



*Case Report*

**DIAGNOSTIC CAPABILITIES OF THE VIRTUAL BRONCHOSCOPY AT  
ADVANCED NEOPLASTIC PROCESS OF ESOPHAGUS WITH  
FORMATION OF TRACHEOBRONCHIAL FISTULA:  
DESCRIPTION OF A CASE**

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**ABSTRACT**

The relevance of the problem is related to the continued increase in the neoplastic processes, and at the same time also to the development and improvement of the endoscopic and CT equipment, and thus expanding the diagnostic capabilities. **Purpose:** The presented research examines the results of the study of a rare case of ruptured trachea as a result of cancer of the esophagus. **Methods:** Fiberoptic esophagoscopy (FOE) and CT of the chest followed by virtual bronchoscopy on a patient with a ruptured trachea, a 63 year-old man, were performed. **Result:** Performing MDCT with virtual bronchoscopy, according to this study, is crucial as the sole and complex methodology for the described case in connection with the finding of the trachea-oesophageal fistula and evaluation of the mediastinum and the pulmonary parenchyma. **Conclusion:** The VB is a successful method equally effective compared to the FB, to diagnose of advanced neoplastic processes.

**Key words:** Virtual bronchoscopy, neoplastic process, Oesophagus, tracheobronchial fistula

**INTRODUCTION**

The relevance of the problem is related to the continued increase in the neoplastic processes, and at the same time also to the development and improvement of the endoscopic and CT equipment, and thus expanding the diagnostic capabilities, which is essential for the detection of early changes, for the method of treatment and its outcome, as well as for tracking the dynamics of the processes. The diseases of the trachea are mainly with endoluminal location (post-intubation, post-traumatic, as a result of

bronchoscopy and removal of foreign bodies) or are the result of external compression of adjacent structures (1, 2, etc). The post-intubation lesions of the trachea are defined as relatively rare in medical practice and therefore they are insufficiently studied and discussed in the scientific literature, including using fiberoptic bronchoscopy (FB) (1, 3). The research on the applicability of the virtual bronchoscopy (VB) in the diagnosis of tracheobronchial lesions is relatively limited (4, etc). There are almost no data on the diagnostic capabilities of the VB as compared to the FB in ruptures of the trachea and bronchi (5, etc.). The virtual bronchoscopy (VB) is a relatively new (in the mid 1990s) three-dimensional multi-layer computed tomography scanning technology for

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presenting of real high-resolution images of the tracheobronchial tree (6, 7, 8, 5, 9, 10, etc.). The VB is a noninvasive technique using multidetector scanner and subsequent 3D reconstruction of the airways. The VB allows visualization of the lumen and the walls of the trachea in areas inaccessible to the FB; it allows assessment of the bronchial obstruction and stenosis.

## PURPOSE

The presented research examines the results of the study of a rare case of ruptured trachea as a result of cancer of the esophagus.

## MATERIAL AND METHODS

In October 2016 a scientific study was performed of a patient with a ruptured trachea, a 63 year-old man. The patient was hospitalized as planned, and reported epigastric pain, burning sensation behind the sternum, nausea and vomiting many times for about 20 days. He had lost about 10 kg for the last 6 months. From the past illnesses he reported alcohol dependence. No family predisposition. The performed paraclinical examinations detected the existence of mild leukocytosis. In the respiratory system during auscultation there was evidence of moist wheezing to the right. Fiberoptic esophagoscopy (FOE) and CT of the chest followed by Virtual bronchoscopy (VB) were performed. For the Fiberoptic gastroscopy the apparatus "Pentax" was used. The VB examination was performed using 64 MDCT of the "Siemens Definition AS". The scanning was performed with holding of the breath for about 10 seconds, automatically regulated, with contrasting or natively. The post-processing of the 0.6 mm MDVB was made on the basis of the obtained reconstructed images. The additional processing was made with protocol for VB. The "Siemens" workstation was used with "Singovia VB10" software and "Philips Essenca" and "Siemens Definition AS" workstations with options for tracking and comparing the images in the axial, coronal and sagittal planes. Multi-planar reconstructions were performed with application of MIP techniques and options for archiving and exporting images and video. Optimizations of the standard protocols for patients with different diagnoses and age groups were made during the performed examinations using different slice thickness, different amperage, voltage and pitch.

