



## A RETROSPECTIVE STUDY OF SURGICALLY TREATED PRIMARY MEDIASTINAL TUMORS IN ADULTS OVER A 3 YEAR PERIOD - A SINGLE CENTRE EXPERIENCE

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### KEYWORDS :

#### INTRODUCTION

The mediastinum is the space that lies between the two pleural cavities. It extends from the thoracic inlet superiorly to the upper surface of the diaphragm inferiorly. Anteriorly it is bound by the sternum and posteriorly by the anterior longitudinal spinal ligament. It contains many vital structures in it and passing through it. When tumors or cysts arise in the mediastinum they can be either asymptomatic or present as space occupying lesions causing symptoms and signs by their effect on the neighboring organs. A study of the neoplasms of the mediastinum is made interesting by the varied number of structures packed in this compartment producing numerous types of lesions making definite diagnosis difficult and their close proximity to vital structures make the management challenging. Recent improvements in diagnostic techniques, advances in surgical and post operative management have improved the outcome. As a result there is a rekindling of interest in tumors of this region. In this study we reviewed our experience in primary mediastinal tumor and cyst patients with respect to their presentation, diagnostic methods used, surgical techniques employed and immediate and late surgical outcomes.

#### AIMS AND OBJECTIVES

##### AIM

To study retrospectively all the primary mediastinal tumors and cysts operated upon in the Dept of Cardiothoracic Surgery, Tamilnadu Govt MultiSuper Speciality Hospital, Chennai over a threeperiod, from the 1<sup>st</sup> January 2015 to the 31<sup>st</sup> July 2018.

##### OBJECTIVE

To analyze retrospectively the incidence and types of different kinds of tumors and cysts in the mediastinum, their clinical presentation, methods employed in diagnosis, surgical interventions done, the immediate and late surgical outcomes.

#### MATERIALS AND METHODS

This retrospective study was based upon analysis of the records of the patients undergoing surgical management for primary mediastinal tumors and cysts over a period of 3 years from 1<sup>st</sup> January 2015 to the 31<sup>st</sup> July 2018.

The records of all the patients were retrieved and the data collected. This study was conducted in the Dept of Cardiothoracic Surgery, Tamilnadu Govt MultiSuper Speciality Hospital, Chennai.

The presenting symptoms and physical findings of all the patients were categorized. The laboratory and radiological techniques used to identify and diagnose the pathology were studied. The surgical approach and technique used and the details of the inpatient treatment analyzed.

Early morbidity recognized included complications like phrenic nerve palsy, wound infection, urinary tract infection, prolonged ventilation, bleeding requiring re-exploration and chylothorax. Early mortality included intra-operative death or deaths during the same admission. Late death meant death of a patient directly related to the disease at any time after discharge.

The details of postoperative treatment in the form of chemotherapy or radiotherapy for patients requiring such treatment were studied.

All the details of follow up of these patients as outpatients at our institution were collected. The details of late morbidity, mortality and recurrence of disease were gathered. The patients who had not presented in the follow up clinic were contacted by mail or telephone and the morbidity or mortality details collected.

#### Inclusion Criteria

- All patients with intra thoracic tumors or cysts which arose primarily from the mediastinal structures were included in this study.

#### Exclusion Criteria

- Involvement of mediastinum by direct extension of a neighboring neoplasm.
- Metastatic lesions in the mediastinum
- Mediastinal lymphoma as part of generalized lymphoma.
- Esophageal lesions.
- Cardiac
- Vascular tumors.
- Pediatric (<14 years) group of patients.

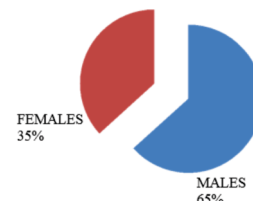
#### RESULTS AND ANALYSIS

There were 91 adult patients who underwent surgery for mediastinal tumors or cysts in the last 3 years from from the 1<sup>st</sup> January 2015 to the 31<sup>st</sup> July 2018. There were 59 (65%) males 32 (35%) females with the male to female ratio being 1.84:1.

