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Anesthetic Management and Prognosis of a Large Right Mediastinal Mass: Strategy of Unipulmonary Ventilation

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Abstract **Case Report**

Introduction: The mediastinum is a complex anatomical region that can be the site of a variety of tumour pathologies. These masses, often discovered late due to their silent growth, pose major diagnostic and therapeutic challenges. Our study focuses on the particularities of anesthetic management of these lesions, which present high operative risks with a morbidity of up to 45%. ***Case report:*** We report the case of a 59-year-old patient, a former smoker, presenting with a voluminous 20 cm right mediastinal mass. After preparation including pleural drainage and non-invasive ventilation, partial surgical resection was performed by thoracotomy. ***Anaesthetic management:*** The team implemented a protective unipulmonary ventilation strategy with rigorous parameters: reduced tidal volume (4-6 ml/kg), individualized PEEP and moderate FiO2. Invasive hemodynamic monitoring managed refractory hypotension requiring the use of noradrenaline. Postoperative analgesia was provided by epidural, favoring early rehabilitation. ***Discussion:*** Several lessons can be drawn from this observation. Firstly, late diagnosis remains frequent, underlining the importance of early chest imaging in the face of persistent respiratory symptoms. Secondly, protective ventilation proved crucial in preserving the patient's lung function, in line with recent data in the literature. ***Conclusion:*** This observation illustrates the complexity of managing mediastinal masses. Recent advances in thoracic anesthesia, notably in protective ventilation and multimodal analgesia techniques, have improved postoperative prognosis.

Keywords : single-lung ventilation, anesthesia, prognosis, right mediastinal mass.

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INTRODUCTION

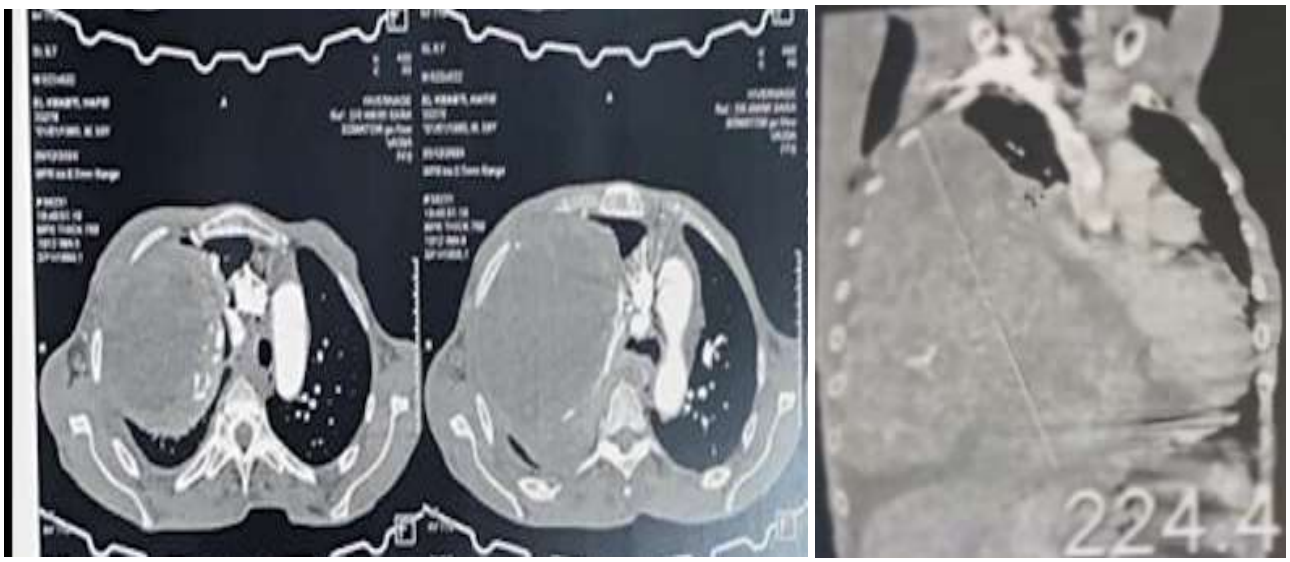
The mediastinum is a complex anatomical compartment containing the thymic residue, the digestive tract, the tracheobronchial tree, numerous lymph nodes and the costovertebral gutters with the sympathetic nerve chain [1]. It can be the site of a variety of mediastinal pathologies, each located in a given mediastinal compartment. These mediastinal masses have developed at the expense of elements of the mediastinum, or have borrowed the latter to develop. In adults, mediastinal masses may be related to benign pathology, but more often they are associated with malignant disease, with different prognoses and therapies. These masses, developed in a small space, may present a borrowed symptomatology, leading to late diagnosis, or be totally asymptomatic. Alternatively, their compressive and invasive nature may require urgent management. Sometimes, the diagnostic approach to mediastinal masses relies thoracic imaging using X-rays or computed tomography (CT), or tumour markers. But in the majority of cases, more complex methods such as anatomopathological examination of the mass are essential. Anesthetic management of mediastinal masses is unique, due to the impact of the mass on heart and lung function, and the endocrine nature of the mass. The morbidity of this surgery ranges from 10 to 45%, depending on the series [2]. The most frequent post-operative complications are pneumonia, arrhythmia and prolonged air leakage. Mortalitý has been reported to vary between 1% and 2% in recent large cohorts [3]. This type of surgery is still associated with a number of risks, which require a multidisciplinary strategy involving surgeons and anaesthetists in order to reduce these risks and improve patient safety. In recent decades, lobectomy surgery has benefited from a number of advances that have influenced the perioperative management of

