

FUNCTIONAL RECOVERY OF LUNGS AFTER ACUTE PNEUMONIA IN NEONATES AND INFANTS

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The problem of recurrent and chronic bronchopneumonic affections becomes ever more urgent. In earlier studies we succeeded in demonstrating their steadily increasing incidence among children of all ages, admitted to the clinic for treatment. Most frequently, in these cases the onset of the disease dates back to an acute pneumonia illness in the neonatal period. The same inference was reached by other authors too, e. g. V. Surkov established chronification in 10—11 per cent of neonatal pneumonias (cited by 1). Moreover, in the last few years the opinion prevails that acute affections of the respiratory system in the neonatal period may condition the so-called postnatal defects in the development of the bronchopulmonary apparatus (4).

Hence treatment of acute pneumonia in the earliest age becomes quite a responsible task, demanding the adoption of more reliable criteria for the course of convalescence. Researches conducted by J. Michalickova prove in a convincing manner that complete functional and morphological recovery of the respiratory system in infants lags far behind normalization of the clinical condition, some laboratory indicators and the X-ray find.

Having in mind the claimed in pediatric literature average duration of acute pneumonia in childhood (12—15 days according to Y. E. Dombrovskaia and N. S. Molchanov, cited by 1), we set out to study the functional state of the respiratory system among children with acute pneumonia within the time limits referred to above. Our attention was focused on the suckling and infantile age because of the great risk of pulmonary changes' chronification in these particular age groups.

Material and method

A total of 100 ill children with ages ranging from 10 days to 3 years, treated in the clinic for medium heavy and heavy acute pneumonia, were investigated. The patients were distributed into four age groups, submitted in Table 1.

Table 1

Distribution of the Patients under Study according to Age Group.

Group	I	II	III	IV
Age Number	10 d—3 m 23	3—6 m 25	6—12 m 20	1—3 y 32

Apart from the clinical study, routine X-ray and laboratory investigations, blood gas analysis and acid-base parameters were followed up in dynamics in all patients. Samples of arterialized capillary blood were taken at 1, 7 and 15 days of hospitalization (at shorter intervals in case of need). The study of samples was made in the clinic using the Astrug apparatus, type AME I, just after obtaining. To record the parameters, the nomogram of Sig. Andersen was employed.

Assessment was made on the basis of: 1) calculated mean values of the basic indicators by age groups, 2) relative number of patients with variations in partial blood pressure of blood gases leading to respiratory insufficiency — similarly by age groups. For the purpose of comparison, the age normatives of acid-base parameters according to Albert and Withers were used, and for PaO_2 — the borderline values adopted by V. Antova et al (80 mm Hg).

Results and discussion

In all patients under study it was a matter of acute pneumonia, running a medium heavy and heavy course. Evidence of unilateral localization was established in 26 cases, bilateral — in 64, and pleural complications were present in ten patients. The clinical course of the disease is illustrated in Table 2. From the Table it becomes obvious that in 35 per cent of the patients the severity of the course was dominated by respiratory system manifestations alone. A propensity for morbid process generalization was particularly characteristic of the neonatal and infantile age, with involvement of the cardiovascular system ranking first. This inevitably restricted the possibilities of prompt and complete functional and morphological recovery of the respiratory system.

Table 2

Incidence of Syndromes Observed.

Syndrome	No of patients
Localized forms	35
Cardiovascular syndrome	46
Toxicoseptic syndrome	18
Meningoencephalitic syndrome	10
Dyspeptic syndrome	15

In all patients under observation a complex treatment was applied in compliance with the severity and clinical course of pneumonia. Lethality was reduced to 4 per cent. Functional recovery of the respiratory system, studied in dynamics through blood gas analysis and acid-base parameters, expressed in averaged quantities, is presented in Table 3. The first investigation shows presence of medium heavy hypoxemia (61.91—70.91 mm Hg) in all age groups, mostly pronounced in those aged up to three months. At 15 days, a slight degree hypoxemia still persists in two of the age groups. At the first examination, hypercapnia is established only in the two groups with age up to six months. In older children PaCO_2 values augment in the course of illness, and at 15 days

