EDITORIAL REVIEW

Management of the patient with a large anterior mediastinal mass: recurring myths

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Purpose of review

This editorial review summarizes the current anesthetic management of patients with anterior mediastinal masses.

Recent findings

With increased appreciation of the correct intraoperative management of these cases severe intraoperative respiratory or cardiovascular collapse is less likely to occur during general anesthesia. Maintenance of spontaneous ventilation is the anesthetic goal whenever possible. Major life-threatening complications now occur more frequently postoperatively.

Summary

General anesthesia is not safe in patients with severe positional symptoms from an anterior mediastinal mass. With modern imaging techniques, general anesthesia is rarely needed for diagnostic procedures in these patients. Preoperative flow-volume loops are not useful in the management of these patients and the concept of cardiopulmonary bypass on 'standby' is not appropriate during induction of anesthesia.

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Abbreviation

CT computed tomography

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The risk of life-threatening or fatal airway obstruction or cardiovascular collapse during induction of anesthesia in patients with large anterior mediastinal masses has been recognized since the 1970s [1]. Over the subsequent 30 years and more anesthesiologists have become very aware of the high risk associated with general anesthesia in these patients. It seems that the perioperative management of these patients has improved, judging by the rarity of recent case reports of intraoperative fatalities and by the low morbidity reported in current retrospective surveys. Major airway complications in these patients are now more likely to occur in the postanesthetic care area rather than in the operating room [2]. We would like to briefly review the current management of these patients and in particular to comment on two myths that recur in essentially all anesthetic discussions of these cases: the usefulness of preoperative flow-volume loops and intraoperative cardiopulmonary bypass as a standby in case of cardiorespiratory arrest [3].

The anesthetic considerations for patients with an anterior mediastinal mass will vary according to the individual anatomy, pathology and the proposed surgical procedure. Thus, although there are general principles of safe anesthesia for these patients, there is the need to individualize management on a case-by-case basis. Masses may be benign or malignant tumors or cysts or aneurysms and may arise from the lung, pleura or any of the components of the anterior mediastinum. The commonest diagnoses in order of frequency in adults are lymphoma (Hodgkin's or non-Hodgkin's), thymoma, germ cell tumor, granuloma, bronchogenic carcinoma, thyroid tumors, bronchogenic cyst and cystic hygroma [4] (the commonest diagnoses in children are essentially the same and vary only in order of frequency). Possible diagnostic or therapeutic surgical procedures include sternotomy, thoracotomy, cervical mediastinoscopy, anterior parasternal mediastinoscopy, video-assisted thoracoscopic biopsy or biopsy of an extrathoracic mass. Occasionally a patient with an anterior mediastinal mass will present for anesthesia for another related or non-related emergent surgical indication such as ascending aortic aneurysm [5] or cesarean section [6].

Patients may present with signs or symptoms that include chest pain or fullness, dyspnea, cough, sweats, superior vena cava obstruction, hoarseness, syncope or dysphagia;

or patients may be asymptomatic and have a mass diagnosed on a screening chest radiograph or computed tomography (CT) scan. Among the signs and symptoms which should alert the anesthesiologist to an increased perioperative risk are increased dyspnea (orthopnea) or cough when supine (increased risk of airway complications) and syncopal symptoms or pericardial effusion (increased risk of cardiovascular complications). Symptoms are graded mild, moderate or severe according to the patient's tolerance of the supine position. Patients with severe symptoms will not voluntarily lie supine even for a short duration.

All patients with an anterior mediastinal mass should have a chest radiograph and a CT scan prior to any surgical procedure and the anesthesiologist must look at the imaging to plan the airway management. The CT scan will show the site, the severity, and the extent of the airway compromise. With modern fast CT scanners this can be accomplished with scan times under 20 s. In addition the patient's head and chest can be elevated to 30° without affecting scan quality. Alternatively, the scan can be done in the lateral or even prone position if necessary. Patients with cardiovascular symptoms, or those patients unable to give an adequate history should also have trans-thoracic echocardiography to assess for cardiac, systemic or pulmonary vascular compression.

There are important differences in the management of children versus adults. Anesthetic deaths have mainly been reported in children [7]. The deaths may be the result of the more compressible cartilaginous structure of the airway in children or because of underestimation of the severity of the airway compression in children due to the difficulty in obtaining a clear history of positional symptoms. Even with proper management, children with tracheo-bronchial compression greater than 50% cannot safely be given general anesthesia [8]. Also, securing the distal airway with awake fiberoptic intubation and placement of an endotracheal tube distal to a tracheal obstruction, which is an option for some adults with masses compressing the mid-trachea, is not an option in most children.