**TABLE 1**  
**SEX DISTRIBUTION**

Sex	Number of Patients	Percentage
Male	59	65
Female	32	35
Total	91	100

**FIG 1 SEX DISTRIBUTION**



#### AGE DISTRIBUTION

The mean age of patients who underwent surgery was  $36.9 \pm 12.5$  years (range 14 to 67 years). There was a total of 35 thymoma, 16 of them associated with myasthenia gravis. The mean age of presentation of a patient with thymoma was  $42.94 \pm 11.52$  (range 19 to 67 years). Among the patients with myasthenia gravis it was  $41 \pm 10.55$  years (range 21 to 57 years) and it was  $44.58 \pm 12.32$  years (range 19 to 67 years) among the patients without myasthenia. In non-myasthenic patients females are more commonly undergoing surgery in the 4th decade (3 out of 4 patients) but males present later in the 5th and 6th decades (10 out of 15 patients). Eleven patients underwent surgery for germ cell tumors and their mean

age at surgery was 30.72 ± 9.31 years (range 16 to 45 years).

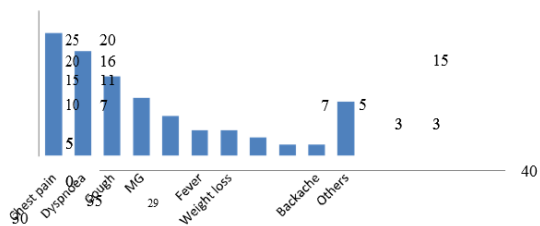
There were 17 patients who underwent surgery for neurogenic tumors with a mean age of 35.17 ± 9.09 years (range 19 to 50 years). Ten patients underwent surgery for mediastinal cysts with mean age of 0.5 ± 11.61 years (range 17 to 50 years).

**TABLE 2**  
**AGE DISTRIBUTION**

Lesion	Mean Age	Range
Thymoma (MG)	41	21-57
Thymoma (non- MG)	44.6	14-67
Germ Cell Tumor	30.7	16-45

**Table 3**  
**DISTRIBUTION OF SYMPTOMATOLOGY**

Symptom	Thymoma	Neurogenic tumors	Germ cell tumor	Lymphoma	Cysts	Others	Total	%
Chest pain	7	9	7	2	6	3	34	37.4
Cough	3	2	3	4	4	3	20	22
Dyspnoea	7	5	8	2	4	3	29	32
Asymptomatic	3	4	2	0	0	1	11	12
Myasthenia Gravis	16	0	0	0	0	0	16	17.6
Fever	0	0	4	1	1	1	7	7.7
Weight Loss	4	0	1	0	0	2	7	7.7
Generalized Weakness	5	0	0	0	0	0	5	5.5
SVC obstruction	0	0	1	1	0	1	3	3.3
Backache	0	2	0	0	0	1	3	3.3
Others	6	3	0	2	1	3	15	16.5



**Fig 2 Distribution Of Symptomatology**

**Anatomic Location Of Tumor And Cysts**

Of the 91 patients 65 (73.6%) had lesion in anterior mediastinum, 20 (22%) had it in the posterior mediastinum and 4 (4.4%) in the middle mediastinum.

**TABLE 4**  
**Distribution Of Anatomic Location**

Compartment	Number of patients	Percentage
Anterior	67	73.6
Middle	4	4.4
Posterior	20	22



**TABLE 5**  
**Distribution Of Mediastinal Masses In Different Anatomic Locations**

Mediastinal Masses	Anterior	Middle	Posterior
Thymoma	18 (19.8)	0	0

Neurogenic Tumor	35.2	19-50
Mediastinal Cysts	30.5	17-50
Total	36.9	14-67

**Symptomatology**

There were varying clinical presentations of mediastinal tumors and cysts. Chest pain was the chief mode of presentation in 34 (37.4%) patients, dyspnoea in 29 (32%) patients, cough in 20 (22%) patients and nonspecific fever in 7 (7.7%). Eleven patients (12%) were asymptomatic and had been diagnosed incidentally. Other less common symptoms were weight loss, symptoms of SVC obstruction, backache, generalized fatigue, dysphagia, pedal edema and, increased frequency of micturition. Myasthenia gravis was the commonest symptom among the patients with thymoma.

