AIRWAY MANAGEMENT IN PATIENTS WITH MEDIASTINAL MASSES
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Introduction

Mediastinal masses can compress the major airways, so these patients should be carefully evaluated before subjecting them to anaesthesia.¹ However, even large mediastinal masses can present without any clinical symptoms of airway compression.² These large mediastinal tumours with apparently normal airways preoperatively may develop an obstructed airway after induction of general anaesthesia (GA).² Sometimes, a life threatening airway compression can occur even after an uneventful endotracheal intubation, and performing an emergency tracheostomy to relieve obstruction may prove futile, as the obstruction may be distal to the tube (lower airway obstruction).² In the presence of severe symptoms of cardiorespiratory compression such as, positional dyspnoea, orthopnoea, stridor, syncope, and superior venacava syndrome (SVCS), administration of GA may be fatal.⁴,⁵,⁶ The profound hypoxia may also be due to compression of great vessels in the presence of patent airway.¹,⁷,⁸ In high risk patients with mediastinal mass, irreversible cardiorespiratory collapse can occur with the use of sedative premedication, induction of anaesthesia, with the use of muscle relaxants,² initiation of intermittent positive pressure ventilation (IPPV),⁹ simply by making the patient supine,¹ change of posture,⁷ and tumour resection or manipulation.¹,¹⁰ It is also possible that tracheobronchomalacia i.e., softening of tracheal wall, due to prolonged compression by mediastinal mass, may potentiate the airway collapse, with the onset of relaxation produced by anaesthesia or commonly after tracheal extubation or emergence.²,¹¹ Therefore, airway management in patients with large mediastinal masses with or without the evidence of airway obstruction poses a difficult challenge to the anaesthesiologists. This review presents an overview of mediastinal masses, preoperative evaluation and risk assessment, anaesthetic management, and various measures utilized for airway management in these patients.

Anatomy masses

Boundaries of the mediastinum were proposed by Shields in 1972. It extends superiorly to the thoracic inlet and root of the neck, inferiorly to the diaphragm and bounded laterally by the adjacent mediastinal parietal pleura.¹² It is divided into superior and inferior mediastina by an imaginary plane passing from the sternal angle anteriorly to the lower border of the body of fourth thoracic vertebra posteriorly (fig. 1). Inferior mediastinum is further divided into anterior, middle and posterior mediastina. As the anterior mediastinum is in continuity with superior mediastinum, it is also known as antero-superior mediastinum.¹³ It is a space between the pleural cavities, extending from the thoracic inlet to the diaphragm and from the under surface of sternum to the anterior surface of the pericardium and great vessels.¹⁴ Therefore, it is also known as prevascular compartment. It contains, thymus, trachea, oesophagus, large veins, large arteries, thoracic duct, sympathetic trunk, lymph nodes, ectopic thyroid gland and parathyroid tissues. Therefore, masses occupying this compartment can compress these structures and frequently present with tracheobronchial compression, dysphagia and SVCS. Middle mediastinum is an anatomical compartment between the anterior mediastinum and the anterior border of the vertebral bodies. It is also known as visceral compartment. It consists of heart and pericardium, great vessels, oesophagus, and vagus and phrenic nerves. Masses

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occupying the middle mediastinum may also cause airway obstruction due to compression or deviation of the airway and often produce cardiac tamponade. The posterior mediastinum or paravertebral sulci present posterior to the middle mediastinum. It is a bilateral compartment and projects on either side of the vertebral column. It contains, intercostal nerves, thoracic spinal ganglion and sympathetic chain. Posterior mediastinal masses rarely cause airway problems. They predominantly produce effects on the spinal cord. Thus, the anatomical location of the mass explains some of its typical symptoms due to compression, deviation or invasion of the adjacent mediastinal structures.

