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ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ
ORIGINAL RESEARCH

Respiratory dysfunction prediction in patients after the left ventricle geometric reconstruction

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Abstract. *Relevance.* One of the most common complications after cardiac surgery is respiratory dysfunction (RD). The high-risk group includes patients after the left ventricle geometric reconstruction (LVGR) due to the presence of chronic heart failure, as well as the complexity and extent of the surgical intervention. At the moment, in clinical practice there is no uniform approach to predicting RD in patients in this group. *The aim:* to identify predictors of the development of RD in the early postoperative period in patients after LVGR. *Materials and methods.* The study included 54 patients who underwent LVGR surgery. Two groups of patients were identified: group I — patients without respiratory complications in the early postoperative period (n = 34); group II — patients with RD in the early period (n = 20). Cardiac function, respiratory system and gas exchange parameters were assessed in the pre- and early postoperative period. *Results and Discussion.* Echocardiography and spirometry indices in the group with RD were reduced before surgery relative to group I (FVC by 10.9 %, p = 0.009; EDV by 27 %, p = 0.004). Patients with RD on the first day after surgery were characterized by a pronounced disturbance in gas exchange compared to patients in group I (PaO_2/FiO_2 decreased by 45.1 %, p < 0.001; Qs/Qt increased by 71.4 %, p < 0.001). A multifactorial model was developed, which included three basic predictors of RD development: FVC, FEF_{50} and EDV. With a decrease in model indicators by 1 %, the risk of developing RD increased by 33.5 %, 24.8 % and decreased by 6.5 %, respectively. According to ROC-analysis, the most significant indicators were FEV_3 (AUC 0.829 ± 0.079) and EDV (0.838 ± 0.087). To assess the risk of developing RD, a classification tree was constructed. Node 7 is characterized by the highest risk with the following parameters: FVC ≤ 89.5 %, EDV > 173.2 ml, FEF_{50} ≤ 78.9 %. *Conclusion.* Impaired gas exchange on the first day after surgery was detected in all studied patients, however, pronounced RD was observed precisely in patients with the most reduced parameters of the cardiorespiratory system before surgery. The developed model for predicting RD in patients after LVGR makes it possible to assess the risk of respiratory complications at the surgical planning stage and prepare the patient's cardiorespiratory system for the upcoming surgical intervention.

Key words: the left ventricle geometric reconstruction, respiratory dysfunction, prognosis, predictors, spirometry

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Introduction

Respiratory dysfunction (RD) is one of the most frequent complications after cardiac surgery, occurring in 9–35 % of cases depending on the complexity of the operation [1, 2]. One of the most dangerous complications occurring in patients with RD is ventilator-associated pneumonia, which occurs in 9–21 % of patients and has a mortality rate of up to 75 % [3].

The main risk factors for respiratory dysfunction in patients undergoing cardiac surgery in the early postoperative period are: $PAP_{mean} > 30$ mmHg, BMI > 30 kg/m^2, age > 75 years, history of acute cerebrovascular accident and COPD, and EF≤30 % [2,4]. In addition, patients with chronic heart failure (CHF) are at risk, because this disease provokes the development of congestion in the small circulation circle, promotes the formation of interstitial pulmonary edema [5] and increases sputum production [6], which can lead to various disorders of external respiratory function (ERF).

Patients with CHF include, in particular, patients with postinfarction left ventricular aneurysm. The development of CHF in this group of patients is caused by dilatation of LV chamber due to extensive myocardial infarction and change of its shape from elliptical to spherical [7], which leads to a decrease in myocardial contractility and hemodynamic disorders in both large and small circles of blood circulation [8]. To restore the elliptical shape of LV, left ventricular geometric reconstruction (LVGR) is performed in this group of patients.

However, taking into account the complexity and volume of this surgical intervention, as well as the presence of CHF, the risk of early postoperative respiratory dysfunction in patients of this group can be quite high [9, 10].

Therefore, for risk stratification of unfavorable outcomes it is necessary to identify predictors of respiratory dysfunction characteristic for this group of patients. The scientific literature devoted to predicting respiratory dysfunction in patients after cardiac surgery is extremely sparse.

Unfortunately, at present there are no unified ideas about the possibilities and algorithms for predicting respiratory dysfunction in patients after cardiac surgery [11–13]. In the domestic and foreign literature, we failed to find large-scale fundamental studies devoted to the prediction of respiratory dysfunction in patients after LVGR.

Thus, the aim of our study was to identify predictors of early postoperative respiratory dysfunction in patients after the left ventricular geometric reconstruction.

