetic ganglia [5]. These peripheral neuroblastic tumors include neuroblastoma, ganglioneuroblastoma and GN. Neuroblastoma is the most frequent neural crest tumor and has an unfavorable outcome unless the patient is aged <1 year or the tumor is localized. In contrast, the prognosis of GN is good with a 5-year event-free survival rate of >90% [8].

GN is mainly composed of mature ganglion cells, Schwann cells and nerve fibers. Some GNs can arise *de novo* and others might mature from neuroblastoma or ganglioneuroblastoma [9]. Patients with primary GN are significantly older than those with neuroblastoma and more usually present with thoracic and abdominal, non-adrenal tumors, in contrast to those with adrenal ganglioneuroma [10]. Patients with intrathoracic GN are usually asymptomatic or present with nonspecific symptoms that arise from compression of the tracheobronchial tree [10,11]. Neurological symptoms, such as Horner syndrome, limb weakness, or incontinence, can occur if a large tumor extends to the spinal cord. Symptoms caused by increased catecholamines and their metabolites, often seen in neuroblastoma and pheochromocytoma, are rarely found in GN. Selective uptake of the radionuclides metaiodobenzylguanidine (^{123}I or ^{131}I -mIBG) is useful in neuroblastoma diagnosis and therapy because it is believed that neuroblastoma loses its ability to take up mIBG when it matures to GN [12]. However, Georger et al studied 49 cases of primary GN and have found that 57% of tumors revealed mIBG uptake, and 39% showed increased plasma or urine catecholamine levels. They have concluded that GN requires tissue investigation for diagnosis because the tumor can share biological characteristics with neuroblastoma [10].

Imaging studies such as ultrasonography and CT are widely performed to evaluate these tumors. A well-defined mass with homoechogenicity is often revealed by ultrasonography and CT. GN usually appears as an encapsulated mass that is enhanced slightly by contrast medium. Calcification might be found within the tumor, as in the present case. MRI shows diagnostic accuracy of lesion malignancy of >90% [13–15]. GN appears on MRI as a homogeneous mass with signal intensity less than that of liver on T1-weighted images, and as a heterogeneous mass with

predominant signal intensity greater than that of liver on T2-weighted images [15]. Moreover, in thoracic paraspinal GNs, MRI permits easy understanding of the spatial relationship between tumor, vessels, spinal cord and muscles, which is useful in determining the nerves of origin [16].

Application of FDG-PET in detecting and monitoring various tumors is increasing. This new imaging modality provides functional and biological information in tumor diagnosis. Malignant tumors—in particular, dedifferentiated or rapidly growing tumors—often show an increase in glucose uptake and metabolism, thereby facilitating imaging with FDG [17]. Cardona et al reported that quantitative evaluation, using the maximal standardized uptake value with a cutoff of 1.8, is useful in distinguishing benign from malignant neurogenic tumors [18]. In our case, the maximal standardized uptake value was 0.8–1.0 which is considered low-grade FDG avidity, which is compatible with the histological findings.

Surgical removal is the mainstay of treating localized GN. Thoracoscopy and thoracotomy both have been used for resection of posterior mediastinal neurogenic tumors. Increasing evidence has revealed that thoracoscopic resection of childhood mediastinal tumors achieves similar event-free rates and shorter hospital stay than open resection.

In conclusion, we demonstrated a large intrathoracic, posterior mediastinal GN that was accidentally found in a young child. Although diagnosis depends on tissue pathology, preoperative biological study and imaging examination, especially CT, MRI and FDG-PET, are helpful in treatment planning.

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發生在一位 6 歲女童的後縱膈腔細胞節神經瘤： 兒童胸腔內偶見瘤之影像學診斷

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在兒童胸腔疾病的領域中，胸腔內腫瘤是很少見的疾患。百分之四十到五十的兒童胸腔內腫瘤源自於神經組織，這類腫瘤可能會造成嚴重的症狀，譬如呼吸困難、神經學症狀及內分泌代謝異常。後縱膈腔細胞節神經瘤通常出現在較大的兒童，並且可能是意外地發現。要在術前正確的診斷細胞節神經瘤是非常困難的，而術前的診斷對於手術的施行方式有很大的影響。我們報告一個意外在一位 6 歲女童的胸部攝影中發現的後縱膈腔細胞節神經瘤。電腦斷層攝影和核磁共振攝影顯示這是一個含有點狀鈣化並蔓延入脊柱內的右側脊柱旁腫瘤。正子攝影發現腫瘤的 FDG 標準吸收值不高。電腦斷層攝影和核磁共振攝影可以顯現細胞節神經瘤的特徵而正子攝影可幫助區分腫瘤是良性或惡性。

關鍵詞：兒童，細胞節神經瘤，胸腔內腫瘤，正子攝影

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