patients undergoing pulmonary lobectomy, both surgically, with the spread of video-thoracoscopy, and anesthetically, with the generalization of protective ventilation techniques, locoregional trunk analgesia techniques and the expansion of enhanced rehabilitation measures after surgery [4]. Through this case and literature reviews, we discuss the particularities of anesthetic management of mediastinal masses.

OBSERVATION

The patient is 59 years old, 60kg, a former 15PA smoker weaned 20 years ago, with no history of tuberculosis or recent tuberculosis contagion. He underwent total thyroidectomy 8 years ago and is on levothyroxine 100 µg with good follow-up. Who has presented for one month with dyspnea and right basithoracic pain without hemoptysis, evolving in a context of altered general condition with asthenia, anorexia and weight loss of 5kg in 1 month, ARISCAT score 67 and FEV1 60%. Clinical examination revealed a hemodynamically stable conscious patient with a heart rate of 87 beats/min and blood pressure of 123/65 mmHg. Pleuropulmonary examination revealed right basal condensation syndrome. The rest of the clinical examination was unremarkable.

Thoracic CT scan (Figure 1) shows a voluminous posterolower right mediastinal mass measuring 20.2 x 19.1 x 22.4 cm, heterogeneous, solidocystic, with calcifications enhanced after iodine contrast injection. This mass involves the posterior, middle and lower mediastinum, pushing back the lung with atelectasis in its entirety, with moderate pleural effusion and pushing back of the mediastinum to the left.



Thoracic CT scan (Figure 1): voluminous right posteroinferior mediastinal mass measuring 20.2 x 19.1 x 22.4 cm, heterogeneous solidocystic with calcifications, enhanced after iodine contrast injection

Anatomopathological study revealed biopsy cores of whitish color and firm consistency, which were embedded separately in 3 cassettes. Microscopic examination revealed mesenchymal cell proliferation. This was arranged in intersecting bundles. Cellularity was low, with slightly denser foci in places. Cells were spindle-shaped, with elongated nuclei and dense chromatin, with no cytonuclear atypia or abnormal mitoses. Cytoplasm is abundantly eosinophilic. Interstitial tissue is small and fibrous. It is punctuated by mononuclear inflammatory elements arranged in clusters.

