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Percutaneous endoscopic gastrostomy in comprehensive preparing the patients with severe body mass deficiency for lung transplantation

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Introduction. *Currently, lung transplantation is an approved method for treating a wide range of end-stage lung diseases refractory to medical or surgical treatments when patient's life expectancy without transplantation makes no more than two years.*

The aim *was to evaluate the efficacy of continuous nutritional support via percutaneous endoscopic gastrostomy in potential recipients of lung transplantation with a Body Mass Index under 16 kg/m^2.*

Material and methods. *The study was based on the analysis of 93 potential recipients with various lung diseases; 27 of them with diagnosed cystic fibrosis. The enteral nutrition results of the patients with cystic fibrosis whose Body Mass Index (BMI) was under 16 kg/m^2 were assessed by the increment in BMI and compared between those fed via gastrostomy* (n=15) *and those fed per os* (n=22).

Results. *As a result of enteral nutrition via the gastrostomy in the daytime and at night, the majority of recipients (73.3% of cases) had the Body Mass Index (BMI) corrected by 0.1 to 4.91 kg/m^2 during the first year, the mean BMI increment made 1.87 ± 0.4 kg/m^2. After the BMI correction, 11 of the 15 potential recipients were included in the waiting list, and 6 of them (40%) underwent lung transplantation.*

In the comparison group, the BMI increment was 0.9 ± 0.3 kg/m^2, also having reached a significant difference compared to the baseline (p = 0.04). However, the BMI increment in the main group was significantly higher than in the comparison group (p = 0.02).

Conclusion. *A statistically significant increase in BMI in a group of patients with cystic fibrosis and BMI under 16 kg/m^2, has been demonstrated after percutaneous endoscopic gastrostomy, which allows extending the criteria for the inclusion in the waiting list for lung transplantation.*

Keywords: lung transplant, percutaneous endoscopic gastrostomy, cystic fibrosis

BMI, Body Mass Index

PF, pulmonary fibrosis

LT, lung transplantation

PEG, percutaneous endoscopic gastrostomy

ISHLT, International Society for Heart and Lung Transplantation

Currently, lung transplantation (LT) is an approved method for treating a wide range of end-stage lung diseases refractory to medical or surgical treatments when patient's life expectancy without transplantation makes no more than two years [1].

The recommendations of the International Society for Heart and Lung Transplantation (ISHLT) of 2014 set out absolute and relative contraindications to LT. Naturally, they should be interpreted with some caution, as more experienced clinics, having extensive experience with LT, can limit these contraindications.

The results of lung transplantation are assessed according to several criteria, such as the survival, quality of life, and functional parameters, the survival being the most meaningful one. According to ISHLT data, a 1-, 3-, and 5-year survival after lung transplantation makes 82.0%, 66.7%, and 55.3%, respectively [2].

An important prognostic factor of survival before and after LT is the nutritional status [3, 4]. In patients with Body Mass Index (BMI) under 17 kg/m^2, the mortality increases by 25% compared with the patients showing normal BMI, therefore this is the threshold limiting LT [3].

In 1980, M.W.L.Gauderer from the Cleveland State University (USA) used percutaneous endoscopic gastrostomy (PEG) in patients having various diseases that were accompanied by weight loss.

In 2011, there was published a positive 7-year experience of using PEG with day and night feeding to correct nutritional status in patients with a BMI equal to or under 17 kg/m^2 having various pathologies, including the patients with pulmonary fibrosis before LT [4].

According to F.M.Hollander et al. (2014), the combination of various enteral nutrition methods: oral, tube, and PEG provided no significant increments in the body weight of the patients on the waiting list for LT who had the BMI equal to or under 18.5 kg/m^2. However, the authors noted the normalization of body mass indices in those patients at 6–12 months after LT [5]. The issue of expanding the criteria for the inclusion of the patients having severe pulmonary pathology and BMI under 17 kg/m2 in the waiting list for LT remains relevant to this day.

The study objective was to evaluate the efficacy of continuous nutritional support via percutaneous endoscopic gastrostomy in potential LT recipients with BMI under 16 kg/m^2.

Study material and methods

From 2011 to 2017, 93 potential recipients with various lung diseases were placed on the waiting list for LT in N.V.Sklifosovsky Research Institute for Emergency Medicine. There were 54 women and 39 men at the age ranging from 16 to 60 years old. Lung transplantation was performed in 49 patients (25 women, and 24 men). The age of the patients undergoing LT ranged from 17 to 60 years old.

The cystic fibrosis patients accounted for the majority of potential recipients n=27 (28.7%), besides, there were 11 patients (11.7%) with exogenous allergic alveolitis, 8 patients (8.5%) with chronic obstructive pulmonary disease, and 8 patients (8.5%) with pulmonary fibrosis (PF).

A comparative prospective study included 15 potential LT recipients with cystic fibrosis whose BMI ranged from 11.9 to 16.6 kg/m^2 (mean BMI 14.6 kg/m^2). All those patients, in addition to the basic nutrition per os, received an enteral nutritional support for the body weight correction.

For that purpose, to provide a continuous enteral nutrition during the daytime and at night, all the patients in that group underwent PEG. Those patients constituted the main study group.

The remaining 12 patients with cystic fibrosis had a BMI ranging from 15 to 19 kg/m^2 (mean BMI 17.8 kg/m^2). Patients of this group were included in the waiting list for LT, PEG was not performed to them, and the nutritional support was administered per os.