**Mediastinal masses**

The natural history of mediastinal masses varies from those that are asymptomatic (benign) to that with aggressive symptoms (invasive neoplasm) resulting in death. The incidence of various mediastinal masses varies in infants, children and adults. In a series of 196 infants and children, it was found that the most common lesions were, lymphomas (45%), neurogenic tumour (34%), and germ cell tumor (11%). Other series have also reported an incidence more or less similar to this. In adults, neurogenic tumours (neurilemmoma and neurofibroma) have been reported to be the most common mediastinal masses. These occur in posterior mediastinum and therefore do not cause airway obstruction. The incidence of malignancy varies with age with the lesions more likely to be benign in the first decade of life (73%) and malignant from 2nd to 4th decade. The classification of the common mediastinal masses by location is shown in table 1.

<table>
<thead>
<tr>
<th>Anterior mediastinum</th>
<th>Middle mediastinum</th>
<th>Posterior mediastinum</th>
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<tbody>
<tr>
<td>Thymoma</td>
<td>Foregut cyst</td>
<td>Neurolemmoma</td>
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<tr>
<td>Lymphoma</td>
<td>duplication</td>
<td>Neurofibroma</td>
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<td>Germ cell tumour</td>
<td>Lymphoma</td>
<td>Malignant</td>
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<td>Other mesenchymal</td>
<td>Pleuropericardial</td>
<td>Schawannoma</td>
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<td>tumour</td>
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<td>Thymic cysts</td>
<td>Granulomatous</td>
<td>Ganglio-neuroma</td>
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<td>Endocrine tumour</td>
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Patients with benign tumours are more often asymptomatic (54%) than patients with malignant tumours (15%). Lesions in the anterio-superior mediastinum frequently produce symptoms (75%) related to the compression or invasion of the airway and generally present with cough, stridor, and dyspnoea. Symptoms of Homer’s syndrome (ptosis, miosis, anhydrosis, apparent enophthalmos, absence of pupillary dilatation on shading the eye and abolition of ciliospinal reflex), hoarseness and severe pain are often indications of malignant pathology. The commonly encountered mediastinal masses by the anaesthesiologist are the lesions located in the anterio-superior mediastinum. These are lymphomas (Hodgkin’s and non-Hodgkin’s), teratomas, lymphoblastic leukemias or benign lesions like cystic hygroma, bronchogenic cyst, etc.

**Preoperative evaluation and risk assessment**

It includes clinical presentation, radiological examination, pulmonary function studies, awake fibreoptic bronchoscopy and echocardiography.

**Clinical presentation**

Presenting features in a patient with mediastinal mass depend upon the pressure effects on the surrounding structures. Amongst the structures that can be compressed, compression of the airway viz., trachea, main bronchi is of primary concern to the anaesthesiologist. Therefore, while evaluating a patient with mediastinal mass, he should always try to know the symptoms related to the airway obstruction. These could be cough, stridor, dyspnoea, orthopnoea, postural dyspnoea, or cyanosis. Sometimes, the symptoms may be very subtle, especially the ones related to the postural changes may be ignored by the patient. The anaesthesiologist should therefore, talk to the relatives in detail to explore all the relevant symptoms in a given patient. The presence of even the subtle symptoms should warn him of the possibility of airway compression. Sometimes, compression of the heart and its big vessels may lead to cyanosis, syncope, and dysrhythmias. In extreme cases, SVCs characterized by engorgement of the veins of the neck, right upper arm, chest wall and oedema of neck, head and upper arm and mental obtundation may be present. These pressure effects by the anterior mediastinal mass on airway, heart and its big vessels are described as “superior mediastinal syndrome” and identify these patients at higher risk. Therefore, these signs and symptoms of airway and cardiovascular compression are predictors of anaesthetic problems and are considered as clear warning to avoid surgery other than lymph node biopsy under local anaesthesia (LA). It has been advised to establish the diagnosis from alternate sources (thoracocentesis) to avoid complications in these symptomatic patients.

