Tracheo-oesophageal fistula diagnosed with multidetector computed tomography

Introduction

This case highlights important issues in investigation of patients with suspected tracheo-oesophageal fistula including the value of multidetector computed tomography, the importance of thorough imaging evaluation when high clinical suspicion of tracheo-oesophageal fistula exists and the value of close interaction between radiologists and intensive care physicians in the investigation of these patients.

Discussion

Tracheo-oesophageal fistula may be congenital, neoplastic or inflammatory (Nagata et al, 2006). In adults, tracheo-oesophageal fistulas are usually acquired lesions with a range of aetiologies described (Vasquez et al, 1988). The most common aetiologies include infection, intrathoracic malignancies, chest trauma and iatrogenic causes including trauma from cuffed endotracheal tubes (Vasquez et al, 1988). Tracheo-oesophageal fistula is most commonly associated with oesophageal tumours, but may also be caused by tumours at other sites including lung, trachea and metastatic lymph nodes (Giménez et al, 2002; Pickhardt et al, 2002). Tracheo-oesophageal fistula associated with intrathoracic tumours is more common following radiation therapy (Giménez et al, 2002; Pickhardt et al, 2002).

Tracheo-oesophageal fistulas secondary to blunt trauma to neck and thorax have increased in frequency and typically occur at or above the level of the carina (Vasquez et al, 1988). Some authors believe trauma secondary to cuffed endotracheal tube is the most common cause of acquired tracheo-oesophageal fistula with factors implicated including prolonged intubation and pressure exerted by cuff (Vasquez et al, 1988).

Conventional barium oesophagography is the most sensitive test for diagnosing tracheo-oesophageal fistula as it effectively differentiates fistula from aspiration (Pickhardt et al, 2002). Vasquez et al (1988) suggested that repeated swallowing of oral contrast or even repeated studies may be needed to demonstrate tracheo-oesophageal fistula when it is temporarily occluded with debris or oedema, or that contrast ingestion in prone position may help demonstrate tracheo-oesophageal fistula (Vasquez et al, 1988). Therefore, failure to demonstrate tracheo-oesophageal fistula in this case was not surprising, considering that the patient was intubated and ventilated at the time of contrast oesophagography and repositioning the patient in prone position was not feasible.

Experience with contrast oesophagography has shown that lateral projection will generally best define tracheo-oesophageal fistulas, whereas bronchoesophageal fistulas may require a slightly different obliquity (Pickhardt et al, 2002). Other examinations that may be used to visualize the orifice of a fistula include oesophagoscopy, bronchoscopy and bronchography but these are believed to be less successful (Vasquez et al, 1988).

Continuing rapid advances in multidetector computed tomography allow vol-

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Case Report

A 61-year-old man presented acutely to hospital with respiratory distress. He had a background history of recurrent respiratory tract infections. Chest radiograph showed bilateral lower lobe air-space opacification. Subsequently the patient developed acute respiratory decompensation and respiratory arrest requiring endotracheal intubation.

The patient was admitted to the intensive care unit, and intensive care unit staff noted that unusually high positive end expiratory pressure values were required to maintain adequate oxygenation. Another notable finding was repeated reflux of air through the patient's oropharynx. The endotracheal tube was replaced with a larger calibre endotracheal tube without improvement. The possibility of tracheo-oesophageal fistula was considered and the patient underwent flexible bronchoscopy and contrast oesophagography, none of which showed a tracheo-oesophageal fistula. Clinical concern for tracheo-oesophageal fistula persisted and the patient continued to require mechanical ventilation.

Multi-detector computed tomography (Aquilion 4, Toshiba Medical Systems, Toshiba, Tokyo, Japan) extending from hyoid bone to lung bases was performed with the following technical parameters: 120 kVp, 225 mAs, 1 mm slice thickness in helical mode with table speed of 0.75 and pitch of 3, without intravenous contrast administration. An attending radiologist and intensive care physician were present during the examination and the images were reviewed and discussed during the study. A subtle, focal, ill-defined thinning of the trachea was identified at the level of the endotracheal tube cuff (*Figures 1a* and *b*). A decision was made to repeat the study following temporary deflation of the endotracheal tube cuff and advancement of endotracheal tube into the right mainstem bronchus. This demonstrated a posterior tracheal defect with oesophageal communication, confirming a tracheo-oesophageal fistula at the site of thinning on the earlier imaging phase. Multiplanar reconstructions in the sagittal plane (*Figures 1b* and *2b*) and virtual bronchoscopy (*Figure 3*) (Vitrea workstation, Vital Images Minnetonka, Minnesota, USA) confirmed the presence of a tracheo-oesophageal fistula at the level of the endotracheal tube cuff.

Three days later, with the aid of multi-detector computed tomography and the multiplanar reconstructions, focused conventional bronchoscopy confirmed the presence of the tracheo-oesophageal fistula. The patient succumbed to overwhelming sepsis 2 weeks later.

