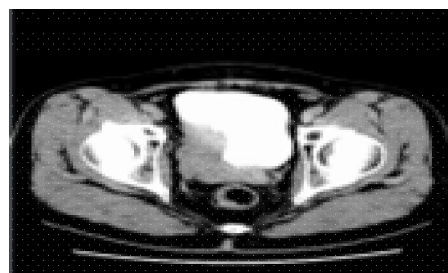


## Multi -slice CT Diagnosis of Ectopic Pheochromocytoma

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**Abstract:** Objective: Analysis of MSCT imaging manifestation of ectopic pheochromocytoma to discuss the value of MSCT in diagnosis of abdominal ectopic pheochromocytoma. Methods: MSCT findings of 10 cases surgically and pathologically proved with ectopic pheochromocytoma were retrospectively analyzed. Results: Soft tissue mass with 12 cases were single tumor. 5 case was located in front of the the abdominal aorta. 3 case located in adrenal area, 3 cases located in beside the iliac blood vessels, and 1 case located in urinary bladder. 10 cases Capsule necrosis obviously, and 2 cases Capsule necrosis was not obvious. 1 case of mild strengthening, 2 cases of moderate to strengthen, and 9 cases of obvious strengthening were also found. Conclusion: CT findings of are of certain characteristics, and a reliable diagnosis can be made by combining typicality clinical information.



**Keywords:** Ectopic pheochromocytoma, Computed Tomography, X-ray computer

Received 15 October 2014, Revised 9 November 2014, Accepted 23 November 2014

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### 1. Introduction

It is Ectopic pheochromocytoma, also known as paraganglioma, refers to pheochromocytoma occurred to organs except the adrenal gland and originating in the paraganglioma of the sympathetic nerves. It accounts for approximately 10 percent of all pheochromocytoma [1-2]. Most have typical clinical manifestations, such as persistent or paroxysmal hypertension. Laboratory tests may facilitate the finding. In recent years, its incidence has demonstrated a rising tendency. The author hereby collects 12 cases of ectopic pheochromocytoma pathologically confirmed by MSCT (Multi-slice Spiral CT) in AHQU (Affiliated Hospital of Qingdao University) during the period of March, 2008 through September, 2014. The data thus obtained have been retrospectively analyzed in order to enhance the understanding of the disease, providing more support for clinical practice.

### 2. Methods

#### 2.1 General Materials

The object group consists of 12 patients, including 8 males and 4 females and aged from 26 to 55 with a median age of 36. 9 cases manifest persistent or paroxysmal hypertension with the triad syndrome (i.e., headaches, heart palpitations and profuse sweating), antihypertensive means taking no or minimal effect. 3 cases are without hypertension. 10 cases are found positive in laboratory tests with a rising of catecholamines in blood and a significant rising of 3-methoxy-4-hydroxy-mandelic acid (vanillylmandelic

acid, VMA) in the urine to approximately 80~170umol/d (normal 35.3 ~ 85.9umol/d) in 24 hours. Preoperative diagnosis consists with test findings. 2 cases are found negative in laboratory tests. Preoperative diagnosis designates them as suspected cases. And both are confirmed by intraoperative hypertension. 1 case of malignant pheochromocytoma in bladder area reports hypertension and hematuria. Laboratory tests find significant rising of catecholamine in blood and VMA in urine. Hypertension is found both intraoperatively and postoperatively.

#### 2.2 CT Examination Method

Imaging was performed on a Philips Brilliance 16-slice spiral CT. Abrosia 4h before examination. Oral administration of 1% to 2% iodine contrast agent 1h before examination. Precontrast scan was followed by contrast scan. Scan parameters: tube current=500 mA, tube voltage=120 kV, tube rotation speed=0.5 s / r, pitch=1.375: 1, collimation=64 × 0.6 mm, detector width=40 mm, field of vision (FOV)=35cm×35cm, matrix=512 × 512. Scanned area extended from the diaphragmatic dome to the pubic symphysis. Conventional axial scan parameters: slice thickness=5 mm, layer spacing =5 mm, contrast agent=iohexol, injected dose=2.5mL/kg, injection rate=3 mL/s. Precontrast scan was followed by contrast scan. First scan began 25 ~ 30 s after contrast agent injection. Second scan began 60 ~ 70s after contrast agent injection. When scanning has been completed, coronal and sagittal MPR was carried out to observe the relationship between the lesion and the surrounding tissue.



