

Posterior Mediastinal Tumors: Outcome of Surgery

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ABSTRACT

Background and Purpose: The incidence of posterior mediastinal tumors relative to all tumors of the mediastinum is 23% to 30%. The posterior mediastinum is a potential space along each side of the vertebral column and adjacent proximal portion of the ribs. Primary tumors of posterior mediastinum are usually neurogenic. The aim of this study was to evaluate different surgical approaches used for the resection of posterior mediastinal tumors, and to assess morbidity, mortality and patients' survival.

Patients and Methods: Between January 2001 and January 2004, 30 patients with posterior mediastinal tumors were included. CT scan of the chest and CT guided biopsy were done for all patients; whereas MRI was done for suspected intraspinal extension. Posterolateral thoracotomy was the approach used in most of the patients. The Akwari approach was used in most of the patients with Dumbbell tumors.

Results: Neurogenic tumors constituted 67% of cases, being neuroblastoma in 60%. The non neurogenic tumors included a heterogenous group of rare tumors (n=10). Dumbbell tumors were found in 10 patients. Neuroblastoma was the commonest tumor to cause intraspinal extension (40%). Wide local excision was done in 13 patients; whereas extended resection was done in the remaining 17 patients. The mean intra-operative blood loss was 800cc and the mean hospital stay was 12 days. The size of the resected tumor ranged from 3X4cm to 30X22cm, 80% of tumors were malignant. Morbidity in relation to the procedures developed in 8 patients (atelectasis, meningitis, paraplegia, Horner syndrome and mild wound sepsis in 4, 1, 1, 1 and 1 of the patients; respectively). One postoperative mortality, due to meningitis was recorded. The overall survival by the end of three years was 87.7% with a mean survival of 30.4 months. The overall disease free survival was 55.9% with a mean disease free survival of 26.2 months.

Conclusions: Posterior mediastinal tumors may reach large size before becoming symptomatic. Complete surgical excision (including adjacent invaded organs) mainly by open technique should be the rule for these patients as there is survival benefit. Great care should be taken when dealing with Dumbbell tumors.

Key Words: Posterior mediastinal tumor - Surgery.

INTRODUCTION

The mediastinum is an anatomic region located in the center of the thorax, a simple and recent division is a three compartment model consisting of the anterior, visceral and paravertebral sulci. Here the posterior mediastinum is the potential space along each side of the vertebral column and adjacent proximal portion of the ribs [1]. Neurogenic tumors are the commonest posterior mediastinal tumors accounting for 19%-39% of all mediastinal tumors and 75% of all posterior mediastinal tumors [2]. These tumors are benign in 70%-80% of patients, of neural crest origin which give rise to peripheral nerves, including the sympathetic ganglia, paraganglia and schwann cells [3]. The remaining 25% of posterior mediastinal tumors are a heterogenous group of rare tumors including lymphoma, teratoma, sarcoma etc. In addition, many lesions arising outside the mediastinum may project into the posterior compartment and masquerade as posterior mediastinal mass [4].

Approximately, 40% of mediastinal masses are asymptomatic, and are discovered incidentally on routine chest radiography. Symptoms are usually due to compression or direct invasion of surrounding mediastinal structures or due to paraneoplastic syndromes. Symptoms may include chest pain, cough, dyspnea or neurological abnormalities [5]. Asymptomatic patients are more likely to have benign lesions; whereas symptomatic patients are more often malignant [6]. CT scan of the chest is considered the primary diagnostic modality in patients with posterior mediastinal tumors, however; MRI has become the single best examination when intraspinal extension is suspected. MRI has the

ability to distinguish the spinal cord proper from other soft tissue masses within the spinal canal, assess thecal sac impingement, and detect associated spinal cord pathology [7,8].

Surgery, mostly by open technique is the main line of treatment for posterior mediastinal tumors, aiming at complete excision [9]. Thoracoscopy may be used for the diagnosis, staging, assessment, and can be used for the resection of small tumors [10]. Tumors with spinal canal extension, have a reported incidence of about 10%; 60% of symptoms related to intraspinal component [11]. These tumors require combined one stage resection by a team of thoracic and neurosurgeons to minimize morbidity and mortality of the procedure [12]. The aim of this work was to study the demographic data of the patients, to evaluate the different surgical approaches used for resection, and to assess morbidity, mortality and patients' survival.

PATIENTS AND METHODS

Between January 2001 and January 2004, 30 patients with posterior mediastinal tumors underwent surgery at the National Cancer Institute, Cairo University.

