Characteristics and computed tomography evaluation of primary retroperitoneal tumours: report of 113 cases

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ABSTRACT

INTRODUCTION Benign and malignant primary retroperitoneal tumours (PRT) have different clinical manifestations and pathological characteristics. We explore the characteristics and evaluate the value of computed tomography (CT) for PRT.

METHODS Fifty-six benign and fifty-seven malignant PRT with clinical, radiographic and surgical data were retrospectively investigated. Statistical analysis was carried out using SPSS software.

RESULTS We found that mean size of benign tumours was 12.4 ± 7.7 cm but 20.7 ± 11.6 cm in malignant cases ($P < 0.05$). The accuracy of CT localisation was approximately 70%. The sensitivity and specificity of CT diagnosis for benign tumours were 96% and 85%, respectively; 51 (91%) underwent complete resection among benign cases but 42 (74%) in malignant cases ($P < 0.05$). Sensitivity of CT evaluation for invaded organs and vessels was 50% and 65%, respectively, and specificity was 88% and 81%, respectively.

CONCLUSIONS Large size, no capsule, irregular margin, heterogeneous density and specific enhancement pattern on CT are highly suggestive of malignancy. CT is the most useful tool in assessing the size and characteristics of PRT but it does not have the sensitivity to assess the involvement of organs and vessels.

KEYWORDS

Primary retroperitoneal tumour – Characteristics – Computed tomography

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Introduction

Primary retroperitoneal tumours (PRT) are divided into benign and malignant neoplasms that arise within the retroperitoneal space. They account for 0.2–0.6% of all neoplasms.¹ PRT originate from mesenchymal, neurogenous or embryonic tissue in the retroperitoneal space, excluding tumours in retroperitoneal organs such as kidney, adrenal, pancreas and metastatic.² They often do not come to clinical attention until they have reached a considerable size with involvement of adjacent vital structures. Consequently, surgical resection of these tumours is often challenging, which affects local recurrence, postoperative outcomes and long-term survival rates.^{3,4}

Computed tomography (CT) is the most useful tool in the evaluation of retroperitoneal tumours. It cannot only assess the tumour's location and its relationship to adjacent organs, but also identify metastatic lesions in peritoneal cavity.⁵ We relied primarily on CT scan in the evaluation of PRT from 113 patients in our department. The aim of this retrospective study was to identify the characteristics of benign and

malignant PRT through clinical manifestations, CT findings and postoperative pathologic specimens. By understanding the characteristics of PRT we can conduct better preoperative evaluation to obtain the most appropriate therapy plans for different PRT.

Materials and Methods

Patients

From January 2005 to December 2014, 113 patients with PRT (56 benign and 57 malignant) were treated in Tongji Hospital. We retrospectively investigated their data: sex, age, clinical manifestations, histopathological diagnosis, CT findings (image of localisation, diagnosis, density, enhancement and relation to adjacent structures) and surgical data (surgical approach, resected organs, adjacent structures and tumour profile). All patients underwent CT diagnosis and received surgical therapy and pathological examination. We compared the data of benign and malignant tumours.

Statistical analysis

Statistical analysis was carried out by SPSS software (SPSS, Chicago, IL, USA). Descriptive statistics were represented as the mean $\pm$ standard deviation (SD). Chi-square or Fisher's exact test was adopted to analyse categorical variables. The t-test was used to analyse continuous variables with a normal distribution and a *P* value of less than 0.05 was considered significant.

Results

There were 46 males and 67 females patients with PRT. Mean age was 47 years (range 13–92 years). Among benign cases, the mean size (maximal diameter) was 12.4 ± 7.7 cm (range 3–45cm) but 20.7 ± 11.6 cm (range 5–55cm) in malignant cases. Thus, the size of malignant tumours is significantly larger than that of the benign ($P < 0.05$).

Clinical symptoms of most patients frequently appeared with the expansion of the tumour and its invasion into the adjacent organs in a restricted space. Some asymptomatic patients did not learn of the abdominal mass until taking physical examinations. The clinical presentation of 56 benign and 57 malignant tumours is shown in Figure 1. The main clinical manifestation of benign and malignant PRT was abdominal mass and abdominal distension, respectively.

Figure 1 Distribution of clinical manifestations of benign and malignant cases; A: the main clinical manifestation of 56 benign primary retroperitoneal tumours (PRT) was abdominal mass (49%); B: the main clinical manifestation of 57 malignant PRT was abdominal distension (31%)

Most primary retroperitoneal tumours originate from mesenchymal tissue, neurogenous tissue and embryonic tissue. Postsurgical pathological findings are summarised in Table 1. Pathology confirmed that 50% of tumours were benign. A majority of benign tumours derived from mesenchymal tissue and neurogenous tissue, while malignant tumours mostly originated from mesenchymal tissue.

