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Quality of life parameters in chronic obstructive pulmonary disease patients with gas exchange abnormalities

Key words: *chronic obstructive pulmonary disease, quality of life, hypoxemia, hypercapnia, capnometry.*

Chronic obstructive pulmonary disease (COPD) – one of the most important medical and social problems both in Ukraine and in the world. Its relevance is due to high rates of prevalence, morbidity, mortality and growing economic losses [2]. Gas exchange abnormalities are the part of the pathophysiology of COPD. In the Global Initiative for Chronic Obstructive Lung Disease (GOLD) summarized that gas exchange abnormalities – a reduction of ventilation and ventilation drive, worsening respiratory muscle function due to high work of breathing in severe obstruction and hyperinflation, ventilation-perfusion disturbances that the amount resulting in hypoxemia and hypercapnia [4].

Untreated, chronic hypoxia results in the development of COPD adverse effects, including pulmonary hypertension, secondary polycythemia, systemic inflammation and skeletal muscle dysfunction. The combination of these factors leads to a deterioration in the quality of life, decreased exercise tolerance, increased risk of cardiovascular disease and increased risk of death [13].

Hypercapnia also contributes to the development of serious complications, such as: a risk factor for death in patients who need hospitalization due to exacerbation of COPD, may worsen the aftermath of infection [3], accompanied by a high level of hemoglobin, polycythemia, edema [1, 8], complications on central nervous system, infringement of mental activity and consciousness. [9] Hypercapnia with a partial tension of carbon dioxide ($CO2$) $\geq$ 50 mm Hg. It is a sign of end-stage COPD, in which, by definition, the National Hospice Organization of the United States, the forecast life expectancy of patients is limited to six months [14].

An integral part of current medical science is the study of health related quality of life, HRQL. This theme is relevant and in relation to chronic obstructive lung disease (COPD), in that experts GOLD (Global Initiative for Chronic Obstructive Lung Disease) in 2011, noted that within the same GOLD spirometry classification category in COPD patients may take place any state of health – from relatively good to very bad [4]. The most often used definition of quality of life is a balance between what person want to achieve in life and what has already been achieved or achievable, but that definition is too abstract for practical use [11]. World Health Organization has defined quality of life as «an individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, and their relationship to salient features of their environment [16].

Scientists need to measure the impact of the disease on quality of life, which would be allowed this option to compare among different patients, and in the context of the results of the treatment. For this purpose, measurement of health disorders should be standardized, so that each patient was examined the same, and questionnaires were suitable for all patients with a particular nosology. All items questionnaires should be acceptable, at least potentially, for each patient [11]. The study of quality of life in patients with COPD is an important part of their health care, and at end-stage COPD can be used to predict the life expectancy of the patient [6].

St George's respiratory questionnaire (SGRQ) examines the health problems of patients with asthma, COPD, bronchiectasis, kyphoscoliosis, sarcoidosis, and contains two parts.. The first part examines the symptoms – Symptoms Score – the patient's respiratory problems from the previous period (from 1 month to 1 year), their frequency and severity. The second part concerns the limitation of physical activity due to dyspnea at the moment (Activity Score) and the influence of psychosocial problems caused by breathing problems (Impacts Score). Also deducted the total account is Total Score – impact diseases on general health. Account 100 points represents the worst possible health, 0 points is the best possible state of health. High level points of the questionnaire is associated with mortality, repeated hospitalizations, the high cost of medical care. [12].

The scientific issue when evaluating the results of the questionnaire is to determine the level of change, which would be considered to be significant. Minimal clinically significant difference is the smallest difference points of the questionnaire, in which the patient feels better, and which comes in the absence of adverse events and excessive increase of the cost of treatment. For SGRQ this difference is 4 points [7].

Means (95 % confidence intervals) for SGRQ scores in normal subjects with no history of respiratory disease are given in table 1.

