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A retrospective observational study over surgical management of giant thoracic tumours: horrendous but manageable

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Abstract

Background Giant thoracic tumour (GTT) does not have a clear definition, but, as per usual terminology, they are thoracic masses whose long axis is > 10 cm or covering more than 50% of the hemithorax. The mediastinum is a unique space in the thoracic cavity that can have a wide range of masses of different cellular origins imposing both diagnostic and therapeutic challenges. This retrospective observational study aims to evaluate the surgical treatment outcomes of giant intrathoracic tumours and final histopathological diagnosis with evidence for manageability. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines has been followed for reporting this observational study.

Results Between January 2018 and December 2022, the medical data of a total of 11 patients (06 males, 05 females; age range, 05 to 52 years) who underwent radical surgery for GTT in our centre were retrospectively reviewed in this observational study. We evaluated presenting symptoms, radiological findings, presumptive pathological diagnosis, and surgically excised mass gross and histopathological examination. Six (54.5%) of our patients were male, and five (45.5%) were female. The age range was between 05 and 52 years. The tumour localisations of our patients were five (45.5%) hemithorax and six (54.5%) mediastinal. The largest excised mass was 26 × 24 × 12 cm, and the heaviest mass was 3600 g. All patients underwent conventional open surgery. The overall survival was 100%, with no immediate postoperative mortality, indicating an excellent prognosis despite a dreadful appearance.

Conclusion Due to neighbouring vascular structures, the surgical resection of manoeuvres in this crucial cavity with the excision of giant masses may be difficult and tricky. Preoperative diagnostic investigations and planning play a significant role in accurately localising the mass and the invasion possibility of adjacent vital structures. The results of this study may provide scientific evidence to guide the treatment of giant thoracic tumours in clinical practice.

Keywords Mediastinum, Giant thoracic tumour, Thymoma, Pleural tumour, Thoracic surgery

Background

The thorax cradles a wide range of masses of different cellular origins, inflicting diagnostic and therapeutic challenges. The GTT is the term usually designated for a mass involving the whole hemithorax or unequivocally for a size of 10 cm or more [1]. These huge masses comprise only 02% of thoracic tumours and are usually initially asymptomatic [2]. However, a quandary arises in cases of large tumours, which compress, obstruct or invade the essential surrounding structures. Nevertheless, the complex anatomy of the thorax and sometimes

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the fatal symptoms of respiratory and hemodynamic decompensation in these large tumours is a predicament for surgeons and anaesthetists [3, 4]. Therefore, thorough preoperative radiologic assessment, evaluation of its relation to the surrounding vital structures, prediction of intraoperative complications and planning neoadjuvant chemotherapy or debulking alternatives may help to enhance the patient outcome and prevent morbidity and possible mortality with these horrible-looking masses. With this retrospective observational case series, we try to correlate our clinical experience with other available literature to shed better information for successfully managing these giant intrathoracic tumours.

Methods

Thorough scrutiny of the medical records of 1250 patients, who underwent surgical operation between January 2018 and December 2022 at the Department of Cardio-thoracic Surgery in our institute, a regional tertiary care centre case, was performed. Ethical Approval of this study was taken from our Institutional ethical committee (Approval number: AIIMS/IEC/23/158/30th April 2023). In our institute, a multidisciplinary tumour board consisting of specialists from all oncology and diagnostic branches take the decision for surgery, neo/adjuvant chemotherapy and/or radiotherapy treatment after thorough discussion. This multidisciplinary board's joint discussion and treatment resolution had paramount importance and was greatly beneficial for best management. The cases which undergone thoracic surgery after consultation and decided by Multidisciplinary tumour board despite being huge in size are included in this observational series. All patients underwent transthoracic needle aspiration and histopathology examination to make a presumptive diagnosis and exclude pathologies requiring medical treatment as per standard guidelines. All these patients with thoracic masses were already screened through preoperative chest radiographs, contrast-enhanced computed tomography (CECT) scans and transthoracic 2-D echocardiography (TTE). In four cases, magnetic resonance imaging (MRI) was also performed to complete localisation and to find exact invasiveness. Due to these diagnostic tests, the exact relationship of the mass with the surrounding tissues with invasion in neighbouring structures was determined preoperatively. We found 11 GTT cases operated in this duration of 5 years. Henceforth, these cases are included in this retrospective observational study. Before the operation, in all these cases, the surgeon, anaesthetist and full team decided on invasive line requirements, positioning and surgical approach with possible complications beforehand to avoid any intraoperative mishaps. For all these cases, a standby cardiopulmonary bypass machine with femoral arteriovenous cannulation readiness, a cell saver machine with adequate blood product availability, was assured beforehand.