During hospitalization prior to surgery, the patient presented with acute respiratory distress, with severe polypnoea, signs of respiratory struggle and sweating, SpaO2 88%, neurological Fr 40, SG 14/15, hemodynamically stable, requiring transfer to intensive care, On admission to the intensive care unit, he received several sessions of non-invasive ventilation, and a follow-up thoracic angioscan was performed as a matter of urgency, showing worsening pleural effusion and mediastinal compression and compression on the left. Biological tests were carried out, notably thyroid hormones, blood count, renal function, liver function, blood glucose and blood ionogram were all normal.

Tumor markers, including alpha-fetoprotein (AFP), carbohydrate antigen 19-9 (CA 19-9), carcinoembryonic antigen (CEA), human chorionic gonadotropin (HCG or BHCG), prostate-specific antigen (PSA) were all normal. Thoracic drainage was performed. The pleural effusion was bloody, the Rivalta test was positive, lymphocyte and neutrophil counts were 55% and 45% respectively; total protein was 35.40 g/L, lactate dehydrogenase (LDH) 171 U/L, adenosine deaminase (ADA) not done. Cytological examination of the pleural fluid revealed a small number of mesenchymal cells, but no malignant cells were found.

After adequate preparation, surgery by right posterolateral thoracotomy through the 5th intercostal

space was scheduled. Total vertical sternotomy and video-assisted thoracoscopy were difficult to perform, given the size and location of the mass. On admission to the operating room, the patient was placed in a half-seated position and 2VVP was taken. Initial monitoring was standard (ECG scope, PANI, Spao2, diuresis). Initial filling of 4cc/kg to compensate for the fasting period. The anesthetic strategy during the procedure was general anesthesia. A 4min preoxygenation period with inspiratory support to achieve SpaO2 >95%. Anesthetic induction consisted of a balance anesthetic with the morphine drug fentanyl 5g/kg, the hypnotic propofol 2.5mg/kg and the curare rocuronium 0.6mg/kg. Tracheal intubation was performed with a n° 38 left double lumen tube under video-laryngoscopy in apneic ventilation with OHD.

Checked by auscultation for correct probe positioning, ventilatory adjustments to limit VILI ventilated lung. A tidal volume of 5-3ml/kg of ideal weight for a mobilized volume of 300-180ml, a PEEP of 5-8cmH2O and recruitment maneuvers every 15min in unipulmonary ventilation according to desaturation episodes. Respiratory rate adjusted to PaCO2 35-45mmhg to avoid hypocapnia and reduce dynamic hyperinflation, low Fio2 40-60% to limit denitrogenation, motor pressure <13cmH2O, peak pressure <30cmH2O and plateau pressure <28-30cmH2O._Anesthetic maintenance was performed with 1.5% sevoflurane mac and fentanyl titration, invasive monitoring with blood pressure in the right arm and then a central venous catheter under the left clavian under ultrasound guidance without delaying the procedure. Curarization was monitored with a train of four and the depth of anaesthesia was monitored with Bis.

after resection of the mass, the patient presented arterial hypotension at 07/40mmhg with tachycardia at 120 bpm, resistant to crystalloid filling. Maintenance of a good perfusion pressure with Noradrenaline SAP 1µ/kg/min was necessary to target MAP at 65-70mmhg, and Noradrenaline was weaned after 24 hours post-operatively.

Initial exploration revealed a voluminous mediastinal mass occupying the entire right hemithorax, with total atelectasis of the right lung. Release of the adhesions and lifting of the mass onto the mediastinum enabled decompression of the mediastinal elements and bipulmonary ventilation, thanks to re-expansion of the right lung, the mediastinal mass was large and firm in consistency, widely adherent and infiltrating the surrounding tissues, in particular the mediastinal pleura, inferior vena cava, pulmonary hilum and heart. Complete monobloc resection was impossible. A 4cm tumour residue was left in place, identified by clips. Extubation was performed on a normal tube after changing the double-lumen tube at the end of the procedure. After extubation, the patient benefited from several sessions of postoperative non-invasive ventilation. Post-operative analgesia was provided by epidural bupivacaine for the first few days, followed by paracetamol and nefopam.

