Assessment of Quality of Life Among Patients After Lung Transplantation: A Single-Center Study

Tomasz Stącel[a], Izabela Jaworska[a,b], Fryderyk Zawadzki[a,b,*], Marta Wajda-Pokrontka[a,b], Zofia Tatoj[a,b], Maciej Urlik[a], Mirosław Nęcki[a], Magdalena Latos[a,b], Wioletta Szywacz[a,b], Alicja Szczerba[a,b], Remigiusz Antończyk[a,b], Anna Pióro[a,b], Piotr Przybyłowskia[c], Marian Zembala[b], and Marek Ochman[a,b]

[a]Silesian Center for Heart Diseases, Zabrze, Poland; [b]Department of Cardiac, Vascular, and Endovascular Surgery and Transplantology, Medical University of Silesia, Katowice, Poland; and [c]First Chair of General Surgery, Jagiellonian University, Medical College, Kraków, Poland

ABSTRACT

Introduction. Lung transplantation (LTx) is the only effective method of treatment to improve the health and quality of life (QoL) of patients with end-stage lung diseases. After LTx, medical examination accompanied by quality of life assessment should be performed on routine follow-up visits. The aim of the study was to assess the QoL of patients after LTx.

Material and methods. The study group consisted of 60 patients (29 women and 31 men); 20 patients received single lung transplantation (SLT), and 40 received double lung transplantation (DLT). To determine the patient's QoL, the General Health Questionnaire (GHQ), the World Health Organization Quality of Life Test–BREF (WHOQOL-BREF), and the Saint George Respiratory Questionnaire (SGRQ) were used. Spirometry and the 6-minute walk test were analyzed to examine efficiency of transplanted organs.

Results. In SGRQ there are differences between patients with cystic fibrosis and interstitial lung disease in symptom domain (20.28% vs 39.26%, $P = .025$) and total score (19.38% vs 32.47%, $P = .028$). As reported in the GHQ, men had worse overall results than women in sten scale (5.22 points vs 4.69 points). Patients after SLT achieved similar scores in every questionnaire.

Conclusion. Studies assessing QoL should be an important addition to lung function tests and an integral part of control during postoperative follow-up visits. This study is one of the important contributions to understanding of how essential QoL is after LTx. The authors of this study realize that their work does not cover the whole issue, and further studies in this area are warranted.

LUNG transplantation (LTx) is the final option for treating patients with end-stage lung diseases. The most common indications for LTx are chronic obstructive pulmonary disease (COPD), interstitial lung disease (ILD), cystic fibrosis (CF), and idiopathic pulmonary arterial hypertension (IPAH) [1]. Before LTx, every patient with end-stage lung disease needs specific therapy consisting of pharmacologic and appropriate nonpharmacologic support [2]. Prior to the procedure, typical patient symptoms are fatigue, dyspnea, or intolerance of any life activity. This affects patients' frame of mind and negatively influences quality of life (QoL). LTx prolongs life and positively affects its quality in general [3–8]. The definition of QoL defined by World Health Organization (WHO) is an "individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns."

*Address correspondence to Fryderyk Zawadzki, Department of Cardiac, Vascular, and Endovascular Surgery and Transplantology, Silesian Center for Heart Diseases in Zabrze, Medical University of Silesia, ul. Curie-Skłodowskiej 9, 41-800, Zabrze, Poland. E-mail: zawadzkifryderyk@gmail.com

0041-1345/20
https://doi.org/10.1016/j.transproceed.2020.03.048

Interpretation of this general universal definition includes psychological state, social relationships, personal beliefs, and their relationships to salient features of the environment, level of independence, and individuals' physical health [9]. Among medical tests, QOL questionnaires and psychiatric assessments should not be forgotten during follow-up visits. The aim of this single-center study was to analyze the QoL in patients who underwent LTx between 2003 and 2018.

MATERIALS AND METHODS

This study assessed 60 patients (29 women and 31 men) with the mean age of 44.2 years ± 14.7 (range 18-72 years of age) who underwent LTx in the Lung Transplant Program of Silesian Center for Heart Diseases in Zabrze, Poland, between 2003 and 2018.

The mean time between LTx and completion of the questionnaires was 54.97 months ± 41.28 (range 12-145 months). Among our study group, 40 patients (66.7%) had double lung transplantation (DLT) (20 women and 20 men). Twenty patients (33.3%) underwent single lung transplantation (SLT) (9 women and 11 men). The most common diagnoses were CF: 15 patients (25%); COPD: 15 patients (25%); IPAH: 6 patients (10%); ILD: 20 patients (33.3%), which includes idiopathic pulmonary fibrosis (12), sarcoidosis (2), histiocytosis (3), lymphangioleiomyomatosis (1), and hypersensitivity pneumonitis (2); and other diagnoses: 4 patients (6.7%), which includes Osler-Weber-Rendu syndrome (1), Williams-Campbell syndrome (1), pulmonary veno-occlusive disease (1), and bronchiectasis (1).

