Clinical Reports

Anterior mediastinal mass in a patient susceptible to malignant hyperthermia

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We report a malignant hyperthermia-susceptible patient who required investigation for a large, symptomatic anterior mediastinal mass. Multiple attempts at tissue diagnosis under local anaesthesia were unsuccessful. Following awake fiberoptic tracheal intubation, general anaesthesia was administered using ketamine, midazolam, and nitrous oxide, maintaining spontaneous ventilation. Prophylactic dantrolene was not used, to avoid potential muscle weakness and respiratory compromise. Diagnostic mediastinotomy was performed without incident. We conclude that ketamine anaesthesia is appropriate for patients with anterior mediastinal masses, and is considered safe in malignant hyperthermia-susceptible patients.

Nous rapportons l'observation d'un patient connu pour sa susceptibilité à l'hyperthermie maligne et qui doit subir une investigation pour une masse médiastinale antérieure symptomatique. De nombreuses tentatives de biopsies diagnostiques ont déjà faites sans succès sous anesthésie locale. À la suite d'une intubation trachéale vigile au fibroscope, une anesthésie générale à la kétamine, au midazolam et au protoxyde d'azote est administrée en ventilation spontanée. On ne donne pas de dantrolène prophylactiquement afin d'éviter une détérioration de la fonction respiratoire par faiblesse musculaire. Une médiastinostomie diagnostique est réalisée sans incident. Nous concluons que l'anesthésie à la kétamine est appropriée pour les porteurs de masses médiastinales antérieures et que cet agent

anesthésique ne présente pas de dangers particuliers pour les patients dont la susceptibilité à l'hyperthermie maligne est connue.

The anaesthetic management of a patient with a large anterior mediastinal mass is challenging. Severe cardiopulmonary complications may occur at any time, related to compression of vital mediastinal structures. We recently managed a patient with a large, symptomatic anterior mediastinal mass, who was also susceptible to malignant hyperthermia (MH).

Case report

A 21-yr-old woman presented with a one year history of intermittent atypical chest pain, dyspnoea on exertion, and non-productive cough. She also complained of worsening dyspnoea and cough on lying supine, and for the last three months had slept in the prone position to relieve the dyspnoea. Family history included a younger brother who had been treated for Hodgkin's lymphoma, and a maternal great-grandfather and great aunt who allegedly died from malignant hyperthermia (MH). The patient considered herself MH-susceptible (MHS), although no one in her immediate family had been tested for MH.

Physical examination revealed only an increase in neck size, without tracheal shift, and a palpable left anterior cervical lymph node. Plain x-rays and computerized tomography (CT) of the chest showed a 12 cm anterior mediastinal mass, with greater than 50% compression of the distal trachea and proximal mainstem bronchi (Figure), minimal compression of the pulmonary arteries and superior vena cava, and a large pericardial effusion. Pulmonary function tests revealed a severe restrictive defect, with further deterioration in the supine position (Table).

A clinical diagnosis of malignant lymphoma was made. Diagnostic pericardiocentesis was performed: 400 ml of straw-coloured fluid were collected, but showed no malignant cells. A scalene lymph node biopsy performed

Key words

ANAESTHESIA: dissociative;
ANAESTHETICS, INTRAVENOUS: ketamine;
HYPERTHERMIA: malignant;
SURGERY: thoracic.

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FIGURE Enhanced computerized tomographic scan of the chest at the level of the distal trachea. The tracheal lumen is compressed by the anterior mediastinal mass. A 5 cm scale appears along right-hand margin. The average mid-tracheal diameter in an adult woman is 1.5 cm.

under local anaesthesia was negative for malignant cells. A percutaneous transthoracic needle aspiration biopsy of the mediastinal mass was also not diagnostic.

Because the patient's subsequent anaesthetic management would depend on whether she was MH-susceptible, a biopsy of the left *vastus lateralis* muscle was performed under femoral nerve block anaesthesia with lidocaine 1% and 1:200,000 adrenaline. The results of the caffeine halothane contracture test were positive for MH (3.0 g contracture to 3% halothane, 1.0 g contracture to 2 mM caffeine).¹

A left anterior mediastinotomy under regional anaesthesia was scheduled. With the patient in a semi-sitting position, a pleural catheter was placed in the left pleural cavity and 20 ml lidocaine 2% with 1:200,000 adrenaline were injected. The patient also received fentanyl and midazolam *iv* for sedation. Extrapleural mediastinotomy was performed through the second intercostal space using lidocaine 1% for local infiltration. The pleural catheter was connected to an underwater seal while multiple biopsies of the mediastinal mass were taken. However, the specimens showed only dense fibrous tissue and a few lymphoid cells, with no evidence of malignancy.

Since the medical oncologists were unwilling to begin treatment without a tissue diagnosis, a cervical and a repeat left anterior mediastinotomy under general anaesthesia with MH precautions was planned. No dantrolene prophylaxis was given. Monitors included a non-invasive blood pressure device, ECG, pulse oximeter, capnograph, axillary temperature probe, and a radial arterial catheter. Supplemental oxygen was administered by face mask. The patient's pharynx was anaesthetized with atomized

TABLE Pulmonary function tests

Test	Sitting	% Pred.	Supine	% Pred.
FVL (L)	1.89	40	1.53	33
FEV ₁ (L)	1.81	46	1.42	36
FEV ₁ /FVC (%)	96	—	93	—
PEFR (L · sec ⁻¹)	4.18	56	3.23	43
FEF ₂₅₋₇₅ (L · sec ⁻¹)	2.61	59	1.12	25
FEF ₅₀ (L · sec ⁻¹)	2.88	62	1.55	33
FIF ₅₀ (L · sec ⁻¹)	2.10	45	2.34	50

FVC = forced vital capacity; FEV₁ = forced expired volume in 1 sec; PEFR = peak expiratory flow rate; FEF = forced expiratory flow rate; FIF = forced inspiratory flow rate.