Results

A total of 11 patients [six (54.5%) male, and five (45.5%) female] were included in this observational study. The age group in this cohort was between 05 and 52 years. The youngest patient was in the early childhood age group (05 years). The patient's symptoms included atypical chest pain, cough, dyspnoea, and severe respiratory distress. Five tumours (45.5%) were localised in the hemithorax and six (54.5%) were localised in the mediastinum. Transthoracic computerised tomography (CT) or ultrasonography-guided biopsy was performed in all eleven patients. In none of the cases, positron emission tomography was done due to localised disease on primary diagnostic investigations. In all cases, general anaesthesia with standard invasive monitoring methods was used. Thoracotomy was conducted in four (36.4%) patients, median sternotomy in six (54.5%) patients and clamshell incision was done for one patient (9.1%). The heaviest excised mass was 3600 g (between 650 and 3600 g). Final histopathologic diagnoses were determined to be three (27.3%) thymomas, two (18.2%) solitary fibrous pleural tumours (SFTP), two (18.2%) germ cell tumours, two (18.2%) neurofibroma, one (9.1%) thymolipoma, and one (9.1%) pleuro-pulmonary blastoma type-II. In all these cases, preoperative and postoperative pathological diagnosis had a very good correlation. The result of this study is summarised in Table 1 (images of respective cases—Figs. 1, 2, 3, 4, and 5) and Table 2.

Blood transfusion was performed in five (45.5%) of these patients due to postoperative decline in the haemoglobin (Hb) level below 08 g/dL. Superficial skin wound infection was found in one postoperative patient as a minor complication. There was no immediate and 30 days mortality in this cohort group but, in one case (9.1%) of pleuropulmonary blastoma, type-II local recurrence occurred 3 months and this case was sent for chemotherapy. Another case had developed stroke unrelated to primary pathology. Compilation of preoperative and postoperative diagnosis and detailed follow-up of these cases are summarised in Table 2.

Discussion

A giant thoracic mass is an uncommon entity. In a study by Shi X et al., the presentation of these huge masses was bimodal, with peaks at 25–30 and 45–55 years and a median age of diagnosis at 40 years, with slight male predominance [1]. However, in another study by Sunam et al., the mean age was 33 years, with female predominance [2]. This discrepancy is mainly attributed to the

Table 1 Clinical, investigation and diagnostic data of cases

S. No	Age/sex (years)	Preoperative symptoms	Primary location	CECT Scan –Thorax finding with mass dimensions	Additional investigation	Surgical incision/ route	Resected specimen size/weight/en bloc piecemeal	Final histopathological diagnosis
	F/12	Atypical chest pain, dyspnoea	Mediastinum	Heterogeneous enhancing Mediastinal mass of size 21 × 12 × 8 cm encasing heart with a patchy area of fat attenuation (Fig. 1A and B)	MRI, TTE	**MS**	Encapsulated, lobulated mass of size 20 × 10 × 13 cm, 1660 g, en bloc (Fig. 1C and D)	Thymolipoma
	F/51	Severe respiratory distress with respiratory failure—emergency Intubation	Right hemithorax	Homogenous enhancing mass in right thoracic cavity of size 28 × 25 × 13 cm with complete collapse of right lung and severe compression of left lung, heart and gross mediastinal shift towards left side (Fig. 2A)	TTE	PLT	Encapsulated mass size 26 × 24 × 12 cm, 3600 g, en bloc (Fig. 2B–D)	SFTP
	F/39	Atypical chest pain, dyspnoea	Left Hemithorax	Homogenous enhancing mass in upper part of left thoracic cavity occupying nearly 2/3 of left hemithorax in the posterior mediastinum, approximate size 20 × 18 cm with partial collapse of the left lung. (Fig. 3A and B)	MRI, TTE	PLT	Encapsulated mass size 20 × 16 cm, 1100 g/en bloc (Fig. 3C)	Neurofibroma
	F/26	Atypical chest pain, dry cough	Mediastinum	Heterogeneous enhancing, solid cystic prevascular space mediastinal mass of size 16 × 14 × 9 cm with areas of fat and calcification attenuation with the collapse of the upper and middle lobes of the right lung	TTE	**MS**	Encapsulated, bosselated mass size 15 × 14 × 9 cm, 1250 g, areas of bone, hair, cartilage teeth/en bloc	GCT

Table 1 (continued)