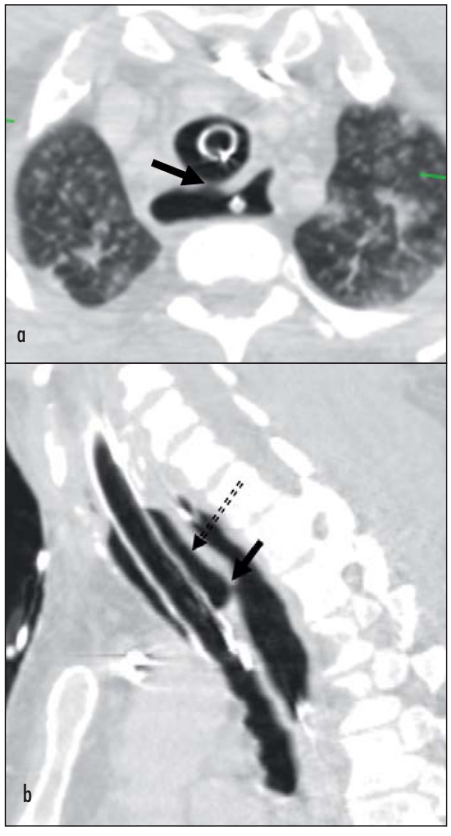


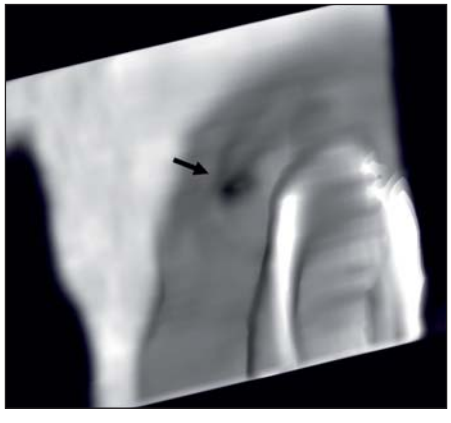
Figure 1. a. Axial and (b) multiplanar sagittal reconstructed multidetector computed tomography showing thinning (black arrow) of the posterior tracheal wall at the site of the endotracheal tube inflated cuff (broken arrow) within the trachea.

Figure 2. a. Axial and (b) multiplanar sagittal reconstructed multidetector computed tomography with the endotracheal tube advanced into the right main bronchus with the cuff deflated showing a defect in the posterior trachea consistent with tracheo-oesophageal fistula (black arrow).

umetric imaging with accurate multiplanar reconstruction (Islam, 2004). Virtual bronchoscopy is now possible where acquired axial data are used to reconstruct the mucosal surfaces of hollow viscera (Islam, 2004). This case illustrates the effective use of these techniques (*Figures 1b, 2b* and *3*) for diagnosing tracheo-oesophageal fistula when oesophagography and initial bronchoscopy did not show the abnormality. In this case, reconstruction in the sagittal plane with multiplanar reconstructions and virtual bronchoscopy gave the best definition of the tracheo-oesophageal fistula. Previous reports have described the use of multidetector computed tomography to diagnose congenital tracheo-oesophageal fistula in paediatric patients (Kirchner et al 2000; Islam, 2004; Soye et al, 2005).

One of the most important points in this case was the potential for failure to depict the tracheo-oesophageal fistula because it was located at the level of the endotracheal tube cuff, which resulted in stretching and bridging of the defect by the endotracheal tube cuff. The decision to deflate the endotracheal tube cuff and advance the endotracheal tube into the right main bronchus was crucial in diagnosis of tracheo-oesophageal fistula. This diagnosis would not have been made without the input of the intensive care physician and interaction with the radiologist.

Figure 3. Virtual bronchoscopy multidetector computed tomography images showing endotracheal tube in situ and defect (black arrow) in trachea.



Patients with benign oesophagorespiratory fistulas may have symptoms for several days to several years before a diagnosis is made (Vasquez et al, 1988). Thus, an important factor in clinching the diagnosis in this case was that clinical suspicion for tracheo-oesophageal fistula was maintained, even in the setting of normal contrast oesophagogram, bronchoscopy and multidetector computed tomography scan.

This case highlights many of the advantages of multidetector computed tomography over other modalities traditionally used in diagnosis of tracheo-oesophageal fistula. Multidetector computed tomography is non-invasive and easier to perform in the critically ill patient, removing the risk of pneumonitis resulting from aspirated oral contrast and allowing accurate anatomical display of the tracheo-oesophageal fistula. Its major disadvantage is associated radiation dose – an even greater issue in children.

Conclusions

When clinical suspicion of tracheo-oesophageal fistula is high, confirming the diagnosis may require innovative modifications of standard investigations which can require close interaction between referring clinicians and radiologists. Improvements in multidetector computed tomography and reconstruction techniques have resulted in a central role for multidetector computed tomography in the investigation of critically ill patients as in this case of suspected tracheo-oesophageal fistula. **BJHM**

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