Transoesophageal echocardiography and the intraoperative diagnosis of left atrial invasion by carcinoid tumour

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A 41-yr-old woman with pulmonary carcinoid tumour presented for thoracotomy and lung resection. However, intraoperative transoesophageal echocardiography (TEE) revealed that the tumour had invaded the left atrium, and the planned resection was aborted to allow resection under cardiopulmonary bypass at a later date. Although the incidence of cardiac involvement by lung cancer at the time of pulmonary resection is unknown, transoesophageal echocardiography can be useful in identifying the extension of hilar lung tumours. This should preferentially be done preoperatively, but can be done intraoperatively as described in this case report.

Une patiente de 41 ans souffrant d'une tumeur cardinoïde pulmonaire se présente pour thoracotomie et résection pulmonaire. Toutefois, l'échocardiographie trans-oesophagienne peropératoire montre que la tumeur envahit l'oreillette gauche et la résection programmée est retardée pour permettre d'effectuer la résection sous circulation extracorporelle à une date ultérieure. Bien que l'incidence de l'atteinte cardiaque au moment d'une résection pulmonaire soit inconnue, l'échocardiographie trans-oesophagienne peut devenir utile pour identifier l'extension hilare des tumeurs pulmonaires. Elle est préférable avant l'intervention, mais on peut la réaliser pendant l'opération, comme c'est le cas ici.

Key words

MEASUREMENT TECHNIQUES: echocardiography;
SURGERY: cardiovascular, thoracic.

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The intraoperative performance of transoesophageal echocardiography (TEE) during cardiac surgery has become common practice,¹ but its use has been more limited during thoracic surgery. Transoesophageal echocardiography is an effective method for diagnosing cardiac tumours and thrombi. Transoesophageal echocardiography provides better imaging of the left atrium and the pulmonary veins than transthoracic echocardiography (TTE),² because of the proximity of the oesophagus to the left atrium. Transoesophageal echocardiography may therefore be useful in determining if there is cardiac involvement from tumour originating in the pulmonary hilum. We report a case in which, with the use of intraoperative TEE, a carcinoid tumour was seen to be invading the left atrium (LA), and the planned pulmonary resection was not performed.

Case report

The patient was a 41-yr-old woman presenting for rigid bronchoscopy, left thoracotomy, and left lower lobectomy. Ten years before the current admission she had chest pain, haemoptysis, and fever. The chest x-ray revealed a left upper lobe (LUL) mass. The patient underwent LUL lobectomy at that time for a bronchial carcinoid tumour invading the bronchial wall and adjacent lymph nodes. The patient remained asymptomatic and without evidence of recurrence until three months before the current admission. The patient had two isolated episodes of blood-tinged sputum. Chest x-ray and CT scan of the chest showed a mediastinal nodule and evidence of tumour recurrence in the hilum of the residual lung. Pulmonary function tests included forced vital capacity (FVC) of 3.1 L (93% predicted), forced expiratory volume in one second (FEV₁) of 2.1 L (74% predicted), and FEV₁/FVC 65.6%. Forced expiratory flow (FEF)^{25-75%} was 3.1 L · sec⁻¹ (62% predicted). Arterial blood gas analysis breathing room air showed pH 7.41, PaCO₂ 35 mmHg, and PaO₂ 85 mmHg.

There was a past medical history of mitral valve prolapse, which was treated with propranolol. The patient

FIGURE 1A Longitudinal view transoesophageal echocardiogram showing tumour invasion of the left atrium.

was not taking any other medications and had no known drug allergies. Previous operations included thyroglossal duct removal 13 yr earlier, and tonsillectomy in childhood, both without sequelae.

Preanaesthetic medication consisted of diazepam 10 mg *po*. Placement of intravenous, radial artery, and internal jugular cannulae was performed under local anaesthesia. Anaesthesia was induced with propofol, fentanyl, midazolam, and oxygen, and muscle relaxation was obtained with vecuronium. Rigid bronchoscopy was performed, during which anaesthesia was maintained with propofol and vecuronium, and ventilation was performed using a high-frequency jet ventilator. Rigid bronchoscopy revealed tumour involving the stump of the left upper lobe and partially obstructing the left lower bronchus. Following bronchoscopy and tracheal intubation with a left-sided double-lumen endobronchial tube, a left thoracotomy was performed. At thoracotomy, the mediastinal nodal metastasis was removed. The tumour in the hilum of the lung extended centrally. The pericardium, which was densely adherent to the heart, was opened to expose the left atrium. A large mass was felt within the atrium extending in from the hilum. Further dissection revealed that the tumour extended from the left lower lobe, and appeared to encroach upon the left pulmonary vein. Transoesophageal echocardiography was then performed to delineate the anatomy.

