

**Diagnostic fiberoptic bronchoscopy in potential lung donors**

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*The article has summarized the global practice of the lung graft assessment with defining the absolute and relative criteria of donor lung suitability. The authors have presented their own experience of fiberoptic bronchoscopy in 115 potential donors in the period from 2010 to 2015. The results of endoscopic examination of donor lungs were reviewed to determine the degree of the bronchial mucosa inflammation. A therapeutic fiberoptic bronchoscopy allowed clearing the bronchial lumen from pathologic contents and adequate preparing the lung graft in 29.6% of cases.*

**Keywords:** lung transplant, fiberoptic bronchoscopy, donor, tracheobronchitis.

Lung transplantation is a definite treatment technique for chronic non-specific pulmonary diseases with severe respiratory failure when the possibilities of alternative treatments have been exhausted [1]. A careful donor selection and management, as well as a multidisciplinary approach to the recipient treatment, largely determine the result of surgery.

The main limiting factor for lung transplantation is the shortage of donor organs. This leads to long waiting times for the recipients with severe lung diseases. The mortality of the patients while being on the waiting list for lung transplantation makes 10-15% [2]. Meanwhile, a post-transplant mortality still remains high, reaching

11.5% within the first 6 months after transplantation [3]. The need to improve the lung graft quality for achieving better transplantation outcomes and using a suboptimal donor pool dictates the necessity of a thorough endoscopic monitoring at all stages of transplantation.

A diagnostic-and-therapeutic fiberoptic bronchoscopy (FOB) can be used at any stage of lung transplantation to assess endobronchial abnormalities in a donor and to perform necessary endoluminal endoscopic interventions [4].

The criteria for an "ideal" donor lung include: the donor age between 20-45 years, the recipient stay on mechanical ventilation for no longer than 3 days, no lung abnormalities as per the results of endoscopic and radiological studies, no gram-negative flora in the bronchial content, an intact oxygenation function of the lung assessed as oxygenation index  $\geq 3$  [3, 5, 6]. Thus, FOB is one of the key tools in making a decision on the donor organ suitability for lung transplantation; it also can be used to perform endobronchial therapeutic manipulations in a complex management during donor conditioning.

**Objective:** To study the potential of the diagnostic-and-therapeutic FOB in assessing the donor lung suitability for transplantation.

## **PATIENTS AND METHODS**

In the period from August 2010 to June 2015, 115 donors (29 women and 86 men) were assessed for their lung suitability for transplantation. The mean age of donors was 36 years old. The mean stay on mechanical ventilation was 49.3 hours. At the stage of brain death diagnosis, the standard FOB according to the protocol of endoscopic examination for lung donors was performed in all cases (Table 1) that included: cleansing the tracheobronchial tree with sampling the bronchial contents for microbiology; assessing the position of the endotracheal tube distal tip, the contents from the tracheobronchial tree, bronchial mucosa status; identifying the anatomic features of the trachea and bronchi.

**Table 1. Protocol of endoscopic examination of a potential lung donor**

<b>1</b>	Cleansing the bronchial tree + sampling the bronchial contents for microbiology
<b>2</b>	Checking the endotracheal tube position
<b>3</b>	Assessment of the bronchial contents
<b>4</b>	Evaluation of the bronchial mucosa condition
<b>5</b>	Identification of structural peculiarities of the tracheobronchial tree anatomy

Endoscopic criteria of an "ideal" lung were considered the following:

- 1) no abnormal secretion, or scanty mucous secretion in the tracheobronchial tree;
- 2) no mucosa abnormalities in the trachea and bronchi;
- 3) no structural abnormalities of the main and lobar bronchi.

The expansion criteria for donor lungs were considered the following: a moderate amount of mucino-purulent secretion in the bronchi without the trend to its increasing after repeated FOB, signs of blood aspirate, and degree I-II bronchitis.

The exclusion criteria were the purulent degree III bronchitis, signs of gastric content aspiration, and traumatic damage of bronchial mucosa.

The mucosal inflammation of the trachea and bronchi was assessed using a tracheobronchitis classification into 3 severity degrees as developed by J. Lemoine (1965) and modified by Lukomsky G.I. et al. (1982) (Table. 2) [7]. The extent of inflammation was also evaluated as diffuse (all visible bronchi being affected), partially diffused (the upper lobar bronchi being intact), and limited.

**Table 2. Tracheobronchitis classification [J. Lemoine (1965), G.I. Lukomsky (1982)]**

Process severity	Endoscopic signs
Bronchitis, I degree of inflammation	Moderate hyperemia and swelling of the bronchial mucosa, blurred vascular pattern, the mucosal edema slightly disguises the relief of cartilaginous rings, there is a large amount of mucous secretion
Bronchitis, II degree of inflammation	Bright hyperemia and swelling of the bronchial mucosa; an undefined vascular pattern. The relief of cartilaginous rings is hardly discernible due to swollen bronchial mucosa, the orifices of segmental and subsegmental bronchi are narrowed due to mucous membrane edema; mucopurulent secretions, viscous and liquid, their amount varies.
Bronchitis, III degree of inflammation	The bronchial mucous membrane is of purple-bluish color with severe edema causing the orifices of segmental bronchi to look dot-like. The relief of cartilaginous rings is completely smoothed. The secretions are purulent, viscous or liquid, in a very large amount.

## RESULTS

The FOB performed in potential lung donors demonstrated no abnormalities in the trachea and bronchi in 14 cases (12.2%) (Endoscopy photo 1); so according to the endoscopy results, the donor lungs were considered suitable for transplantation.



**Endoscopy photo 1**

Expanded endoscopic criteria of using the donor lungs for transplantation were recorded in 84 cases (73%), including 68 cases (59.1%) of identified degree I-II bronchitis, and 16 (14%) cases of the identified blood aspiration (Endoscopy photo 2).