Thymic Carcinoma	4 (4.4)	0	0
Neuroendocrine tumor thymus	2 (2.2)	0	0
Benign germ cell tumor	10 (11)	0	0
Malignant Teratoma	1 (1.1)	0	0
Neurogenic tumor	0	0	17 (18.7)
Mediastinal Cysts			
? Bronchogenic	4 (4.4)	4 (4.4)	2 (2.2)
? Pericardial	2 (2.2)	2 (2.2)	2 (2.2)
? Thymic	0	2 (2.2)	0
?	2 (2.2)	0	0
Lymphomas	6 (6.6)	0	0
Ewing's Sarcoma	0	0	1 (1.1)
Intrathoracic Goiter	2 (2.2)	0	0
Castleman Disease	1 (1.1)	0	0
Cystic Lymphangioma	1 (1.1)	0	0
Sclerosing Mediastinitis	1 (1.1)	0	0
Total	67 (73.6)	4 (4.4)	20 (22)

**Size Of Tumors And Cysts**

In present study the mean size of tumors and cysts was 8.9 ± 4.3 cm (range 2 to 21 cm). The largest tumor being a posterior mediastinal schwannoma.

There were 35 patients with thymoma with a mean tumor size of 7.68 ± 3.93 cm (range 2 to 20cm). The mean size of germ cell tumors was 10.9 ± 4.67cm (range 3 to 18cm). There were 16 patients with neurogenic tumors of mean size 8.58 ± 3.84cm (range 5 to 21cm). The mean size of cysts was 9.1 ± 4.43cm (range 4 to 15cm).

**TABLE 6**  
**Distribution Of Tumor Sizes**

Lesions	Mean size (cm)	Range (cm)
All tumors	8.9	2-21
Thymoma	7.68	2-20
Germ cell	10.9	3-18
Neurogenic	8.58	5-21
Cysts	9.1	4-15

**Diagnostic Modality**

Chest X-rays was the first mode of investigation revealing a lesion in 79 (86.8%) of patients. In 82 (90%) the diagnosis was confirmed with CT scan and in 9 (10%) patients the preferred confirmatory investigation was an MRI.

**Preoperative Biopsy**

Thirty-one (34%) patients had undergone pre-operative biopsy procedure, out of which 11 (12.1%) were diagnosed to be thymoma, 5 (5.5%) as neurogenic tumor, 3(3.3%) as lymphoma and neuroendocrine tumor of thymus each and 6 (6.6%) patient's biopsies were inconclusive.

**Preoperative Chemotherapy**

Of the seven patients who received chemotherapy pre-operatively to downsize the tumor, 4 had malignant thymoma and 1 each had germ cell tumor, thymic carcinoma and lymphoma.

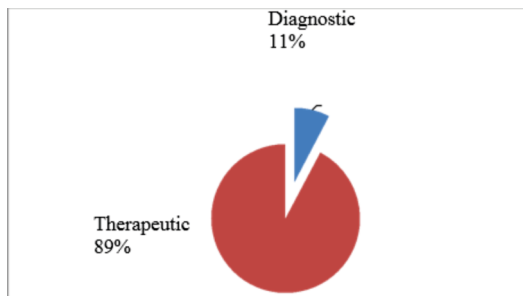
**Surgical Treatment**

Of the 91 patients, 81 (89%) patients had undergone therapeutic surgery and 10 (11%) patients had undergone open biopsy only. Of the patients who had therapeutic surgery, 75 (82.5%) had complete resection and 6 (6.6%) underwent debulking. Seven patients underwent concomitant procedures - two had wedge resection of lung, 3 had thyroidectomy, 1 had middle lobectomy and 1 had a pericardiectomy.