The TEE examination revealed that the tumour extended through the free wall of the left atrium, and projected into the left atrial cavity. This was visualized in both the transverse and longitudinal planes (Figure 1). The mitral valve did not appear to be directly involved, although the tumour did involve the left atrium adjacent

FIGURE 1B Illustration of transoesophageal echocardiogram seen in Figure 1A in which the tumour is inside the left atrium (LA). The mitral valve (MV) and left ventricle (LV) are also illustrated.

to the annulus of the mitral valve. Colour-flow interrogation of the mitral valve was normal, and there was no mitral leaflet prolapse or valvular pathology. The examination also revealed that the tumour encroached on the left upper pulmonary vein, but interrogation by pulsed wave Doppler indicated a normal triphasic flow pattern and unobstructed flow into the atrium was seen on colour-flow examination.

After discussion it was decided not to proceed further with the operation at that time. The patient had an uneventful recovery from anaesthesia and surgery. Postoperatively, TEE was performed again to confirm the intraoperative findings. Coronary angiography showed that there was no vascularization of the tumour via the coronary arteries. The patient was scheduled to return for lung resection and intracardiac tumour resection via a median sternotomy approach. Two weeks after the thoracotomy, left (completion) pneumonectomy was performed under cardiopulmonary bypass. The carcinoid tumour surrounded the proximal aorta and the circumflex coronary artery. The tumour was extensively resected, but its invasiveness precluded complete resection. The patient made an uneventful recovery from surgery and anaesthesia, and was discharged from the hospital on the 11th postoperative day.

Discussion

Transoesophageal echocardiography has been established as an important clinical tool for intraoperative monitoring. This case report, together with others previously reported, demonstrate the importance of TEE as an intraoperative

diagnostic tool. In this case, invasion of the LA by the carcinoid tumour was detected intraoperatively. The planned operative procedure was changed based on the unexpected surgical and TEE findings, which were not detected by the preoperative CT scan. Transoesophageal echocardiography has been previously used for the intraoperative diagnosis of an aortic valve tumour,³ but to the best of our knowledge, this is the first report in which pulmonary carcinoid tumour invasion of the heart was diagnosed by intraoperative TEE.

Intracardiac tumours, primary or metastatic, are rare. Transoesophageal echocardiography is superior to TTE for recognition of LA masses² because the TEE probe lies immediately posterior to the LA and a better interrogation is thus possible. Alam and Sun⁴ compared TEE with TTE in the evaluation of 12 consecutive patients with LA masses and concluded that the size, morphology, site of origin, mobility, and the extension of the LA masses were better defined and delineated by TEE imaging than with TTE. Transoesophageal echocardiography provides an image of the pulmonary veins as opposed to TTE which does so only rarely.

The most common tumour of the LA is myxoma which generally appears as a pedunculated homogenous mass that is attached to the interatrial septum.⁴ Transoesophageal echocardiography is able to define precisely the attachment site, and the extent of the tumour. Other common findings in the LA are thrombi, which are highly echogenic, irregular in shape, and are usually located in the atrial appendage or are free-floating in the atrial chamber.⁴

Although 25% of patients with lung cancer have been found to have cardiac involvement at autopsy,⁵ the incidence at the time of surgery is not known. Invasion of the LA by a carcinoid tumour is extremely rare. We are aware of only one case report by Darby *et al.* in which a malignant bronchial carcinoid had invaded the LA, and it produced a carcinoid crisis intraoperatively.⁶ The tumour was able to secrete directly into the LA and systemic circulation. A somatostatin infusion was required for resuscitation, and the carcinoid tumour was subsequently resected from the LA under CPB.

In our case report, extension of carcinoid tumour into the LA was not detected by chest CT before surgery, but was suspected intraoperatively by the surgeon, and confirmed using TEE. The planned lung resection was postponed based upon the intraoperative detection of the LA involvement, to allow resection under CPB at a later date. Systemic embolization of tumour fragments or uncontrolled haemorrhage could have occurred if there had been an attempt to resect the atrial extension of tumour without CPB. In conclusion, intraoperative TEE can assist in delineating the extent of hilar lung tumours and

in planning the surgical approach. Although there are no data on the incidence of cardiac involvement of hilar lung tumours at the time of surgery, TEE may be considered as part of the preoperative evaluation in these patients.

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