**Figure 1. Male. Aged 31. Retroperitoneal ectopic pheochromocytoma. Quasi-circular soft tissue density images can be seen at the rear of pancreas head and neck region and in front of the abdominal aorta. Edges are clear with non-uniform density. A) Precontrast CT scanning showed lower density with clear edges. B) CT arterial enhancement images showed enhancement at ring edges of the lesion with obvious cystic necrosis in the center. C) CT venous phase enhanced showed obvious cystic necrosis in the center.**

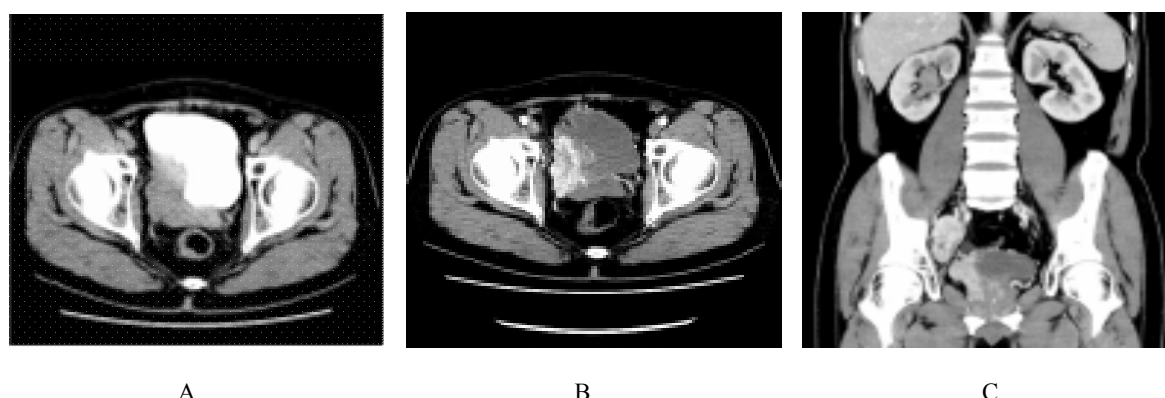
### 2.3 Image Analysis

Three experienced deputy chief physician read and analyzed the images and made conclusion. Differences were solved by consensus among three physicians. Analysis objects: the tumor location, size (maximum cross-section measurement), shape (round, lobulated, irregular-shaped, etc.), density (two-thirds of solid tumor selected from ROIs, avoid cystic necrosis and calcification), cystic necrosis, contrast scanning of the solid tumor enhancement (mild, moderate, obvious).

### 3. Results

12 cases of ectopic pheochromocytoma were analyzed. 5 cases were located near abdominal aorta (among which 3 cases between left side of the abdominal aorta and the left kidney, 2 cases between the right side of the abdominal aorta and inferior vena cava)

(Figure 1), 3 cases were located in renal hilum area (Figure 3). 3 cases were located next the common iliac vessels. 1 case was located at the bladder (Figure 2). Maximum cross-sectional diameter of the tumor was approximately 1.6 ~ 25 cm with an average of 7.5cm. 9 cases were in round or oval shape. 3 cases were in lobulated or irregular shape. 10 cases were with significant cystic degeneration. 2 cases were without significant cystic degeneration. With 12 cases of ectopic pheochromocytoma, the precontrast CT scanning value was 8 ~ 43HU with the median value at 25.5. Arterial phase CT value was 16 ~ 117HU with the median value at 86. Venous phase CT value was 9 ~ 167 HU with the median value at 93. Contrast scanning showed mild enhancement on 1 case, moderate enhancement on 2 cases, and significant enhancement on 9 cases. (Figure 1 to 3).



**Figure 2. Male. Aged 40. Bladder ectopic pheochromocytoma. Right posterior wall shows irregular soft tissue mass with unclear edges and unclear boundaries with the lower ureter and prostate. A) Urography shows low density and unclear edges. B) CT arterial enhancement images showed Significant and heterogeneous enhancement with cystic necrosis in the central area. C) CT venous phase enhanced showed heterogeneous enhancement. Side iliac vessels area shows multiple swollen lymph nodes.**