The VB's diagnostic capabilities compared to the FB were evaluated according to the following criteria:

- location of the rupture;

- shape of the rupture;
- length of the rupture (mm);
- damaging the integrity of the tracheal rings;
- distance of the rupture to the carina;
- distance of the rupture to the rima and the vocal cords.

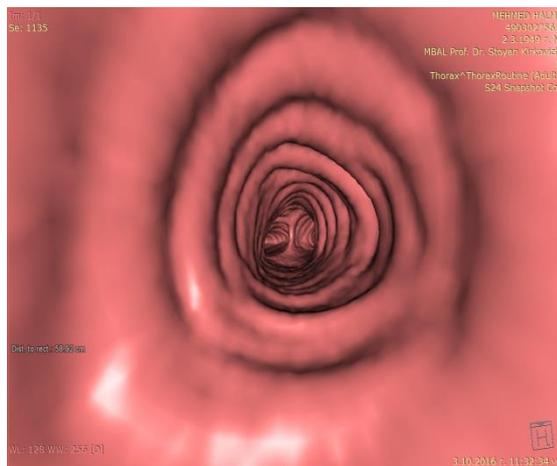
## RESULTS

The present study presents the results of the techniques and methodologies applied at one patient - a 63 year-old man with advanced neoplasm of the esophagus and formation of a tracheo oesophageal fistula. Failing to perform Fiberoptic bronchoscopy (FB), esophagoscopy was performed. Described were strong spastic changes of the rima, due most likely to affected nervus reccurens, which hindered the performance of FB with which to determine the location, the shape, the size of the lesion and potential stenosis of the trachea.

By performing esophagoscopy a volumetric formation was found, situated in the lower third of the esophagus, abundantly bleeding when touched. There were no endoscopic evidence of availability of a fistula path. From the performed CT unfolded pulmonary parenchyma with deformed strip and grid pattern and irregular nodular thickened areas of the pleura, bilaterally basally were found. There were also single nodules with sharp outlines in perivascular direction, more to the right, the changes being suspicious for remote lesions from the known primary lesion with concomitant infiltrative - inflammatory changes. In the background of the mediastinum there was an evidence of a hyperdense formation originating from the lower third of the esophagus, located at the level of the tracheal bifurcation. At the axial and multi-planar reconstructions in the same zone back laterally to the left a defect was found with the availability of a skew fistula path ensuring the communication of the esophagus with the left main bronchus. The defect was located at 3 millimeters to the left of the parasagittal line at the base and along the medial part of the left main bronchus. The regular oval shape of the bronchus contour was damaged. The next part of the carina was attracted to the left, distorted and deformed. The size of the fistula in the axial plane was 9/5 mm. The direction of the fistula path from the esophagus to the trachea was caudal-cranial. There was no CT evidence for pneumomediastinum. After the postprocessing with subsequent virtual bronchoscopy a lesion was detected located on the medial wall at the base of the left main bronchus, close to the deformed carina. The distance between the fistula and the rima was 25 cm. The distance from the middle of the

carina was 25 mm. The carina looks deformed and attracted to the left. The shape of the lesion, determined by the VB, was oval, with dimensions in the axial plane 7.2/4.7 mm. The edges of the lesion were irregular, continuous and raised due to the formed granulation. Next to it an irregularly shaped multi-arc prominence of the wall to the lumen was observed, with wide angle and multiple bumps of the tracheal wall due to infiltration and granulation. The advanced neoplasm caused a neoplastic tracheomalacia with segmental deformation and stenosis first degree in the area of the neoplasm. The described changes were found proximally to the fistula and they changed the regular ovality of the contour of