S. No	Age/sex (years)	Preoperative symptoms	Primary location	CECT Scan –Thorax finding with mass dimensions	Additional investigation	Surgical incision/ route	Resected specimen size/weight/en bloc piecemeal	Final histopathological diagnosis
	M/23	Atypical chest pain	Mediastinum	Heterogeneous enhancing, solid cystic anterior mediastinal mass of size 14×12×10 cm with areas of fat and calcification attenuation. with the collapse of the lower and middle lobes of the right lung (Fig. 4A)	TTE	**MS**	Partially encapsulated bosselated mass, size 14×13×9 cm, 1300 g, areas of bone, hair, cartilage teeth present/ en bloc (Fig. 4B)	GCT (mature cystic teratoma)
	M/42	Dyspnoea	Mediastinum	Homogenous enhancing, solid anterior mediastinal mass of size 14×12×10 cm with skip areas of fat attenuation with the collapse of the upper lobe of the right lung	TTE	**MS**	Encapsulated mass size 14×12×10 cm, 1000 g/ en bloc	Thymoma
	M/35	Atypical chest pain, dyspnoea	Mediastinum	Homogenous enhancing, solid anterior mediastinal mass of size 18×15×12 cm with the collapse of the upper lobe of the right lung	TTE	**MS**	Encapsulated mass size 20×16×12 cm, 1650 g/ en bloc	Thymoma
	M/34	Pain in the back region, dry cough	Right hemithorax	Homogenous enhancing mass in the upper part of right thoracic cavity occupying nearly 2/3 of right hemithorax in the posterior mediastinum, approximate size 20×18×10 cm with partial collapse of right lung	MRI, TTE	PLT	Encapsulated mass size 19×15×12 cm, 1400 g/ en bloc	Neurofibroma

Table 1 (continued)

S. No	Age/sex (years)	Preoperative symptoms	Primary location	CECT Scan –Thorax finding with mass dimensions	Additional investigation	Surgical incision/ route	Resected specimen size/weight/en bloc piecemeal	Final histopathological diagnosis
	M/52	Myasthenia gravis, dysphagia, dyspnoea	Mediastinum	Homogenous enhancing, solid anterior mediastinal mass of size 15 × 12 × 10 cm with skip areas of fat attenuation	MRI, TTE	**MS**	Encapsulated mass size 15 × 12 × 10 cm, 1200 g/ en bloc	Thymoma
	M/5	Severe respiratory distress with urgent intubation while undergoing investigations	Right hemithorax	Heterogeneous enhancing solid cystic mass in the right thoracic cavity of size 18 × 20 × 10 cm with a complete collapse of the right lung with severe compression of the left lung, heart and gross mediastinal shift towards left side. (Fig. 5A–C)	CECT scan of brain and abdomen for Metastasis, TTE	***Clam shell incision*** (Fig. 5D)	Excised in piecemeal/largest solid mass component of 19 × 16 × 12 cm/650 g (Fig. 5E)	Pleuro-pulmoblastoma-type II
	F/35	Atypical chest pain, cough	Left hemithorax	Homogenous enhancing mass in left thoracic cavity of size 13 × 12 × 9 cm with partial collapse of left lung and compression of left lower lobe of the lung	TTE	PLT	Encapsulated mass size 12 × 11 × 9 cm, 950 g/ en bloc	SFTP

Abbreviations used in the above table: *M* male, *F* female, *CECT* contrast-enhanced computerized tomography, *MRI* magnetic resonance imaging, *TTE* trans-thoracic echocardiography, *MS* midline sternotomy, *PLT* posterolateral thoracotomy, *GCT* germ cell tumour, *SFTP* solitary fibrous pleural tumour

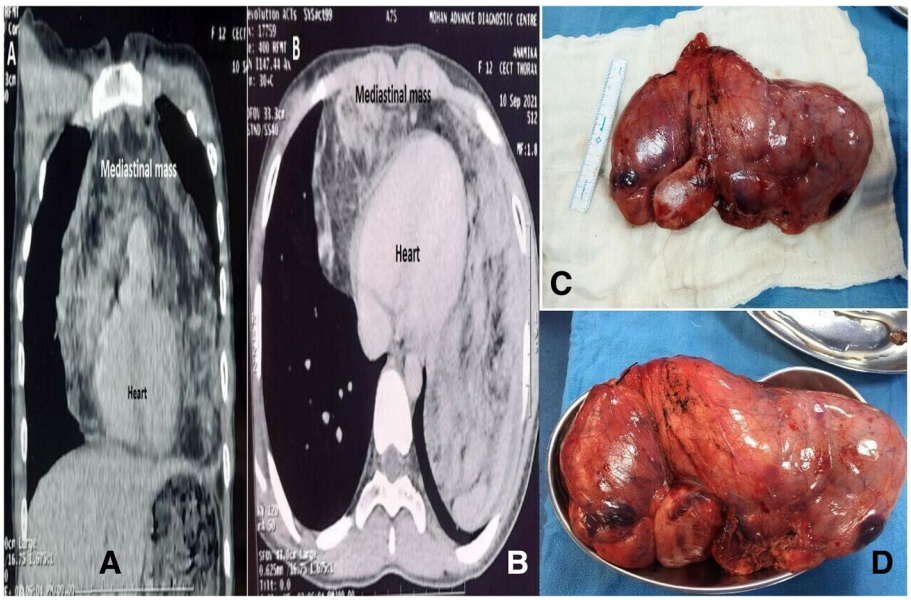

Fig. 1 **A** and **B** CECT scan images of case no. 1, showing a heterogeneous mediastinal mass encompassing the heart with a patchy area of fat attenuation and without cardiac invasion. **C** and **D** Excised encapsulated lobulated mass of thymolipoma