**Endoscopy photo 2**

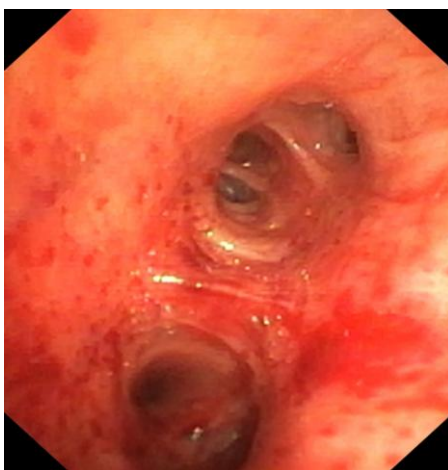
Those 84 donors with expanded endoscopic criteria were considered suboptimal, and the decision on their using for lung explantation and further transplant was taken based on other tests.

In that group, the lungs were used for transplantation in 16 cases only (14%), in other cases, the decision to refrain from using the grafts for transplantation was taken because of the lung abnormalities detected at X-ray in 56 cases (48.7%), and at the lung oxygenation function measurement in 12 cases (10.4%).

The endoscopic criteria of excluding a potential lung donor were found in 17 cases (14.8%), among those there were 11 cases of gastric content aspiration (Endoscopy photo 3). Post-intubation mucosal damage of the trachea, carina, and bronchi in the form of traumatic erosions and submucosal hemorrhage were diagnosed in 5 donors (Endoscopy photo 4).



**Endoscopy photo 3**



**Endoscopy photo 4**

Those donors were considered marginal donors and their lungs were not used for transplantation.

One case was diagnosed as having a tracheal bronchus of the right lung. However, the presence of the tracheal bronchus in the patient with an ideal radiological and endoscopic presentation was not an obstacle for using his lung for transplantation, but required the repair of the bronchial anastomosis during the operation on the recipient.

## **DISCUSSION OF THE RESULTS**

According to the International Society for Heart and Lung Transplantation, more than 3,500 lung transplants are performed in the world annually, while the demand for these surgical procedures is 10 times higher [4].

The main limiting factor with the available donor pool is a small amount of suitable lung allografts due to traumatic lung injury, aspiration, and other reasons [3, 8-10]. Only 15-20% post-mortem organ donors become lung donors [11-13]. Our study demonstrated that among the total number of evaluated donors, the endoscopic signs were consistent with the "ideal" or expanded criteria in 98 cases (85%). After a comprehensive assessment of these donors for their lung suitability for transplant, the lungs were qualified as "ideally" suitable in 14 cases (12.2%), and suboptimal in 84 cases (73%). Based on the endoscopic evaluation, 17 donors (14.8%) were considered marginal, and their lungs were not used for transplantation.

## **CONCLUSION**

FOB is an integral part of a comprehensive assessment of potential lung donors at donor conditioning stage, and it allows an evaluation of tracheobronchial tree mucosa, bronchial secretions, and anatomical peculiarities to make a decision on using the lung for transplantation.

## **References**

1. Pasque M.K., Cooper J.D., Kaiser L.R., et al. Improved technique for bilateral lung transplantation: Rationale and initial clinical experience. *Ann Thorac Surg.* 1990;49(5):785–791.
2. Van Raemdonck D., Neyrinck A., Verleden G.M., et al. Lung donor selection and management. *Proc Am Thorac Soc.* 2009;6(1):28–38.
3. Yusen R.D., Edwards L.B., Kucheryavaya A.Y., et al. The Registry of the International Society for Heart and Lung Transplantation: Thirty-second Official

Adult Lung and Heart-Lung Transplantation Report-2015; Focus Theme: Early Graft Failure. *J Heart Lung Transplant*. 2015;34(10):1264–1277.

4. Pishchik V.G. *Status light multiple organ donors and the possibility of a clinical assessment of their suitability for transplantation: Cand. med. sci. diss.* Saint-Petersburg, 1998. 138 p. (In Russian).

5. Chaney J., Suzuki Y., Cantu E., Van Berkel V. Lung donor selection criteria. *J Thorac Dis*. 2014;6(8):1032–1038.

6. Shumway S.J., Hertz M.I., Petty M.G., Bolman 3rd R.M. Liberalization of donor criteria in lung and heart-lung transplantation. *Ann Thorac Surg*. 1994;57(1):92–95.

7. Lukomskiy G.I., Shulutko M.L., Vinner M.G., Ovchinnikov A.A. *Bronhopulmonologiya*. Moscow: Meditsina Publ., 1982. 399 p. (In Russian).

8. Savel'ev V.S., Buyanov V.M., Lukomskiy G.I., eds. *Manual of clinical endoscopy: a guide*. Moscow: Meditsina Publ., 1985. 543 p. (In Russian).

9. Ware L.B., Wang Y., Fang X., et al. Assessment of lungs rejected for transplantation and implications for donor selection. *Lancet*. 2002;360(9333):619–620.

10. Moretti M.P., Betto C., Gambacorta M., et al. Lung procurement for transplantation: new criteria for lung donor selection. *Transplant proc*. 2010;42(4):1053–1055.

11. Porro G.A., Valenza F., Coppola S., et al. Use of the Oto lung donor score to analyze the 2010 donor pool of the Nord Italia transplant program. *Transplant proc*. 2012;44(7):1830–1834.

12. Toledo-Pereyra L.H. *Organ preservation for transplantation*. USA: Landes Bioscience, 2010. 246 p.

13. Vigneswaran W.T., Garrity E.R. Jr., eds. *Lung transplantation*. UK: Informa Healthcare, 2010. 448 p.