How-to-do-it

Three-dimensional CT imaging and virtual endoscopy for the placement of self-expandable stents in oesophageal and tracheobronchial neoplastic stenoses

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Abstract

We examined the value of multislice computed tomography (CT) with three-dimensional (3D) reconstruction of the images as a pre-treatment examination in order to plan endoluminal stenting in 14 patients with large tumours involving the oesophagus and/or the tracheobronchial tree. The measurement of the stenosis obtained during 3D reconstruction of the CT images corresponded to that obtained by endoscopy and to the prosthesis chosen in all cases, with the exception of one patient undergoing double stenting due to inadequate gaseous distension of the oesophageal lumen. 3D CT may add information with respect to axial imaging, and be helpful to better plan and perform stenting of the oesophagus and airways without burdening the preoperative work-up. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

In patients suffering from non-resectable oesophageal and/or tracheobronchial neoplastic stenosis, placement of a self-expandable metal stent is an effective and safe palliation technique [1,2]. When cancer affects both the oesophagus and the respiratory tract double stenting may be necessary; furthermore, placement of a stent in the oesophagus may cause compression or occlusion of the trachea or bronchi, leading to respiratory insufficiency [3]. In such cases, a decision must be made regarding which stenosis (oesophageal or tracheobronchial) requires treatment first.

Therefore, the aim of the pre-treatment work-up is to define not only the site and characteristics of the stenosis, but also the grade of involvement of the mediastinal organs. Upper gastrointestinal endoscopy, tracheo-bronchoscopy, barium swallow, chest roentgenogram, and axial computed tomography (CT) are used to obtain these information. Multislice CT with three-dimensional (3D) reconstruction of the images and virtual endoscopy, combines the advantages of conventional axial CT to study the stenosis and the degree of compression of the adjacent organs with the possibility to obtain an internal image of the upper airways and the oesophagus [4,5].

We assessed the diagnostic possibilities of spiral CT with 3D reconstruction and virtual endoscopy as a single non-invasive examination in support of endoscopy for oesophageal and tracheobronchial stent planning.

2. Materials and methods

The indication to the placement of a prosthesis is usually posed on the basis of the clinical history and the instrumental examinations performed before sending the patient to our referral centre. In fact most of the cases present a progression of a previously known disease. In order to plan the endoscopic treatment, the pre-operative work-up was traditionally based on a chest CT scan and a recognition oesophagoscopy or tracheo-bronchoscopy. Once the critical stenosis to be treated first, whether the oesophageal or tracheo-bronchial, was defined, the patient was treated endoscopically.

In the present series a 3D image elaboration of the preoperative CT scan was done. The spiral CT was performed using an Elscint Twin Slice Flash tomograph. Aerial contrast was used to study the respiratory tract. The oesophagus was
studied empty with oral administration of a double dose of effervescent powder to obtain adequate distension of the lumen. The following parameters were adopted: 120 kVp, 199 mA and a scan rotation time of 1 s. For the spiral technique, the following parameters were used: 3.2 mm sections and a pitch of 2.0 with an increase of 1.5 mm. The examination lasted 25–30 s. For the image post-processing, the thorax data were transferred to an ‘Mxview-Picker’ workstation. Three-dimensional volume reconstruction was performed using the programme ‘3D’ and the ‘Voyager’ programme was used for the virtual endoscopy.

We never performed the diagnostic endoscopy before stenting. When only the oesophageal stenting was indicated, the procedure was performed in the radiologic-endoscopic suite. In case of possible airways stenting, the patients were treated in the operative room under general anaesthesia. They were usually ventilated via a rigid endoscope. Before introducing the stent, measurements were taken with the fibre-endoscope of the length of the stenosis and of the tract of oesophagus and airways proximal and distal to the stenotic area. Measurements with the 3D imaging process and with the endoscope were compared.

Fourteen consecutive patients (12 males and two females; mean age 69, range 58–86 years), candidates to stenting for large neoplastic masses involving the oesophagus and/or the upper airways, were included in the study. The causes of the stenosis were: in six cases, cancer of the oesophagus; in four cases, relapse of lung cancer after lobectomy; in two cases, relapse of cancer of the oesophagus; in one case, cancer of the trachea; in one case, cancer of the thyroid. In eight patients, the main symptom reported was dysphagia, while...
in six, there were varying degrees of contemporary dyspnoea and dysphagia.

Self-expandable metal stents (Microinvasive, Boston Scientific Corp., Boston, MA USA) were positioned endoscopically according to the current procedures.

3. Results

The 3D CT images with respect to the axial images confirmed that the stenosis was limited to the oesophagus in seven patients. In the other seven patients, the tumour involved both the oesophagus and the respiratory tract to varying degrees. In four of these cases, the stenosis was critical (>50%) on the oesophagus and relative (<50%) on the trachea or bronchi. In the other three patients 3D CT images perfectly documented the involvement of the oesophagus and the respiratory tract, suggesting the need for double stenting. The measurement of the length and the calibre of the stenosis, of the free margins above and below the stenotic area was easier with 3D CT than with axial CT (Fig. 1).

In the patient series, 14 oesophageal, two tracheal and two bronchial stents were positioned. The measurements drawn from 3D CT images corresponded to those obtained with oesophagoscopy and tracheo-bronchoscopy. The prosthesis, chosen before starting the endoscopic procedure on the basis of 3D images, did fit correctly in all cases but one. In this case, of possible double stenting, the 3D CT over-estimated the degree and length of the oesophageal stenosis as gaseous distension of the lumen had been inadequate. Endoscopy demonstrated that only the tracheal stent was indicated. In the other two cases undergoing double stenting, the indication based on the 3D CT images proved correct.

4. Discussion

In cases of large neoplastic masses, the risk of jeopardizing the patency of the respiratory tract after insertion of the oesophageal stent is far from being rare [3,6]. Contemporary placement of oesophageal and tracheobronchial stents may achieve satisfactory palliation of both dysphagia and dyspnoea [6–8]. Usually the pre-stenting work-up will include a barium swallow, oesophagoscopy and/or tracheo-bronchoscopy with chest CT scan. Computed tomography is the only examination able to define the degree of involvement of the mediastinal organs and prevent inappropriate or risky manoeuvres.

This study suggests that multislice CT with 3D images offers some advantages over axial imaging. With this technique it is unnecessary to perform pre-operatively the X-ray barium swallow and an endoscopic over-look of the oesophagus and of the tracheo-bronchial tree, because it permits to define accurately the strategy of stenting and to choose, before starting the procedure, type and size of the stents to apply.

To conclude, using the new generation of spiral CT scan, the 3D imaging process provides information helpful to simplify the process of stenting the oesophagus and the airways in the presence of large un-resectable tumours involving both organs. The additional costs of the procedure are negligible when the dedicated software is available.

References