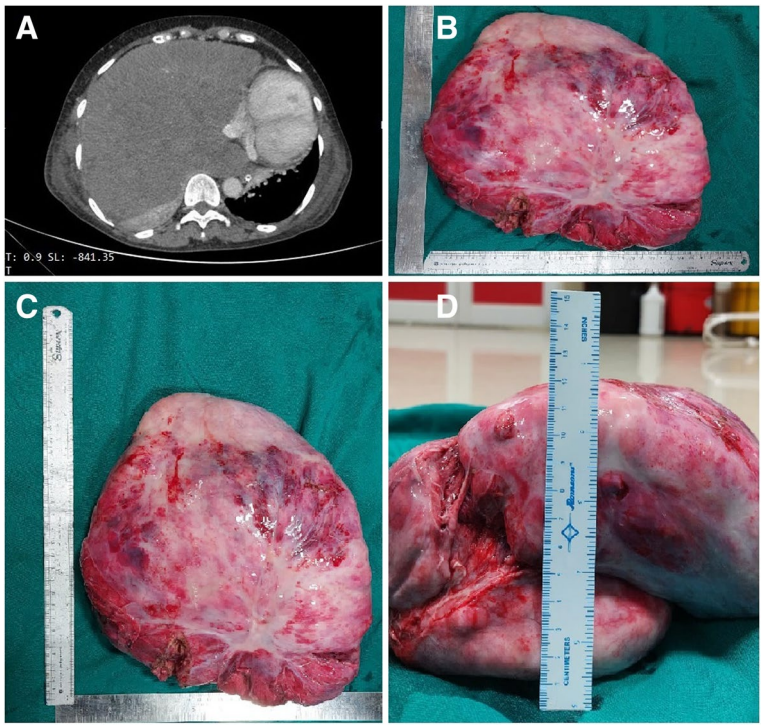

Fig. 2 **A** CECT scan image of case no. 2, showing a homogenous enhancing mass in the right thoracic cavity with a complete collapse of the right lung and severe compression of the left lung, heart and gross mediastinal shift towards the left side. **B**–**D** Excised encapsulated mass size 26 × 24 × 12 cm of solitary fibrous pleural tumour

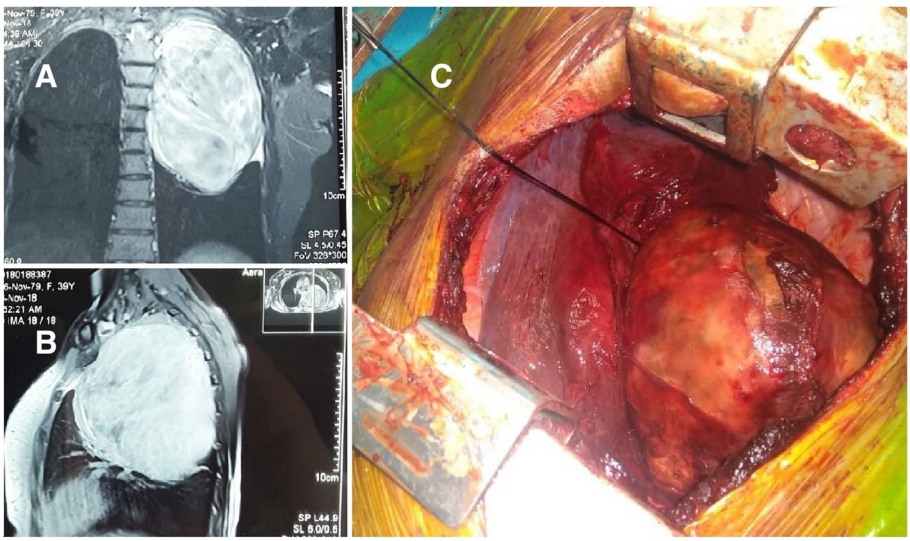

Fig. 3 **A** and **B** CECT scan images of case no. 3, showing a homogenous enhancing mass in the upper part of the left thoracic cavity occupying nearly 2/3 of the left hemithorax in the posterior mediastinal region, with partial collapse of the left lung. **C** Intraoperative image of an encapsulated mass of neurofibroma in posterior mediastinum and the left thoracic cavity