**TABLE 7**  
**Distribution Of Surgical Treatment**

Surgical Treatment	Number of patients	Percentage
Diagnostic	10	11
Therapeutic	81	89

**Fig 4 Distribution Of Surgical Treatment**



**OPERATIVE CHARACTERISTICS**

In 50 (55%) patients, the lesion was approached through a midline sternotomy, and 47 (94%) of them had resections. In 41 (45%) patients, the lesion were approached through a thoracotomy and of them 34 (83%) had resections.

In the present study, 46 patients had thymoma out of which 19 were Masaoka stage I, 10 were stage II, 6 were stage III and 1 was stage IVA. Fifteen of the thymoma were found to be adherent to the surrounding tissues. Four (21%) of these were later diagnosed to be stage I and 6 (40%) as stage II.

**TABLE 8**  
**Distribution Of Surgical Approach**

Surgical Approach	Number of patients	Percentage
Midline Sternotomy	50	55

	Diagnostic	3	6
	Therapeutic	47	94
Thoracotomy		41	45
	Diagnostic	7	17
	Therapeutic	34	83

**Final Diagnosis**

Out of 91 patients, 35 (38.4%) had thymoma (Stage I-18, Stage II-10, Stage III-6 and Stage IVa-1), 17 (18.7%) had neurogenic tumors, 10 (11%) had benign germ cell tumors, 10 (11%) had mediastinal cysts (6 bronchogenic, 2 pericardial and 2 thymic), 7 (7.7%) had lymphoma, 4 (4.4%) had neuroendocrine tumor of the thymus, 2 (2.2%) had thymic carcinoma, and 2 (2.2%) had intrathoracic goiter. There was 1 each of malignant teratoma, Castleman's disease, sclerosing mediastinitis, cystic lymphangioma and Ewing's sarcoma.

**TABLE 9**  
**Distribution Of Histopathology**

Histopathology	Number of patients	Percentage
Thymoma	35	38.5
Stage I	18	19.5
Stage II	10	11
Stage III	6	6.6
Stage IV	1	1.1
Neurogenic Tumors	17	18.7
Schwannoma	13	14.3
Neurofibroma	1	1.1
Paraganglioma	2	2.2
Ganglioneuroma	1	1.1
Benign germ cell tumors	10	11
Mediastinal Cysts	10	11
Bronchogenic	6	6.6
Pericardial	2	2.2
Thymic	2	2.2
Lymphoma	6	6.6
Neuroendocrine tumor, thymus	4	4.4
Thymic Carcinoma	2	2.2
Intrathoracic Goiter	2	2.2
Malignant Teratoma	1	1.1
Sclerosing Mediastinitis	1	1.1
Castleman's Disease	1	1.1
Cystic Lymphangioma	1	1.1
Ewing's Sarcoma	1	1.1

**Benign Vs Malignant**

In our study, there were 60 (66%) patients with benign lesions, out of which 30 (33%) were in the anterior compartment, 4 (4.4%) in the middle compartment and 20 (22%) in the posterior compartment. Thirty-one (34%) had malignant lesion, of which 30 (33%) were in the anterior compartment and 1 (1.1%) was in the posterior compartment.

**TABLE 10**  
**Distribution Of Benign & Malignant Lesion**

	Number of patients	Percentage
Benign	60	66
Anterior	30	33
Middle	4	4.4
Posterior	20	22
Malignant	31	34
Anterior	30	33
Middle	0	0
Posterior	1	1.1

**TABLE 11**  
**Distribution Of Mediastinal Lesions In Different Age Groups**

Age group	Benign	Malignant
14-20	5 (5.5)	5 (5.5)
21-30	12 (13.2)	7 (7.7)
31-40	22 (24.2)	5 (5.5)
41-50	12 (13.2)	8 (8.8)
51-60	8 (8.8)	6 (6.6)
61-70	1 (1.1)	0

\*Parentheses are percentages

**Perioperative Complications**

Thirteen (14.3%) patients had complications. Three (3.3%) patients who underwent thymectomy had phrenic nerve palsy, 4 (4.4%) had wound infections (3 sternotomies and 1 thoracotomy). One patient had urinary tract infection and one had urinary incontinence. One patient was re-explored for bleeding, one went into acute renal failure managed conservatively, one had chylothorax treated conservatively and one myasthenic required prolonged ventilation.