Materials and methods

The retrospective study was performed on the basis of A.N. Bakulev National Medical Research Center for Cardiovascular Surgery of the Ministry of Health of Russian Federation and approved by the local ethical committee (protocol № 5 of 07.10.2023). The study used the results of examination of 54 patients (44 men and 10 women), the average age of whom was 62 ± 6 years, who underwent elective surgery for left ventricular geometric reconstruction (LVGR).

Inclusion criteria: 1) patients after left ventricular geometric reconstruction; 2) absence of chronic respiratory diseases; 3) age from 18 years; 4) absence of respiratory complications in the early postoperative period; 5) development of respiratory dysfunction in the early postoperative period.

Depending on the course of the early postoperative period and compliance with the inclusion criteria, two groups of patients were singled out: group I — patients without complications in the early postoperative period (n = 34); group II — patients with respiratory dysfunction in the early postoperative period (n = 20).

The study used baseline data of external respiratory function (ERF), echocardiography (ECHO-CG) and computed tomography (CT), as well as clinical and demographic characteristics of the patients. In addition, data from the surgical and intensive care phases of patient treatment, results of blood laboratory tests, and data from pulmonary artery pressure (PAP) measurements, including pulmonary capillary wedging pressure (PCWP) with a Swan-Ganz catheter were additionally included.

Baseline ERF data were provided by the patients at the time of hospitalization. The following spirometric parameters were taken into account: forced vital capacity of the lungs (FVC), forced expiratory volume in 1, 3 and 6 seconds (FEV_1, FEV_3 and FEV_6), Gensler index (FEV_1/FVC), maximal ventilatory volume (MVV), forced expiratory duration (FET), FEV_1/FEV_6 index, maximal volumetric expiratory flow rate (FEF_{25}, FEF_{50}, FEF_{75}, FEF_{25-75}), peak expiratory flow (PEF) and estimated lung age (ELA). The results obtained were expressed as a percentage of the estimated expected values (%Predicted).

Echocardiographic study was performed according to the recommendations of the American Echocardiographic Society using a Philips HD15 (Philips, the Netherlands) [14]. The following left ventricular parameters were taken into account: end-diastolic volume (EDV), end-systolic volume (ESV), ejection fraction (EF), end-diastolic dimension (EDD), end-systolic dimension (ESD), stroke volume (SV) and the presence of LV hypokinesis zones.

According to generally accepted formulas, the following gas exchange indices were calculated: oxygenation index (PaO_2/FiO_2), blood oxygen capacity (CaO_2), partial pressure of alveolar oxygen (PAO_2), intrapulmonary blood shunt (Qs/Qt), oxygen delivery index (DO_2), oxygen consumption index (VO_2), oxygen extraction coefficient (REO_2), alveolar-arterial oxygen gradient ($P(A\text{-}a)O_2$).

The operation was performed under general anesthesia with artificial circulation and artificial lung ventilation, at normal or moderately hypothermic body temperature. Myocardial protection was performed using cardioplegic solution.

Statistical analysis was performed in Stattech 3.1.7 and SPSS 26.0 programs. Normality of distribution was assessed using the Shapiro-Wilk criterion. For normal distribution, mean values (M), standard deviations (SD) and 95 % confidence interval (95 % CI) were calculated to describe quantitative data. For data with non-normal distribution, median values (Me) and upper and lower quartiles (Q_1-Q_3) were calculated. When comparing two groups by quantitative indicator with normal distribution, Student's t-criterion was used; in the absence of normal distribution, Mann-Whitney U-criterion was used.

The method of binary logistic regression was used to create a model predicting the development of respiratory dysfunction. The quality of the model was assessed based on the values of Nagelkerke's R^2 coefficient.

The method of ROC-curve analysis was used to predict the risk of respiratory dysfunction development. The obtained results were evaluated on the basis of area under the curve and statistical significance of calculations.

The CHAID (Chi Squared Automatic Interaction Detection) method was used to rank patients by the degree of risk of respiratory dysfunction development, as well as to determine the prognostic significance of various cardiorespiratory system indices. The values were considered significant at $p < 0.05$.

Results and discussion

Patients of the two studied groups had no differences in demographic parameters (Table 1). Among the concomitant pathology in groups I and II, hypertension was the most frequent (70.6 % and 90 %, respectively). Statistically significant differences between the groups were also revealed in COVID-19 incidence: in group I there were 2.7 times more such patients (p = 0.046).