**Radiological evaluation**

Detailed radiological examination by way of chest X-ray, computed tomography (CT) scan and magnetic resonance imaging (MRI) scan is generally
available in most of these patients. However, these are normally performed with the objective of evaluation of the tumour and not the airway. While the airway is clearly visible in CT and MRI scans, it may not be so in the plain chest X-ray. The anaesthesiologist should evaluate the airway and if in doubt, a penetrated view (60-70 KB) of the neck (antero-posterior and lateral view) should be obtained, which clearly delineates the airway (fig. 2). Since, airway obstruction can be present in asymptomatic patients, this should be done even in the presence of a slightest doubt.

CT and MR scans of the chest provide more accurate information about the relation of mediastinal mass and its effects on the tracheobronchial tree by compression or invasion. CT scan quantifies the degree of airway compression, which is not always obvious on the plain X-ray of the chest (fig. 4). It is especially useful for the evaluation of lower airway (main bronchi). The measurement of the diameter, cross-sectional area, mediastinal thoracic ratio (MTR) and mediastinal mass ratio (MMR) can be used to identify patients at risk.

Postero-anterior and lateral views of the chest X-ray provide important information about the location of the mass and its relation to the tracheobronchial tree, compression and deviation of the airway and lung collapse. It also helps in confirming the density of the mass (cystic, solid or calcified). In 55% of patients with Hodgkin’s lymphoma involving the mediastinum, tracheobronchial compression can be detected by plain radiograph of the chest. Airway compression can be very clearly appreciated in some patients (fig. 3) and therefore, forms an important investigation.

Tracheal diameter: The degree of tracheobronchial compression confirmed on CT scan predicts airway difficulty under GA. A 35% decrease in the diameter of tracheobronchial lumen is associated with respiratory symptoms, while a greater than 50% decrease may be associated with complete airway obstruction during induction or emergence from GA. King et al have also reported a higher risk for developing respiratory complications with the use of GA in patients with anterior mediastinal mass with more than 50% compression of the trachea. However, they have reported that degree of tracheal compression on CT scan cannot be regarded as a good predictor of respiratory complications, as 8% patients with more than 50% diameter also had respiratory complications under GA.

Tracheal cross-sectional area: It can be used to predict airway obstruction. Griscom and Wohl have measured tracheal cross sectional area in 130 normal children and described a formula to calculate the tracheal area, tracheal area = age in years / 9, plus 0.35 cm² for boys and girls up to the age of 14 years. The tracheal area, relative to the predicted tracheal area can be calculated as % tracheal area = measured area / predicted area x 100. They have reported that patients with less than 50% of the predicted area have higher risk of respiratory
complications and recommended that these patients should not receive GA. Shamberger et al.\(^3\) have measured the tracheal cross-sectional area in 42 patients with anterior mediastinal masses. They reported orthopnoea in only two patients and each had a tracheal cross sectional area of less than 40%. They have also suggested that a less than 50% of the normal predicted tracheal cross sectional area is associated with significant anaesthetic complications and demonstrated a reduction in airway complications by avoiding the use of general endotracheal anaesthesia in patients with greater than 50% tracheal narrowing. It has been recommended that patients with 50% or more reduction of tracheal cross sectional area should have their femoral vessels cannulated under LA, prior to induction of GA in readiness for cardiopulmonary bypass (CPB).\(^2\),\(^5\),\(^6\),\(^3\)

Mediastinal thoracic ratio (MTR) and mediastinal mass ratio (MMR)\(^2\) : MTR is calculated by comparing the size of the mediastinal mass with the thoracic diameter. A patient with a MTR of more than 50% has higher risk of perioperative respiratory complications.\(^3\),\(^1\)\(^2\) King et al.\(^2\) have described the “Mediastinal mass ratio” (MMR) as a maximum width of the mediastinal mass relative to the maximum width of the mediastinum, measured by the CT scan. They have described mediastinal masses as small, if MMR is less than 30%, medium if MMR is equal to 31% to 41%, and large, if MMR of more than 45%. Further, they observed that children with small masses have no risk of anaesthetic complications, whereas patients with MMR of more than 56% are associated with respiratory complications. However, they do not regard MMR as a true predictor of respiratory complications as 3 patients with MMR of more than 56%, underwent anaesthesia without difficulty.\(^2\)

Pulmonary function study

These are quantitative and should be performed in upright and supine position. These provide more objective data in identifying the high risk patients.