**TABLE 13**  
**Perioperative Complications**

Perioperative Complications	Number of patients	Percentage
Phrenic Nerve Palsy	3	3.3
Wound Infection	4	4.4
UTI	1	1.1
Urinary Incontinence	1	1.1
Prolonged Ventilation	1	1.1
Acute renal failure	1	1.1
Bleeding requiring re-exploration	1	1.1
Chylothorax	1	1.1

**Post-operative hospital stay**

The median post operative hospital stay was 5 days (range 3 to 65 days)

**Early mortality**

We had one intra-operative death and no early post operative deaths. This patient was a 52 year old gentleman with a giant (37-89 x 493 cm) neuroendocrine carcinoma in the right hemithorax. He sustained a cardiac arrest during induction of anesthesia but was resuscitated. The tumor was densely adherent to the surrounding structures and hence a debulking surgery was attempted. This caused uncontrollable hemorrhage resulting in death.

**Post-operative chemotherapy**

There were 12 (13.2%) patients who received post-operative chemotherapy of which 5 had received chemotherapy pre-operatively also. Six (6.6%) of these were for Malignant thymoma, 3 (3.3%) for lymphoma, 3 (3.3%) for neuroendocrine tumor of thymus and 1 (1.1%) for thymic carcinoma.

**Post-operative radiotherapy**

In all 13 (14.3%) patients received post-operative radiotherapy of which 4 patient had received pre-operative chemotherapy also. 8 (8.8%) patients were for malignant thymoma, 2 (2.2%) patients had neuroendocrine tumor of thymus, 1 (1.1%) had thymic carcinoma, 1 (1.1%) patient had malignant teratoma and 1 (1.1%) patient had lymphoma.

**Follow up**

Eighty-one (89%) patients had a follow up in the outpatient clinic of this hospital with a mean follow up of 37.3 ± 26.7 months (range 8 to 110 months).

**Late morbidity**

One patient developed foreign body granuloma in his sternotomy scar requiring wire removal. There were no other late morbidities recorded.

**Late mortality**

There were 2 (2.2%) late mortalities. One patient was a 19 year old man with complaints of dyspnoea at rest, who underwent a successful debulking of a stage III malignant thymoma and succumbed to his illness 4 months hence. The second patient is a 26 year old man who underwent resection of a malignant thymoma (B2/B3) with phrenic nerve involvement followed by chemotherapy. He died of respiratory failure 10 months later.

**Recurrences**

In all 4 (4.4%) patients had recurrences of their tumor, 3 (3.3%) with thymoma and 1 with neuroendocrine tumor of the thymus. All these were anterior compartment tumors.

**Incidence**

In our study there were a total of 91 cases of mediastinal tumors in the adults who underwent surgery in our institution over the 10 year period between 2000 and 2009. There was a male preponderance in the incidence of primary mediastinal tumors with a male: female ratio of about 59 : 32 (65%: 35%). This sex distribution was comparable to other studies like that of Benjamin et al<sup>20</sup>, who reported a ratio of 54%: 46%. Solaini et al<sup>7</sup>, had a sex ratio of 75:25 and Vaziri et al<sup>4</sup> had 62% males and 38% females in his study.

**Age at presentation**

Large number of patients in the present study were in the fourth decade of life, mean age at surgery being 36.1 ± 12.49 years (range 14 to 67 years), which is comparable to other studies<sup>4,22,23</sup>. The mean age of presentations for males was 38.6 ± 13.6 years and for females was 33.8 ± 10.3 years.