Table 1

Clinical and demographic characteristics of patients

Indicators	Group I (n = 34)	Group II (n = 20)	P
Demographic indicators			
Age, full years	64 [60–68]	61 [59–64]	0,465
Height, cm	172 ± 7	174 ± 9	0,419
Body weight, kg	84 ± 15	83 ± 10	0,868
Body mass index, kg/m^2	29 ± 4	27 ± 4	0,428
Female, abs. (%)	4 (11,8)	6 (30,0)	0,326
Male, abs. (%)	30 (88,2)	14 (70,0)	
Smoking, abs. (%)	18 (52,9)	6 (30,0)	0,424
Concomitant diseases			
COVID-19, abs. (%)	22 (64,7)	4 (20,0)	0,046
Diabetes mellitus	8 (23,5)	0 (0,0)	0,264
Chronic renal disease	2 (5,9)	6 (30,0)	0,128
Hypertension	24 (70,6)	18 (90,0)	0,363
Acute cerebrovascular accident	2 (5,9)	2 (10,0)	1,000
Surgical characteristics of patients			
Duration of operation, hour	6 ± 2	6 ± 1	0,303
Duration of cardiopulmonary bypass, min	113 ± 56	148 ± 65	0,159
Aortic compression time, min	55 ± 28	72 ± 21	0,124
Number of shunts applied	1 ± 1	2 ± 1	0,297
Duration of stay in the ICU, hour	42 [21–46]	175 [145–264]	0,005
Duration of ventilation in the ICU, hour	20 [12–22]	146 [99–226]	< 0,001

Computed tomography revealed reticular changes in the lung parenchyma in 23.5 % of group II patients (p = 0.041). This pathology was not detected in group I.

Regression analysis showed no effect of imaging data and COVID-19 incidence on the risk of respiratory dysfunction.

Intraoperative characteristics did not differ between the two groups, but in group II, the duration of stay in ICU in the early postoperative period was 4.1 times longer (p = 0.005) and the duration of artificial ventilation was 7.3 times longer (p < 0.001).

During the first day in ICU, significant differences in gas exchange parameters were observed between the groups (Table 2).

Table 2

Indicators of gas exchange in the ICU on the first day after surgery

Indicators	Group I	Group II	P
Index PaO_2/FiO_2	332 ± 108 [276–388]	182 ± 59 [140–225]	< 0,001
CaO_2 ml/l	148 ± 17 [139–157]	133 ± 16 [121–144]	0,031
$P(A\text{-}a)O_2$ mmHg	156 ± 64 [123–189]	265 ± 71 [214–316]	< 0,001
Qs/Qt,%	14 ± 4 [12–17]	24 ± 6 [19–28]	< 0,001
Index DO_2 ml/kg/m^2	425 ± 134 [356–494]	251 ± 61 [207–294]	< 0,001
VO_2 index, ml/kg/m^2	97 [77–139]	64 [57–82]	0,011
REO_2,%	27 ± 6 [24–30]	30 ± 9 [24–36]	0,317

Thus, the oxygenation index (PaO_2/FiO_2) in group II was reduced by 45 %, and intrapulmonary blood shunt was increased by 71.4 % relative to similar parameters of group I.

The pulmonary artery pressure (PAP_{mean}) was statistically significantly different between the groups by 12.5 % (p = 0.027), at the same time, no differences were found in the $PCWP_{mean}$ parameter ($p > 0.05$) (Table 3).

Table 3

Some indicators of hemodynamics in the small circle of blood circulation in the ICU on the first day after the operation

Indicators	Group I	Group I	P
PAP_{mean}, mmHg	24 [20–26]	27 [24–32]	0,027
$PCWP_{mean}$, mmHg	16 [13–19]	17 [13–18]	0,919

Analysis of the results of spirometry and echocardiography performed before surgical intervention showed statistically significant differences between the groups. According to the data presented in Table 4, patients who developed respiratory failure were characterized at the preoperative stage not only by decreased volume-velocity respiratory indices, but also by increased LV volume and linear characteristics.

Table 4

Indicators of spirometry and echocardiography performed before surgery and having statistically significant differences between the groups

Indicators	Group I	Group II	P
FVC,%	91 ± 7 [87–94]	81 ± 12 [72–89]	0,009
FEV_1,%	91 ± 15 [83–99]	79 ± 8 [72–85]	0,028
FEV_3,%	92 ± 13 [85–98]	77 ± 8 [72–83]	0,012
FEF_{50},%	80 ± 13 [73–87]	70 ± 6 [65–74]	0,024
FEF_{75},%	77 [58–98]	58 [53–69]	0,045
ELA,%	100 [94–112]	122 [114–137]	0,003
MVV,%	89 ± 17 [81–98]	74 ± 8 [68–80]	0,012

End of the table 4

Indicators	Group I	Group II	P
EDV, ml	170 [154–181]	216 [183–269]	0,004
EDD, mm	59 ± 5 [56–62]	65 ± 8 [59–71]	0,035
ESD, mm	46 ± 5 [43–49]	52 ± 8 [46–58]	0,030

Binary logistic regression analysis was performed to identify predictors of RD development among cardiorespiratory system parameters. The results of single-factor analysis of predictors are presented in Table 5.