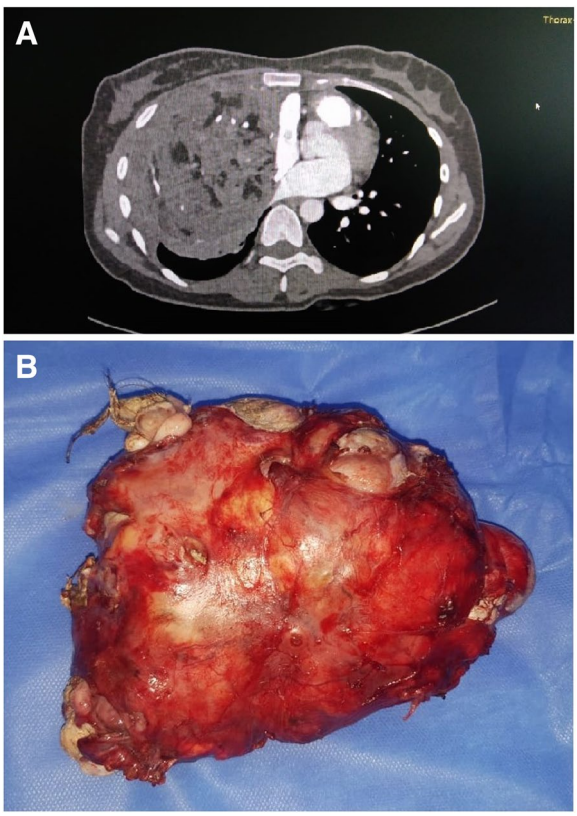

Fig. 4 **A** CECT scan image of case no. 5, showing a heterogeneous enhancing solid cystic anterior mediastinal mass of size with areas of fat and calcification attenuation. **B** Excised partially encapsulated bosselated mass of germ cell tumour (mature cystic teratoma), with hair and cartilage protruding through it

fact that most of these results are explicated from various individual case report studies based on the predominant histological type found in that particular series [5–7].

The thorax contains two pleural cavities with the mediastinum in between. Anatomically the mediastinum is arbitrarily divided into different compartments. The lack of definitive planes between them makes the mediastinal mass ubiquitous in the thoracic cavity. However, they may arise non-specifically from more than one compartment, and diagnosis of these masses can be determined from their compartment of origin. However, with the increase in size, determining their site of origin becomes difficult. One of the discriminator features might be the localisation of the tumour [8].

It is believed that up to 33% of these masses are asymptomatic at presentation, and as the size increases gradually, the symptoms become more pronounced. However, this incidence of symptomatology also varies in different series. Some studies suggest that almost half of the patients are asymptomatic. This symptomatology is more convincing in favour of benign nature as these sizeable masses usually present only with compression symptoms. The most common symptom reported was atypical chest pain in our case series. This was followed by dyspnoea and cough. The patients may present with nonspecific symptoms such as dysphagia, neurogenic symptoms such as myasthenia and arrhythmia, or deadly symptoms such as respiratory failure [9–11]. These symptoms are due to compression of vital structures such as the central airways, major vessels, oesophagus or spinal cord. These symptoms of respiratory insufficiency, hemodynamic