Although CT can demonstrate important characteristics of PRT, diagnosis is often challenging for radiologists. Diagnostic challenges include the precise localisation of the lesion, the extent of invasion and the characteristics of these tumours.⁶ The first step is to determine whether the tumour is located within the retroperitoneal space, then whether it is benign or malignant. Finally, the extent of the tumours and their characteristics such as enhancement and density are described. CT findings are listed in Table 2. The accuracy of CT localisation (approximately 70%) was not significantly different between

Table 1 Pathological findings of primary retroperitoneal tumours

Finding	Patients (n)
Benign:	56
Lymphangioma	11
Leiomyoma	6
Lipoma	3
Paraganglioma	9
Benign teratoma	6
Ganglioneuroma	6
Neurilemmoma	11
Neurofibroma	3
Telangiectatic fibroma	1
Malignant:	57
Liposarcoma	34
Leiomyosarcoma	6
Rhabdomyosarcoma	1
Mucinous cystadenoma	1
Malignant mesothelioma	1
Malignant mesenchyma	1
Melanoma	1
Synovial sarcoma	1
Aggressive angiomyxoma	1
Neurblastoma	2
Spindle cell sarcoma	2
Clear cell sarcoma	1
Undifferentiated carcinoma	2
Fibrosarcoma	2
Primitive neuroectodermal tumour	1

benign and malignant tumours ($P > 0.05$). However, malignant tumours were significantly more enhanced and heterogeneous on CT than benign tumours ($P < 0.05$). The sensitivity and specificity of CT diagnosis for benign tumours were 96% and 85%, respectively (Table 3).

Surgical resection is the most effective method for the treatment of PRT. In our study, 51 patients (91%) with benign tumours underwent complete resection and 42 (74%) in malignant cases (Table 4). The complete resection rate for benign tumours was significantly higher than

Table 2 Computed tomography findings of benign and malignant primary retroperitoneal tumours

CT Findings	Benign	Malignant	χ^2	P value
Right localisation	36	31	0.177	0.674
False localisation	14	15		
Homogeneous density	21	3	16.827	0.000
Heterogeneous density	17	30		
Enhancement	17	25	8.538	0.003
No enhancement	18	5		

Table 3 Correlation between computed tomography and pathological diagnosis (sensitivity 96%; specificity 85%)

Computed tomography	Pathology		Total
	Benign	Malignant	
Benign	45	7	52
Malignant	2	39	41
Total	47	46	93

Table 4 Surgical data for benign and malignant cases

Surgical data	Benign	Malignant	χ^2	P value
Resection:				
Complete	51	42	5.441	0.020
Incomplete	5	15		
Combined organ	2	12	8.207	0.004
No combined organ	52	40		
Capsule:				
(positive)	50	26	13.647	0.000
(negative)	4	17		
Surface:				
Regular	40	11	22.457	0.000
Irregular	13	32		

Table 5 Comparison of the relation of adjacent structures between surgical observation and computed tomography findings

	Surgical observation (n)		Total (n)
	Benign	Malignant	
CT (organ): ^a			
Benign	15	6	21
Malignant	15	45	60
Total	30	51	81
MRI (organ): ^b			
Benign	6	1	7
Malignant	2	13	15
Total	8	14	22
CT (vessel): ^c			
Benign	13	11	24
Malignant	7	46	53
Total	20	57	77
CT angiogram (vessel): ^d			
Benign	14	1	15
Malignant	0	5	5
Total	14	6	20

^a Sensitivity 50%, specificity 88%

^b Sensitivity 75%, specificity 93%

^c Sensitivity 65%, specificity 81%

^d Sensitivity 100%, specificity 83%

^a Sensitivity 50%, specificity 88%

^b Sensitivity 75%, specificity 93%

^c Sensitivity 65%, specificity 81%

^d Sensitivity 100%, specificity 83%

malignant tumours ($P < 0.05$). There were 14 cases with combined organ resection among PRT. The resected organs included the colon (the majority), followed by kidney, spleen, pancreas, uterus and psoas major. The rate of organ resection was significantly higher in malignant cases ($P < 0.05$). In addition, we found that benign tumours were more inclined to have capsule and regular surface relative to the malignant ($P < 0.05$).