Table 5

The results of a single-factor analysis of predictors of development RD in patients after LVGR

Predictor	OR	95 % CI	P
FVC	0,895	0,806–0,994	0,034
FEV_1	0,928	0,860–1,002	0,052
FEV_3	0,892	0,811–0,980	0,017
FEF_{50}	0,891	0,795–0,998	0,046
FEF_{75}	0,970	0,931–1,011	0,150
ELA	1,057	1,003–1,113	0,039
MVV	0,908	0,827–0,998	0,027
EDV	1,029	1,000–1,055	0,020
EDD	1,154	0,998–1,335	0,054
ESD	1,237	1,029–1,486	0,024

According to the data obtained, an increase in such parameters as ELA, EDV and ESD was accompanied by an increase in the risk of respiratory dysfunction. The other predictors presented in the table showed an inverse relationship with the risk of respiratory dysfunction after LVGR surgery.

To obtain a multifactor model predicting the risk of respiratory dysfunction in patients after surgical treatment of LVGR based on spirometry and echocardiography data, we used a binary logistic regression method with factor selection by exclusion method.

The obtained model is described by the equation:

$P = 1 / (1 + e\text{-}z) \times 100\,\%$

$z = 27{,}982 – 0{,}287X_1 – 0{,}222X_2 + 0{,}063X_3$

where P — probability of RD development, X_1 — FVC, X_2 — FEF_{50}, X_3 — EDV.

The characteristics of the predictors included in the model and affecting the likelihood of respiratory dysfunction are summarized in Table 6.

Table 6

Multifactorial analysis of the influence of predictors on the development of RD in patients after LVGR

Predictor	AOR	95 % CI	P
FVC	0,749	0,580–0,967	0,027
FEF_{50}	0,801	0,639–0,991	0,043
EDV	1,065	1,008–1,130	0,031

Based on the Nagelkerke coefficient value, the model obtained ($p < 0.001$) explained 80.3 % of the variance occurring in the development of respiratory dysfunction. The sensitivity of the model was 80 % and specificity was 82.3 %. The ROC-curve of the model is presented in Figure 1.

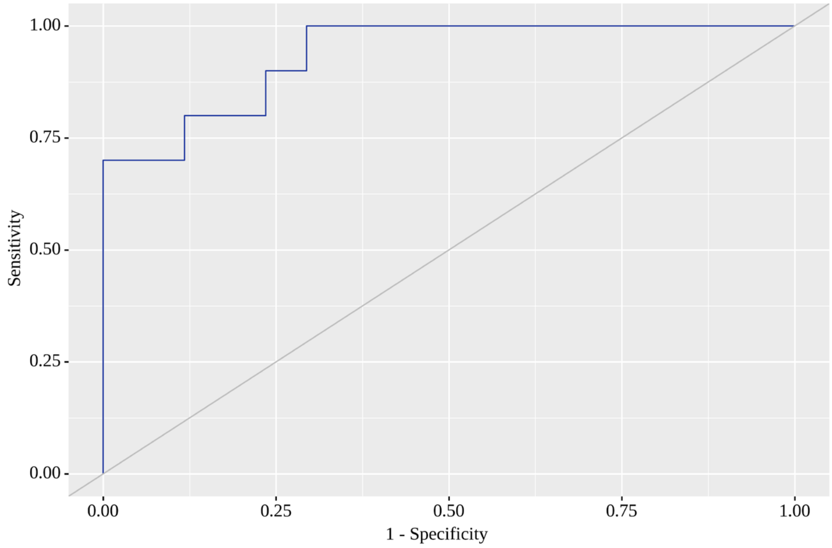


Fig. 1. ROC-curve of the model reflecting the dependence of the probability of RD development on the data of the logistic function P

Thus, the results obtained, indicate that a 1 % decrease in FVC increases the risk of respiratory dysfunction by 1.335 times (by 33.5 %), and a 1 % decrease in FEF_{50} increases the risk of RD by 1.248 times (by 24.8 %).