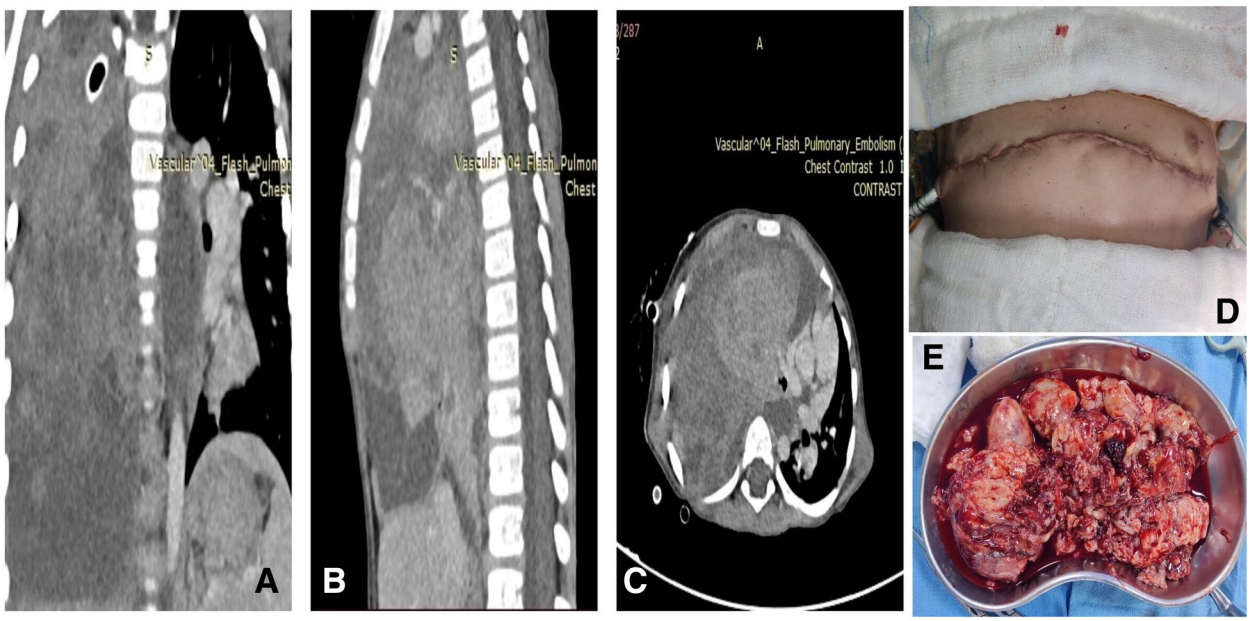

Fig. 5 **A** CECT scan images of case no. 10. **A** Coronal view showing heterogenous cystic solid right-sided tumour mass with gross mediastinal shift. **B** Sagittal view showing right hemithoracic cystic, solid tumour. **C** Axial view showing right hemithoracic cystic, solid tumour, and mediastinal shift with compressed left lung. **D** Clamshell incision with bilateral Intercostal tubes after the operation. **E** Excised piecemeal solid cystic mass of pleuro-pulmonary blastoma type II

decompression or neurological disturbance can be exacerbated with the induction of anaesthesia or a change in position during surgery [12, 13].

Preoperative diagnoses of these thoracic masses are vital to help plan optimum management. CECT is the choice of imaging modality because it provides information concerning the tumour morphology, anatomical location and its relation to the surrounding structures. However, Rendina et al. suggested that CT has weak histological prediction due to variable appearance [14]. The presence of fat attenuation on CT might assist in the diagnosis and makes the differential diagnosis of thymolipoma, lipoma, liposarcoma or teratoma. Teratomas are usually uni or multiloculated, large and well-demarcated masses with variable attenuation due to the presence of different tissues. The finding of a cystic mass with bony tissue or fat-fluid level is highly specific for teratomas. The vascular enhancement pattern is another distinctive feature on CECT. The intense enhancement due to hypervascularity on CECT also helps to diagnose intrathoracic masses. These GTTs might compress and invade neighbouring vital cardio-vascular and respiratory structures. Adjacent lung parenchyma invasion is anticipated by multilobulated mass with at least one acute angle between lobulations. Mediastinal fat tissue invasion is seen as irregular borders. Abutment of > 50% of a mediastinal vascular structure with loss of the fat plane might be a predictor of vessel invasion. However, direct endoluminal invasion of the great vessels is rarely seen in these GTTs. Diaphragmatic elevation, pleural or pericardial effusion, and significant lymph node enlargement of any mediastinal substation might be other co-findings on CECT [15, 16].

For better delineating the tumour boundary and soft tissue differentiation, magnetic resonance imaging (MRI) is a superior modality. It is also better for diagnosing chest wall and spinal cord invasion and is mandatory in suspected neurogenic cases in the posterior mediastinum. Nevertheless, the dynamic nature of the heart and the surrounding structures can confound by motion artefacts in the images produced by CECT or MRI. Electrocardiogram (ECG)-gated cardiac CT or MRI produces high-quality, artefact-free images to evade this problem [17]. For tumour staging and planning treatment strategy, the new modality of fluorodeoxyglucose positron emission tomography (FDG-PET) has a definitive role [18].

In addition, diagnostic endoscopic procedures such as bronchoscopy are necessary for the preoperative evaluation of airway compression. It helps appropriate patient positioning and anticipate "at-risk" intraoperative positional airway compromise. TTE provides complementary information regarding the compression and invasion of the cardiac structure in planned surgery [19]. Due to its noninvasiveness and easy availability, TTE was performed in nearly all of our patients with these giant masses but it was mostly inconclusive, and no pericardial