the trachea wall. The cartilages in the area were deleted, with a discontinuous contour. Performing MDCT with virtual bronchoscopy, according to this study, is crucial as the sole and complex methodology for the described case in connection with the finding of the trachea-oesophageal fistula and evaluation of the mediastinum and the pulmonary parenchyma. The presence of persistent cough can cause suspicion of tracheal rupture, but at the same time due to suspected pneumonia and lack of pneumomediastinum it can not be categorical. There have been comparisons with the results of the virtual esophagoscopy where because of large lesion and bleeding the fistula path was not found (**Figures 1-2**).



**Figure 1.** Normal image of the trachea



**Figure 2.** Broncho-oesophageal fistula

## DISCUSSION

The lesion and the fistula path were distinguished by the virtual bronchoscopy. VB was determined as more practical, more brief and more precise than FB in assessing the trachea and the main bronchi, enabling 3-dimensional evaluation of the tracheobronchial tree (11). The authors find that VB is better than FB for the diagnosis of rupture of the trachea in patients with pneumomediastinum. Such data are also set out in the research of many other authors (4, 6, 7, 8, 5, 9, 10, etc.). The state of the patient of this study can be described as risky and dangerous because of the available tracheo-oesophageal fistula and the possibility of secondary complications such as mediastinitis, pneumomediastinum and impaired lung function, etc. In this case, due to spasm and hindering of the intervention FB can not be performed. Thus the important and determining role of the MDCT and the virtual bronchoscopy is manifested as a single and comprehensive methodology for establishing the trachea-oesophageal fistula and for complex assessment of the mediastinum and

the pulmonary parenchyma. When comparing the results with the fiber-optic esophagoscopy it is clear that the esophagoscopy proves a neoplastic process, but can not detect the fistula path while using MDCT with virtual bronchoscopy maximum performance is achieved. The methodology allows for accurate localization of the lesion, determining its shape, possibility to perform measures, to determine the exact distance of the lesion from the rima, the carina or adjacent processes.

According to the performed study, the advantages of the VB are:

- As a non-invasive method it can be used for dynamic tracking of the process;
- VB allows to take into account existing granulation;
- It allows accurate assessment of the changes occurred proximally and distally to the lesion, ie in the studied case it provides an opportunity to assess the distal changes, the changes in adjacent area and the size of the changes.
- It allows to capture metric data and to track the dynamics of the process;

- It can be used as a preliminary method for noninvasive evaluation of the tracheobronchial tree and to guide the proper behavior at subsequent FB or surgery.

Identified deficiencies of the VB are:

- It does not allow to distinguish and to conduct an accurate assessment of the accumulated intraluminal secretions;
- It can not accurately assess the changes in the mucosa.

These deficiencies can cause incorrect interpretation of some data from the VB and wrong conclusions.

In this case the results of the VB in the presented study show a high degree of sensitivity in the diagnosis of the described case of rupture due to advanced neoplasm. According to the study results, the increased success rate is due to the exceptional development and improvement of the equipment and the methods of diagnosis (optimized protocol of the study), significantly increasing the sensitivity and precision of the studies. VB is presented as a complementary technique, increasing the possibilities for visualization with improvement of the success rate of diagnosis and treatment in an emergency, especially for patients with severe disabilities.

## CONCLUSION

The study determines MDCT with VB as a basic and expert diagnostic method. The method is also applicable and recommended in cases with damage of the respiratory tract where fiberoptic bronchoscopy can not be performed, e.g., in case of high degree stenoses. This study gives grounds to assume that the VB is a successful method equally effective compared to the FB, to diagnose post-intubation and posttraumatic ruptures and with a greater efficiency in the described case of a rare rupture due to advanced neoplastic processes.

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