SAM-TT R-1029-0870

USAF SAM TECHNICAL TRANSLATION

Changes of Some Indices of External Respiration During Chronic Pneumonia in Children

by

Ye. S. Yermakov

UNITED STATES AIR FORCE
SCHOOL of AEROSPACE MEDICINE
AEROSPACE MEDICAL DIVISION (AFSC)
BROOKS AIR FORCE BASE, TEXAS

From the Russian

Changes of Some Indices of External Respiration During Chronic Pneumonia in Children

by

Ye. S. Yermakov

Original Title: Izmeneniya Nekotorykh Pokazateley Funktsii Vneshnego Dykhaniya Pri Khronicheskoy Pnevmonii u Detey

Source: Sovet Med. vol. 28 Sept 1965

Translated by: Translation Consultants, Ltd

Translated for the
Translation Branch
Support Services Division,
School of Aerospace Medicine,
Brooks Air Force Base, Texas

CHANGES OF SOME INDICES OF EXTERNAL RESPIRATION DURING CHRONIC PNEUMONIA IN CHILDREN

by

Ye. S. Yermakov

One of the causes of chronic pneumonia is a prolonged disturbance of the external respiratory function (Yu. F. Dombrovskaya, S. P. Borisov). With every recurrence of this ailment, changes in the lungs increase, which result in the development of respiratory failure (V. P. Davydov).

The data on oxyhemometry and the gaseous composition of the arterial blood characterize the external respiratory function, in addition to results of direct spirometric examinations (Yu. F. Dombrovskaya, R. A. Meytina).

The degree of O_2 saturation of the arterial blood, i.e., the oxyhemoglobin content, is one of the important indices of the external respiratory function. It changes according to the severity of the ailment (N. A. Novoselova). The physiological standard for the oxyhemoglobin content is set at 96%. More differentiated indices are given by Cassels and Morse: for children in the 2 to 4 year age group, 94.2%; in the 7 to 17 year age group, 95.8%.

The gaseous content of the arterial blood is closely connected with the external respiratory function. The findings of various authors on this question were systematized by L. F. Gusarova. According to the indices given by her, the average O_2 content in the arterial blood is 16% by volume, and that for the CO_2 is 41% by volume.

We examined the gaseous content of the arterial blood in 52 children who suffered from chronic pneumonia in various stages. Oxyhemometric examinations were made on 28 children. The age of the patients ranged from 3 to 16 years. In the children, changes in the studied indices were discovered at all stages of the ailment, starting from the exacerbation period of the process.

Among 28 children in whom the oxyhemoglobin content was determined in the arterial blood, six patients indicated the initial stage of

chronic pneumonia, 14 advanced stages, and 8 exhibited the disease in the late stage with the development of bronchiectases.

In the initial stage of the ailment, in the exacerbation period, the oxyhemoglobin content was 89.3%, with variations in individual patients from 87% to 92%, depending on the severity of the course (Table 1). As a measure of improvement in the children's condition after treatment, the oxyhemoglobin percentage increased, reaching 93.3% in the remission period. These findings make it possible to believe that even at the start of the remission period, the degree of O_2 saturation of the arterial blood does not reach normal.

Even more considerable was the drop in the oxyhemoglobin content of arterial blood in the exacerbation period in children who exhibited the advanced stage of chronic pneumonia. Its content reached 83%. The degree of saturation increases at a slow rate, reaching 86.4% in tne remission period, i.e., it stays considerably lower than normal, which indicates a considerable deterioration in the external respiratory function even during the remission period.

Finally, in children who exhibited the disease in the bronchiectatic stage, the oxyhemoglobin percentage in the arterial blood is very low, and during the exacerbation period of the process it reached 72%, while in one 15 year old child, who had a severe, continuously recurrent case, it dropped to 68%. In this stage of chronic pneumonia, after improvement of the children's condition, the oxyhemoglobin content in the arterial blood increases to only 77% at the beginning of the remission period, i.e., it remains at the borderline of the low figures.

Thus, the oxyhemoglobin content in the arterial blood can serve as a satisfactory index of the degree to which the lungs are affected by the pathological process.

The gases in the arterial blood undergo considerable change. In the initial stage of the disease, the CO_2 content was within the range of the physiological standard, while in the exacerbation period it dropped from 41% by volume to 38.3% by volume by the end of the therapeutic treatment, which points to sufficiently complete clearance of metabolic products from the blood.

We found a somewhat different picture in the arterial blood of children who exhibited advanced and bronchiectatic stages of the disease. In the exacerbation period, the CO_2 content was higher than the normal value, reaching an average of 43.4% by volume in the advanced stage of the disease, while in the bronchiectatic stage it reached 47.4% by volume. Consequently, in these cases hypercapnia of the arterial blood took place.

Depending on the degree of improvement in the condition of the sick children, there was a regular reduction in the CO_2 content of the arterial blood, which reached normal values during the remission period. Only

in individual patients who exhibited the bronchiectatic stage of the disease did hypercapnia of the arterial blood keep up even during the remission period (Table 2).