Peak expiratory flow rate (PEFR)\(^2\) : It reflects central airway diameter. A less than 50% of the predicted PEFR in supine position has been associated with significant anaesthetic complications.\(^3\),\(^5\),\(^10\) Shamberger et al.\(^3\) have plotted PEFR (% of the predicted) versus tracheal area (% of the predicted) in 31 patients with anterior mediastinal mass undergoing preoperative evaluation and developed a “Shamberger risk assessment box” to select the appropriate anaesthetic technique in these patients. The box is divided into 4 sections (A, B, C, and D). Patients in sections “A” (tracheal area less than 50% and PEFR more than 50% of the predicted values) and “D” (tracheal area more than 50%, and PEFR less than 50% of the predicted values) have moderate risk and therefore should receive LA, if possible. If GA is necessary, it is safe to use spontaneous inhalational anaesthesia and avoid the use of muscle relaxants. Whereas, patients in section “B” (tracheal area as well as PEFR more than 50% of the predicted) have “low risk” and can receive GA without any complications. But, patients in section “C” (tracheal area and PEFR, both less than 50% of the predicted) have “high risk” and should receive LA only.

Flow volume loop - It graphically relates the instantaneous airflow rate to the lung volume. It helps to differentiate between the extrathoracic and the intrathoracic airway obstruction.\(^3\) It is a dynamic, minimally invasive, and most sensitive test,\(^3\) to reveal airway obstruction.\(^3\) Therefore, in some patients with a normal CT scan study, it may reveal a significant reduction in peak flow rates.\(^3\),\(^4\)

The patients with intrathoracic airway obstruction will present with reduced expiratory flow rate, demonstrated by appearance of expiratory flow truncation (expiratory limb plateau), (Fig-5) whereas, those with extrathoracic airway obstruction have diminished flow in the inspiratory phase (inspiratory plateau).\(^4\),\(^5\) Patients with anterior mediastinal masses causing airway obstruction demonstrated by severe expiratory plateau in supine position can develop significant airway obstruction under GA. Therefore, GA should be avoided in these patients and biopsy should be performed under LA, whenever possible or he should undergo pretreatment e.g. radiotherapy or chemotherapy, before biopsy is performed.\(^10\),\(^3\)

Flow volume loop showing reduced vital capacity and expiratory flow rate. Note the expiratory limb plateauing (arrow) indicative of an intrathoracic airway obstruction.

Awake fibreoptic bronchoscopy

It should be performed in symptomatic older children or adult patients with anterior mediastinal masses to assess the degree of obstruction due to extrinsic compression or invasion by the mass. It has important advantages,\(^7\),\(^9\),\(^11\),\(^3\) such as, it allows direct visual assessment of the obstruction
and of the proximal and distal airways, and anaesthesia can be safely induced by passing a bronchoscope jacketed with an armoured endotracheal tube through the obstructed portion of the airway and thus having control of distal portion.

**Echocardiography**

In addition to the tracheobronchial compression, the patient with anterior mediastinal mass can have cardiac tamponade and SVCS. Tumour enveloping the heart and infiltrating the pericardium can develop refractory cardiovascular collapse under the effects of GA. Therefore, preoperative cardiac assessment by ECG and echocardiography is recommended in the symptomatic patients and femoro-femoral CPB should be available before induction of GA in these patients.