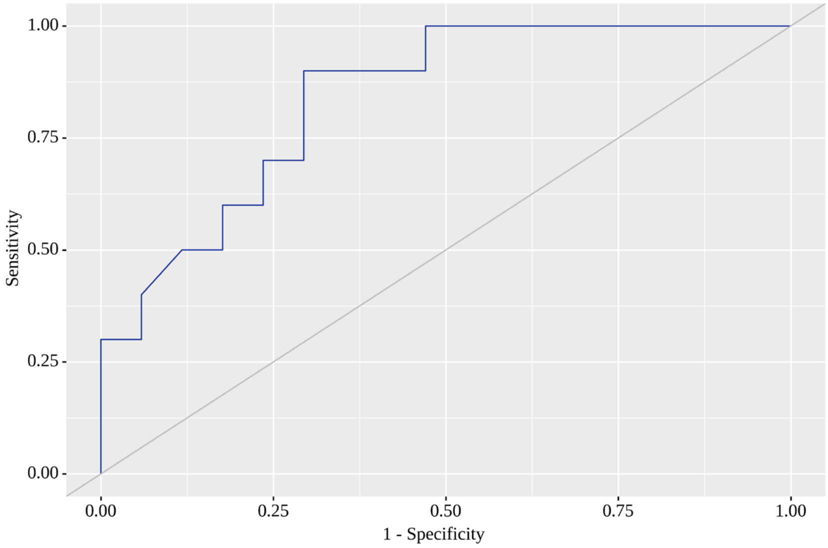
EDV is characterized by a direct correlation with the risk of developing respiratory dysfunction. When the EDV value decreases by 1 %, the risk of developing RD decreases by 1.065 times (by 6.5 %).

To determine the threshold values of predictors reflecting the state of the cardiorespiratory system in predicting the development of RD in the early postoperative period after LVGR, a ROC-analysis was performed (Table 7). Among all the predictors shown in the table, the largest area under the curve (AUC) was shown by two parameters — FEV_3 and EDV (Figure 2).

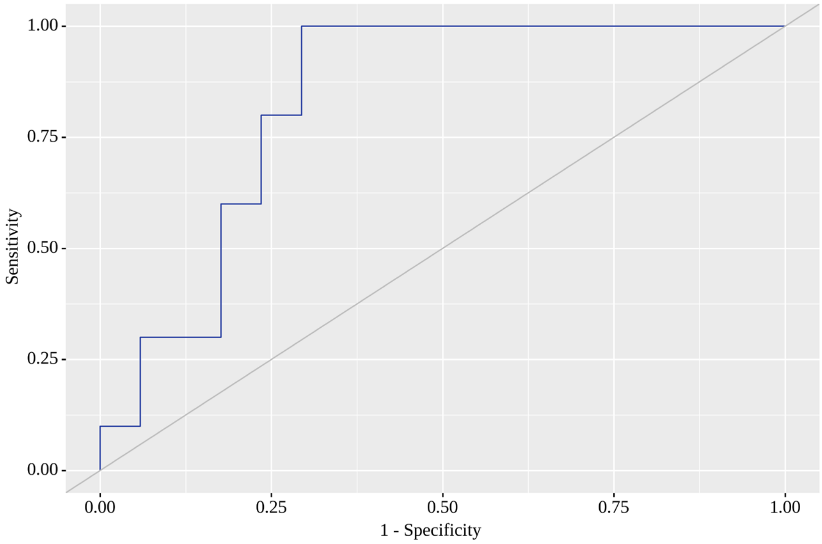
Table 7

Comparative characteristics of ROC-curves reflecting the relationship between the probability of RD and the initial parameters of spirometry and echocardiography

Indicators	AUC	95 % CI	cut-off	Se,%	Sp,%	P
FVC	0,756 ± 0,093	0,573–0,939	88 %	80	64,7	0,029
FEV_3	0,829 ± 0,079	0,675–0,983	87 %	73	70,6	0,005
FEF_{50}	0,791 ± 0,087	0,621–0,961	72 %	76,4	70	0,013
ELA	0,825 ± 0,084	0,689–1,000	112 %	70	70,6	0,007
MVV	0,823 ± 0,073	0,710–0,996	80 %	70	76,5	0,005
EDV	0,838 ± 0,087	0,667–1,000	181 мл	80	70,6	0,004
ESD	0,813 ± 0,094	0,629–0,997	48 мм	70	73,3	0,009



a



b

Fig. 2. ROC-curve reflecting the relationship between the probability of RD and the initial indicators of EDV *(a)* and FEV_3 *(b)*

The CHAID method was used to analyze the effect of predictors reflecting the state of the cardiorespiratory system on the likelihood of developing respiratory dysfunction and building a classification tree (Figure 3).