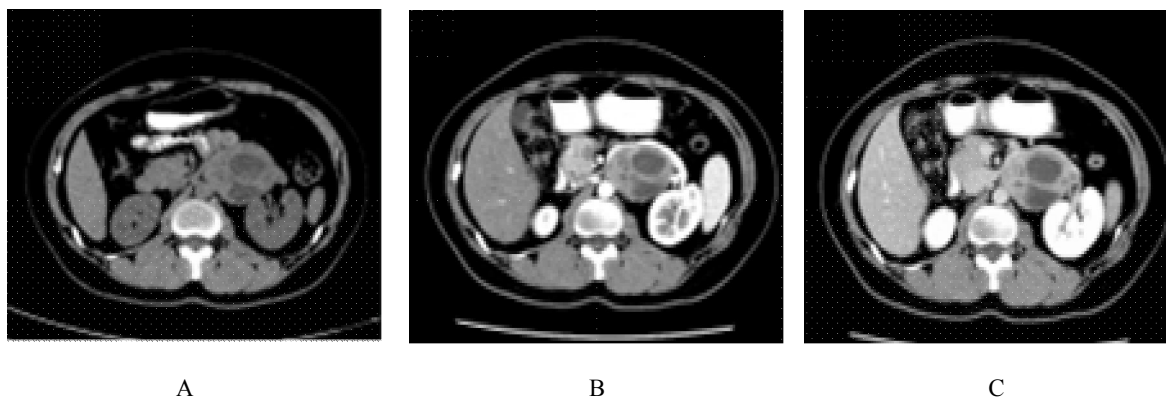
#### 4. Discussion

##### 4.1 Neoplasia and distribution of ectopic pheochromocytoma

Ectopic pheochromocytoma, also known as paraganglioma, refers to pheochromocytoma occurred to organs except the adrenal gland and originating in sympathetic paraganglioma. Pheochromocytoma tumor is also called 10% tumor as 10% of them are located outside adrenal gland, 10% are bilateral and multiple tumors, 10% are malignant tumors and 10% are familial. Most pheochromocytoma occur in the adrenal medulla, with only 10% occurring outside the adrenal gland, including sympathetic nerve chains or ectopic tissues next to the aorta. For this disease, the tumor continuously or intermittently releases large amounts of catecholamines to blood vessels, causing high blood pressure. According to WHO classification In 2004 [3], ectopic pheochromocytoma is a paraganglioma that originates from sympathetic and parasympathetic nerves outside the adrenal gland. Some scholars have proposed to adopt the nomenclature and taxonomy proposed by Glener and Grimley, i.e. named according to the lesion site and its relationship with the sympathetic plexus [4-5]. In this paper, the author adopts the conventional name used by most researchers.

Adrenal medulla pheochromocytoma originates from the chromaffin cells in intra-abdominal sympathetic ganglia region. Chromaffin tissues in other organs are mostly close to prevertebral sympathetic plexus. So in theory chromaffin tissues may occur in the area covering the skull base to the pelvis. During body

growth and development, most chromaffin tissues degrade while only those close to renal hilum and aorta still remain. And this is why tumors of this type mostly occur in the area close to aorta and renal hilum. According to the literature, abdominal aortic area above the renal hilum accounts for 46%. That below the renal hilum accounts for 29%. The area close to mediastinal paraspine accounts for 10%. The bladder wall accounts for 10%. Tumors are rarely found in uterus, rectum area, ureter area, postmediastinum, neck and skull base. For 12 cases in this group, all ectopic pheochromocytomas were located in areas where chromaffin tissues abound. 8 cases occurred in the common area. 1 case occurred in the bladder wall. The findings are close to those reported in literature [6]. The pathologic features of pheochromocytoma include necrosis, cystic degeneration and bleeding. Most have a complete capsule while the malignant ones may infringe the surrounding tissues and spread to distant areas. The cases in this group all had cystic degeneration and necrosis. The case in the bladder area was of malignant pheochromocytoma with an incomplete capsule and infringing lymph nodes next to the right iliac vessels. This also consists with the literature. Wang Dengbin, et al. [7] proposed that the incidence rate of ectopic pheochromocytoma is 22%, mostly on the youth and the middle-aged with no significant difference between genders. As this group consists only of 8 males and 4 females, the results may slightly differ from those reported in the literature due to the limited size of samples. In recent years, it has been reported that ectopic pheochromocytoma incidence is on the rise.