In 1987 EuroQoL Group was created, international multidisciplinary network of specialists in the study of the health status participants of which developed the EQ-5D questionnaire, that found wide application in clinical research and practical medicine. The questionnaire is simple to use, available to understand by patients regardless of their level of education. Narrative of the questionnaire contains 5 questions, taking into account such vital spheres: mobility, self-care, the usual everyday activities (such as work, study, housework, family or leisure activities), pain (discomfort), anxiety (depression). Every single issue can have one of three responses that meet the absence of problems, moderate or extreme problems. Visual-analog scale in EQ-5D designed to reflect the patient's own health assessment on the segment, one final point of which marked as 100 represents the best possible state of health that can imagine the patient, and the other marked 0 – the worst [17].

We study the of quality of life features in COPD patients with gas exchange abnormalities. This work is carried out to study the effect of hypoxia and hypercapnia on the parameters of the quality of life in patients with COPD.

Materials and methods

This work was financed from the state budget of Ukraine.

The study was coordinated with the local Medical Ethics Committee of the NIPhP NAMS, participants were familiarized with the study protocol and signed an informed consent form to participate in the study..

The study involved 40 patients with COPD with severe and very severe course (III and IV stages by spirometric classification GOLD), and 20 healthy individuals (control group).

Table 1

The normal level of the results of the questionnaire of St George's Hospital [12]

Symptoms score	Activity score	Impacts score	Total score
12 (9–15)	9 (7–12)	2 (1–3)	6 (5–7)

To study the quality of life patients filled the questionnairiy SGRQ [12]. The patient is instructing before filling out the questionnaire SGRQ, the investigator ask him to answer each question as he feels his disease. The patient fill out the questionnaire at the table in a quiet room without being distracted and without affecting the family, friends or health care workers. After filling SGRQ the doctor checks the questionnaire regarding the lack of spaces and asks the patient to answer skipped questions. The results are calculated with the use a special calculator based on Excel. Each item of the questionnaire has empirically counted up weight variation and responses: Yes/No or true/false [10].

In addition, all study participants filled out a questionnaire EQ-5D. Before the filling out the questionnaire EQ-5D the researcher instruct the patient to off one answer for each question, taking into account the health state at the time of the survey. The results are calculated with the use a special «key» questionnaire and is expressed in the form of an index (EQ-5D score). The questionnaire also contains the EQ-5D visual-analog scale, all of which had their own displays the evaluation of patient's health (EQ-5D VAS) [17].

The study of lung ventilation function performed in all patients by body plethysmography and spirometry data on the unit MasterScreen PFT company Cardinal Health (Germany) according to the procedure of the manufacturer [5]. We studied the following parameters of respiratory function:

- Forced expiratory volume in one second (FEV1);
- Forced vital capacity (FVC);
- Residual volume (RS).

All figures are estimated as a percentage of the values properly developed by the European Coal and Steel Community [15].

Pulse oximetry and capnometery held at the complex for the study of the cardiorespiratory system Oxycon Pro company Cardinal Health (Germany). We studied next indicators: oxygen saturation (SpO2) and the concentration of carbon dioxide at the end of exhalation (FETCO2) [18].

Data collection and mathematical processing carried out by licensing software products included in the package Microsoft Office Professional 2007 license Russian Academic OPEN No Level № 43437596. Statistical analysis was performed using mathematical and statistical features MS Excel. Parameters studied in this work are presented as the mean (M) and average error (m) by the formula ($M \pm m$) and then comparing the results using Student t-test and the U-criteria Mann-Whitney test, depending on the distribution received data.

Table 2

Characteristics of patients, the results of a survey of lung ventilation function and quality of life parameters

Indices		COPD patients with hypoxemia, (n = 20)	COPD patients without hypoxemia, (n = 20)	The control group, (n = 20)
Sex: (n, %)	Men	15 (75 %)	17 (85 %)	12 (60 %)
	Women	5 (25 %)	3 (15 %)	8 (40 %)
Age, years		64,5 ± 2,1	57,4 ± 1,9*	42,4 ± 0,32,3
FEV1, % pred		34,9 ± 2,7	39,2 ± 1,6	100,6 ± 2,12,3
FVC, % pred		70,5 ± 3,4	71,9 ± 4,2	102,8 ± 2,52,3
RV, % pred		209,1 ± 17,4	200,3 ± 12,4	106,8 ± 5,82,3
Symptoms score		68,2 ± 4,7	57,3 ± 4,41	4,5 ± 1,62,3
Activity score		74,7 ± 5,5	55,2 ± 3,91*	14,3 ± 2,12,3
Impacts score		53,8 ± 5,5	44,6 ± 4,11	1,6 ± 0,92,3
Total score		62,5 ± 5,0	49,9 ± 3,31*	6,3 ± 1,12,3
EQ-5D score		0,5 ± 0,07	0,7 ± 0,05*	0,9 ± 0,042,3
EQ-5D VAS		40 ± 4	60 ± 3*	90 ± 12,3