The inclusion criteria were patients 18 years or older who attended our center for a controlled hospitalization and agreed to take part in our study and who had undergone LTx at least 1 year previously. Time from transplantation was not a limitation for inclusion provided the patient completed 1 year of follow up since LTx. To determine the patients' QoL, patients were asked to fill out the following questionnaires:

1. World Health Organization Quality of Life–BREF (WHOQOL-BREF) questionnaire. This questionnaire was used to assess the psychometric QoL. It analyzes the emotional state (joy of life, the possibility of realizing interests, relationships with the immediate environment, experiencing negative feelings) and the physical condition of the respondent (sleep disorders, efficiency in everyday life, energy level enabling functioning in society) and contains 4 separate domains: somatic, psychological, social, and environmental. Each question is scored by the 5-level Likert scale (1: strongly disagree; 2: disagree; 3: neither agree nor disagree; 4: agree; 5: strongly agree).
2. General Health Questionnaire (GHQ-28). This questionnaire is used to assess the mental health of adults. GHQ-28 allows the selection of people whose mental state has collapsed temporarily or for a long time as a result of experienced difficulties, problems, or as a result of mental illness, and those who have a significant risk of mental health disorders. It consists of 28 questions included in 4 domains: symptoms, anxiety and insomnia, social dysfunction, and severe depression; each is scored on a 4-point Likert scale (0-1-2-3). Results calculated by the Likert scale were transferred to a 10-point sten scale. The probability of mental illness is assessed as a cutoff point at >6 points on the sten scale. The higher the result on the sten scale, the higher probability of mental illness.
3. Saint George Respiratory Questionnaire (SGRQ). This questionnaire is designed to measure health impairment. It is divided into 2 parts and 3 components. Part 1 shows the frequency of respiratory symptoms and assesses the patient's perception of his or her recent respiratory problems. This part contains the symptoms component. Part 2 is about the patient's current state, which is composed of an activity component and impacts component. The activity component consists of questions about activities that cause or are limited by breathing difficulty, whereas the impacts component covers functioning and psychological disturbances resulting from airway disease.
4. Authorial metric. This questionnaire includes marital status, education, employment, and number of hospitalizations per year.

We assessed pulmonary function before and after LTx by the 6-minute walk test (6MWT), which includes distance (m), Borg scale, oxygen saturation (SpO2 [%]) before and after 6MWT, as well as spirometry; forced expiratory volume in first second (FEV1); and forced vital capacity (FVC). We believe that results of pulmonary function tests (satisfactory or not) are only surrogate of QOL. We also examined the following parameters (separately for SLT and DLT patients) before LTx and at the time of survey: body mass index (kg/m2), hemoglobin concentration (dL), estimated glomerular filtration rate (eGFR [mL/min/1.73 m^2]), and time on waiting list (days). Donor's information as medium age (years), body mass index, and cause of death were collected. This comparison between SLT vs DLT recipients revealed that patients who received DLT were significantly younger than SLT recipients (36.45 ± 14.77 years vs 45.65 ± 12.97 years; $P = .021$). At the time of qualification, SLT recipients gained better results in spirometry than DLT recipients (FEV1%-44.88% ± 23.88 vs 28.52% ± 18.64; $P = .029$). Kidney function at the time of qualification measured by eGFR (mL/min/1.73 m^2) was within normal range in both groups; however, eGFR was higher among DLT patients (130.49 ± 55.23 vs 95.57 ± 22.62; $P = .016$). That data are presented in Table 1.

STATISTICAL ANALYSIS

Results of collected data are presented as a mean and ± standard deviations. The Smirnov-Kolmogorov test was used to verify the type of distribution. Differences for quantitative variables between groups were measured by the Student's t test. All findings with $P < .05$ were considered statistically significant. For statistical analysis, Statistica 10.0 software (StatSoft, Inc., Tulsa, Oklahoma, USA) was used.

Patients with Osler-Weber-Rendu syndrome (n =1), Williams-Campbell syndrome (n = 1), pulmonary veno-occlusive disease (n = 1), bronchiectasis (n = 1), and IPAH (n = 6) were excluded from comparative analysis because of the small populations of these patients.

RESULTS

From January 2003 to December 2018, 177 LTx were performed in our center; 117 patients were excluded from the study because of the following reasons: death (n = 84), lack of 1-year follow-up visit (n = 10), admittance to ward because of deterioration of lung function (n = 16), or no follow-up visit (n = 7).

