

Determination of the Degree of Operational and Anesthesiological Risk in Children with Chronic Suppurative Lung Diseases

T SH Ikromov^{1*}, AA Abdulaliev² and KH I Ibodov²

¹Government Department Republican Scientific and Clinical Center of Pediatrics and Pediatric Surgery, Ministry of Health and SHF of the Republic of Tajikistan, Dushanbe, Tajikistan

²SEI Institute of Postgraduate Education in Health Sphere of the Republic of Tajikistan, Dushanbe, Tajikistan

*Corresponding Author: T SH Ikromov, Government Department Republican Scientific and Clinical Center of Pediatrics and Pediatric Surgery, Ministry of Health and SHF of the Republic of Tajikistan, Dushanbe, Tajikistan.

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Abstract

Aim: To determine the degree of operational and anesthetic risk in children with chronic suppurative lung diseases (CSLD).

Materials and Research Methods: Based on the data of a comprehensive examination of 120 children with CSLD for the period from 2016 to 2021, in the age aspect from 5 to 14 years old: According to the form of CSLD there were: chronic deforming bronchitis (CDB) - 21 (17.5%) sick; unilateral bronchiectasis 62 (51.7%); bilateral bronchiectasis - 10 (8.3%); chronic lung abscess (CAL) - 15 (12.5%); chronic empyema of the lung (CEL) - 12 (10.0%) patients.

Research Results and their Discussion: We developed, on the basis of objective criteria, depending on the severity of the condition, we determined the degree of operational and anesthetic risk (OAR) in children with CSLD.

Conclusion: The methodology developed by us for determining the degree of operational and anesthetic risk can reduce complications in the intra-postoperative period.

Keywords: Operational-Anesthetic Risk; CNPD; Children; Perioperative Period; Pain Relief

Relevance

The risk of surgery and anesthesia is the likelihood of complications in the perioperative period. Surgical intervention and anesthesia are always accompanied by a risk to the patient's health. There are multiple factors that increase the risk of anesthesia and surgery. Therefore, one of the main tasks of the anesthesiologist in the perioperative period is to minimize the risk and ensure the patient's safety during the operation and in the postoperative period. The method of determining the operational anesthetic risk (OAR) is of great importance. Correct risk assessment helps to reduce the likelihood of complications in the intra- and postoperative period. There are many methods for assessing OAR. The most widely used in many countries is the classification of the patient's objective status proposed by ASA - the American Association of Anesthesiologists (1941, 2014), the Moscow Scientific Society of Anesthesiologist's resuscitator (MSAR, 1988), Balagina VM., *et al.* (2002), Mikhelson VA, Sidorov VA, Stepanenko SM (2007) and others. One of the limitations of the existing classifications is that they are based on a subjective assessment given to doctors, and not on an objective indicator due to the presence of specific

diseases. Therefore, on the basis of existing methods for determining OAR, it is difficult to determine the true OAR, to assess the severity of the condition, to determine the amount of preoperative preparation and operability of patients, to predict the course of the operating and postoperative period, the choice of the method of anesthesia and mechanical ventilation.

Anesthetic management of the operating period in children with chronic suppurative pulmonary diseases (CSLD) is complex, difficult and is accompanied by a high degree of operational anesthetic risk (OAR). Especially the risk increases in children in connection with the anatomical and physiological features of the child's body, the initial dysfunctions of the lungs and the onset of pathophysiological changes during anesthesia and surgery. To ensure the safety of the child during surgery, it is necessary to develop an OAR method for children with CSLD. There are many ways to determine OAR, but they either rely on subjective factors or on individual indicators of the function of external respiration or decide only the question of the admissibility of surgery. Therefore, based on existing methods for determining OAR, it is difficult to determine the true OAR, to assess the severity of the condition, to determine the amount of preoperative preparation and operability of patients, to predict the course of the operating and postoperative period, the choice of the method of anesthesia and mechanical ventilation.

Aim of the Study

To determine the degree of operational and anesthetic risk in children with chronic suppurative lung diseases (CSLD).

Materials and Research Methods

Based on the data of a comprehensive examination of 120 children with CSLD who were in the thoracic department of the State Institution Health Complex "Istiklol" for the period from 2016 to 2021, in the age aspect from 5 to 14 years: at the age from 3 to 7 years there were 45 (37.5%) patients 8 - 10 years old - 35 (29.2%), 11 - 15 years old - 40 (33.3%) patients. According to the form of CSLD there were: chronic deforming bronchitis (CDB) - 21 (17.5%) patients; unilateral bronchiectasis 62 (51.7%); bilateral bronchiectasis - 10 (8.3%); chronic lung abscess (CLA) - 15 (12.5%); chronic empyema of the lung (CEL) - 12 (10.0%) patients.