Notes: * statistically significant difference between the groups of indicators of COPD patients, p < 0,05; 1 a clinically significant difference indicators (up to 4 points) between the groups of patients with COPD; 2 a statistically significant difference between the performance control group and the COPD patients with hypoxemia, p < 0,05; 3 a statistically significant difference between the performance control group and the COPD patients without hypoxemia, p < 0,05.

Results and discussion

The study involved 40 patients with COPD (32 males and 8 females) aged 44 to 84 years, the average age (61,0 ± 1,5) years. To study the quality of life we have divided these patients into 2 groups depending on the results of pulse oximetry: COPD patients with hypoxemia (SpO2 ≤ 94 %) and without hypoxemia (SpO2 ≥ 95 %). The control group were 20 healthy individuals. Patient characteristics are shown in Table. 2. Among patients with hypoxemia 8 patients had stage III COPD and 12 patients – IV stage. Among patients without hypoxemia III stage was 2 patients, and IV – in 18.

The age of patients with hypoxemia (64,5 ± 2,1) years was significantly higher than in patients without hypoxemia (57,4 ± 1,9) years, p <0,05, the representatives of the control group were younger – (42.4 ± 0,3) years. Indicators of lung ventilation function (FEV1, FVC, PA) in groups of patients with chronic obstructive pulmonary disease were not statistically different. A survey of healthy persons showed normal respiratory function.

As for the indicators of St. George Hospital quality of life questionnaire, then by all domains the quality of life of patients with clinically significant hypoxemia was worse than in patients with COPD, and for domains Activity score, Total score, difference was still statistically significant.

Account symptoms formed on the basis of complaints of cough, sputum, shortness of breath, wheezing. Obviously, patients with hypoxemia more acutely aware of the burden of shortness of breath, so they Symptoms score higher than patients with normal oxygen level – (68,2 ± 4,7) and (57,3 ± 4,4) points, respectively (for comparison – from healthy individuals through symptoms of (4,5 ± 1,6) points).

Limiting activity is estimated by the degree of dyspnea: arises whether it is in sports, up the hill and up the stairs, walking on flat terrain or at home, during the washing and dressing, or even alone – sitting or lying down. Also taken into account as breathing problems affect the ability to perform daily activities such as working at home, working in the garden, dance, carry heavy loads, ride a bike, swim. A similar situation with Symptoms score, we believe that the Activity score higher in patients with hypoxemia – (74,7 ± 5,5) scores than patients without hypoxemia – (55,2 ± 3,9) points, p <0 05 due to the burden of shortness of breath with a deficit of oxygen in the body. In the control group score is Activity (14,3 ± 2,1) points.

Psychosocial problems (Impacts score) regard with severe disease, such as the patient gasps in conversation, have pain from coughing, suffering from sleep disorders, is rapidly losing strength. In addition, Impacts score there, if the patient is shy about his cough, believes his disease of the respiratory system that causes inconvenience to family, friends or neighbors experiencing shortness of breath when panic, do not expect to improve the flow of the disease, and consider themselves disabled. And in this category of patients with hypoxemia demonstrated the worst result – (53,8 ± 5,5) points, whereas patients without hypoxemia have less expense – (44,6 ± 4,1) points. A healthy person does not suffer from the limitation of activity due to respiratory diseases – (1,6 ± 0,9) points.

Total score summarizes all of the factors set forth above, and repeats the trend. The worst quality of life according to the Quality of Life Questionnaire of the St. George Hospital is the case in patients with hypoxemia – (62,5 ± 5,0) points, whereas in patients without

hypoxemia – (49,9 ± 3,3) points, p <0, 05. In the control group Total score – (1,6 ± 0,9) points.