1. Demographic metrics: Information on marital status, education, employment, and number of hospitalizations were collected. According to marital status, the study group was split into participants who married or lived

Table 1. Data of Comparison Single Lung Recipients vs Double Lung Recipients Including Demographic Data, Clinical Data at the Time of Qualification, Information About Donors, and Clinical Data at the Time of Survey

	SLT (n = 20)	DLT (n = 40)	*P* Value
Demographic Data			
Age, y	45.65 ± 12.97	36.45 ± 14.77	.021
Sex, % male	55	50	.715
COPD, %	20	27.5	
ILD, %	65	17.5	
Sarcoidosis, %	10	0	
Histiocytosis, %	15	0	
IPF, %	30	15	
LAM, %	5	0	
Hypersensitivity pneumonitis, %	5	2.5	
CF, %	10	32.5	
PVOD, %	0	2.5	
Williams-Campbell syndrome, %	0	2.5	
Osler-Weber-Rendu syndrome, %	0	2.5	
Bronchiectasis, %	0	2.5	
IPAH, %	5	12.5	
Clinical Data at the Time of Qualification			
BMI, kg/m^2	22.37 ± 4.22	20.32 ± 3.76	.075
Time on waiting list, d	212.68 ± 275.85	256.91 ± 270.84	.436
Hgb, g/dL	12.79 ± 3.59	13.12 ± 3.07	.738
eGFR, mL/min/1.73 m^2	95.57 ± 22.62	130.49 ± 55.23	.016
FEV1%	44.88 ± 23.88	28.52 ± 18.64	.029
FVC%	56.78 ± 23.58	48.06 ± 20.36	.252
Distance in 6MWT, m	299.86 ± 155.57	325.36 ± 145.17	.581
Borg's scale, points	5.00 ± 2.29	4.91 ± 1.89	.893
SpO2 before 6MWT, %	89.94 ± 5.11	89.61 ± 8.67	.891
SpO2 after 6MWT, %	73.94 ± 9.79	75.50 ± 14.33	.711
Donor's Information			
Age, y	33.85 ± 11.96	39.36 ± 11.22	.267
BMI, kg/m^2	24.01 ± 2.38	22.88 ± 15.97	.323
Donor's cause of death			
Cerebrovascular accidents, %	55	52.5	
Cerebral trauma, %	40	37.5	
Other, %	5	10	
Clinical Data at the Time of Survey			
Hgb, g/dL	8.01 ± 0.71	7.63 ± 0.98	.148
eGFR, mL/min/1.73 m^2	46.19 ± 21.86	62.73 ± 39.58	.107
FEV1%	56.75 ± 17.01	68.92 ± 25.74	.056
FVC%	68.05 ± 15.66	81.97 ± 18.25	.005
Distance in 6MWT	480.72 ± 97.09	514.23 ± 119.95	.285
Borg scale, points	2.10 ± 1.96	2.11 ± 2.13	.978
SpO2 before 6MWT	97.40 ± 1.43	98.28 ± 1.71	.421
SpO2 after 6MWT	93.10 ± 4.91	95.72 ± 4.11	.034

Abbreviations: BMI, body mass index; CF, cystic fibrosis; COPD, chronic obstructive pulmonary disease; DLT, double lung transplantation; eGFR, estimated glomerular filtration rate; FEV1, forced expiratory volume in first second; FVC, forced vital capacity; Hgb, hemoglobin concentration; ILD, interstitial lung disease; IPAH, idiopathic pulmonary arterial hypertension; IPF, idiopathic lung disease; LAM, lymphangioleiomyomatosis; PVOD, pulmonary veno-occlusive disease; SLT, single lung transplantation; SpO2, oxygen saturation.

with his/her partner, 38 (63.33%); single, 18 (30%); separated or divorced, 3 (5%); and widow/widower, 1 (1.67%). According to education status, most patients completed secondary school, 34 (56.67%); vocational, 12 (20%); higher education, 9 (15%); and primary school, 5 (8.33%). Based on employment status, the study group was divided into patients who did not work and claimed annuities, 42 (70%); patients who worked after LTx, 9 (15%); patients who were retired, 7 (11.67%); and patients who were unemployed (did not work before and after LTx), 2 (3.33%).

In the analyzed group, the average number of hospitalizations were 4.13 ± 3.02 per year. The requirement of hospital admission was observed slightly more often in SLT