Table 3

**Mean Values' Determination of the Basic Indicators — I, II and III.
Age Group Study.**

Indi- cator	PaO ₂ x			PaCO ₂ x			ApH x			SB x		
	I	II	III	I	II	III	I	II	III	I	II	III
I.	61,91	70,41	76,69	45,04	38,98	36,74	7,31	7,41	7,40	20,74	23,62	22,69
II.	68,08	76,58	85,09	39,52	37,27	37,64	7,37	7,40	7,40	21,88	23,94	23,19
III.	67,40	76,79	78,31	35,20	37,20	38,05	7,40	7,41	7,41	22,72	23,46	23,42
IV.	70,91	00,53	85,00	33,98	37,43	39,67	6,38	7,41	7,39	21,03	23,56	23,24

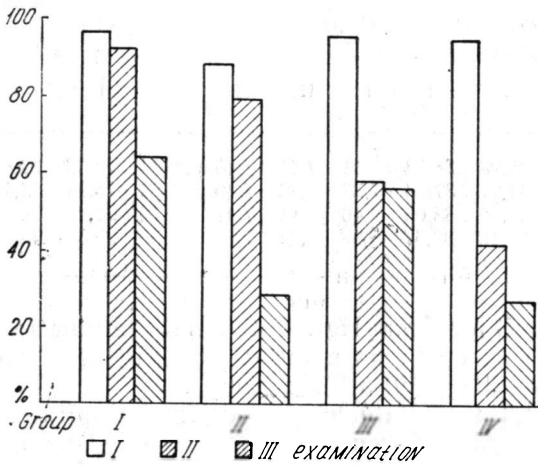
they exceed the age group normal limit (37.5 mm Hg). At the first examination, acidemia is found among patients aged up to six months, and shifting of the metabolic indicator (SB) towards acidity — in all age groups.

An overall idea about the functional state of the patients' respiratory system in the course of treatment is obtained from diagrams 1 and 2. Diagram 1 shows the relative number of children with hypoxemia. During the first investigation, hypoxemia is established in practically all patients. At 7 days, the percentage of patients with hypoxemia shows a clearcut fall only in the groups with ages above six months. It is worth noting that within 15 days of the onset of the disease, the percentage of patients with hypoxemia is still rather elevated, in the youngest age group in particular (62.5 per cent). Diagram 2 illustrates the relative number of children with hypercapnia. At the first examination, it is substantially higher in the younger ages (up to six months), while in children older than six months it augments in the repeated examinations (particularly clearcut in patients aged above one year).

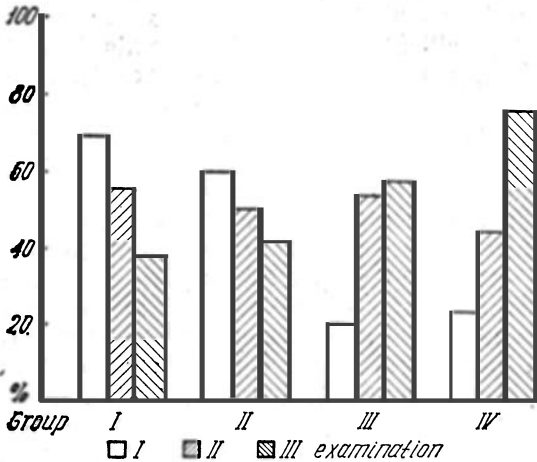
Our observations point to a high incidence and considerable severity of hypoxemia in the course of heavy acute pneumonia in sucklings and infants. Not infrequently, hypoxemia is an expression of partial respiratory insufficiency, with disproportionate distribution of alveolar ventilation and perfusion being assumed as the basic mechanism of its occurrence (Antova et al). Total respiratory insufficiency with rather marked hypercapnia is characteristic of neonates up to six months of age mainly, and is explained by the more favourable conditions for alveolar hypoventilation development in this particular age group. The data reported corroborate earlier observations by the author, as well as the findings of V. Antova et al, J. Michalickova, K. Erecinski¹ et al, and others, and once again support our viewpoint about the necessity of setting up well equipped centers, specially adapted for the treatment of acute respiratory insufficiency in the neonatal age.