PEG was performed according to the standard procedure: the first stage included the endoscopic examination of the esophagus, stomach, and duodenal. If no erosive and ulcerative lesions were seen, the air was forced into the stomach lumen until the folds were fully expanded. A 0.6 cm-long skin incision was made along the right parasternal line, at 2.5–3.0 cm below the costal arch. A needle-catheter was used to puncture the anterior abdominal wall and the anterior wall of the stomach under endoscopic guidance. After the needle had been removed, a string was passed through a plastic cannula into the lumen of the stomach. The string was captured with an endoscopic snare and drew out together with the endoscope. The tip of the gastrostomy tube was treated with sterile saline to enhance the hydrophilic properties, and with Levomekol ointment as an antiseptic. The snare of the gastrostomy tube and the plastic guidewire were fixed as a “lock”. By pulling up the guidewire, the gastrostomy tube was brought into the lumen of the stomach until the rigid fixation of its tip in the cannula. After that, the whole complex was drawn out until the stop of the inner fixing ring against the inner surface of the anterior wall of the stomach. The outside fixing device was put on the gastrostomy tube, which tightly pressed the tube to the anterior abdominal wall, and was fixed with a clamp. The aboral tip of the

gastrostomy tube was connected to a two-channel Luer cannula. The mean duration of the PEG placement procedure was 9±3 min. Taking into account the severity of patient condition, PEG procedures in all cases were performed under an intravenous anesthesia using local anesthesia with 0.5% Novocain solution.

PEG was performed using gastrostomy kits of various manufacturers with a tube diameter of at least 20 Ch. The standard algorithm of the patient examination, besides the endoscopic study, included the ultrasound examination of the abdominal cavity for the presence of free fluid both before PEG procedure, and on the first day after PEG.

Nutrition via gastrostomy was started from the first day, 500 ml of salt solutions were given dropwise; later on, after 24 hours, 1000 ml of a balanced nutritional protein formula were given. On day 7 after PEG, the amount of administered nutritional formula depended on patient's individual nutritional requirements.

The comparison group consisted of 22 adult patients with cystic fibrosis, with comparable nutritional status data (BMI 15.0 ± 1.1 kg/m^2) who were not included in the waiting list at the time of the study as they had no indications to LT.

All these patients received oral balanced hypercaloric nutrition only, after consulting a nutritionist and the calculation of daily caloric intake making 2,700–3,100 kcal. Thus, the main group and the comparison group had a comparable daily caloric intake. The increments in BMI were compared between the main group and the comparison group at a year from the start of the nutritional support.

The differences between the groups were determined using Student's t-test. The dynamics of parameters in dependent groups was compared using the Wilcoxon test. Differences were considered statistically significant at $p<0.05$.

Study results

As a result of the study, the body weight correction was achieved in 11 cases. No BMI increase could be achieved in 4 other patients, and they were not included in the waiting list for LT. The ratio of BMI in the recipients as a result of the nutritional support provided via PEG for 1 year is shown in the Table. No PEG-associated intraoperative or early postoperative complications were observed.

Table. The results of nutritional support after the procedure of percutaneous endoscopic gastrostomy

No.	**BMI before PEG**	**BMI in the long-term after PEG**	**Increment**
1	13.9	17.46	3.56
2	14.2	14.2	0
3	16.13	19.01	2.88
4	14.4	16.55	2.15
5	13.84	16	3.84
6	14.22	17.3	3.08
7	15.31	20.22	4.91
8	12.38	16.54	4.16
9	13.25	15.6	2.35
10	14.53	17,8	3.27
11	15.2	18.12	2.92
12	11.9	11.9	0
13	13.1	13.1	0
14	16	16.1	0.1
15	16.6	16.8	0.2

In the study group, as a result of enteral feeding via gastrostomy and per os during the daytime and at night, the BMI increase by 0.1 to 4.91 kg/m^2 was achieved. During the first year, the BMI increased by average 1.87 ± 0.4 kg/m^2. The BMI increment was statistically significant ($p = 0.03$). After the BMI correction, 11 patients (73.3%) were included in the waiting list, and 6 of them underwent LT. In the remaining 5 cases, the LT was not performed for reasons non-related to either PEG, or BMI.

In the comparison group, the increment in BMI made 0.9 ± 0.3 kg/m^2, also reaching a statistical significance compared to the baseline ($p = 0.04$). However, the increment in BMI in the main group was significantly higher than in the comparison group ($p = 0.02$).

All 12 patients with cystic fibrosis and BMI over 17 kg/m^2 who had no PEG performed were included in the waiting list; 10 patients in this group underwent LT.

Discussion of results

The patients with the diagnosis of cystic fibrosis constitute a pool of severely ill patients with low BMI who need nutritional support both in the preoperative period and after LT. The PEG procedure performed in the preoperative period allows an adequate preparation of the recipient for LT, contributing to the prevention of possible postoperative complications while the patient is on drug immunosuppressive therapy. Our study has shown that PEG performed in potential recipients with cystic fibrosis and BMI under 16 kg/m^2 made it possible to improve this parameter during the first year average by 1.87 ± 0.4 kg/m^2 and expand the criteria for inclusion in the waiting list for 11 patients with followed LT in 6 of them. Additionally, our

study has demonstrated that the nutritional support via gastrostomy is more effective than "normal" oral nutrition.

We should note that by the time of lung transplantation, all recipients with PEG had had a comletely formed scar between the stomach wall and the anterior abdominal wall, which helped to avoid complications associated with suture incompetence at the site in the post-transplant period.

Conclusion

In 13 of 15 patients (87%) with a body mass index under 16 kg/m^2, a percutaneous endoscopic gastrostomy and the followed nutritional support provided a statistically significant increment in the body mass index from 0.1 to 4.91 kg/m^2 during the first year, which allowed extending the criteria for inclusion of these patients in the waiting list for lung transplantation in 73% of cases.

Conflict of interests. Authors declare no conflict of interests.

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