Table 2. Data From WHOQOL-BREF, GHQ-28, and SGRQ Questionnaires

	Study Population	SLT	DLT	Men	Women	CF	COPD	ILD
WHOQOL-BREF (points)								
Somatic, points	26.75 ± 4.97	27.05 ± 4.16	26.60 ± 4.96	27.09 ± 3.57	26.38 ± 5.66	27.53 ± 4.53	26.93 ± 4.68	26.75 ± 4.28
Psychological, points	22.28 ± 3.52	22.55 ± 4.04	22.15 ± 3.28	22.45 ± 2.89	22.10 ± 4.13	23.20 ± 2.57	21.53 ± 3.18	22.90 ± 3.59
Social, points	11.21 ± 2.78	11.25 ± 3.06	11.20 ± 2.67	11.13 ± 2.41	11.31 ± 3.17	11.53 ± 2.75	11.13 ± 2.44	11.30 ± 2.97
Environmental, points	29.77 ± 3.72	30.45 ± 4.08	29.43 ± 3.54	29.84 ± 3.05	29.69 ± 4.38	30.40 ± 2.53	28.73 ± 3.15	30.40 ± 4.19
GHQ-28 (points)								
Symptoms, points	6.08 ± 4.11	5.65 ± 4.28	6.30 ± 4.05	5.48 ± 3.13	6.72 ± 4.91	4.80 ± 2.91	6.67 ± 5.12	6.00 ± 3.55
Anxiety and insomnia, points	5.80 ± 4.51	4.90 ± 4.62	6.25 ± 4.43	5.25 ± 3.93	6.37 ± 5.04	5.00 ± 3.56	6.53 ± 5.28	5.55 ± 4.54
Social dysfunction, points	7.67 ± 2.75	7.85 ± 2.03	7.57 ± 3.07	7.32 ± 1.39	8.03 ± 3.68	6.60 ± 2.73	7.80 ± 2.34	7.80 ± 1.82
Depression, points	1.57 ±2.21	0.90 ± 1.25	1.90 ± 2.51	1.19 ± 1.44	1.96 ± 2.78	1.86 ± 3.04	1.73 ± 2.25	1.15 ± 1.34
Total, points	21.12 ± 11.41	19.30 ± 10.94	22.03 ± 11.67	19.25 ± 8.07	23.10 ± 14.01	18.27 ± 9.84	22.73 ± 12.26	20.50 ± 10.49
Sten scale, points	4.96 ± 2.03	4.55 ± 1.73	5.17 ± 2.16	5.22 ± 1.73	4.69 ± 2.32	4.13 ± 1.99	5.33 ± 2.32	5.05 ± 1.79
Low sten, points	24 (40%)	10 (50%)	14 (35%)	11 (35.48%)	13 (44.83%)	9 (60%)	5 (33.33%)	7 (35%)
Average sten, points	22 (36.67%)	8 (40%)	14 (35%)	12 (38.72%)	10 (34.48%)	4 (26.67%)	4 (26.67%)	10 (50%)
High sten, points	14 (23.33%)	2 (10%)	12 (30%)	8 (25.80%)	6 (20.69%)	2 (13.33%)	6 (40%)	3 (15%)
SGRQ (percentage)								
Symptoms, %	32.76 ± 26.07	31.13 ± 27.78	33.57 ± 25.49	34.78 ± 26.14	30.61 ± 26.28	23.28 ± 21.16	36.99 ± 32.47	32.36 ± 23.77
Activity, %	35.83 ± 28.97	39.78 ± 21.84	33.86 ± 32.02	40.86 ± 25.57	30.45 ± 31.77	20.28* ± 26.25	40.26 ± 30.77	39.26* ± 21.81
Impacts, %	26.39 ± 18.67	27.38 ± 14.78	25.91 ± 20.49	27.18 ± 18.10	25.55 ± 19.54	17.67 ± 16.84	28.21 ± 18.13	28.65 ± 16.66
Total, %	30.24 ± 20.87	31.71 ± 17.18	29.61 ± 22.57	32.47 ± 19.03	27.86 ± 22.78	19.38† ± 17.51	33.07 ± 23.39	32.47† ± 16.02

Results of WHOQOL-Bref are featured as raw scores and transformed into numeric values ranging between 0 and 100 points.

Abbreviations: CF, cystic fibrosis; COPD, chronic obstructive pulmonary disease; DLT, double lung transplantation; GHQ-28, General Health Questionnaire 28; ILD, interstitial lung disease; SGRQ, Saint George Respiratory Questionnaire; SLT, single lung transplantation; WHOQOL-BREF, World Health Organization Quality of Life Test–BREF.

*$P = .025$.

†$P = .028$.