Criteria for Eligibility were:

- Any age and sex.
- Patients with only posterior mediastinal tumors diagnosed by CT scan of the chest
- Pre operative tissue diagnosis.
- Forced expiratory volume in first second (FEV1) not less than 0.8L.
- Fitness for general anaesthesia.
- No paraplegia.

All patients were subjected to full history taking, neurological examination and full laboratory investigations. Serum markers as VMA, HVA, NSE were done for patients with neuroblastoma or peripheral neuroectodermal tumors (PNET). MRI was done in 83.3% of patients to rule out intraspinal extension.

The standard posterolateral thoracotomy was used in most of our patients. Posterior mediastinotomy was used in one patient with an intraspinal tumor. Thoraco-abdominal approach through the bed of the 8th rib was used

in 2 patients. One stage combined anterior-posterior approach starting with laminectomy at one or multiple levels, was used for Dumbbell tumors. Widening of the intervertebral foramen to deliver the intraspinal component was used in patients with small intraspinal part. Wide local excision of the mass was done for localized disease in nearly half of the patients. In the presence of a nearby structural invasion, extended resection including en-bloc excision of the mass with ribs, vertebral body, lung or diaphragm was done with subsequent appropriate reconstruction. Prolene mesh was used for chest wall and diaphragmatic reconstruction. Vertebral body reconstruction was done by autologous iliac bone graft for benign lesions and methylmethacrylate for malignant tumors with subsequent vertebral fixation by plate and screws. Good post-operative pain control was achieved by either thoracic epidural catheter or via intrapleural analgesia.

All patients with neuroblastoma or PNET received neo-adjuvant chemotherapy, and 3 adult patients with rare tumors received pre-operative radiotherapy before referral. Post-operatively, patients were either followed-up or sent for adjuvant treatment according to the pathology. Patients were followed up every 3 months, by clinical examination and CT of the chest and 6 monthly thereafter. MRI was requested whenever needed.

Survival data were calculated at the end of the study. Statistical package for social science (SPSS) was used for data analysis, mean and standard deviation described quantitative data and proportions described qualitative data. Kaplan-Meier procedure was used for survival estimation and Log rank test for comparing survival curves.

RESULTS

The study group included 16 females (53%) and 14 males (47%). Their age ranged from 7 months to 60 years with a median of 15 years. Patients were classified into 2 groups; pediatric (<18y) and adult (>18y). The tumors were more common in children (63.3%) than adults (36.7%) with a ratio of 1.7: 1. Fifty percent of the patients were symptomatic; respiratory symptoms were the commonest complaint. Right sided lesions were found in 14 patients, 15 patients had left

sided lesions and one patient had chordoma presenting with bilateral disease.

CT guided biopsy was positive in 27 (90%) patients. Vertebral body invasion (n=4) was detected by CT scan. Of the 14 patients with rib invasion only, 11 (78.6%) were detected by CT. Four of 5 (80%) patients with lung invasion, and 7 (70%) of 10 patients with spinal canal extension were detected pre-operatively by CT. MRI was ordered for 25 patients and was found to be more accurate than CT in the detection of intraspinal extension, as it detected all patients with intraspinal extensions (n=10).

Neurogenic tumors constituted 67% of cases (n=20), neuroblastoma was the commonest (n=7), followed by ganglioneuroblastoma (n=5) [of the 12 patients, 2 with stage II, 8 with stage III and 2 with stage IV], PNET in 4, malignant schwannoma in 2, one with benign schwannoma and one with ganglioneuroma. The non neurogenic group included 10 patients with heterogeneous rare tumors, including one with each of the following histological subtypes; chordoma, chondrosarcoma, giant cell tumor, spindle cell sarcoma, rhabdomyosarcoma, carcinosarcoma, undifferentiated large cell tumor, desmoid tumor, liomyoma and angiomyolipoma. Figures. (1-7) demonstrates some of our patients.

Post-operative pathology identified malignancy in 24 (80%) of patients. The tumor size ranged from 3x4cm and 30x22cm. Eighteen patients (60%) had a tumor size of $\geq 10 \times 10$ cm. Dumbbell tumors were diagnosed in 10 (33.3%) patients, neuroblastoma was the commonest cause of spinal canal extension (4/10). Nine of the 10 patients with dumbbell tumors were malignant.

The Akwari approach using 2 separate median dorsal and thoracotomy incisions was used in 5 patients, thoracotomy with widening of the inter-vertebral foramen was used in 4 patients, and the posterior approach using dorsal vertical incision was used in a patient with spindle cell sarcoma. Types of resection and types of reconstruction were summarized in tables I and II; respectively.