Updated methods of successful treatment of heavy pneumonia conditions in the earliest age render exclusively urgent the issue of functional recovery of the respiratory system following heavy illness. General homeostasis impairment with ensuing vasoconstriction of pulmonary capillaries and hemodynamic disorders create conditions for rather persisting disturbances in gas exchange, and accordingly for a delayed morphological recovery of pulmonary tissues. Unfortunately, the possibility of following up functional and

morphological recovery of the respiratory system in sucklings is still limited since some of the methods hardly lend themselves to routine application in the practice. As the most accessible and readily executed procedure we have picked out the study of external respiration through gas analysis and acid-base parameters' determination in the capillary blood.



Diagr. 1: Relative number of patients with PaO₂ beneath 80 mm Hg.



Diagr. 2: Relative number of patients with PaCO₂ beneath 37.5 mm Hg.

37.5 mm HG (that is of patients with light degree respiratory insufficiency) remains rather high — 50 to 60 per cent for the various age groups. This means that within 15 days of the onset of the disease, external respiration is not fully restored in nearly one half of the patients. Using gammagrams of the lungs in similar cases, J. Michalickova established persisting perfusion disorders in the affected area, as well as heavier morphological changes. The discrepancy between clinical recovery in children with pneumonia and gas exchange normalization is emphasized by other authors too (K. Kamin-

The data obtained, PaO₂ values in particular, point to a considerable improvement of gas exchange in the course of repeatedly performed examinations. The values of PaCO₂ in patients up to six months of age similarly show a clearcut fall by the seventh day. It is of interest to note the dynamics of PaCO₂ values among patients older than six months — they are the highest on the 15th day when they exceed insignificantly the uppermost limit of the age group norm. We believe that this, on first sight, paradoxical phenomenon may be attributed to the more effective adaptation mechanisms in older children, triggered by hypoxemia and light degree metabolic acidosis. The evident tendency towards gas alkalosis in these patients, recorded in the early stage of the disease, is followed by a slight increase in PaCO₂ after the overcoming of hypoxemia. The significance of the latter becomes apparent upon comparison of the two diagrams.

Notwithstanding the substantially improved and normalized mean values of the parameters under study, the percentage of patients with PaO₂ below 80 mm Hg, and PaCO₂ exceeding

ska et al, N. S. Sjuleimanova et al, Z. Vokac et al). The data submitted comply with the conclusions about a rather protracted course of contemporary pneumonia (V. Antova et al), which is our impression too. Hence it is mandatory to reconsider the average duration of modern pneumonia and its treatment in children, and to carry on further complex researches into the problem.

Conclusions

1. Functional recovery of the respiratory system after pneumonia, running a heavy course in newborns and infants, requires a longer period of time. Within 15 days of treatment, a slight degree respiratory insufficiency is still present in half of the patients. The viewpoint adopted in pediatric practice concerning the average duration of acute pneumonia among children should be revised.

2. All acute pneumonia affections, running a heavier course in neonates and infants, require complex and prolonged treatment with a view to prophylactic against chronic bronchopneumopathic conditions in older age.

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ФУНКЦИОНАЛЬНОЕ ВОССТАНОВЛЕНИЕ ЛЕГКИХ ПОСЛЕ ОСТРЫХ ПНЕВМОНИЙ В ГРУДНОМ И РАННЕМ ДЕТСКОМ ВОЗРАСТЕ

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РЕЗЮМЕ

У 100 детей, в возрасте от 10 до 3 лет, прослежены газы в крови и кислотнощелочные параметры на 1-ый, 7-ой и 15-ый день лечения. Более чем у 90% детей существовали данные о наличии острой дыхательной недостаточности, причем легкостепенные нарушения задерживаются у половины из них и на 15-ый день. Подчеркивается необходимость в продолжительном комплексном лечении, в целях профилактики хронических бронхопневмопатий в более позднем возрасте.