**Anaesthetic management**

The incidence of complications related to airway obstruction with the use of GA in patients with mediastinal masses has been reported to be 7% to 18%. Patients with large mediastinal masses present unique problems to the anaesthesiologist. There are numerous reports of sudden refractory cardio-respiratory collapse on induction of GA in symptomatic as well as asymptomatic patients. The patients present to the anaesthesiologist for performing the biopsy or definitive resection via sternotomy or thoracotomy. The anaesthesiologist should always be prepared to deal with an emergency even in patients who have no symptoms or evidence of airway obstruction. GA exacerbates extrinsic airway compression by various mechanisms; 1) By reducing functional residual capacity (FRC), as the lung volume is reduced by about 500 ml – 1500 ml under GA due to increased abdominal muscle tone and decreased inspiratory muscle tone. 2) Loss of spontaneous diaphragmatic movement under GA with the use of muscle relaxants eliminates the normal transpleural pressure gradient as compared with the spontaneous inhalational anaesthesia. 3) Relaxation of the tracheobronchial smooth muscles enhances extrinsic compressibility of the airways, 4) The supine position causes an increase in central blood volume, which may increase tumour blood volume and its size. A rapid tumour enlargement is also reported due to haemorrhage or congestion within the tumour, and with the change of its position under anaesthesia, exacerbates the airway compression.

The spontaneous ventilation preserves diaphragmatic movements in a caudal direction so that a normal transpleural pressure gradient is maintained. This keeps the airway dilated and thus minimizes the airway collapsibility from the extrinsic compression by the mediastinal mass. Therefore, the anaesthesiologist must work out an appropriate anaesthetic plan that will avoid the airway obstruction and if it does occur, he should be ready with an alternative that will quickly establish the airway patency or restore the oxygenation. Often, such a plan is prepared in consultation with the surgeon. Preserving the spontaneous ventilation during induction of anaesthesia appears to be an important component of such a plan. A schematic plan in dealing with such patients is shown in fig. 6.

**Fig. 6** Showing simplified algorithm for anaesthetic management in a patient with mediastinal mass causing airway obstruction. (CT: computed tomography, MRI: magnetic resonance imaging, IV: intravenous, LA: local anaesthesia, CPB: cardiopulmonary bypass)

Sedative premedication should be avoided in the symptomatic patients. Opioids and benzodiazepines delay the awakening and are dose dependent respiratory depressants. Benzodiazepines also have muscle relaxation properties and therefore, exacerbate airway compression by increasing the tracheobronchial collapsibility by the large mediastinal masses. Intramuscular atropine or glycopyrrolate are used as antisialagogue agents. The optimal anaesthetic management of a patient with anterior mediastinal mass is guided by the presence of symptoms of airway obstruction, reduction in tracheobronchial lumen assessed on CT scan, reduction in the flow rates determined by expiratory plateau
of the flow volume study in supine position and the nature of surgical procedure to be performed.

**Anaesthesia for biopsy**

Tissue biopsy should be performed under LA or regional anaesthesia in a symptomatic patient with large mediastinal mass with definite evidence of airway obstruction. Application of EMLA (eutetic mixture of local anaesthetics) cream locally, improves the cooperation in a very young symptomatic child for obtaining superficial lymph node biopsy. Lymph node / tissue biopsy can be performed safely with the use of ketamine sedation or anaesthesia (0.5–1 mg kg⁻¹, i.v.). Usually antisialogogue agents are used before administration of ketamine to decrease the salivation. Spontaneous ventilation under ketamine anaesthesia preserves its sympathomimetic properties help in maintaining the haemodynamics in these patients. Tissue biopsy can also be performed under general inhalational anaesthesia, in high risk patients with severe airway compression, when the procedure cannot be performed under LA.

**Anaesthesia for definitive surgery**

The optimal anaesthetic plan for definitive surgery via sternotomy or thoracotomy should be decided on the evidence of airway obstruction, based on symptoms, reduction in tracheobronchial lumen revealed on CT scan examination, severity of expiratory plateau shown on supine flow volume loop study and abnormal echocardiography. If there is no evidence of airway obstruction, inhalational induction with a volatile anaesthetic agent such as, sevoflurane / halothane or titrating dose of IV propofol or ketamine is preferred. After documentation of the airway patency by bag and mask ventilation, a short acting muscle relaxant (suxamethonium) can be used to facilitate endotracheal intubation. If IPPV can be achieved without any problems, a long acting muscle relaxant can be administered, till the procedure is completed. But, always be ready to deal with any eventuality because, use of muscle relaxants and positive pressure ventilation may result in catastrophic airway obstruction, as the increased gas flow across the stenosis decreases intraluminal pressure leading to further tendency to collapse.