Intra-operative blood loss was in the range of 50cc-2500cc with a mean of 800cc. Hospital stay ranged from 7 to 28 days with a mean of

12 days. Morbidity in relation to surgery developed in 8 (26.6%) patients, atelectasis was the commonest (n=4), meningitis in 1, paraplegia in 1 due to extradural hematoma, re-operated upon with unsatisfactory results, Horner syndrome in 1, and one patient suffered from a superficial wound infection. Only one case of postoperative mortality was recorded as a result of meningitis.

Postoperatively, 16 patients received chemotherapy (patients with pediatric neurogenic tumors), while 7 patients received radiotherapy. During the follow-up period, 5 (16.6%) patients developed metastases; to the brain in 3, vertebrae in 1 and one to the bone marrow. Three patients with neuroblastoma developed local recurrence, they were re-explored, and complete tumor resection was done. Two patients with PNET died after 6 month and one year postoperative. One patient was lost for follow-up. By the end of the study, 22 patients (73.3%) were alive disease free and two (6.7%) were alive with disease. The overall survival by the end of three years was 87.7% (Fig. 8). The overall disease free survival was 55.9% (Fig. 9).

The patients were classified into different groups, according to their age (pediatric versus adult), pathology (neurogenic versus non neurogenic), presence of spinal canal extension and the type of resection (simple versus extended resection). Analysis of the overall free survival showed no statistically significant difference among neurogenic and non-neurogenic groups ($p=0.91$), pediatric and adult groups ($p=0.99$) and the group treated by simple versus extended resection ($p=0.66$). Although the group with no spinal canal extension showed a better overall survival, 94% versus 75% for the group with spinal canal extension, the difference did not reach a significant value ($p=0.16$).

Analysis of the disease-free survival showed that the group with no intraspinal extension had a significant higher disease free survival (66.9%) compared to the group with spinal canal extension (30%), ($p=0.05$). Although the disease-free survival in the group treated by simple resection (70%) was higher than the group treated by extended resection (45.5%), the difference did not reach a statistically significant level ($p=0.86$).

Table (1): Types of resection in study patients.

Type of resection	Number	%	Pathology
Simple resection	13	43.3	
Extended resection:	17	56.7	
Tumor + segment of 1 rib	3	10	PNET+ GNB + Ben.schwannoma
Tumor + segment of 2 ribs	4	13.3	3NB+ desmoid tumor
Tumor + partial 2 vertebrectomies	1	3.3	Chordoma
Tumor + 3 ribs + partial 2 verteb	1	3.3	Spindle cell sarcoma
Tumor + 4 ribs + total 1 Verteb	1	3.3	Chondrosarcoma
Tumor + 3 ribs + total 2 verteb	1	3.3	Giant cell tumor
Tumor + 2 ribs + 2wedges of lung	1	3.3	PNET
Tumor + lobectomy	2	6.6	Carcinosarcoma+Malig. Schwannoma
Tumor + 4 ribs + upper lobectomy	1	3.3	Malignant schwannoma
Tumor + 3 ribs + wedge lung excision	1	3.3	Undiff. Large cell carcinoma
Tumor + 3 ribs + part of diaphragm	1	3.3	PNET
Total	30	100	

Table (2): Types of reconstruction in study patients.

No.	Type of resection	Type of reconstruction	Pathology
3	Rib resection	Double layer prolene mesh repair	PNET + 2 Neuroblastoma
1	Resection of D2 vertebra.	Methyl methacrylate + plates & screws fixation	Chondrosarcoma
1	Resection of D6,7 vertebrae	Iliac bone graft + plates & screws fixation	Giant cell tumor
1	3rib + 2partial vertebrectomies	Plates & screws fixation	Spindle cell sarcoma
1	Diaphragmatic resection	Prolene mesh repair	PNET

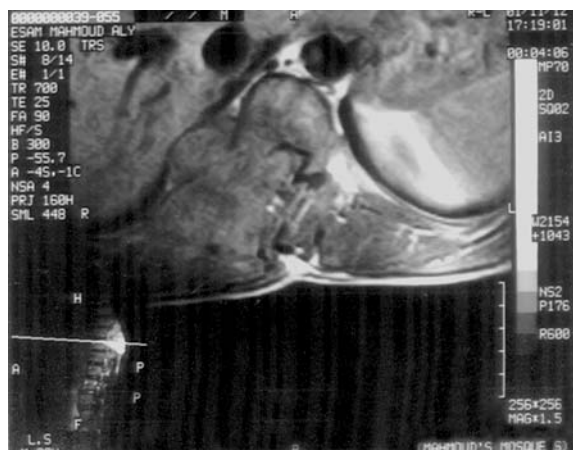


Fig. (1): MRI of a spindle cell sarcoma.