Also interesting are the results of the dynamic study of the O_2 content of the arterial blood in children suffering from chronic pneumonia. In all stages of the disease, its reduction was noted during the exacerbation period, i.e., a higher or lower degree of hypoxemia of the arterial blood. In the initial stage of the disease, the reduction reached 15.9% by volume, in the advanced stage it reached 13.0% by volume, and in the bronchiectatic stage of the disease it reached 12.9% by volume.

Depending on the degree of improvement in the children's condition and on the abatement of the pathological process in the lungs, the O_2 content of the arterial blood increased considerably, although a moderate degree of hypoxemia continued even in the patients who exhibited the initial stage of the sickness (Table 3).

Conclusions

1. The oxyhemoglobin content and the gaseous composition of the arterial blood may serve as indices of the external respiratory function.

2. O_2-saturation of the arterial blood during the exacerbation period of chronic pneumonia is reduced in all patients, while the degree to which the oxyhemoglobin percentage is reduced is proportionate to the degree of severity of the disease.

3. During the exacerbation period, hypercapnia of the arterial blood is noticed in sick children who exhibited the advanced and bronchiectatic stages of chronic pneumonia. During the remission period, the CO_2 content in the arterial blood reached the normal value in all patients, except in a few individuals who exhibited the bronchiectatic stage in which case the state of hypercapnia is maintained.

4. In all our patients there was marked hypoxemia of the arterial blood during the exacerbation period, which also continued to a moderate degree until the beginning of the remission period.

5. On the basis of the data obtained, it can be stated that in chronic pneumonia the external respiratory function is not fully restored at the outset of the remission period, not even in children who exhibit the initial stage of the disease.

Summary

For the purpose of studying the functional state of the external respiration the author conducted investigations of the gaseous composition

of the arterial blood in 52 children with different stages of chronic pneumonia. The content of oxyhemoglobin in the arterial blood was determined in 28 patients. There was found a reduced oxygen saturation of the arterial blood depending on the severity of the disease. Arterial hypoxemia was disclosed in all patients during the period of exacerbation. At the beginning of remission all these alterations are preserved; however, they are less pronounced. Arterial hypercapnia was noted during exacerbation in children with acute and bronchiectatic stages of chronic pneumonia.

Table 1: Average Oxyhemoglobin Content in the Arterial Blood of Children with Chronic Pneumonia (M±σ, in %)

1 Стадия заболевания	2 Число больных	3 Исследование		
		1st	2nd	3rd
4 Начальная	6	89.3±2.0	91.5±1.9	93.3±2..
5 Выраженная	14	83.0±2.0	85.5±1.5	86.4±1..
6 Бронхоэктатическая	8	72.0±2.5	75.0±1.5	77.0±1.5

1. Stage of the disease
2. Number of patients
3. Examination
4. Initial
5. Advanced
6. Bronchiectatic

Table 2: Average CO_2 Content in the Arterial Blood of Children with Chronic Pneumonia (M±σ, % by volume)

1 Стадия заболевания	2 Число больных	3 Исследование		
		1st	2nd	3rd
4 Начальная	8	41.0±2.6	39.0±1.9	38.3±1.3
5 Выраженная	30	43.4±3.2	41.4±2.2	39.7±1.8
6 Бронхоэктатическая	14	47.4±4.3	44.6±4.9	41.6±2.3

1. Stage of the disease
2. Number of patients
3. Examination
4. Initial
5. Advanced
6. Bronchiectatic

Table 3: Average O_2 Content of the Arterial Blood in Children with Chronic Pneumonia (M±σ, % by volume)

1 Стадия хронической пневмонии	2 Число больных	3 Исследование		
		1st	2nd	3rd
4 Начальная	8	13.9±1.5	14.0±1.9	15.5±1.7
5 Выраженная	30	13.0±2.0	14.0±1.9	15.1±1.6
6 Бронхоэктатическая	14	12.9±2.0	14.0±2.4	15.5±1.6

1. Stage of the disease
2. Number of patients
3. Examination
4. Initial
5. Advanced
6. Bronchiectatic

Bibliography

Борисов С. П. В кн.: Пневмонии у детей. М., 1955, стр. 103.—Гусарева Л. Ф. Газы крови при пневмонии у детей. Дисс. канд. Л., 1947.—Давыдов В. П. Труды 7-го Всесоюзн. съезда детских врачей. Л., 1959, стр. 550.—Домбровская Ю. Ф. Заболевания органов дыхания у детей. М., 1957.—Мейтина Р. А. В кн.: Хирургическое лечение митральных стенозов. М., 1958, стр. 109.—Новоселова Н. А. В кн.: Вопросы легочно-сердечной патологии. Томск, 1960, т. 2, стр. 131.—Cassels D. E., Morse M., J. clin. Invest., 1953, v. 32, p. 824.