If the patient has evidence of airway obstruction, a more careful approach is required. If the obstruction is severe as evidenced by stridor, orthopnoea, supine dyspnoea, tracheal cross sectional area less than 50% of the predicted, PEFR less than 50% of the predicted and supine flow volume loop study shows severe expiratory plateau, the anaesthesiologists have utilized various methods to deal with the obstructed airway. In all such patients, fibrooptic bronchoscope, rigid bronchoscope, emergency tracheostomy sets, double lumen tubes etc. should be readily available. In addition, the surgeon should be ready to intervene, if the need be.

Preoperatively, radiotherapy and chemotherapy have been used in a sensitive group of patients (e.g. lymphoblastic lymphomas) to reduce the tumour size and its encroachment on the airways, prior to their receiving GA in an attempt to decrease the risk of airway obstruction. Even a single dose can shrink many tumours markedly and prevent airway obstruction. Tempe et al have described cystic aspiration, as a technique to relieve lower airway obstruction in a patient with large cystic anterior mediastinal mass causing severe airway obstruction and SVSC. An inhalational anaesthetic technique was used for cystic aspiration and definitive surgery was performed 2 days later under GA with the use of muscle relaxants and IPPV. One basic precaution that should be practiced in such patients is to induce anaesthesia in the position in which symptoms of airway compression are not present, e.g. right lateral position in a tumour that is pressing the left main bronchus.

Awake fibreoptic intubation can be performed under topical, surface anaesthesia to advance the tip of the endotracheal tube in the non compressed area before induction of anaesthesia. If awake intubation is not possible, anaesthetic induction and endotracheal intubation can be performed under deep inhalational anaesthesia. A short acting muscle relaxant can be administered with all precautions. If there is no airway obstruction on IPPV, a longer acting muscle relaxant can be administered to complete the procedure.

Patients with airway compression of the trachea and distal main bronchi pose difficult challenge. This is so, as the rigid bronchoscope or endotracheal intubation cannot be performed beyond the obstructed segment of the airway. Likewise, tracheostomy will also not be helpful. In such a patient, it is obligatory to have some standby measures such as CPB, to overcome the fatal complications that may occur as a result of total airway obstruction. This should include cannulation of vessels and keeping CPB circuit primed and ready for instituting emergency CPB. Such an approach provides absolute safety to the patient.

**Management of acute airway obstruction**

Airway obstruction is the most common and feared complication in patients with anterior mediastinal mass under anaesthesia. Loss of control of the airway can occur at any stage of anaesthesia and consequences may be fatal. Its management poses special problems due to frequent involvement of the lower airways, therefore, possibility...
exists that emergency tracheostomy would not relieve the airway obstruction in these patients. The first response should be to minimize or reverse the deleterious effects of GA (IPPV) and change the patient's position.

**Change of patient's position**: Sometimes, turning the patient lateral, semiprone or prone position may prove life saving under anaesthesia. It relieves the refractory airway obstruction by taking some weight of the tumor off the tracheobronchial tree.²

**Emergency thoracotomy / median sternotomy and tumor debulking**: A rapid emergency thoracotomy and tumor debulking can be performed in a patient with refractory airway obstruction under anaesthesia, in an attempt to decrease the extrinsic compression on the airway by the anterior mediastinal mass.³³