Fig. (2): Post operative reconstruction.

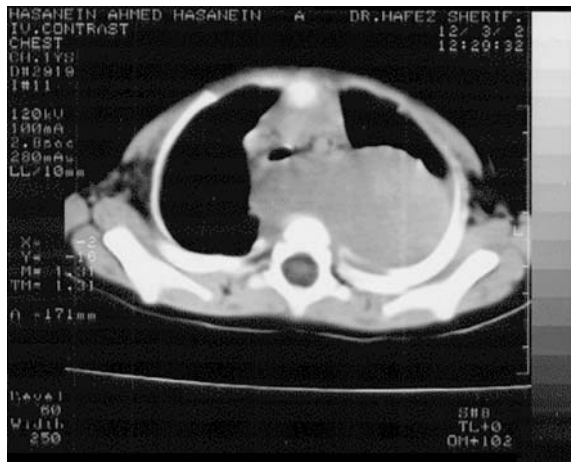


Fig. (3): CT of posterior mediastinal neuroblastoma pre chemotherapy.



Fig. (4): CT of posterior mediastinal neuroblastoma post chemotherapy.



Fig. (5): Operative specimen.



Fig. (6): Posterior mediastinal schwannoma.

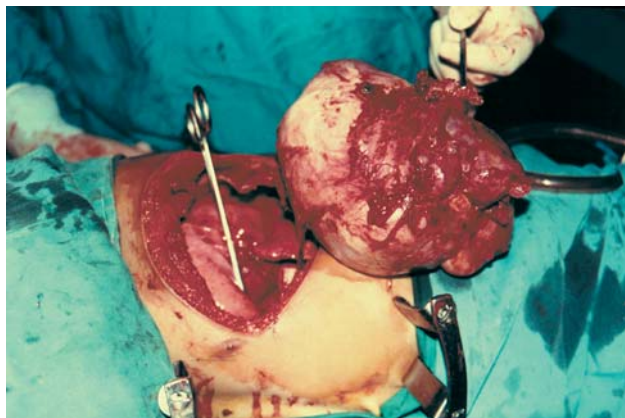


Fig. (7): Operative view with 3 ribs resected.

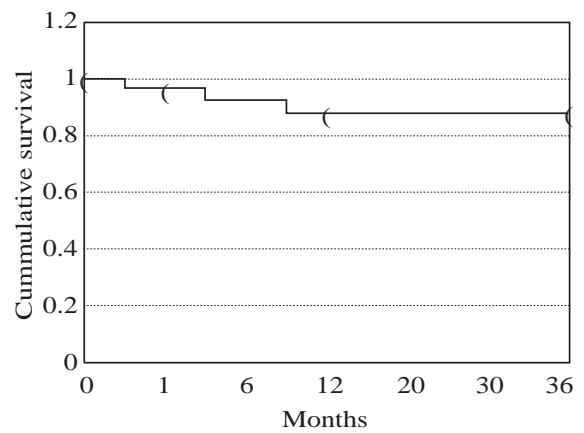


Fig. (8): The overall survival of all patients.

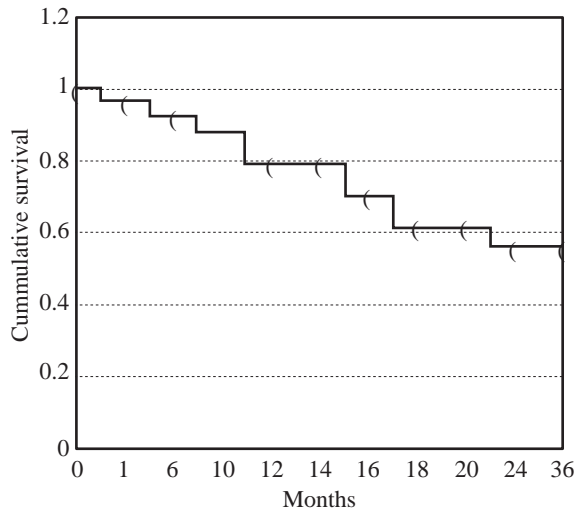


Fig. (9): Disease free survival in all patients.