The patient recovered well after 4 days in the post-operative surgical intensive care unit, transferred to the thoracic surgery department and then to the oncology department for further management. The patient underwent chemotherapy and analgesic radiotherapy. The patient died 6 months later.

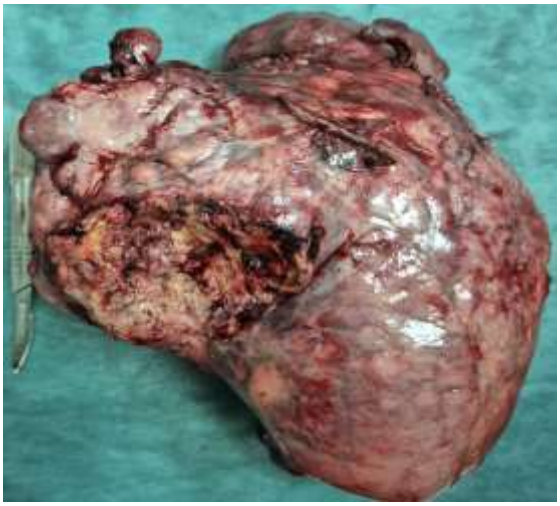


Figure 2: Macroscopic appearance of a large mediastinal mass

Anatomopathological study of the surgical specimen revealed an excisional specimen weighing 2800g and measuring 28 x 20 x 11cm. Immunohistochemistry showed moderate and diffuse membrane expression of anti-CD34 antibody in tumour cells. Moderate and diffuse nuclear expression of antiSTAT6 antibody in tumor cells. Absence of anti-cytokeratin, anti-EMA and anti-CD31 expression. Moderate and diffuse nuclear expression of 15% anti-Ki67.

DISCUSSION

The objectives of anesthetic and resuscitation management during thoracic surgery are numerous: To offer a preoperative assessment geared to assessing the risk of complications, particularly respiratory, without forgetting the risks associated with associated pathologies; to ensure the various technical modalities of selective intubation and conduct uni-pulmonary ventilation; to choose and implement an analgesia technique that must be effective from the moment the patient wakes up, and last for 3 to 5 days after thoracotomy; to prevent and rapidly recognize postoperative complications, whether they arise in the first few hours or in the first few days postoperatively. Thoracic surgery is fraught with significant morbidity and mortality, and requires preoperative management involving not only anesthetists, but also thoracic surgeons and pulmonologists. In our study, we describe the ventilatory strategy for thoracic surgery using uni-pulmonary ventilation.

In our study, the patient was a former smoker weaned off smoking 20 years ago. But according to [**Turan A, et al**] and [**Mason DP, et al].** Smoking cessation may appear to be the simplest measure to implement. However, it requires the support of a tobaccology team. The benefits of even short-term smoking cessation before surgery are not disputed [5]. Respiratory morbidity may be reduced after thoracic surgery a few weeks after smoking cessation [6], although this result has not been found in all studies [7].

In thoracic surgery, undernutrition, defined as a body mass index (BMI) below 18.5, is a risk factor for post-operative complications and death. Our patient lost over 5kg in 1 month, **[Fiorelli *et al].*** showed in 117 patients over 70 years of age that patients with a BMI < 18.5 kg/m2 were at risk of major complications [8]. Undernutrition and weight loss of more than 5% in the 3 months prior to surgery were also independent risk factors for one-year mortality. **Ramos *et al.*** reported on a prospective cohort of 219 patients undergoing lung resection for cancer that impaired nutritional status, as measured by the *nutritional risk index*, was associated with an increased incidence of postoperative complications, longer hospital stay and shorter cancer-free survival [9]. Finally, two retrospective studies involving large groups of patients report similar results. [**Matsunaga *et al]*** showed that undernutrition was a risk factor for respiratory complications and post-operative death in 1,518 patients undergoing lung resection for cancer [10].

