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Thymoma is the most frequent type of tumor in the anterior-superior mediastinum. The presentation of thymomas is variable; most are asymptomatic and others present themself with local compression syndrome or parathymic syndrome; rarely thymomas appear as an acute emergency. Surgery is the treatment of choice for thymic tumors and complete resection is the most important prognostic factor. Surgery with adjuvant radiation is recommended for invasive thymoma. The anaesthetic management of patients with mediastinal thymoma undergoing thymectomy is associated with several risks related to potential airway obstruction, hypoxia and cardiovascular collapse. Patients at high risk of perioperative complications can be identified by the presence of cardiopulmonary signs and symptoms. However, asymptomatic thymomas have been occurred with acute cardiorespiratory complications under general anaesthesia. A careful preoperative evaluation of signs, symptoms, chest X-ray, CT scan, MRI, cardiac echogram and venous angiogram should be helpful to investigate neoplasm presence and the area of invasion; moreover, an adequate airway and cardiovascular management, such as performing an awake intubation in the sitting position, allowing spontaneous and non-controlled ventilation, a rigid bronchoscope available and a standby cardiopulmonary bypass, is suggested to prevent the main life-threatening cardiorespiratory complications.

KEY WORDS: Airway obstruction, Anaesthesia management, Mediastinal mass, Superior vena cava syndrome, Thymoma

Introduction

Thymoma is an epithelial neoplasm arising from the thymus gland and is the most frequent type of tumor in the anterior-superior mediastinum. The most percentage of all thymomas occurs in the anterior mediastinum, with the minority occurring in the neck or other mediastinal area ¹. Thymomas have generally slow-growing pattern and an indolent histologic features. However, they have the ability to invade locally and metastasize regionally ².

Patients with thymomas can pose special problem for perioperative management due to local and myriad systemic effect of the cancer, or the subsequent consequences of tumor therapy. Tumor can have anatomic and physiologic effects on the patient, or both. Anatomic effects are related to local invasion or compression ³. Local invasion occurs most commonly into the pleura (30%), pericardium (25%), lungs (8%), and recurrent laryngeal nerve

(4%). Invasion into the intracardiac and great vessel is extremely rare but it has been reported ⁴. Physiologic effects are related to paraneoplastic syndrome which frequently goes with thymomas. The presentation of thymomas is variable. Half of thymomas present asymptomatically and are detected incidentally on radiographic imaging, while half will present with symptoms associated with a paraneoplastic syndrome or with symptoms related to the local mass effects. The most common symptoms of local tumor growth are cough, dyspnea, chest pain, jugular vein distension or superior vena cava syndrome. Moreover, thymomas are associated with a number of paraneoplastic disorders. 47.7% of patients have associated myasthenia gravis, but other disorders are pure red cell aplasia and hypogammaglobulinemia ⁵. Rarely thymomas may undergo infarction or hemorrhage, which leads to acute, atypical presentations with acute severe chest pain. The prognosis seems to be good in patients presenting infarction or hemorrhage at the beginning ⁶. Chest x-ray in conjunction with history and physical exam is the first step to determine the presence of a tumor. CT scan, dynamic Magnetic Resonance Imaging (MRI), cardiac echogram and venous angiogram are used to investigate the area of invasion and to improve staging and differential diagnosis determination 7.

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Surgery is the treatment of choice for thymic tumors and complete resection is the most important prognostic factor for both localized and locally invasive thymic tumors. Multimodal approach with neoadjuvant chemotherapy, surgery and postoperative radiation therapy may improve the outcome in patients with advanced thymomas ⁸.

Traditional surgical approach is via a sternum-splitting incision (median sternotomy), which permits total exposure but could be associated with some morbidity related to postoperative ventilatory need. An alternative surgical approach is via the transcervical route. Although a more radical procedure can be achieved via the transsternal route, the morbidity is greater, and equally good outcome results have been claimed following transcervical thymectomy. For a large mediastinal thymoma, however, a transsternal approach is usually preferred. Success has also been reported with minimally invasive video-assisted thymectomy that improves effectiveness of the transcervical approach for thymectomy with minimal trauma and excellent results ^{9,10}.

The anaesthetic management of patients with mediastinal thymoma undergoing thymectomy is associated with several risks related to potential airway obstruction, hypoxia and cardiovascular collapse. These complications may occur while placing the patient in supine position, at the induction of the anaesthesia, at the extubation, in the immediate postoperative period and even few days after extubation ^{11,12}.