As a result of the filling members of the research questionnaire EQ-5D and its index, and the average mark of a visual analog scale indicate: the quality of life in patients with COPD was significantly worse than in healthy individuals, and in the subgroups of patients with chronic obstructive pulmonary disease – in patients with hypoxemia quality of life was significantly worse than in patients without hypoxemia.

We see that patients with COPD (and in our work involved patients with severe (stage III) and very severe (IV stage) course of the disease) have a significant deterioration in the quality of life compared with healthy individuals, with the accession of hypoxemia exacerbates this trend.

Next, we examined the effect of hypercapnia on the quality of life of patients with COPD. Hypercapnia is considered a marker of elevated CO2 in exhaled air (FETCO2) above 5,6 % [18]. Among the surveyed 40 patients, 6 occurred hypercapnia, the parameters of quality of life are given in Table 3.

From the results it follows that such a violation of gas exchange as the hypercapnia also adversely affects the quality of life of patients with COPD, and according to the Hospital of St. George Quality of Life Questionnaire, and according to the EQ-5D. In all domains of Hospital of St. George quality of life questionnaire and the difference in a clinically and statistically significant. It should be noted that in 6 patients with hypercapnia hypoxemia occurred at the same time. And if patients with hypoxemia Symptoms score of (68,2 ± 4,7) points, that patients with hypercapnia joining up (82,7 ± 7,1) points. Activity score for this pair of results of (74,7 ± 5,5) and (88,9 ± 6,2) points, respectively, and for the Impacts score – (53,8 ± 5,5) and (72,5 ± 10,4). Obviously, in the same way patients with hypoxemia Total score equals the average (62,5 ± 5,0) points, and in patients with concomitant hypercapnia – is (79,2 ± 7,7) points. Similar results apply to the results of the questionnaire EQ-5D. Thus, hypercapnia brings severe impairment in quality of life in patients with COPD, which may be characterized as disabling.

Table 3

The parameters of quality of life of patients, depending on the presence of hypercapnia

Index	COPD patients with hypercapnia, (n = 6)	COPD patients without hypercapnia, (n = 34)
FETCO2, %	6,6 ± 0,4	4,5 ± 0,11
Symptoms score	82,7 ± 7,1	59,2 ± 3,31,2
Activity score	88,9 ± 6,2	60,7 ± 3,71,2
Impacts score	72,5 ± 10,4	45,1 ± 3,21,2
Total score	79,2 ± 7,7	52,1 ± 3,01,2
EQ-5D score	0,3 ± 0,1	0,6 ± 0,041
EQ-5D VAS	24 ± 6	54 ± 31

Notes: 1 statistically significant difference between the groups of indicators of COPD patients, p <0,05; 2 a clinically significant difference indicators (up to 4 points) between the groups of patients with COPD.

Conclusions

Patients with severe COPD (stage III) and very severe (IV stage) course of the disease have a significant deterioration in the quality of life compared with healthy individuals according to the Hospital of St. George Quality of Life Questionnaire and the EQ-5D. Formation of hypoxemia impairs the quality of life of patients as a whole and, in particular, regarding the symptoms, limitations in activities of daily living and psychosocial problems. Hypercapnia worsens the abovementioned violations largely. Thus, gas exchange abnormalities are making a negative contribution to the quality of life of patients with COPD. Timely detection and adequate treatment of chronic obstructive pulmonary disease, the prevention of its complications is an important task of clinical medicine, the solution of which will allow to preserve and improve the quality of life of patients.

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КАЧЕСТВО ЖИЗНИ ПАЦИЕНТОВ С ХРОНИЧЕСКИМ ОБСТРУКТИВНЫМ ЗАБОЛЕВАНИЕМ ЛЕГКИХ С НАРУШЕНИЯМИ ГАЗООБМЕНА

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Резюме

Изучение качества жизни больных хроническим обструктивным заболеванием легких (ХОЗЛ) является важным элементом оказания им медицинской помощи.