All patients underwent a study of the following criteria: ventilation insufficiency (VL) with Metatest-2 and Cosmed (Denmark), pulmonary hypertension (PH) using ultrasound dopplerographic method; statistical compliance (SC) and static elasticity (SE) by V.M. Lelyukha; the area of the lesion of the lung tissue (LLT) by anatomical structures; age of patients (year); the invasiveness of the operation (IO) depending on the number of segments resection, the amount of blood loss and the duration of the surgical intervention; saturation of hemoglobin with oxygen (SpO_2) pulse oximeter; hypocoagulant lung function (HLF) was studied by comparative analysis of indicators of mixed venous blood (MVB) and outflowing arterial blood in 32 apparently healthy children (control group) and children with surgical suppurative lung diseases. The HLF of the lungs, according to the developed classification of the Department of Pediatric Surgery, is divided into three stages: Ist - compensated - while the indices of HLF in patients, in comparison with practically healthy children, turned out to be reduced from 80 to 60%; II Art. subcompensated, the deviation of the HLF indices is below 60% or there is no difference in the indices in the MVB and the AB, that is, the lungs do not participate in metabolic processes; Sh Art. - de-compensated, manifested by inverse indicators in MVB and ab, in comparison with the indicators of NFL in practically healthy children, that is, a faulty violation of non-gas exchange lung function. III stage of NFL violation, depending on the opposite manifestation of indicators in percentage, is divided into three substages (a, b, c). III a Art. when the reverse deviation of the NFL indices in comparison with the apparently healthy children is from 3 to 10%, III b Art. - From 10 to 20% and III in Art. more than 20% (Abdufatev T.A., 1998). To study HLF, hemostasis was studied according to the following tests: blood clotting time according to Lee-White, prothrombin index (PI) according to Quick, fibrin and fibrinogen according to Rutberg, thrombotest according to Fouett, activation of recalcification time (AVR) according to Howell, free heparin according to Sirmaj, plasma heparin tolerance (PHT) according to Sig, fibrin degradation products according to Ivanov; alveolar-respiratory failure (ARF), which determines the degree operational and anesthetic risk of OAR: pO_2 , pCO_2 and acid-fundamental state (AFS) in arterial blood, gas

analyzer ABL-330 by Radiometer, Denmark; the severity of the phenomenon of endobronchitis (EB) after bronchoscopy "Friedel" and 0.2 mm diameter video fiberoptic bronchoscope by KARL STORZ, Germany.

The obtained digital data were processed using the methods of variation and difference statistics with the calculation of $M \pm m$ and the assessment of the reliability of the results according to the Student's criterion.

Research Results and their Discussion

Based on the above 10 objective criteria, depending on the degree of change of each parameter, four degrees of change are distinguished. Each degree corresponds to 1 point. The criterion that determines the degree of operational and anesthetic risk (OAR) includes the determination of (VL) was carried out according to the indicators: tidal volume, vital lung capacity (VC), residual volume (RV), maximum ventilation (MV), residual lung capacity (RLC), forced expiratory volume (FEV), well-ventilated parts of the lungs (CVCL), forced vital capacity (VC) and peak flow rate (PFL).

With VL, TV, FEV, RLC, OФB1, CVCL are reduced from 80 to 70%, and RO and FRU are within the normal range or increased by 140 - 150% ($p < 0.001$) of the due values. With VN II. Art. the above parameters were reduced from 69 to 60% ($p < 0.01$), and with VN III st. reduced by 59 - 50% ($p < 0.001$), and at IV stage. below 50% ($p < 0.001$).

Alveolar-respiratory respiratory failure is the second criterion that determines the degree of operational and anesthetic risk of OAR: pO_2 and pCO_2 in arterial blood reflects the state of ventilation, perfusion, diffusion and gas exchange in the body. A decrease in pO_2 and an increase in pCO_2 characterize alveolar-respiratory respiratory failure (CARF) due to general and regional ventilation of the alveoli with an uneven ratio of ventilation-blood flow in the lungs. (CARF) according to the degree of decrease in pO_2 and increase in pCO_2 distinguish three degrees: Ist moderate - decrease in pO_2 from 90 up to 80 mm Hg. Art. and an increase in pCO_2 40-45 mm Hg. Art.; II Art. average - a decrease in pO_2 from 79 to 70 mm Hg. Art. and an increase in pCO_2 from 46 to 50 mm Hg. Art. and III Art. severe - pO_2 below 69 - 60 mm Hg. Art. and an increase in pCO_2 50 - 59 mm Hg. Art.; 1set $pO_2 < 50$ mm Hg. Art.; $pCO_2 > 60$ mm Hg. Art.

The third criterion for determining OAR is the determination of the average pressure in the pulmonary artery. Depending on the degree of increase in mean arterial pressure, there are 3 tbsp. pulmonary hypertension (PH): Ist LH-pressure in the pulmonary artery up to 27 mm Hg. Art.; II Art. from 27 to 35 mm Hg Art.; III Art. LH 35 to 45 mm Hg Art. and IV Art. LH from 46 mm Hg. Art. and higher.