It has been estimated that perioperative anesthetic complications occur in 12.8% of these patients. The ability to identify which patients with mediastinal thymoma are at risk of cardiopulmonary complications is limited. Few studies have tried to investigate the usefulness of clinical signs, symptoms and radiological and pulmonary function tests (PFT) to assess anesthetic and perioperative risk. Factors with predictive value for anesthetic complications include main stern compression, facial oedema and venous engorgement. However, asymptomatic mediastinal masses may cause acute circulatory and upper airway collapse under general anaesthesia ¹³. Therefore, careful anaesthetic management is necessary to avoid the main respiratory and cardiovascular complications.

Respiratory complication and anaesthesia management

The induction of general anaesthesia can lead to complete airway obstruction with potentially fatal outcome ¹². Previous study have found an incidence of anesthesia related life-threatening respiratory complications of up to 20%. In a review of 22 case reports, this complications was found in 20 cases and induction of anaesthesia precipitated airway obstruction ¹⁴. It has been suggested this is due to several factors. First, large airway patency decreases with bronchial smooth muscle relaxation of general anaesthesia; second, transpleural pressure

gradient, distending the airway during inspiration, is diminished; third, diaphragmatic movement is decreased or absent; fourth, supine position worsens tracheal compression ¹⁵.

In a study of 105 case reports, perioperative respiratory complications were encountered in 4 cases and the incidence of airway obstruction was 0% during intraoperative period and 6.8 % in the postoperative period ¹³.

King et al. proposed that respiratory symptoms were usefulness to predict the risk of general anaesthesia ¹⁶. However, the absence of significant signs and symptoms does not exclude the possibility of airway collapse. Bechard et al. concluded that patients at high risk of perioperative complication can be identified by the presence of respiratory signs and symptoms, CT scan evaluation (tracheal compression more of 50%) and mixed abnormality (combined obstructive and restrictive patterns) on PFRs ¹³.

Most reports consider general anaesthesia as the last resort, preferably after radiotherapy, chemotherapy and steroids; however, when therapeutic surgery is indicated the most important factors in preventing anaesthetic complications is anticipation of airway problems.

During preoperative evaluation, a careful anamnesis is important to identify dyspnea, stridor, wheezing or positional dyspnea. An history of these problems suggests a possible mediastinal compression and if the patient is scheduled for biopsy the procedure should be performed under local anaesthesia. Preoperative evaluation of asymptomatic patient for respiratory symptoms should include CT scan of the chest, inspiratory and espiratory flow volume loops with pulmonary function tests, and echocardiography to rule out tracheobronchial, pulmonary artery, or cardiac compression.

When the patients require general anaesthesia a careful evaluation of the airway using a fiberoptic bronchoscope is recommended. Indeed, awake fiberoptic intubation should be performed and after induction, maintenance of spontaneous ventilation without neuromuscular blocking drugs is indicated to preserve normal transpulmonary pressure gradient to distend the airways and maintains their patency, even in the presence of extrinsic compression. If airway obstruction occurs during general anaesthesia, it can be relieved by quickly changing patient's position from supine to lateral or prone. Obstruction can also be relieved by passage of a rigid ventilating bronchoscopy beyond the obstruction and femoral cannulation and institution of extracorporal circulation has been reported ¹⁷.

In the Bechard's study postoperative respiratory complication, defined as those occurring within 10 days after surgery and necessitating additional treatment such as reintubation, non-invasive mechanical ventilation, bronchoscopy, special inhalation therapy, or antibiotics for radiographically documented pulmonary infection, occurred in the first 48 postoperative hours and the incidence of these events was 6.7%. Reintubation can be due to obstruction by oedema secondary to surgical manipulation.

If sternal incision is performed for complete removal of the thymoma, a good pain management is required during surgery and postoperative period to allow smooth emergence from anaesthesia. Moreover, it is necessary to maintain spontaneous respiration and avoid muscle relaxants. Continuous thoracic epidural is an ideal option to provide surgical analgesia, minimize the anesthetic requirements during critical intra and postoperative period and avoid narcotics with their possible respiratory depression ¹⁸.

Cardiovascular complications and anaesthesia management

Symptoms consistent with cardiovascular compression have been reported less frequently and they may be due to superior vena cava obstruction, cardiac compression, and, rarely, to mechanical compression on the pulmonary artery ¹¹.

Thymic tumors commonly cause superior vena cava (SVC) syndrome by extrinsic compression of the SVC, but less commonly by intraluminal permeation to the great vessels ⁷. The syndrome is most severe if the tumor is growing rapidly, because a collateral circulation does not have adequate time to develop itself. The SVC syndrome is characterized by engorged neck veins and marked oedema in the upper trunk and extremities. Respiratory symptoms and changes in mental status can occur due to venous engorgement in the airway and to an increase in cerebral venous pressure. The SVC syndrome can be exacerbated during the anesthesia, and the combination of decreased venous return from the upper part of the body associated with pharmacologic vasodilatation can result in severe hypotension and cardiovascular collapse.