**Symptomatology**

The patients having anterior mediastinal masses are more frequently symptomatic because of the restricted space in this compartment whereas lesions of the middle and posterior compartment are frequently asymptomatic. Most patients presented with chest pain (37.4%) followed by dyspnoea (32%), cough (22%) and myasthenia gravis (17.6%). Only 11 (12%) patients were asymptomatic which is similar to the distribution of symptomatology in other reports<sup>4,21</sup>.

**Preoperative investigations**

Routine blood investigations are done to evaluate a patient's fitness for surgery. All young patients with anterior mediastinal mass get their alpha fetoprotein and β-HCG levels assessed. In addition to the chest X-ray and CT scan, other radiological and nuclear medicine imaging are done if and when necessary to evaluate a lesion. If a mass appears to be benign after the initial investigations, it can be removed surgically without a biopsy. Otherwise, a diagnostic tissue sample is obtained by transthoracic or transbronchial needle aspiration, mediastinoscopy, anterior mediastinotomy, or video-assisted thoracoscopic surgery, depending on the anatomic location and radiographic appearance of the lesion. MRI studies were done only if there were specific diagnostic questions of involvement of major blood vessels or spinal canal that is not obvious in a CT scan.

**Location of tumor**

There were 67 (73.6%) patients who had tumors in the anterior compartment, 4 (4.5%) patients in the middle compartment and 20 (22%) patients in the posterior compartment with malignancy rates of 33% in the anterior, none in the middle and 1 patient in the posterior compartment. This distribution is different from the distribution quoted in other studies<sup>3,4,23</sup>. We had less number of patients in middle mediastinum as we have not included the patients with cardiac and vascular tumors.

**Specific Preoperative Preparations**

All the patients above the age of 40 years had an electrocardiogram (ECG) done and if any abnormality detected underwent an echocardiography to rule out any cardiac pathology. All the patients

planned for surgical resection of mediastinal tumor had their pulmonary functions assessed. Intense preoperative physiotherapy was given to all our patients to optimize their pulmonary function and this was continued in post operative period too. Patients with myasthenia gravis who had persistent weakness even on full therapeutic doses of anticholinesterases and steroids were subjected to plasmapheresis. During plasmapheresis, in each sitting, 2 to 3.5 L of plasma is exchanged for a solution of albumin or saline. Up to a volume of 125ml/kg of plasma is exchanged over a period of 1 week. The response to plasmapheresis may be noted in 3-5 days in the form of more than 80% reduction in circulating antibodies against acetylcholine receptors and remarkable improvement in muscle weakness clinically.

### Surgical technique

There were 10 (11%) patients who underwent open biopsy including the two who underwent chamberlain's procedure. The histopathological analysis of these patients revealed lymphoma, malignant thymoma and sclerosing mediastinitis. These patients did not warrant curative surgery and they received non-surgical treatment only after the diagnostic surgery. Some of the attempted curative surgeries were limited to biopsies only when the lesion was found to be inoperable intra-operatively. Eight-one (89%) patients underwent surgical resection out of which 75 (82.5%) underwent complete resection and 6 (6.6%) underwent debulking of the tumor. One patient who underwent debulking surgery died intra operatively due to uncontrolled primary hemorrhage.

In our study 50 patients (55%) had midline sternotomy and 41 (45%) patients had thoracotomy to approach the lesion. The surgical approach for excision of an anterior mediastinal mass varies according to the surgeon's preference. A thoracotomy was preferred for an anterior mediastinal tumor if the mass had deviated to either side presenting in either pleural cavity. Though a thoracotomy incision is more painful, it is cosmetically more acceptable. Posterior mediastinal masses are almost always excised through a posterolateral thoracotomy. The use of video-assisted thoracoscopic surgery the surgical procedure of choice has greatly increased in the recent past<sup>5</sup>. Whenever excision of a locally infiltrating malignant mediastinal tumor is planned, the extent of the resection is decided upon by the morbidity it causes and the long-term survival benefit of the extensive resection. Seven (7.7%) of our patients underwent concomitant surgeries- 2 patients had left upper lobectomies along with thymectomy for thymic carcinoma, 1 had a middle lobectomy along with a thymectomy for malignant thymoma, 3 patient had thyroidectomy along with thymectomy, intrathoracic goiter excision and paraganglion resection and 1 patient who underwent open biopsy for lymphoma also had a pericardiectomy done. Though a video assisted thoracoscopic surgery will be ideal for excision of any mediastinal tumors, the cost to the patient, the lack of equipment and expertise limits its usage in most centers. It has better cosmesis, so more acceptable. The pulmonary functions return to normal earlier than in a thoracotomy, with the resultant decrease in the number of days of hospital stay. The post operative pain however is the same.