One of the criteria is the defining SOAR - it is static compliance (SC) and elasticity (ES) of the lungs. There are 4 degrees depending on the change in SP and SE of the lungs, taking into account age norms (in%): Ist. decrease in SP and SE of the lungs from 5 to 10%, 2 tbsp. from II to 15% ($p < 0.05$) and III st. from 16 to 20% ($p < 0.01$) and IV st. $> 20\%$.

The criteria for OAR include the determination of the area of damage to the lung tissue. The defeat of 1 - 2 segments of the lung is 10 - 20% of the area of the lung; 3 - 5 segments corresponds to 20 - 35%, 6 - 10 segments represents 35 - 50% and lesions of 12 - 14 segments represent 50% more of the lung tissue area.

The degree of impairment of the hypocoagulation function of the lungs is distinguished by 3 degrees of impairment. At I-II Art. the hypocoagulative function of the lungs is preserved (stage of compensation), at III stage. there is no difference in the indicators of hemocoagulation properties (stage of subcompensation) and at IV stage. violations of the hypocoagulative function of the lungs in patients in the edematous blood from the lungs is observed hypercoagulable the stage of decompensation begins.

Chronic endobronchitis, depending on the severity, course and prevalence, are distinguished by 4 tbsp. With I Art. the phenomenon of ChE is localized purulent or diffusely localized catarrhal endobronchitis in remission. With II Art. the phenomenon of endobronchitis diffusely localized or unilateral diffuse purulent endobronchitis or bilateral catarrhal endobronchitis in remission. At III Art. the phenomenon of bilateral diffuse purulent endo-bronchitis in remission. At IV Art. fibrinous end bronchitis in the acute stage.

Depending on the anatomical and physiological characteristics of the child's body in different age groups, the protective-adaptive and adaptive mechanisms will be different and, accordingly, there will be a different degree of risk. The younger the age, the higher the risk. In children under 1 year of age, the risk will be stage IV, from 1 to 3 years of stage III. from 4 to 7 years II Art. and over 7 - 15 years of age, the risk will be Art.

There are 4 tbsp. trauma of lung surgery. Stage I - this small traumatic surgery (marginal resection of the lung, resection of the segment of the lung); II Art. - moderate invasiveness of the operation (resection of one lobe of the lung); III Art. - traumatic operations (resection of two lobes of the lung, decortication of the lung); IV Art. - especially traumatic operations (pulmonectomy).

Depending on the percentage of saturation of hemoglobin with oxygen, 4 degrees are distinguished: I st. - from 96 to 90%; II st. - from 89 to 80%; III Art. 79 to 70% and IV Art. from 69% and below.

To determine the degree of OAR, depending on the degree of deviation from the norm, each parameter was assessed from 0 to 4 points. The total number of "physiological" points is the sum of the scores of 10 criteria (from 0 to 4 for each). I Art. - the sum of points corresponds to 10 indicators less - 10 points; II Art. from 11 to 19 points; III Art. from 20 to 29 points; IV Art. the sum of points of 10 indicators corresponds to more than 30 points.

Criterion	Scores	Criterion	Scores
The age of patients		Lung tissue lesion area	
Up to 1 year	4	Up 20%	1
1 - 3 year	3	21 - 35%	2
4 - 7 year	2	36 - 50%	3
8 - 15 year	1	> 50%	4
Ventilation failure		Hypocoagulant lung function	
80 - 70%	1	not broken	0
69 - 60%	2	Compensation	1
59 - 50%	3	Subcompensation	2
≤ 50%	4	Decompensation	3
ARDN		Injury operation	
pO ₂ 90 - 80 mm Hg. Art. pCO ₂ 40 - 45 mm Hg. Art.	1	Small traumatic operations	1
pO ₂ 79 - 70 mm Hg. Art. pCO ₂ 46 - 50 mm Hg. Art.	2	Moderate traumatic surgery	2
pO ₂ 69 - 60 mm Hg. Art. pCO ₂ 50 - 60 mm Hg. Art.	3	Severe traumatic operations	3
pO ₂ ≤ 50 mm Hg. Art. pCO ₂ > 60 mm Hg. Art.	4	Particularly traumatic operations	4
Pulmonary hypertension		Chronic endobronchitis	
Up to 27 mm Hg. Art.	0	1 st.	1
27 - 35 mm Hg. Art.	1	2 st.	2
36 - 45 mm Hg. Art.	2	3 st.	3
> 45 mm Hg. Art.	3	4 st.	4
SP and SE		Saturation	
5 - 10%	1	Up to 90%	1
11 - 15%	2	89 - 80%	2
16 - 20	3	79 - 60%	3
> 20%	4	≤ 60%	4

Table: Operational and anesthetic risk map with chronic suppurative lung diseases in children.

Conclusion

1. The developed method for determining the degree of operational - anesthetic risk allows you to determine the severity of the condition, the amount of preoperative preparation, the choice of methods of anesthesia, the mode of mechanical ventilation and the management of the postoperative period.
2. The degree of operational risk makes it possible to determine the operability of patients.
3. After determining the degree of operational and anesthetic risk in children with CSLD, it allows predicting the outcome of surgical treatment [1-6].

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