Table 3. Data From Pulmonary Function Tests–Spirometry (FEV1%, FVC%, FEV1%, FVC) and 6-Minute Walk Test (Distance, Borg Scale, and Saturation Before and After Test)

	Study Population	SLT	DLT	Men	Women	CF	COPD	ILD
Pulmonary Function Tests								
FEV1%	64.72 ± 23.67	56.75 ± 17.01	68.92 ± 25.74	59.81 ± 25.92	70.37 ± 19.79	68.64 ± 19.94	74.46 ± 31.71	58.95 ± 15.11
FVC%	77.17[*] ± 18.51	68.05[‡] ± 15.66	81.97[‡] ± 18.25	74.83 ± 18.34	79.85 ± 18.67	73.78 ± 15.43	88.73[*,†] ± 22.98	72.80[†] ± 15.51
Distance, m	502.87 ± 113.01	480.72 ± 97.09	514.23 ± 119.95	498.79 ± 123.21	507.39 ± 102.61	539.24 ± 64.09	507.50 ± 121.08	478.60 ± 103.34
Borg scale, points	2.11 ± 2.05	2.10 ± 1.96	2.11 ± 2.13	2.19 ± 2.27	2.02 ± 1.82	1.46 ± 1.02	2.40 ± 2.22	2.32 ± 2.14
SpO2 before 6MWT,%	97.98 ± 1.65	97.40 ± 1.43	98.28 ± 1.71	97.64 ± 1.62	98.35 ± 1.64	98.64 ± 1.15	98.20 ± 1.97	97.70 ± 1.49
SpO2 after 6MWT, %	94.83 ± 4.53	93.10[§] ± 4.91	95.72[§] ± 4.11	94.38 ± 3.98	95.32 ± 5.11	96.50 ± 2.56	94.60 ± 5.93	94.10 ± 4.53

Abbreviations: 6MWT, 6-minute walk test; CF, cystic fibrosis; COPD, chronic obstructive pulmonary disease; DLT, double lung transplantation; FEV1%, forced expiratory volume in first second; FVC, forced vital capacity; ILD, interstitial lung disease; SLT, single lung transplantation; SpO2, oxygen saturation.

*$P = .04$.
†$P = .01$.
‡$P = .005$.
§$P = .034$.

recipients vs DLT recipients (4.35 ± 2.81 vs 4.02 ± 3.15; not statistically important [NS]) and in men vs women (4.22 ± 2.87 vs 4.05 ± 3.21; NS).

Transplanted patients with CF had the least frequent hospital admissions per year compared with transplanted patients with COPD and ILD (2.64 ± 2.06 vs 4.80 ± 3.59 vs 4.13 ± 2.88 respectively; NS).

2. According to the WHOQOL-BREF questionnaire, CF, COPD, and ILD patients after LTx achieved comparable results in every analyzed domain. Surprisingly, SLT vs DLT recipients reported similar functioning in all domains of the questionnaire: somatic, psychological, social, and environmental. The same situation follows with comparison of men vs women. All results were NS between mentioned DLT vs SLT and between men vs women groups (Table 2).
3. In the GHQ-28 questionnaire, SLT recipients reported fewer instances of somatic disorders, anxiety, and depression, but manifested more social dysfunction than DLT patients. However, this results are NS. The analogues situation compared men and women, and again it was NS. The COPD group reported barely more than other lung recipients in 3 out of 4 domains: symptoms, anxiety, and social dysfunction. It was an NS observation. However, CF patients generally described their QoL as better than ILD or COPD recipients. Out of all studied patients (regardless of diagnosis), good mental status according to the sten scale (<4 points) was observed in 40% of recipients, and poor mental status (>6 points) was noted in 23.33% of recipients (NS). A comparable percentage of men and women assessed their mental health after LTx as good (sten scale <4 points) 35.5% vs 44.8 (NS). High (good) mental status (low sten scale <4 points) was achieved in 60% of CF patients and only in 33.3% of COPD patients and 35.0% of ILD patients; however, results were NS (Table 2).
4. In SGRQ, there were no disparities between men vs women and SLT vs DLT patients. Statistically significant differences were observed between CF and ILD patients in the activity component of SGRQ ($P = .025$) and in total score ($P = .028$) (Table 2). In contrast to ILD patients who led mostly normal lives, CF patients had a lot of activity limitations before LTx. LTx does not allow ILD patients to return to normal pre-disease functioning, but reduces the restrictions of functioning in CF patients.
5. It can be assumed that pulmonary function tests are surrogate for QoL after transplantation. However, results of pulmonary function tests are not included in any of the known questionnaires. Results of pulmonary function tests are presented in Table 3 but have not been analyzed for their impact on the QoL. DLT patients gain significantly better results in FVC% ($P = .005$) and maintain higher saturation after 6MWT ($P = .034$) in comparison to SLT recipients. COPD patients achieve greater FVC % than the ILD group ($P = .01$) and compared to all study populations ($P = .04$) (Table 3).

DISCUSSION

After LTx, routine monitoring of the transplanted organ is important to detect and prevent complications. The importance of measuring graft function is incontestable. The investigation of lung function includes: spirometry, lung plethysmography, bronchoscopy, and 6MWT. Relevant tests also include blood and biochemistry tests, immunosuppression drug level monitoring, and chest radiographs [10–13]. No less important are QoL tests because they reflect the actual, everyday functioning of recipients in family and society, and as such, they should also be included to routine assessment of patients after LTx.