Table 2 Preoperative, postoperative diagnosis with follow-up details of cases

S. No	Age/sex (years)	Primary location	Pre-operative diagnosis on biopsy	Final histopathological diagnosis after excision	Follow-up duration and complication	Local recurrence	Distant metastasis	Current status
	F/12	Mediastinum	Thymoma	Thymolipoma, Masaoka Staging-I	03 years	No	No	Healthy
	F/51	Right hemithorax	Solitary fibrous pleural tumour	Solitary fibrous pleural tumour	02 years	No	No	Healthy
	F/39	Left hemithorax	Neurofibroma	Benign nerve sheath solitary tumour: Neurofibroma	4.5 years	No	No	Healthy
	F/26	Mediastinum	Germ cell tumour	Non-seminatous germ cell tumour—benign mature teratoma	3.5 years	No	No	Healthy
	M/23	Mediastinum	Germ cell tumour	Non-seminatous germ cell tumour—mature cystic teratoma	03 years	No	No	Healthy
	M/42	Mediastinum	Thymoma	Thymoma, Masaoka Staging-I, WHO Classification-A	03 years	No	No	Healthy
	M/35	Mediastinum	Thymoma	Thymoma, Masaoka Staging-I, WHO Classification-A	02 years	No	No	Healthy
	M/34	Right hemithorax	Neurofibroma	Solitary neurofibroma	1 year	No	No	Healthy
	M/52	Mediastinum	Thymoma	Thymoma Masaoka Staging-IIA WHO Classification-B-1	1.5 years, Developed Stroke after 01 year of surgery	No	No	Living: but having left-sided hemiparesis and now under neurology treatment
	M/5	Right hemithorax	Pleuro-pulmoblastoma	Pleuro-pulmoblastoma- type II	03 months	In right hemithorax 03 months	No	Transferred to Medical Oncology
	F/35	Left hemithorax	Solitary fibrous pleural tumour	Solitary fibrous pleural tumour	09 months	No	No	Healthy

The cases in this table are in the same sequence as mentioned in Table 1

or myocardial invasion was detected in any of our patients. These mediastinal masses have a variable blood supply derived from adjoining blood vessels such as the aorta, internal mammary artery, thyrocervical trunk, and pulmonary vessels. Therefore, it is essential to ascertain the anatomy of the feeding vessels to minimise bleeding complications intraoperatively. This abnormal vascularity is especially true for large masses compressing the vena cava due to collateral formation. In addition, the value of high-resolution CT or MR angiography to assess the tumour vasculature and these investigations may also help to judge the need and plan of preoperative embolisation to reduce intraoperative blood loss [20, 21].

The thoracic tumours comprise various histologies. Therefore, preoperative tissue assessment through fine-needle aspiration (FNA) or core needle biopsy is essential for diagnosis and guiding therapy plans. Multiple approaches, such as ultrasound or CT-guided transthoracic, endobronchial or surgical methods using mediastinoscopy can be used to accurately obtain the tissue. We have used CT-guided transthoracic biopsy methods with immunohistochemistry validation in all our cases with near-accurate results which correlated well with the final diagnosis. Biopsy and histopathology examination have been tremendously beneficial for primary mediastinal tumour diagnosis and lay out final treatment plan strategy especially as in these GTTs [22].

Intrathoracic tumours, specially GTTs may still be a diagnostic challenge even after multiple imaging studies, and a final conclusive diagnosis may be reached only after resection. The histopathological spectrum ranges from

benign to locally aggressive and malignant as per the site of origin [23]. The benign tumours generally present with compression symptoms by pressure on the surrounding tissues or by chance. Therefore, the pathology of these GTTs may be more benign in nature than malignant. The asymptomatic growth of these giant masses may also be explained by the poor invasion ability with no metastasis. It is well known that malignant tumours are more invasive with the early capability to metastasise. Hence, the malignant tumours are accepted to be symptomatic earlier due to invasiveness, compressive symptoms and systemic symptomatology. The literature suggests that the most common histopathologies of these gigantic masses are germ cell tumours (33%), sarcoma (10%), and thymoma (10%). However, other studies provide significant variability in the histopathological analysis of these tumours. Lipoma, thymolipoma, schwannoma, benign solitary fibrous tumours, and Castleman disease are other reported diagnoses in this category [24, 25]. None of our patients had high-grade malignancy, and all had limited invasion at the time of diagnosis, so they had a high chance of complete resectability. Furthermore, the fact that these tumours are generally encapsulated causes them to be less invasive, despite being enormous in size and volume.

Meticulous surgical resection planning with anaesthesia management protocol is essential. Awake fibre-optic intubation, rescue positioning, single lung ventilation, and standby extracorporeal circulation readiness with meticulous fluid management for the prevention of re-expansion pulmonary oedema are major concerns from the anaesthetist's point of view [26]. Mini-invasive techniques are still not favoured and recommended for the resection of GTT despite some isolated case reports and trials due to space problems [27].

