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Diagnosis Of Intrauterine Pneumonia in Premature Infants

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Abstract. The gestational age of the subjects was 22–36 weeks. Tensiometric blood parameters in the group of premature newborns with VUP and RDS suggest that they have congenital intrapartum pneumonia. When Ds2 < 4.2 × 103 N/m and k2 > 3.3 × 103 s–1, it can be stated that a premature newborn with respiratory disorders has VUP. We recommend using these indicators in the early and differential diagnosis of intrauterine pneumonia.
Keywords: prematurity, method, tensiometry, pneumonia.

Introduction

It has been established that intrauterine and early pneumonia are detected at autopsy in 10–38% of stillborn and 20–63% of live-born children who subsequently died [1]. Among the array of intrauterine infections in premature newborns, intrauterine pneumonia, which manifests itself as severe respiratory disorders and requires respiratory support, deserves special attention [2]. With congenital pneumonia, the clinical picture of the disease in the first day of life is difficult to distinguish from that with respiratory distress syndrome (RDS). In addition, in most cases, pneumonia does not have specific features, and in 20–30% of cases, a chest x-ray taken before the end of the 1st day of life may not reveal characteristic changes [3]. In this regard, the study of dynamic surface tension (tensiometry) of biological fluids is of clinical interest due to the possibility of differential diagnosis and monitoring the effectiveness and quality of treatment [3]. It is important to note that the dynamic surface tension, for example, of blood serum turns out to be quite sensitive to various pathological changes in the human body and is of scientific interest in improving the early diagnosis of diseases [4].

Materials And Methods

The purpose of the work was to analyze the results of testing the use of tensiometric parameters of umbilical cord blood of premature newborns with respiratory disorders in the early and differential diagnosis of intrauterine pneumonia.

We studied cord blood from 90 preterm newborns with a gestational age (GA) of 22–36 weeks and having respiratory distress (RD) at birth. Of these, group I consisted of children with intrauterine pneumonia (IUP), group II - with RDS, and group III - with IUP and RDS (IUP + RDS). There were 30 children in each group. All subjects had hemoglobin levels and hematocrit levels in their blood within normal limits. The control group included 15 “conditionally healthy” premature newborns with gestational age = 35–36 weeks, living together with their mother and receiving breastfeeding on demand.

Results And Discussion

The causative agents of VUP in 68% of cases were of a bacterial nature and in 32% - mixed flora (12% - viral-bacterial; 9.7% - bacterial-fungal; 8.3% - viral-bacterial-fungal).

Tensiometric curves were obtained using a PAT-2 computer analyzer (SINTERFACE Technologies, Germany) [1]. The temperature in the measuring cell was 25 °C. The hanging drop method was used [1, 3]. The principle of the method for measuring dynamic surface tension is that a drop is quickly formed at the outlet of the capillary, the surface tension of which as a function of time can be measured from the shape of the drop.

The decrease in surface tension in the dynamics of the measurement is due to the following processes occurring during the formation of a drop. Low- and high-molecular compounds are adsorbed from the solution onto the drop, which lowers its surface tension. This approach provides for two contributions to the decrease in surface tension, differing in speed.

A typical tensiometric curve of umbilical cord blood from premature newborns in the control group is shown in Fig. 1. As can be seen in Fig. 1, there is a decrease in dynamic surface tension over time until the indicator reaches an equilibrium value. Since the process can last quite a long time, the observation time was limited to 1200 s.