**Figure 3. Female. Aged 40. Retroperitoneal ectopic pheochromocytoma. Quasi-circular soft tissue mass in left renal hilus with clear edges. A) CT scanning shows iso or hypo density. B) CT arterial enhancement images showed significant and heterogeneous enhancement with multiple cystic necrosis. Left renal artery was pressed. C) CT venous phase enhanced showed heterogeneous enhancement with multiple cystic necrosis.**

##### 4.2 Clinical manifestations and general features.

Pheochromocytoma originates from the chromaffin cells in sympathetic nerves. It produces and secretes catecholamines. It is reported that about 25% to 70% of ectopic pheochromocytoma secretes excessive catecholamines and causes corresponding clinical symptoms. Generally, ectopic pheochromocytoma diagnosis depends mainly on clinical symptoms and

laboratory tests. The measurement of unbound catecholamine or its metabolites (vanillyl tonzil) level in the urine collected for 24h is the most commonly used biochemical markers [8]. With 10 cases in this group, laboratory tests showed that catecholamines level in their blood was significantly high that confirmed the preoperative diagnosis. But there is a big difference in the amount of catecholamines in

hypertension and asymptomatic period. Therefore, a single normal catecholamine level does not completely rule out the possibility of pheochromocytoma. The release of epinephrine and norepinephrine may cause the typical symptoms of crisis or 5P symptoms, namely pain, hypertension, palpitations, sweating and anxiety. Ectopic pheochromocytomas in bladder area clinically manifest themselves with triad syndromes, i.e. paroxysmal or persistent hypertension, hematuria, and "voiding episodes" symptoms. 1 case of malignant pheochromocytoma in bladder area in this group reported hypertension and hematuria. Laboratory tests showed catecholamine levels in blood and urine VMA were significantly high. And blood pressure rises both intraoperatively and postoperatively. These symptoms consist with the literature. However, the clinical triad syndromes failed to fully manifest themselves and consisted mainly of hypertension and hematuria.

### 4.3 MSCT images.

Ectopic pheochromocytoma in CT images is mostly found to be masses with smooth edges, regular shapes, and uniform solid portions. They are mostly single tumors with a maximum cross-sectional diameter over 3 cm. As the tumors abound with blood supply, they are often concurrent with cystic degeneration and bleeding. 10 cases in this group manifested significant cystic necrosis, as shown by the unevenly low density areas in CT images. 2 cases were not as significant and manifested themselves as eccentric flake-type low-density areas, which might be related to uneven blood supply to the tumor. Ectopic pheochromocytoma is hypervascular tumors with marked enhancement in the arterial phase. Most are synchronous with the surrounding large arteries. Some have visible tortuous vessels within. These vessels have been pathologically confirmed to be rich sinus in the tumor. The author holds that this symptom is one of the disease-oriented characteristics with a high level of specificity. According to the literature, iodine-containing contrast agents have been suspected of causing increased catecholamines which may further induce hypertensive crisis. Therefore, most researchers argue that contrast scanning should be used with caution when detecting adrenal pheochromocytoma [9]. Applicability assessment should be made before implementation. All 12 cases in this group underwent contrast CT scanning. 9 cases manifested significant enhancement. 2 cases manifested moderate enhancement. Only 1 case showed mild enhancement. All cases showed in the arterial phase significantly heterogeneous enhancement. In venous phase, they showed gradual enhancement. Tumor necrosis, pulmonary hemorrhage or cystic degeneration showed no enhancement. Enhancement characteristics are close to those reported in literature. The findings have confirmed that ectopic pheochromocytoma have rich blood supply with significant and long-duration enhancement.

Malignant pheochromocytoma accounts for about

10% of all pheochromocytoma. Their main features include incomplete capsule, infringing the surrounding vessels, and spreading to distant areas where no chromaffin tissues exist [10]. In this group, 1 case of malignant pheochromocytoma was found on the right wall of the bladder. Urinary angiography showed on the right wall a mass with irregular shape, uneven density, incomplete capsule, significantly swollen lymph node in right iliac vessels area. Both arterial and venous areas showed uneven significant enhancement. Preoperative diagnosis advised malignant bladder tumor. Postoperative pathology found significant specificity on tumor cells which infringed the capsule and lymph nodes in right iliac vessels area.

Nonfunctional ectopic pheochromocytoma are difficult to detect through preoperative diagnosis may get confused with other retroperitoneal tumors. However, intraoperative tumor touch and squeeze may cause hypertension crisis and hypertension volatility.

## 5. Conclusion

In summary, MSCT imaging manifestation of ectopic pheochromocytoma has shown significant characteristics. Tumors are mainly located around the abdominal aorta, near the renal hilum and at the root of the bladder and mesentery. They show obvious edges and cystic necrosis with different degrees of enhancement of long duration. Catecholamine-induced metabolic disorder symptoms and hypertension have been found clinically. When the tumors grow big with lobulated edges and large areas of necrosis, it indicates malignancy. MSCT scanning has significant value for the diagnosis and treatment of ectopic pheochromocytoma. It shows tumor location, shape, size, boundary and its relationship with adjacent tissues. It may also support the choice of surgery programs and postoperative follow-ups.

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