Цель данной работы – *изучить влияние гипоксемии и гиперкапнии на параметры качества жизни у больных ХОЗЛ.*

Материалы и методы исследования. *В исследовании приняли участие 40 больных ХОЗЛ и 20 здоровых лиц, которым проведены бодиплетизмография, пульсоксиметрия, капнометрия и анкетирование относительно качества жизни.*

Результаты. *Согласно данным опросника качества жизни Госпиталя святого Георгия, у больных ХОЗЛ с тяжелым (III стадия) и очень тяжелым (IV стадия) течением болезни отмечается значительное ухудшение качества жизни по сравнению со здоровыми лицами. Формирование гипоксемии ухудшает качество жизни больных как в целом ((62,5 ± 5,0) баллов при гипоксемии и (49,9 ± 3,3) без гипоксемии, $p < 0,05$, клинически значимая разница), так и в частности, относительно выраженности симптомов ((68,2 ± 4,7) и (57,3 ± 4,4) баллов соответственно, клинически значимая разница), ограничений в повседневной активности ((74,7 ± 5,5) и (55,2 ± 3,9) баллов соответственно, $p < 0,05$, клинически значимая разница) и психосоциальных проблем ((53,8 ± 5,5) и (44,6 ± 4,1) баллов соответственно, клинически значимая разница). Гиперкапния в значительной степени усугубляет названные выше нарушения.*

Выводы. *У больных ХОЗЛ с тяжелым (III стадия) и очень тяжелым (IV стадия) течением болезни отмечается значительное ухудшение качества жизни по сравнению со здоровыми лицами, а развитие гипоксемии усугубляет эту тенденцию. Гиперкапния привносит тяжелейшие нарушения в качество жизни больных ХОЗЛ, которые можно охарактеризовать как инвалидизирующие.*

Ключевые слова: *хроническое обструктивное заболевание легких, качество жизни, гипоксемия, гиперкапния, капнометрия.*

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ЯКІСТЬ ЖИТТЯ ХВОРИХ НА ХРОНІЧНЕ ОБСТРУКТИВНЕ ЗАХВОРЮВАННЯ ЛЕГЕНЬ З ПОРУШЕННЯМИ ГАЗООБМІНУ

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Резюме

Вивчення якості життя у хворих на хронічне обструктивне захворювання легень (ХОЗЛ) є важливим елементом надання їм медичної допомоги. Дана робота виконується з метою вивчити вплив гіпоксемії і гіперкапнії на параметри якості життя у хворих на ХОЗЛ.

Матеріали та методи дослідження. *У дослідженні приймали участь 40 хворих на ХОЗЛ і 20 здорових осіб, яким проведено бодіплетізмографію, пульсоксиметрію, капнометрію та анкетування щодо якості життя.*

Результати. *Згідно з даними опитувальника якості життя Госпіталю святого Георгія, хворі на ХОЗЛ з тяжким (III стадія) і дуже тяжким (IV стадія) перебігом хвороби мають значне погіршення якості життя в порівнянні зі здоровими особами. Формування гіпоксемії погіршує якість життя хворих як в цілому ((62,5 ± 5,0) балів при гіпоксемії і (49,9 ± 3,3) без гіпоксемії, $p < 0,05$, клінічно значуща різниця), так і зокрема, відносно вираженості симптомів ((68,2 ± 4,7) і (57,3 ± 4,4) балів відповідно, клінічно значуща різниця), обмеження повсякденної активності ((74,7 ± 5,5) і (55,2 ± 3,9) балів відповідно, $p < 0,05$, клінічно значуща різниця) і психосоціальних проблем ((53,8 ± 5,5) і (44,6 ± 4,1) балів відповідно, клінічно значуща різниця). Гіперкапнія в значній мірі посилює названі вище порушення.*

Висновки. *Хворі на ХОЗЛ з тяжким (III стадія) і дуже тяжким (IV стадія) перебігом хвороби мають значне погіршення якості життя в порівнянні зі здоровими особами, а розвиток гіпоксемії посилює цю тенденцію. Гіперкапнія привносить найтяжкі порушення в якість життя хворих на ХОЗЛ, які можна охарактеризувати як інвалідизуючі.*

Ключові слова: *Хронічне обструктивне захворювання легень, якість життя, гіпоксемія, гіперкапнія, капнометрія.*

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