There are a variety of different questionnaires assessing QoL after LTx in the available literature. The most commonly used are Nottingham Health Profile, the Short-Form Health Survey, Quality of Life Index, and Karnofsky Performance Index [14]. Recently, Singer et al [15] published validation of Lung Transplant Quality of Life questionnaire, which is a new tool for testing QoL after LTx. Considering this, we decided to choose the following questionnaires: WHOQOL-BREF, GHQ-28 and SGRQ. WHOQOL-BREF evaluates the emotional state (including positive and negative feelings) and physical condition. GHQ-28 assess changes in mental status due to difficult experiences. SGRQ measures the quality and quantity of symptoms from the respiratory tract, physical activity, and its limitations due to the occurrence of the disease and everyday functioning in society.

We compared the results of WHOQOL-BREF questionnaire in LTx patients with a healthy patient population. The results obtained from WHOQOL-BREF questionnaire differ substantially from results among healthy Polish responders gathered for a study conducted by Jaracz et al [16], who validated this questionnaire in the Polish. Main differences were observed in physical, psychological and environmental domains (26.75 points ± 4.97 vs 15.79 points ± 2.23; 22.28 points ± 3.52 vs 13.79 points ± 2.51; and 29.77 points ± 3.72 vs 13.10 points ± 2.43, respectively) [16]. The differences show a better perception of QoL in patients after LTx than among the healthy population of Jaracz's group. The only worse results were obtained in social domain (11.21 points ± 2.78 vs 14.87 points ± 3.04). This can be explained by more restriction in daily life after LTx, dependence of immunosuppression therapy, and the fear of greater exposure to infections. These factors cause greater difficulties in the social sphere, which translates into difficulties in creating personal relationships and reducing the quality of the sex life. Based on data from the WHOQOL-BREF questionnaire, CF patients from our study compared to results of the healthy population in the Polish study differ positively in 3 of 4 domains: somatic, psychological, and environmental (27.53 points ± 4.53 vs 15.79 points ± 2.23; 23.20 points ± 2.57 vs 13.79 points ± 2.51; 30.40 points ± 2.53 vs 13.10 points ± 2.43, respectively) [16]. CF patients before LTx have permanent problems with respiratory system (eg, retention of mucus in the bronchial tree, endless infections) and other problems (digestive or genitourinary system). After LTx, CF patients get a new life: it lets them stop being dependent on assistive devices like oxygen concentrators and physiotherapy equipment assisting mucus removal, which makes them more independent, and their QoL improves [17].

Our results obtained from GHQ-28 among CF patients differ slightly from Swedish adults with CF examined in a QoL study in the Stockholm Cystic Fibrosis Centre [18]. The differences between our study and this Swedish population in somatic symptom, anxiety and insomnia, social dysfunction, and severe depression are as follows: 4.80 points ± 2.91 vs 6.27 points ± 4.15; 5.00 points ± 3.56 vs 6.14 points ± 4.61; 6.60 points ± 2.73 vs 7.10 points ± 3.09; 1.86 points ± 3.04 vs 2.63 points ± 3.33, respectively. This means that our population in described domains are less susceptible to disorders than the Swedish population; however the differences are NS. In general, 13.33% of CF patient recipients in our study and 32.20% in the cited study experienced poor mental health (high risk of mental disorder; $>$ 6 points in sten scale). The lower results achieved by CF patients after transplantation in the GHQ-28 questionnaire mean that they are experiencing better mental health after the procedure than patients still struggling with CF.

Lack of a sufficiently large amount of studies on the QOL after LTx that use GHQ-28 does not allow to compare our results to other centers and populations. Data obtained from GHQ-28 may be useful to notice changes in subjective assessment of patients' prosperity during follow up and as a screening test to examine mental condition. These are particularly important for patients whose mental state temporarily collapsed or collapsed long term after LTx, especially during acute deterioration of graft function or chronic lung allograft dysfunction.

The results obtained from SGRQ in our study are convergent to those demonstrated in a study by Smeritschnig [19] among patients after LTx for symptoms, activity, impact component, and total score (32.76% ± 26.07 vs 21.1% ± 18.5; 35.83% ± 28.97 vs 36.9% ± 25.0; 26.39% ± 18.67% vs 20.7% ± 18.3; 30.24% ± 20.87 vs 24.4% ± 18.3; respectively). Normative mean values for Spain's general population with no history of lung disease in SGRQ are: 12.00%, 9.00%, 2.00%, and 6.00%, respectively, for symptoms, activity, impacts, and total score [20]. Presented results of studies among LTx patients from cited studies using the SGRQ test show similarities in their perception of respiratory problems, limitations of activities by breathing functioning, and psychological disturbances, and these are worse than in the healthy population. Patients after LTx report more respiratory symptoms and limitations in daily life functioning, which can be connected to more prohibited activities after LTx (swimming, playing group sports, being in larger groups of people, especially during the infectious season) as well as greater vulnerability to infections. Respiratory difficulties (cough, breathing problems) after LTx may negatively influence employment status and may be embarrassing in public.