The most common surgical procedure for these tumours is open radical surgery via posterolateral thoracotomy or median sternotomy. Median sternotomy is preferred in the case of anterosuperior and middle mediastinal tumours. Postero-lateral thoracotomy is preferred for hemithoracic, unilateral or posterior mediastinal masses. Clamshell or bilateral thoracotomy with a sternotomy approach is chosen in cases of bilateral involvement of the thorax as in one of our cases. A collar incision with median sternotomy is recommended for tumours in the anterosuperior location and involving the neck. For tumours located in the anterior mediastinum and extending to either hemithorax, the hemi-clamshell procedure may be needed. This surgical approach with wide exposure is essential to achieve complete resection. It also helps to avoid injury to surrounding vital organs [28]. It is preferred to excise these masses in encapsulated form. Nevertheless, in cases where a tumour cannot be removed en-bloc or mass lesions without the capsule, piecemeal surgery is another alternative to prevent the intraoperative risk of injury to the vital adjoining structures. For giant cystic tumours, the cyst may be drained before to allow more comfortable surgical mobilisation with adequate exposure. However, for enormous solid mass lesions, the laminated excision method has been reported for assisting mobilisation by debulking the mass after opening the capsule, and excision layer by layer up to peduncle of mass through thermal cautery. However, this is a palliative procedure only [29]. It is crucial to determine the most suitable method for exposure to prevent any vascular injuries. Their presence in the vicinity of major vascular and neural tissues with a narrow operational area may cause surgical manoeuvres to be more complex and need extreme gentleness. Any accidental, iatrogenic damage to the major vessel in this area can make the operation difficult. These accidents not only increase the risk of intraoperative and postoperative mortality and morbidity, but also postoperative complications due to chances of excessive transfusion. In the case of accidental torrential bleeding urgent incision extension to gain rapid bleeding control may be required, and this may also increase the chances of more postoperative pain with respiratory compromise [30].

Our study favoured that GTTs are surgically amenable and could be resected entirely with the necessary preoperative investigation and proper planning. Pre-operative planning by a surgeon, anaesthetist and surgical team for approach, anticipated complications, readiness with all equipment and possible methods to bail out has to be done for the best outcome. Despite being vast and horrendous in size, reported surgical mortality is usually under 1%, with very less morbidity after these operative procedures as in other similar case series [29, 30].

The main limitations of the present study include its retrospective and single-centre design with a small sample size ($n=11$). Therefore, further large-scale, or multicentre, prospective studies are needed to confirm and generalise these findings.

Conclusions

GTTs are usually asymptomatic initially due to slow growth and may be symptomatic later only when compression and invasion occur due to overgrowth of the lesions. Our cases were symptomatic due to late presentation. The surgical route and mode should be cautiously planned before the operation by the whole team to reduce the chances of intraoperative complications of ultimate mortality. Nonetheless, in this era of minimally invasive surgeries, video-assisted thoracoscopic and robotic surgeries have a very limited role in these cases. The large size of the thoracic mass is neither an indicator

of inoperability nor poor prognosis, and complete resection is considered the best management strategy. After adequate preoperative diagnostic workup and for well-chosen cases open, radical thoracic surgery is the current best strategy to relieve symptoms with a good prognosis.

Abbreviations

STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
GTT	Giant thoracic tumour
CECT	Contrast-enhanced computed tomography
MRI	Magnetic resonance imaging
TTE	Transthoracic 2-D echocardiography
CT	Computerised tomography
GCT	Germ cell tumour
SFTP	Solitary fibrous pleural tumour
ECG	Electrocardiogram
FDG-PET	Fluorodeoxyglucose positron emission tomography

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Authors' contributions
AD and ARS initially planned this manuscript concept and design. All the cases were operated by AD with ARS and anaesthesia support from AK. AD, AG, and ARS collected and assemble the data after researching the literature. Data analysis and interpretation were done by AD, BD and ARS. Manuscript writing was done by all authors and jointly edited. All authors have made substantial contributions and contributed equally in the article's preparation. All authors have read, reviewed and approved the manuscript in its current form. The requirements for authorship have been met, and each author believes that the manuscript represents an honest work.

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AK is a Super-Specialist Cardiothoracic anaesthetist and Additional professor at All India Institute of Medical Science (AIIMS) Rishikesh, India.
AG and ARS are postgraduate students at All India Institute of Medical Science (AIIMS) Rishikesh, India, and great support in cardio-thoracic surgery cases.

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Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Permission and approval have been taken from our Institutional ethical committee (AIIMS, Rishikesh, India), and hospital authority (Medical Superintendent, AIIMS, Rishikesh) to scrutiny of medical case sheets of all cases and publication of this manuscript.

Consent for publication
Individual consent forms (signed by the patient or their guardian/relative) for the use of images and investigation figures of all the patients used in this manuscript are available with us. The consent form/s may be produced upon request by the journal/ publisher.

Competing interests
The authors declare that they have no competing interests.

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