Cumulative statistics for the selected nodes are presented in Table 8. According to the data obtained, nodes 6 and 3 characterize patients with a low risk of developing respiratory dysfunction, and nodes 7, 8 and 5 belong to patients with a high risk of RD. Node 7 has the largest share in the overall structure of the classification tree and is characterized by the highest risk of developing RD. The sensitivity of the obtained model was 80 %, specificity was 88.2 %, and the overall diagnostic significance was 92.6 ± 3.6 %.

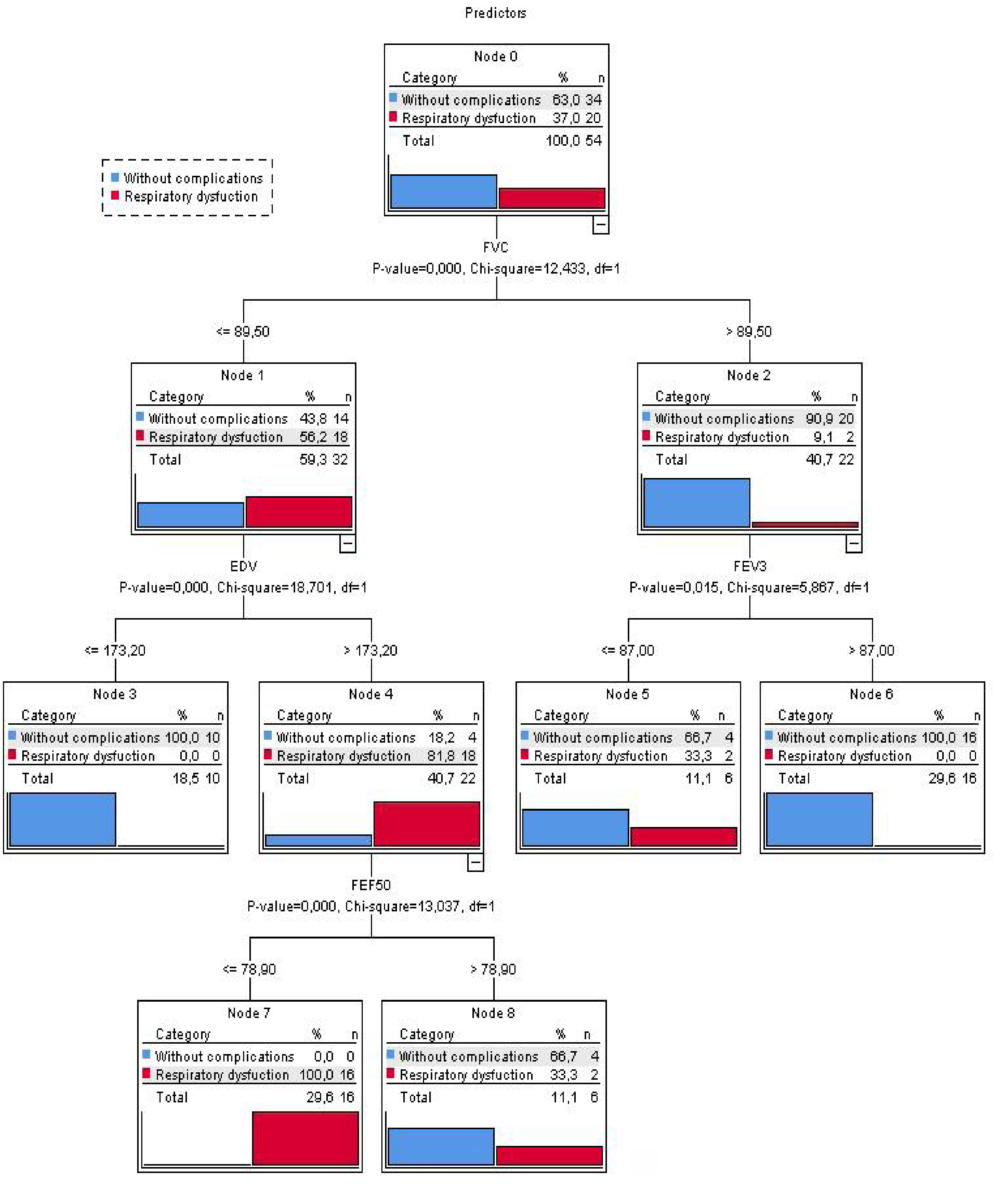


Fig. 3. Classification tree of the studied predictors depending on the risk of respiratory dysfunction