### Histology

The most common tumor in the anterior compartment was thymoma accounting for 38.5% of the lesions. Six out of the ten cysts in the visceral compartment were bronchogenic and 85% of the tumors in posterior compartment were neurogenic tumors. There were 35 patients with thymoma of which 16 (45.7%) had myasthenia gravis, the incidence which is higher than that seen in the study done by Masaoka et al<sup>15</sup>. But unlike in this study by Masaoka, the sex ratio is highly in favor of males (24) over females (11) giving a ratio of 68.5:31.5%, even more than the ratio quoted by Benjamin et al<sup>20</sup>. During the same study period, 41 patients with myasthenia gravis underwent a thymectomy, of which 16 (39%) had thymoma. Similar numbers have been obtained in other studies also<sup>15,23,24</sup>. The second commonest tumor in our study was neurogenic tumors forming 14.5% of the tumors similar to the reports by Takeda et al<sup>25</sup>. There

were 17 schwannoma, 1 neurofibroma and 2 paraganglioma.

We had 11 (12%) patients who presented with germ cell tumor which is similar to the incidence seen in the study done by Nichols et al<sup>6</sup>. In our study there was equal distribution between males and females as in most other studies<sup>9</sup>. Ten of the tumors were benign cystic teratoma. One of our patients presented with non-specific complaints with the CT findings suggestive of a neurogenic tumor which later on histopathology turned out to be Castleman's disease. It is not uncommon to find Castleman's disease the in posterior mediastinum. The presentation is similar to as described by Castleman et al<sup>18</sup>.

In another young patient suspected to have a dumbbell neurogenic tumor in the posterior mediastinum, the excision biopsy revealed an Ewing's sarcoma, which is a rare finding in the mediastinum. Ewing's sarcoma is known to present as chest wall tumors but it is unusual to present as a mediastinal mass. Similar case scenario was encountered by Silver et al<sup>26</sup>. Ideally such patients should undergo preoperative biopsy and then induction chemotherapy prior to surgery. One patient presenting with middle lobe collapse secondary to a mediastinal and hilar mass lesion which turned out to be sclerosing mediastinitis. This is a focal variety of sclerosing mediastinitis which has a good prognosis. The treatment for sclerosing mediastinitis was non specific using immunosuppressants. No antifungal or anti tubercular treatment was considered necessary.

One adult female patient presented with an incidentally detected anterior mediastinal mass on chest radiograph, which was confirmed on histopathology to be a cystic lymphangioma. She presented with typical findings and was completely cured with surgical resection.

The most common histological diagnosis was thymoma (38.5%). Other histology in decreasing order of frequency were neurogenic tumor (18.7%), mediastinal cysts (11%), benign germ cell tumors (11%), lymphoma (6.6%), neuroendocrine tumor of thymus (4.5%), thymic carcinoma (2.2%), intrathoracic goiter (2.2%) and 1 each of malignant teratoma, Castleman's disease, Ewing's Sarcoma, sclerosing mediastinitis, cystic lymphangioma. These incidences are different in different reports<sup>4,22,23,27</sup>. Surgery for malignant tumors infiltrating a neighboring structures causes a higher degree of morbidity, since a concomitant additional procedure to remove involved structure will be necessary. However, up to 21% of the Masaoka stage I and 60% of stage II thymic tumors exhibited adhesions to the surrounding structures. Hence histopathological studies are important along with clinical staging for post operative treatment and prognostication.