Data related to QoL in SGRQ test from Toronto Center study in CF and COPD patients are 46.0% and 47.7%, respectively and these are higher than data obtained from our population of recipients: 19,4% and 33,0% respectively [20]. The results in our population of CF and COPD recipients are better than in Toronto populations. This means that our CF and COPD recipients report fewer respiratory system symptoms (eg, cough, dyspnea) and have fewer disturbances of daily physical activity, which results in better social and psychological functioning.

However, patients with ILD from Polish and Canadian populations had similar scores (32.47% vs 38.5%) [21]. Differences in obtained results may be caused by a different number of conducted surveys (60 vs 326).

In our comparative analysis, CF recipients differ importantly from ILD recipients in the activity component of SGRQ (20.28% ± 26.25 vs 39.26% ± 21.81; $P = .025$) and in total score (19.38% ± 17.51 vs 32.47% ± 16.02; $P = .028$) (Table 2). One of the possible explanations is that ILD patients are older at the time of diagnosis and transplantation, and they lead mostly normal lives while CF patients struggle with disease from birth, and they have a lot of activity limitations before LTx. LTx does not allow to return to normal pre−-disease functioning among ILD patients whereas importantly reduces the restrictions of functioning in CF patients.

Performed statistical analysis revealed that DLT vs SLT recipients during qualification process were significantly statistically younger (36.45 ± 14.77 years vs 45.65 ± 12.97 years; $P = .021$) and had worse results of pulmonary function tests with respect to FEV1% (44.88% ± 23.88 vs 28.52% ± 18.64; $P = .029$); however, after LTx these differences subsided. One should keep in mind that pulmonary function tests are not included in QoL questionnaires. Results gained in WHOQOL-BREF, GHQ-28, and SGRQ differ very slightly and are comparable (Table 2). Similar data were drawn from a study by Gerbase [22]. The authors using SGHQ reported no significant difference between SLT and DLT recipients in patient's perception of QoL and restrictions in activity. This can be explained by indiscriminate postoperative proceedings for SLT and DLT patients including equal type of immunosuppression drugs and number of follow-up visit as well as comparable exposure to infection.

The authors of this study are aware of the following limitations: lack of results referring to the QoL patients with end-stage lung disease from the qualification period for LTx, lack of patients' QoL surveys at follow-up visits to examine changes in QOL, lack of multifactorial analysis with medical data such as amount of bronchoscopy interventions, immunosuppression medication level, and bacterial colonization and infection, which were taken into consideration in the literature review [7,20–22]. Aforementioned limitations will be eliminated in the next study planned by the authors.

CONCLUSION

Studies assessing QoL should be an important addition to lung function tests and an integral part of control during postoperative visits. Those tests enable assessment of full or incomplete return of a patient to a satisfying life. This may also allow the introduction of appropriate adjustments in the treatment used and the patient's return to full QOL in accordance with the WHO definition.

REFERENCES

[1] Chambers DC, Cherikh WS, Goldfarb SB, Hayes D Jr, Kucheryavaya AY, Toll AE, et al. The International Thoracic Organ Transplant Registry of the International Society for Heart and Lung Transplantation: thirty-fifth adult lung and heart-lung transplant report-2018; focus theme: multiorgan transplantation. J Heart Lung Transplant 2018;37:1169–83. https://doi.org/10.1016/j.healun.2018.07.020.

[2] Briganti DF, D'Ovidio F. Long-term management of patients with end-stage lung diseases. Best Pract Res Clin Anaesthesiol 2017;31:167–78. https://doi.org/10.1016/j.bpa.2017.07.007.

[3] Chambers DC, Yusen RD, Cherikh WS, Goldfarb SB, Kucheryavaya AY, Khusch K, et al. The Registry of the International Society for Heart and Lung Transplantation: thirty-fourth adult lung and heart-lung transplantation report-2017; focus theme: allograft ischemic time. J Heart Lung Transplant 2017;36:1047–58. https://doi.org/10.1016/j.healun.2017.07.016.

[4] Thabut G, Mal H. Outcomes after lung transplantation. J Thorac Dis 2017;9:2684–91. https://doi.org/10.21037/jtd.2017.07.85.

[5] Ramsey SD, Patrick DL, Lewis S, Albert RK, Raghu G, Improvement in quality of life after lung transplantation: a preliminary study. The University of Washington Medical Center Lung Transplant Study Group. J Heart Lung Transplant 1995;14:870–7.

[6] Gross CR, Savik K, Bolman RM 3rd, Hertz MI. Long-term health status and quality of life outcomes of lung transplant recipients. Chest 1995;108:1587–93. https://doi.org/10.1378/chest.108.6.1587.