Table 8

Characteristics of terminal nodes

Node number	Parameter values	The share of the node in the overall structure, abs. (%)	Respiratory dysfunction, (%)
7	FVC ≤ 89,5 %, EDV > 173,2 ml, FEF_{50} ≤ 78,9 %	16 (29,6)	100
8	FVC ≤ 89,5 %, EDV > 173,2 ml, FEF_{50} > 78,9 %	6 (11,1)	33,3
5	FVC > 89,5 %, FEV_3 ≤ 87 %	6 (11,1)	33,3
6	FVC > 89,5 %, FEV_3 > 87 %	16 (29,6)	0
3	FVC ≤ 89,5 %, EDV ≤ 173,2 ml	10 (18,5)	0

In this study, a comprehensive assessment of the prognostic value of the indicators of the cardiorespiratory system was carried out, and a model was developed to predict the development of respiratory dysfunction in the early postoperative period in patients after the left ventricle geometric reconstruction.

The revealed intergroup differences in the parameters of the cardiorespiratory system in patients with postinfarction left ventricular aneurysm at the preoperative stage may probably indicate that the mechanism of development of respiratory dysfunction in the early postoperative period involves not only potential violations of ERF, but also more pronounced heart failure [15].

The indicators of gas exchange and hemodynamics in the small circle of blood circulation, in the first postoperative day, differed from the physiological norm in both groups. Nevertheless, severe respiratory dysfunction developed mainly in patients of group II with initially lower rates of ERF in combination with more pronounced LV dilation.

CHF is known to be associated with impaired lung ventilation function [16] and pulmonary gas exchange [17]. At the same time, the degree of these disorders is probably related to the occurrence and severity of pulmonary hypertension, which probably occurs in patients with CHF as a result of pulmonary congestion [17, 18].

In group II patients, there was a significant increase in Qs/Qt and P(A-a)O_2 indices, which may indicate not only the presence of interstitial edema, but also atelectasis. Indeed, there is quite a lot of data in the scientific literature indicating that one of the causes of the development of respiratory dysfunction is X-ray negative microatelectasis of lung tissue resulting from the damaging effects of artificial circulation, and manifested by hypoxemia [19, 20]. Microatelectases resulting from systemic inflammation and damage to the alveolar capillary membrane can occupy up to 50 % of the lung tissue, which leads to an increase in intrapulmonary bypass Qs/Qt and impaired oxygenating lung function [21].

Low hemoglobin levels and a heart index at the lower limit of normal may also contribute to increased respiratory dysfunction in group II patients. In combination, this can have a direct effect on oxygen delivery and absorption, causing oxygen debt [22].

Thus, initially reduced respiratory function indicators and more severe heart failure in group II against the background of the adverse effects of artificial ventilation and artificial circulation probably lead to the formation of microatelectasis and more pronounced stagnation in the pulmonary circulation in this category of patients, which leads to the development of interstitial edema, moderate pulmonary hypertension, and a violation of the ventilation-perfusion ratio and ultimately to a violation of the diffusion of gases through the alveolar-capillary membrane.

Univariate analysis using the logistic regression method revealed a number of independent predictors among indicators of both the respiratory system and cardiac function (Table 5). It should be noted that the FEF_{75} predictor was not statistically significant, which may likely indicate the variability of this indicator and the dependence of the results not only on the severity of concomitant pulmonary complications and the severity of CHF, but also on the degree of physical weakness of the patients [23–25]. The FEF_{75} indicator reflects the condition of the small bronchi, and it largely depends on the muscular effort of the respiratory muscles. Obviously, in weakened patients, the strength of the respiratory muscles may be insufficient to fully perform the breathing maneuver.

Using the ROC-analysis method, threshold values were determined for various indicators of the cardiorespiratory system. The largest area under the curve was characterized by the EDV and FEF_3 indicators (Table 7). In addition, in the analysis, EDV demonstrated high sensitivity (80 %), so it can be recommended for stratifying the risk of developing respiratory dysfunction in patients planned for surgical treatment of LVGR.

The CHAID method was used to build a classification tree, resulting in a hierarchically ordered structure consisting of a root node (FVC indicator) and terminal nodes that characterize the best final outcomes. In the resulting model (Figure 3), terminal nodes 7, 8 and 5 characterize the categories of patients with an increased risk of developing respiratory dysfunction. In the analyzed cohort of patients, the largest share in the overall structure of the classification tree is occupied by node 7, consisting of a combination of connections FVC ≤ 89.5 %, EDV > 173.2 ml and FEF_{50} ≤ 78.9 %, which was identified in 16 patients (29.6 %) with a risk of developing respiratory dysfunction of 100 %.