Relatively short renutrition programs could not be carried out given the state of progression of the mass. [**For example, Kaya *et al***. demonstrated the benefits of a 10-day nutritional management program prior to resection of non-small-cell lung cancer, combining a high-protein diet enriched with arginine, omega-3 fatty acids and nucleotides. This preparation reduced post-operative complications compared with a conventional diet [11].

It is recommended to use a multimodal strategy of protective ventilation associating a tidal volume of less than or equal to 6 ml/kg of theoretical ideal weight, positive expiratory pressure and recruitment maneuvers during unipulmonary ventilation to reduce the incidence of postoperative complications and the length of hospital stay [12]. In our study we used also a multimodal strategy of protective ventilation with respiratory rate adjusted for PaCO2 35-45mmhg avoiding hypocapnia and to decrease dynamic hyperinflation, low Fio2 40-60% to limit denitrogenation, Motor Pressure <13 cmH2O, Peak Pressure < 30cmH2O and Plateau Pressure <28-30 cmH2O. Several prospective randomized studies show a benefit of protective ventilation strategies during single-pulmonary ventilation. **Yang *et al.* [**13] reported in a randomized study of lobectomy patients that the group receiving protective ventilation, including a fraction of inspired oxygen (FiO2) at 0,5 a tidal volume (Vt) of 6 ml/kg theoretical ideal weight and a positive expiratory pressure (PEP) of 5 cmH2O had a significantly lower incidence of postoperative respiratory complications (hypoxemia, atelectasis and radiological opacities) than patients in the "standard ventilation" group (Vt at 10 ml/kg, PEP at 0 cmH2O, FiO2 at 1) **Marret et al. [**14] reported in a prospective randomized study including 346 patients treated by lobectomy or pneumonectomy (18% of the cohort) that serious postoperative respiratory complications and hospital stay were reduced in patients with protective unipulmonary ventilation (Vt at 6 ml/kg + PEEP at 5-8 cmH2O) compared with the "standard ventilation" group (Vt at 10 ml/kg + PEEP at 0 cmH2O). A retrospective study of 1019 surgical procedures (of which around 48% were isolated lung resections) requiring uni-pulmonary ventilation suggests that the isolated lowering of Vt to 6 ml/kg theoretical ideal weight without PEEP is associated with more post-operative complications [15].

Defining an optimal PEEP level is difficult, and must be individualized according to patient characteristics and clinical constraints. This level usually varies between 2 and 10 cmH2O in this type of surgery [16], with a low level to be considered in COPD patients with intrinsic PEEP [14]. **Park *et al*** [17] showed in a randomized double-blind study of 292 patients with protective ventilation, Vt at 6 ml/kg and recruitment maneuvers, in which only the PEEP setting was randomized between a 5 cmH2O group versus an individualized setting within a range of 2 to 10 cmH(2) O to achieve minimal motor pressure, that the incidence of pulmonary complications, pneumonia and post-operative acute respiratory distress syndrome was reduced in the optimized PEEP group. The group with PEEP set to motor pressure had a lower PEEP on average than the control group during single-pulmonary ventilation (3 *versus* 5cmH(2) O) [17-18]. Such a way of adjusting PEEP can therefore be proposed. majority of

studies also include alveolar recruitment maneuvers in this strategy of protective single-pulmonary ventilation, the individual benefit of which is however difficult to affirm in the absence of specific studies with patient prognosis as the criterion of judgment, although it has been shown to improve oxygenation while being associated with a risk of hemodynamic deterioration [18-19]. Lung lobectomy surgery is considered clean contaminated (Altemeier class 2), as the bronchi are opened. Antibiotic prophylaxis is provided by first-generation cephalosporin (cefazolin, 2 g at anesthetic induction, reinjection of 1 g at the fourth hour). If the patient is allergic to beta-lactams, vancomycin (15 mg/kg single dose) may be used [20]. In our study, this recommendation was followed.