Finally, we compared the tumour's relation to adjacent structures between surgical observation and presurgical CT findings (Table 5). The sensitivity and specificity of CT diagnosis for invaded organs was 50% and 88%, respectively, relatively low as compared with magnetic resonance imaging (MRI) diagnosis. In addition, the sensitivity and specificity of CT diagnosis for invaded vessels was 65% and 81%, respectively, relatively low in comparison with CT angiography (CTA) diagnosis.

Discussion

Primary retroperitoneal tumours comprise a rare and diverse group of neoplasms. Characterising this diverse

Figure 2 Characteristics of the benign retroperitoneal tumour; computed tomography shows ganglioneuroma in postcaval region, with regular margin, homogeneous density and no enhancement

Figure 3 Characteristics of the malignant retroperitoneal tumour; computed tomography shows liposarcoma in left lower abdomen, with irregular margin, heterogeneous density and minor enhancement

group of PRT is difficult, owing to the relative rarity of each subtype.⁷ PRT are malignant in 85% of cases; of these, nearly 50% are sarcomas.⁸ In our study, a majority of benign PRT originated from neurogenous tissue, while liposarcomas comprised the majority of malignant PRT. The main clinical manifestation of benign and malignant PRT was abdominal mass and abdominal distension, respectively. When symptoms are present, they relate to the extension of tumour or local invasion. Sepideh Gholami *et al* reported that the duration of symptoms was inversely proportional to the prognosis.⁹ This meant the patients who had symptoms for longer

periods did worse and had a shorter recurrence-free survival time.

Complete surgical resection is the most effective therapy for initial and recurrent retroperitoneal tumours, even if adjacent normal organs need to be removed.¹⁰ Combined organ resection is required in the majority of cases, most frequently involving the kidney, colon, small bowel and bladder.¹¹ Sufficient preoperative preparation is therefore the key to successful surgery. CT can clearly demonstrate the characteristics of the mass, the localisation of tumours and the relation to adjacent organs and vessels. It is also used to detect pulmonary, bone or hepatic metastases and local recurrence in patients who have already been resected,¹² which is helpful in making precise surgical plans.

In our experience, the accuracy of CT localisation is approximately 70%. The sensitivity and specificity of CT diagnosis for benign tumours are more than 85%. It is not satisfactory that the sensitivity of CT findings for invaded organs or vessels is less than 65%. When the tumour is near a vital structure but routine CT does not show their relationship, MRI or CT angiography presents a greater advantage. Nakashima *et al* reported some promising clinical and radiological criteria, including the tumour size, symptom, margin and calcification for the differential diagnosis between benign and malignant retroperitoneal tumours.¹³ One study demonstrates that the irregularity of the margins and the specific enhancement pattern on dynamic MRI may be important predictive factors of malignant retroperitoneal tumours.¹⁴ Another study reported that benign retroperitoneal tumours are usually regular, smaller, with clear margins and a less solid area, they are slower growing, rarely with necrosis and haemorrhage, no metastasis and are rarely recurrent after resection.¹⁵ In our study, the large size, no capsule, irregular margin, heterogeneous density and specific enhancement pattern on CT are highly suggestive of malignancy. Figures 2 and 3 show the characteristics of the benign and malignant tumours, respectively.

Although CT findings of PRT are not specific for the histological diagnosis, a number of CT features may suggest specific diagnosis: (i) the presence of calcification in malignant fibrous histiocytoma; (ii) the presence of fat in a mass lesion of heterogeneous density in liposarcoma; (iii) large regions of necrosis in leiomyosarcoma; (iv) catecholamine excess and para-aortic location in paraganglioma; (v) homogeneous, low density of neurofibroma; (vi) homogeneous, fat density of lipoma; and (vii) characteristic mixed components of teratoma.¹⁶

Malignant retroperitoneal tumours usually have a poor prognosis. The 5-year survival rate after surgical resection remains low, ranging from 36% to 63%.¹⁷ Prognostic factors for overall survival for retroperitoneal sarcoma include grade, stage, histology, size and margin status.¹⁸ In summary, the steps to improve curative effects include: (i) early finding, early diagnosis and early operation; (ii) complete resection; (iii) regular re-examination after operation. Regular follow-up with CT examination to detect recurrence is necessary every 6 months for 3 years.^{19,20}

Conclusions

It is beneficial to discriminate characteristics between benign and malignant PRT for preoperative preparation. Large size, no capsule, irregular margin, heterogeneous density and specific enhancement pattern on CT are highly suggestive of malignancy. CT is the most useful tool in assessing the size and characteristics of PRT but it is not sufficiently sensitive to assess the involvement of organs and vessels.

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