An important part of the anesthetic assessment for these patients is to consider whether the proposed procedure is diagnostic or therapeutic. To obtain tissue for diagnosis in children or adults who are unsafe for general anesthesia the commonest procedure at our institutions is an awake CT-guided needle biopsy. This can be done with local anesthesia and sedation as required, with a diagnostic accuracy over 90% [9]. In adults another very useful option is awake anterior mediastinoscopy with local anesthesia. Cytometric and immunocytochemical studies of pleural fluid can also be used to secure a diagnosis [10]. This is particularly useful in lymphoblastic lymphoma, which is associated with a high incidence of pleural effusions. Like needle biopsy, diagnostic thoracentesis can be done with ultrasound guidance in the sitting position with minimal or no sedation. Once the diagnosis has been confirmed, however, and if the surgery is for therapeutic excision of an anterior mediastinal mass, then a management plan of safe anesthesia needs to be developed.

Patients with an anterior mediastinal mass who require general anesthesia need a step-by-step induction of anesthesia with continuous monitoring of gas exchange and hemodynamics. Maintaining spontaneous ventilation until either the airway is definitively secured or the procedure is completed is a safe and popular strategy [11]. Anesthetic induction can be inhalational with a volatile agent such as sevoflurane, or by intravenous titration of propofol, with or without ketamine. Awake intubation of the trachea before induction is a possibility in some patients if the CT scan shows an area of non-compressed distal trachea to which the endotracheal tube can be advanced before induction. If muscle relaxants are required, assisted ventilation should first be gradually taken over manually to assure that positive-pressure ventilation is possible and only then can a short-acting muscle relaxant be administered. Development of airway or vascular compression requires that the patient be awakened as rapidly as possible and then other options for surgery can be explored. Intraoperative life-threatening airway compression has usually responded to one of two therapies: either repositioning of the patient (it should be determined before induction if there is one side or position that causes less symptomatic compression) or rigid bronchoscopy and ventilation distal to the obstruction (this means that an experienced bronchoscopist and rigid bronchoscopy equipment must always be immediately available in the operating room during these cases). For patients with life-threatening cardiovascular compression after induction that does not respond to lightening the anesthetic the only therapy is immediate sternotomy and surgical elevation of the mass off the great vessels.

Flow-volume loops are commonly ordered as part of the preoperative assessment for patients with an anterior mediastinal mass. Specifically, an increased mid-expiratory plateau when changing from the upright to the supine position is thought to be pathognomonic for a variable intrathoracic airway obstruction and an indicator of patients who are at risk for airway collapse during induction of anesthesia [12]. Apart from sporadic case reports, studies of flow-volume loops have shown a poor correlation with the degree of airway obstruction [13] and have not demonstrated usefulness in managing these patients [14]. One study of 25 patients with intrathoracic masses due to Hodgkin's disease found that no patient showed the pathognomonic pattern of variable intrathoracic obstruction on flow-volume loop even though nine of

25 patients had moderate or severe intrathoracic tracheal compression on CT scan [15]. Also of note in this study, seven of 25 patients showed an inspiratory plateau on flow-volume loop typical for an extrathoracic airway obstruction in spite of the fact that none of the patients actually had an extrathoracic obstruction on imaging. The myth of the usefulness of flow-volume loops in the assessment of patients with anterior mediastinal masses is well established in standard anesthesia texts and on anesthesia specialty exams. In clinical practice, however, flow-volume loops do not add any useful information beyond that which is obtained from the chest imaging.

Another myth which exists in the standard texts and reviews of management of patients with an anterior mediastinal mass is the usefulness of cardiopulmonary bypass as a 'standby' during induction of anesthesia [16]. The establishment of cardiopulmonary bypass by femoral cannulations prior to induction of anesthesia has been safely performed in adult patients [17]. Once airway or cardiovascular collapse has occurred, however, it will require at least 5–10 min to cannulate and establish adequate circulation and oxygenation [18], even with a primed pump and a prepared team. In such a scenario it is probable that a young patient can be resuscitated but will suffer neurological injury [19•]. Patients with severe positional symptoms due to airway or cardiovascular compression cannot be safely given induction of general anesthesia, even with maintenance of spontaneous ventilation, unless an alternative technique to maintain oxygenation or circulation (extracorporeal membrane oxygenation or cardiopulmonary bypass) has been established.

In summary, our management of patients with anterior mediastinal masses has improved over the past two decades as we have become more aware of the potential for airway or cardiovascular collapse during general anesthesia. New imaging modalities have made it possible to avoid general anesthesia for diagnostic purposes in the majority of high-risk cases. The most useful information for the anesthesiologist to guide management of these patients comes from the patient's history and the chest imaging. Flow-volume loops have not demonstrated any clinical benefits for these patients. Cardiopulmonary bypass prior to induction of anesthesia is occasionally required to stay out of trouble but cannot be relied upon as a standby to get out of trouble.

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