DISCUSSION

Posterior mediastinal tumors are commonly neurogenic in origin. Benign tumors predominate in adults, while malignant ones are more common in infants and children. The most common presentation in our patients was respiratory symptoms (50%), neurological in 6.6% and a palpable mass in 3.3%. Saenz and colleagues [13] and Ribet and Cardot [14] reported similar results; respiratory symptoms reported in 45% of patients, neurological symptoms in 13% and a palpable mass in 5%.

Suzuki et al. [15] and Naidich et al. [8] reported that sensitivity of CT scan in the detection of chest wall invasion was in the range of 60%-79% and in the detection of lung invasion was 70%-80%. Similarly, results obtained in the present series showed CT sensitivity of 78.6% in detection of chest wall invasion and 80% in detection of lung invasion. Posterior mediastinal tumors were neurogenic in origin in 67% of our patients. Similarly, other studies reported neurogenic tumors in 75% of their patients [16,17].

Most series reported a diagnostic yield of per-cutaneous needle biopsy in the range of 72%-100% [18] more recently this figure is in excess of 90% [19]. These data were comparable to the present results, CT guided biopsy was diagnostic in 90% of patients. Previous studies recorded that 60% of patients with posterior mediastinal tumors were malignant and malignancy predominates in infants and children,

with 54% of patients diagnosed as neuroblastoma [13,14]. In the present series, 80% of cases were malignant; autonomic ganglia tumors (65%) and neuroblastoma were diagnosed in 12 (60%) patients, all of them belong to the pediatric age group. The higher incidence of malignancy in our patients may be explained by the fact that the National Cancer Institute is a referral center for malignancy especially in the pediatric age.

Thoracic neuroblastomas usually have a better survival than abdominal. Recent chromosomal studies for neuroblastomas have shown that thoracic lesions are less likely to express N-myc oncogene amplification. This amplification has been associated with a poor survival [20].

The 5 years survival rate for thoracic neuroblastoma was reported to be greater than 70% [21]. Our patients with thoracic neuroblastoma had a 3 years actuarial survival of 100%, but with a high recurrence rate (25%), because 66.7% of patients were stage III at the time of diagnosis. On the other hand, long term survival of patients with PNET is infrequent. Askin and colleagues [22] reported a median survival of only 8 months in their PNET cases. This was comparable with our results as 2 of 4 patients with PNET died 6 and 12 months after surgery.

In the present series, 33.3% of patients presented with dumbbell tumors, which was higher than that reported in other studies. Akwari and associates [11] reported that approximately 10% of all posterior mediastinal neurogenic tumors have intraspinal extension. This higher incidence of dumbbell tumors in our patients may be due to higher incidence of malignancy, as 90% of patients with dumbbell tumors were malignant. Sixty five percent of our patients with dumbbell tumors were symptomatic. Similarly, Grillo and Ojmann [23] reported symptoms in 60% of their patients. The overall survival of our patients with spinal canal extension was 75% with a mean survival of 25.9 months; 3 patients developed recurrent disease. In a retrospective analysis of 16 patients with mediastinal dumbbell tumors [24], there were 14 benign and only 2 malignant lesions and no recurrence was observed during a follow-up period from 2 months up to 28 years. The high incidence of recurrence in our patients was due to high incidence of

malignant disease, which was 90% versus 12.5% in the compared series.

Fourney and associates [25] concluded that the combined anterior-posterior approach for the resection of spinal and para-spinal tumors is safe with lesser complications on using the posterior approach alone, they had a complication rate of 27%. Akeynson and McCutcheon [26] found a high incidence of wound sepsis (12%), CSF leak (16%), and graft displacement (16%) in their series when posterior approach was only used. Combined anterior-posterior approach was used in our patients with spinal canal extension, with a reported complication rate of 30%, which is comparable to most of the published data.

The rest of our patients included a heterogeneous group of rare posterior mediastinal tumors, comparison of their demographic and survival data is difficult. However, we had excellent survival in this group of patients treated by radical surgery.

Thus from the results of the present study, we conclude that posterior mediastinal tumors may reach large size before diagnosis. Complete surgical excision including extended resection of adjacent invaded organs should be the aim, as this may be associated with prolonged survival. Open surgery is the appropriate approach for resection; whereas thoracoscopy should be reserved for selected patients only.

For cases with suspected spinal canal extension, the major steps to be followed in their management should begin with scanning the inter-vertebral foramen near the tumor location for widening and expansion with thin slice CT and if widening or expansion was detected, MRI should be performed. If extension into the foramen is proved, a surgical approach planned in consultation with a neurosurgeon should be performed. Complete resection using one-stage combined anterior-posterior approach is recommended, as it is safe and provides an excellent simultaneous ventral and dorsal exposure.

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