Using multivariate analysis with logistic regression, a prognostic model was developed to predict the risk of developing respiratory dysfunction in patients after LVGR (Table 6). It included three factors: FVC, FEF_{50} and EDV. Moreover, the FVC indicator with a threshold value of 88 % showed fairly good sensitivity (80 %) in a univariate analysis, but its specificity (64.7 %) was low. However, within the framework of a multifactorial model, the prognostic value of this indicator turned out to be more significant. The sensitivity and specificity of the resulting model were 80 % and 82.3 %, respectively.

It has been shown that when assessing the influence of indicators of the cardiovascular and respiratory systems on the risk of developing respiratory dysfunction in patients after geometric reconstruction of the left ventricle, the use of multifactorial models and an integrated approach have an advantage over univariate analysis.

Conclusions

Based on the identified risk factors for the development of respiratory dysfunction in patients after the left ventricle geometric reconstruction, a prognostic model was developed, including three indicators — FVC, FEF_{50} and EDV.

According to the ROC-analysis data, the EDV and FEV_3 indicators had the largest area under the curve. At the same time, the EDV indicator demonstrated a fairly high sensitivity, so it can be recommended for stratifying the risk of developing respiratory dysfunction in patients planned for surgery for LVGR.

Deterioration of gas exchange parameters on the first postoperative day was observed in all studied patients. However, significant respiratory dysfunction was observed precisely in patients with initially reduced parameters of the cardiorespiratory system at the preoperative stage.

Identified predictors of the development of respiratory dysfunction in patients after the left ventricle geometric reconstruction make it possible to stratify the risk of respiratory complications at the stage of planning the operation and take appropriate measures to improve the functionality of the cardiorespiratory system of patients before the upcoming surgical intervention.

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Прогнозирование респираторной дисфункции у пациентов после геометрической реконструкции левого желудочка

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Аннотация. *Актуальность.* Одним из наиболее частых осложнений после кардиохирургических вмешательств является респираторная дисфункция (РД). В группе с высоким риском находятся пациенты после геометрической реконструкции левого желудочка (ГРЛЖ) из-за наличия хронической сердечной недостаточности, а также сложности и объема хирургического вмешательства. На данный момент в клинической практике нет единого подхода к прогнозированию РД у пациентов данной группы. *Цель исследования:* выявить предикторы развития РД в раннем послеоперационном периоде у пациентов после ГРЛЖ. *Материалы и методы.* В исследование включено 54 пациента, перенесших операцию ГРЛЖ. Выделено две группы пациентов: группа I — пациенты без респираторных осложнений в раннем послеоперационном периоде (n = 34); группа II — пациенты с РД в раннем периоде (n = 20). Оценивали показатели сердечной функции, дыхательной системы и показатели газообмена в до- и раннем послеоперационном периоде. *Результаты и обсуждение.* Показатели ЭХО-КГ и спирометрии в группе с РД были снижены до операции относительно группы I (FVC на 10,9 %, p = 0,009; КДО на 27 %, p = 0,004). Пациенты с РД в первые сутки после операции характеризовались выраженным нарушением газообмена относительно пациентов группы I (PaO_2/FiO_2 снижен на 45,1 %, p < 0,001; Qs/Qt увеличено на 71,4 %, p < 0,001). Была разработана многофакторная модель, в которую вошли три базовых предиктора развития РД: FVC, FEF_{50} и КДО. При снижении показателей модели на 1 % риск развития РД возрастал на 33,5 %, 24,8 % и снижался на 6,5 % соответственно. По данным ROC-анализа, наибольшую значимость имели показатели FEV_3 (AUC 0,829 ± 0,079) и КДО (0,838 ± 0,087). Для оценки риска развития РД было построено дерево классификации. Узел 7 характеризуется самым высоким риском при следующих параметрах: FVC ≤ 89,5 %, КДО > 173,2 мл, FEF_{50} ≤ 78,9 %. *Выводы.* Нарушение газообмена в первые сутки после операции выявлено у всех исследуемых пациентов, однако выраженная РД наблюдалась именно у пациентов с наиболее сниженными параметрами кардиореспираторной системы до операции. Разработанная модель прогнозирования РД у пациентов после ГРЛЖ позволяет оценить риск респираторных осложнений на этапе планирования операции и подготовить кардиореспираторную систему пациента к предстоящему хирургическому вмешательству.

Ключевые слова: геометрическая реконструкция левого желудочка, респираторная дисфункция, прогнозирование, предикторы, спирометрия

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