[7] Kugler C, Fischer S, Gottlieb J, Welte T, Simon A, Haverich A, et al. Health-related quality of life in 2 hundred-eighty lung transplant recipients. J Heart Lung Transplant 2005;24:2262–8. https://doi.org/10.1016/j.healun.2005.07.005.

[8] Ochman M, Latos M, Orzeł G, Pałka P, Urlik M, Nęcki M, et al. Employment after lung transplantation in Poland - a single center study. Int J Occup Med Environ Health 2019;32(3):379–86. https://doi.org/10.13075/ijomeh.1896.01362.

[9] WHOQOL Group. The World Health Organization quality of life assessment (WHOQOL): position paper from the world health organization. Soc Sci Med 1995;41:1403–9. https://doi.org/10.1016/0277-9536(95)00112-k.

[10] Mason DP, Rajeswaran J, Murthy SC, McNeill AM, Budev MM, Mehta AC, et al. Spirometry after transplantation: how much better are 2 lungs than one? Ann Thorac Surg 2008;85(4):1193–1201, 1201.e1-2. https://doi.org/10.1016/j.athoracsur.2007.12.023.

[11] Becker FS, Martinez FJ, Brunsting LA, Deeb GM, Flint A, Lynch JP 3rd, et al. Limitations of spirometry in detecting rejection after single-lung transplantation. Am J Respir Crit Care Med 1994;150:159–66. https://doi.org/10.1164/ajrccm.150.1.8025743.

[12] Martinez JA, Paradis IL, Dauber JH, Grgurich W, Richards T, Yousem SA, et al. Spirometry values in stable lung transplant recipients. Am J Respir Crit Care Med 1997;155:285–90. https://doi.org/10.1164/ajrccm.155.1.9001326.

[13] Belloli EA, Wang X, Murray S, Forrester G, Weyhing A, Lin J, et al. Longitudinal forced vital capacity monitoring as a prognostic adjunct after lung transplantation. Am J Respir Crit Care Med 2015;192:209–18. https://doi.org/10.1164/rccm.201501-0174OC.

[14] Lanuza DM, Lefaiver CA, Farcas GA. Research on the quality of life of lung transplant candidates and recipients: an integrative review. Heart Lung 2000;29(3):180–95. https://doi.org/10.1067/mhl.2000.105691.

[15] Singer JP, Soong A, Chen J, Shrestha P, Zhuo H, Gao Y, et al. Development and preliminary validation of the lung transplant quality of life (LT-QOL) survey. Am J Respir Crit Care Med 2019;199(8):1008–19. https://doi.org/10.1164/rccm.201806-1198OC.

[16] Jaracz K, Kalfoss M, Górna K, Baczyk G. Quality of life in Polish respondents: psychometric properties of the Polish WHO-QOL-Bref. Scand J Caring Sci 2006;20(3):251–60. https://doi.org/10.1111/j.1471-6712.2006.00401.x.

[17] Vermeulen KM, van der Bij W, Erasmus ME, Duiverman EJ, Koëter GH, TenVergert EM. Improved quality of life after lung transplantation in individuals with cystic fibrosis. Pediatr Pulmonol 2004;37(5):419–26. https://doi.org/10.1002/ppul.20009.

[18] Bergsten Brucefors A, Hjelte L, Hochwälder J. Mental health and sense of coherence among Swedish adults with cystic fibrosis. Scand J Caring Sci 2011;25(2):365–72. https://doi.org/10.1111/j.1471-6712.2010.00840.x.

[19] Smeritschnig B, Jaksch P, Kocher A, Seebacher G, Aigner C, Mazhar S, et al. Quality of life after lung transplantation: a cross-sectional study. J Heart Lung Transplant 2005;24(4):474–80. https://doi.org/10.1016/j.healun.2003.12.013.

[20] Ferrer M, Villasante C, Alonso J, Sobradillo V, Gabriel R, Vilagut G, et al. Interpretation of quality of life scores from the St. George's Respiratory Questionnaire. Eur Respir J 2002;19:405–13. https://doi.org/10.1183/09031936.02.00213202.

[21] Singer LG, Chowdhury NA, Faughnan ME, Granton J, Keshavjee S, Marras TK, et al. Effects of recipient age and diagnosis on health-related quality-of-life benefit of lung transplantation. Am J Respir Crit Care Med 2015;192(8):965–73. https://doi.org/10.1164/rccm.201501-0126OC.

[22] Gerbase MW, Spiliopoulos A, Rochat T, Archinard M, Nicod LP. Health-related quality of life following single or bilateral lung transplantation: a 7-year comparison to functional outcome. Chest 2005;128(3):1371–8. https://doi.org/10.1378/chest.128.3.1371.