**Various other measures described in the literature are as follows**:

**Splinting the trachea and main bronchus**

Airway obstruction can be overcome by splinting the trachea with a long endotracheal tube or armoured tube⁴⁷,⁴⁸ or by passing a rigid bronchoscope²,⁷,⁴⁹ through the affected region up to the level of carina or bronchus, when normal endotracheal tube fails to relieve the airway obstruction. Double lumen endobronchial tubes⁵⁰ can cross the tracheal obstruction and splinting of the main bronchi can maintain the airway patency by ventilating each lung independently, but paediatric sizes are not available. Obstruction of the airway, extending to the main bronchi may require a placement of “inverted Y stents”⁵¹ or “covered stents.”⁵² Rarely, a bilateral bronchial obstruction is treated by endobronchial placement of a conventional single lumen endobronchial tube,⁵³ thereby necessarily sacrificing ventilation to the other lung with resultant shunt. Harte et al⁵³ have used a modified single lumen endobronchial tube (by cutting a 5x3 mm oval fenestration, 11 mm below the tracheal cuff) to ventilate the right lung positioned with the help of a fiberoptic bronchoscope in a patient with severe tracheal and left bronchial compression by mediastinal mass. Todres et al⁵⁴ have used a coupled endotracheal and endobronchial tube system that independently ventilated each lung beyond the site of obstruction in a child with critical obstruction of the distal trachea and the left main bronchus. The compression of left main bronchus was splinted with an endotracheal tube passed through a tracheostomy, and the right lung (where the bronchus was not effected by the tumour) was ventilated by a conventionally placed tracheal tube.

The microlaryngeal bronchial tube has a small diameter (5 mm) and a longer length (31 cm) with a high volume low pressure cuff. It is commonly used to maintain airway during microsurgical procedures on the larynx to avoid obscuring the surgeon’s view.²⁴,⁵⁵ It can be placed into each main stem bronchus beyond the airway obstruction caused by mediastinal mass.⁵⁶

**Femoro-femoral cardiopulmonary bypass**

Successful use of femoro-femoral CPB has been described in patients with mediastinal masses to restore the oxygenation in the event of severe life threatening hypoxia due to severe airway obstruction or by compression of the pulmonary artery.³,⁵⁷,⁵⁸ Some authors have used femoral CPB as a standby only, in patients with tracheal mass causing airway obstruction, but have preferred to keep the femoral vessels exposed under LA without cannulation.⁵⁹,⁶⁰

Tempe et al³⁹ have recommended femoral vessel cannulation under LA, CPB circuit primed and kept ready before induction of GA in symptomatic patients with mediastinal mass causing severe tracheal compression and SVCS so that oxygenation can be maintained by initiation of CPB without wasting any time. Whereas, others have recommended the initiation of femoro-femoral CPB at the time of induction of GA, in a patient with signs and symptoms of airway compression, cardiac compression and SVCS demonstrated on CT scan, echocardiography and supine flow volume loop study.³⁴

**Helium-oxygen mixture**

If extreme difficulty in maintaining oxygenation is encountered in a patient with severe airway compression under spontaneous inhalational anaesthesia, a helium–oxygen mixture can reduce the resistance to the airflow through the compressed airway, and thus help in maintaining the oxygenation.⁶¹,⁶² However, helium is not readily available in India.

**Direct laryngoscopy**

Direct laryngoscopy is also among the manoeuvres used to relieve the airway obstruction under anaesthesia, when conventional endotracheal intubation fails to control the airway. It might apply tension to the tracheal wall tending to straighten it out somewhat and make it taut to relieve the airway obstruction due to extrinsic compression by the mediastinal mass.⁶³

**Conclusion**

Airway obstruction is the most common and feared complication in patients with anterior mediastinal mass under anaesthesia with the use of muscle relaxants and IPPV.³⁴ These symptomatic as well as asymptomatic patients can develop fatal airway obstruction. Therefore, patients at risk of airway obstruction should be identified by the presence of the respiratory symptoms (cough, stridor, orthopnoea, and positional dyspnoea), pulmonary function study (PEFR,
pulmonary flow-volume loops) performed in upright and supine position, and by radiological evaluation, e.g. X-ray chest, CT scan, MRI scan and bronchoscopy.

A subset of patients should undergo pretreatment with chemotherapy/ radiotherapy and cystic aspiration in an attempt to shrink the tumour size and relieve airway compression.\(^{18}\) GA can be administered with minimum risk in patients with airway obstruction under the guidance of a simplified algorithmic approach (Fig. 6). In essence, spontaneous ventilation should be preferred during the induction of anaesthesia and preparedness to restore airway and oxygenation is the key to success.

Reference

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