Patients with extrinsic compression of the vena cava by a tumor mass are usually treated with a preoperative mediastinal irradiation. In patients who don't tolerate the supine position anesthesia may be induced in the Fowler's position (semi-sitting position) and prior to induction of general anaesthesia an arterial line and pulmonary artery catheter should be placed. Neuman et al. recommend a partial cardiopulmonary bypass standby during induction of anesthesia in symptomatic patients ^{17,19}.

Thymomas are occasionally complicated with pericardial effusion. Rarely a large thymoma can lead to tamponade by compression of the right ventricular outflow or by invasion of the pericardium with massive pericardial effusion. Symptoms of tamponade include progressive dyspnea, retrosternal chest pain relieved by sitting forward, and abdominal discomfort from hepatic engorgement. Physical findings include jugular venous distention, diminished heart sounds, narrowed pulse pressure, and hepatic engorgement. Pulsus paradoxus may be part of a careful physical examination but its presence is not pathognomonic of the condition. An ECG may show decreased voltage. Severe circulatory collapse from this compression can be triggered by altered positioning, induction of anesthesia, hypovolemia and reduced cardiac contractility. The main diagnostic technique is echocardiography ²⁰.

The decision to perform a therapeutic intervention for a pericardial effusion depends on the degree of hemodynamic compromise.

Rarely mediastinal thymomas have been associated with compression of the pulmonary artery and the heart causing decrease in right ventricular output and in pulmonary perfusion ²⁰. Clinically dyspnea, deep cyanosis and intolerance of the supine position may result from the compression. When the patient is in the sitting position, compression is decreased and the effective pulmonary flow increased.

Cases of invasive thymoma which extended into the right atrium and right ventricle causing right ventricular inflow obstruction have been reported in the literature ²¹.

Cyanosis in presence of mediastinal thymoma are not always due to compression of the airway, but may be due to cardiovascular compression with a decrease in right ventricular output. Anesthesia management includes a careful cardiovascular evaluation. If there are cardiovascular problems, the procedure should be performed under local anesthesia. Alternatively, preoperative irradiation, massive steroid therapy, and anesthesia in the sitting or even face-down position is recommended. Spontaneous ventilation should be performed and intense observation is required during recovery period.

Conclusion

The anesthetic management of patients with mediastinal thymomas is associated with several risk and challenges, including potential airway compression and cardiovascular collapse. Induction of general anaesthesia tends to exacerbate side effects related to airway and cardiovascular invasion. A careful preoperative evaluation of signs and symptoms, of chest X-ray, CT scan, MRI, cardiac echogram and venous angiogram should be helpful to investigate the area of invasion to prevent cardiorespiratory problems before submitting the patient to general anaesthesia. An adequate airway and cardiovascular management, such as performing an awake intubation in the sitting position, allowing spontaneous and non-controlled ventilation, a rigid bronchoscope available and a standby cardiopulmonary bypass, is mandatory to anticipate disagreeable side effects.

Riassunto

Il timoma è uno dei tumori più frequenti del mediastino antero superiore. I segni con cui si manifesta tale

neoplasia sono variabili; nella maggior parte dei pazienti viene diagnosticata accidentalmente perché asintomatica, in altri compaiono segni e sintomi da compressione locale o da sindrome paratimica; raramente si presenta come un'emergenza. Il trattamento di scelta è la chirurgia e la completa resezione della massa tumorale è il fattore prognostico più importante. Per le forme invasive è raccomandato l'intervento chirurgico associato a radioterapia adiuvante. La gestione anestesiologica dei pazienti con timoma mediastinico candidati a timectomia deve comprendere i rischi correlati alla potenziale ostruzione delle vie aeree, all'ipossia e al collasso cardiovascolare. I pazienti ad elevato rischio di sviluppare complicanze perioperatorie possono essere identificati indagando la presenza di segni e sintomi cardiorespiratori. Tuttavia, non è infrequente vedere pazienti asintomatici con timoma andare in contro, durante anestesia generale, a complicanze acute di tipo cardiorespiratorio. Una valutazione preoperatoria che comprenda un'accurata anamnesi, un attento esame obiettivo ed un adeguato studio delle immagini (RX torace, CT, MRI, ecocardiografia e angiografia venosa), dovrebbe essere utile, non solo per diagnosticare la presenza della neoplasia, ma anche l'invasività. Inoltre, al fine di evitare che durante anestesia generale le complicanze cardiorespiratorie mettano a repentaglio la vita del paziente con timoma è raccomandata un'attenta gestione delle vie aeree e del sistema cardiocircolatorio, attraverso un'intubazione a paziente sveglio e in posizione seduta, ventilazione spontanea, disponibilità continua di un fibrobroncoscopio rigido e di un sistema di bypass cardiopolmonare durante tutto l'intervento chirurgico.

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