### Post Operative Period

All patients received peri-operative antibiotic cover (one dose half hour before skin incision and 5 doses post operatively). All the patients were extubated on table after the surgery. However patients with myasthenia gravis were ventilated overnight as per protocol to give them a drug free interval. The cholinesterase drugs were restarted the next morning, an hour before the proposed extubation. Routine post operative blood tests and chest X-ray were done in the immediate post operative period. The ICDs were removed when indicated. The average length of hospital stay was 5 days.

### Early mortality and morbidity

Fourteen (15.3%) patients had peri-operative complications of which 4 were specific for their disease. Three patients with thymoma had their phrenic nerves sacrificed, one myasthenic patient required prolonged ventilation in the post operative period. There was one intra operative death (1.1%). These incidences are comparable to other reports<sup>22</sup>.

### Post operative radiation therapy

Patients diagnosed to have Masaoka stage II or more of thymoma,



thymic carcinoma, neuroendocrine tumor of thymus and malignant teratoma were referred for radiotherapy. Patients with invasive thymoma received external beam radiation of 45-55 Gy and those with neuroendocrine tumor 45-50 Gy. Patient with malignant teratoma received 45 Gy.

### Post operative chemo therapy

Invasive thymomas were treated with Cisplatin based chemotherapy, initially with cisplatin or carboplatin and etoposide and recently 4 drug combination (adrimicin, cisplatin, etoposide and vincristine) are used. For malignant seminomatous germ cell tumors bleomycin, etoposide and cisplatin combination is used and for nonseminomatous germ cell tumors only etoposide and cisplatin are used. The same drugs are given as neoadjuvant chemotherapy also.

### Follow Up

Out of the 91 patients 7 were lost to follow up. There were 3 deaths during follow up (2.7%). One died intra operatively and two with malignant thymoma succumbed to the malignancy 4 months and 10 months post operatively respectively.

### Limitations of study

- 1) It is a retrospective study.
- 2) Only the operated patients are included. Patients who were diagnosed by nonsurgical methods and treated by nonsurgical methods are not included.
- 3) Not all patients diagnosed to have mediastinal tumors were operated upon because of the non compliance of certain patients. These patients were not included in the study.
- 4) Inoperable tumors are not included in the study.
- 5) Seven patients were lost to follow up 6) Esophageal, cardiac and vascular tumors were not included.
- 7) VATS has not been employed.

### CONCLUSION

- 14.5% of thoracic admissions are mediastinal tumor patients.
- Males are more commonly affected by primary mediastinal tumors.
- Anterior mediastinal compartment is more often involved with higher malignancy rate.
- Thymic tumors are the commonest primary mediastinal tumors.
- Myasthenics with thymoma present earlier as compared to non-myasthenics.
- Thymoma with or without myasthenia was more common in males.
- Most common symptom at presentation was chest pain followed by dyspnoea and then cough. Very few patients were asymptomatic.
- Most of the invasive thymomas can be identified intraoperatively by presence of adhesions but few stage I thymomas may also present with adhesions due to inflammatory processes. Confirmed by histopathology.
- CT scan is the most important investigation for diagnosis of mediastinal tumors.
- Most of the neurogenic tumors were benign, most common being nerve sheath tumor
- Most common mediastinal cyst is bronchogenic cyst.
- Tissue diagnosis need to be obtained in suspected malignant tumors by CT/USG guided biopsy, mediastinoscopy, mediastinotomy or VATS, as management changes.
- Surgery is mainstay of treatment in all benign lesions.
- Most common approach to mediastinal tumors is midline sternotomy, other being thoracotomy.
- In some inoperable tumors, down staging may be possible with neoadjuvant chemoradiation rendering them operable.
- Immediate post operative complications were minimal.
- Early and late results were good with low mortality and recurrences.
- Long-term follow up of post operative patient is mandatory to rule out recurrences.

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