4% lidocaine. After sedation with *iv* ketamine 25 mg and midazolam 3 mg, and with the patient breathing spontaneously in a semi-sitting position, nasotracheal intubation was performed using a fiberoptic bronchoscope, after topical anaesthesia of the trachea with lidocaine 4%. The trachea, itself, was slit-like in appearance in its distal half. General anaesthesia was induced with ketamine 80 mg and maintained with ketamine, midazolam, and N₂O 50% in oxygen. The anaesthesia machine was purged for five minutes at 10 L · min⁻¹, after the vaporizers were removed, the fresh gas outlet hose replaced with a "vapour-free" hose, and a new rubber reservoir bag and plastic circuit were attached.² The CO₂ canister and ventilator bellows were not changed. The patient breathed spontaneously throughout the procedure. Multiple biopsies of the mass were taken without incident. The tracheal tube was removed with the patient awake, sitting upright, and in no distress. A final diagnosis of nodular sclerosing Hodgkin's lymphoma was made.

Discussion

This patient presented with the unusual combination of a large anterior mediastinal mass and MH-susceptibility. Of primary anaesthetic concern was the potential for airway obstruction during general anaesthesia, where even asymptomatic patients have developed severe respiratory compromise.³⁻⁶ This patient was symptomatic, with progressive dyspnoea and cough, which worsened in the supine position. In addition, the tracheal cross-sectional area was reduced by over 50% on CT examination, and this appears to be predictive of airway problems during general anaesthesia.⁷ Pulmonary function testing confirmed the severity of airway compromise in our patient, but would have been more useful if she had been asymptomatic.

Whenever possible, patients with large anterior mediastinal masses should have tissue biopsies under local anaesthesia.⁸ Unfortunately, attempts to do so in our patient were unsuccessful. Preoperative radiation therapy

was rejected, as the oncologists were concerned about an accurate tissue diagnosis.⁹ In addition, radiation and/or chemotherapy would be inappropriate for multinodular goitre or thymoma, which were part of the differential diagnosis.¹⁰

Faced with performing a mediastinotomy under general anaesthesia, awake fiberoptic tracheal intubation was indicated.^{11,12} Awake fiberoptic airway inspection allows assessment of airway dynamics, the degree of airway compression and the effect of changes in posture, and allows the airway to be secured without the use of muscle relaxants. Had respiratory obstruction occurred, selective fiberoptic bronchial intubation would have been performed, bypassing the obstruction.⁵ We were also prepared to move the patient into the lateral or prone position, if necessary.¹¹

If there is any compression of the pulmonary artery on CT imaging, femoral artery-femoral vein cardiopulmonary bypass (CPB) should be made available in the operating room.¹¹ Compression of the pulmonary artery can result in sudden hypoxaemia or hypotension under general anaesthesia, leading to cardiac arrest. In such cases, rapid institution of partial bypass may prevent death or cerebral injury. Hall and Friedman used elective partial bypass for resection of a dermoid cyst in the anterior mediastinum.¹³ High bypass flow rates were required intermittently to allow adequate surgical resection. We did not have CPB standing by because CT imaging and echocardiography demonstrated minimal compression of the pulmonary artery.

This patient's management was further complicated by the presence of MH-susceptibility. Volatile anaesthetic agents are absolutely contraindicated in MHS patients,¹⁴ but are frequently used in patients with mediastinal masses to provide anaesthesia and to allow spontaneous ventilation. If our patient had tested MH(-), a volatile anaesthetic agent might have been used.¹⁵

Ketamine does not trigger MH in susceptible swine,¹⁶ and is considered to be safe for MH patients. Ketamine anaesthesia has also been recommended for patients with mediastinal masses.^{9,17} Functional residual capacity does not change under ketamine anaesthesia during spontaneous ventilation.¹⁸ Ketamine also increases rib cage muscle tone and prevents cephalad motion of the diaphragm,¹⁸ which may prevent airway obstruction caused by a mediastinal mass.¹⁹

Dantrolene prophylaxis was not administered for two reasons. First, a non-triggering technique was planned and the benefit of dantrolene in such cases is controversial.²⁰ Second, patients with pre-existing muscle weakness or respiratory compromise have developed acute respiratory distress following the administration of dantrolene.^{21,22} This might have been catastrophic in our

patient, in whom severe respiratory symptoms were already present.

In summary, an unusual case of an MHS patient with a large anterior mediastinal mass is presented. In view of her symptoms of airway compromise supported by radiologic evidence, we considered the safest anaesthetic management to be awake fiberoptic airway inspection and tracheal intubation, followed by general anaesthesia with ketamine. This approach allowed controlled assessment of the patient's airway, avoided muscle relaxants, and permitted spontaneous ventilation throughout the surgical procedure.

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