A Cochrane Group meta-analysis published in 2013, which included 20 randomized studies and 850 patients, reported no difference in complications between intravenous and inhaled anesthetic agents [21]. It is not recommended that maintenance of anesthesia by one technique over another IACP with propofol or halogen should be preferred to reduce the incidence of postoperative complications or length of hospital stay [22].

Infusion volume is also a risk factor for postoperative respiratory complications it is important to avoid liberal intakes of crystalloid solutions during thoracic surgery [23]. A value of 6 ml/kg/h was found to be the threshold beyond of which the incidence of complications increased significantly; fluid intake > 8 ml/kg was associated with the occurrence of postoperative respiratory complications [24-25-26]. Currently, it is recommended to administer baseline intraoperative fluid intakes of between 2 and 6 ml/kg/h to reduce the occurrence of postoperative respiratory complications [27]. Intraoperative vascular filling should be titrated using hemodynamic monitoring, with esophageal Doppler as the preferred method, to reduce the occurrence of postoperative respiratory complications [28]. For postoperative analgesia, continuous paravertebral block is the technique of first because of its equivalent efficacy but better tolerance profile than APD, with a lower incidence of arterial hypotension, acute urinary retention, nausea and vomiting. In the meta-analysis by Yeung *et al*. of data from 14 prospective randomized studies involving 698 thoracotomy patients [29]. There was no difference in length of stay or mortality between the 2 techniques. Similar results were reported in the meta-analyses by Junior Ade *et al* [30], Baidya *et al* [31], and Scarfe *et al* [32]. With regard to thoracoscopic surgery, Kosinski *et al.* reported in a randomized study a better efficacy of continuous paravertebral block on pain scores during the first 36 hours post-operatively, compared with APD, with the same lower incidence of side effects [33].

In our study, our patient benefited from early postoperative physiotherapy and NIV. This is in line with recommendations in the literature that postoperative physiotherapy and NIV should be started very early in the postoperative period. Several studies have shown that postoperative NIV improves gas exchange and shortens hospital stay [34-35]. Its impact on respiratory morbidity remains to be determined. Rapid removal of drains facilitates ambulation and has a positive impact on hospital stay [36]. In our patient, the drains were removed 4 hours after surgery.

CONCLUSION

Anesthetic management of mediastinal masses is highly specific. It must take into account the nature of the mass and its relationship with neighboring organs, especially the heart, large vessels and bronchial tree. The choice of anaesthetic technique depends on the type of monitoring, conditioning and tracheal approach. Post-operative analgesia is the cornerstone of post-operative rehabilitation, and must be adapted to the approach and the intensity of post-operative pain. Pre-operative investigations have been simplified, and can now be used to stratify risk and propose preparation according to risk assessment. Intraoperative problems are still dominated by the use of double-lumen tubes, particularly hypoxemia, which complicates unipulmonary ventilation. The postoperative period is a source of the highest risk for the patient. This is why we recommend transferring patients postoperatively to an intensive care unit. The technique of unipulmonary ventilation used in our study is perfectly in line with the findings reported in the medical literature. That said, perioperative management was, overall, optimal, given the improvement in our patient's respiratory function right up to discharge from the intensive care unit.

Ethical approval

Due to the type of article (case report), ethical approval was not required.

Registration of research studies

This is not an original research project involving human participants in an interventional or observational study, but a case report. Registration was not mandatory.

Patient consent

Written informed consent has been obtained from the patient for publication of this case report and accompanying images.

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