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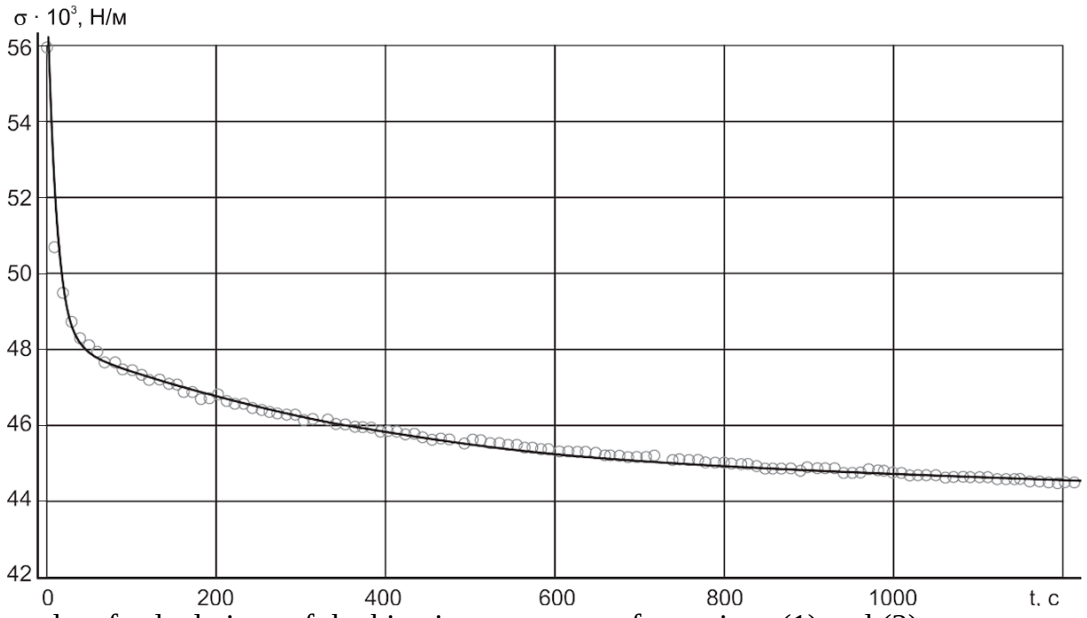

The results of calculations of the kinetic parameters of equations (1) and (2) are presented in table. 1. The table shows that the values of s0, s¥ and Ds1, caused by the presence of low-molecular compounds in the surface layer, in all groups of premature newborns do not differ ($p > 0.5$) within the error of their calculations.

The values of k1—the rate constants of adsorption of low-molecular compounds into the surface layer—are higher in groups I ($p < 0.05$), II ($p < 0.1$) and III ($p < 0.1$) compared to the control, and in the latter group has a tendency to decrease the indicator (Table 1). The values of Ds2 due to presence in the surface layer of high molecular weight polar compounds, less than in the control in groups I ($p < 0.05$), II ($p < 0.1$) and III ($p < 0.1$), and in the last two groups the indicators are higher than in I group, and almost identical ($p > 0.5$) (Table 1). The rate constant of adsorption of high-molecular compounds into the surface layer k2 is higher compared to the control in groups I ($p < 0.1$) and III ($p < 0.05$).

From the analysis of tensiometric parameters it follows that in the group of premature newborns with VUP and RDS, cord blood is characterized by an extremely close set of biologically active substances that affect surface tension and diffuse into the surface layer. Based on the results obtained, we can assume the presence of intrauterine (intrapartum) pneumonia in premature newborns in groups I and II, which does not yet have clear clinical manifestations detected using known instrumental, laboratory and other tests. More pronounced tensiometric indices were observed in patients of group III (VUP + RDS), which allows us to assume that they have intrauterine (antenatal) pneumonia, which is confirmed by clinical and radiological data.

The results obtained allow us to combine groups I and II to analyze tensiometric indicators depending on GA in premature newborns. Thus, the rate constant of adsorption of high-molecular compounds into the surface layer (k2) tends to increase in premature newborns after 32 weeks of gestation ($p < 0.05$): in the group of children with a gestational age of 22–32 weeks - 2.30 ± 0 .79 s–1 and in the group of children with a gestational age of 33–36 weeks – 3.5 ± 1.2 s–1.

The values of Ds2, due to the presence of predominantly high-molecular compounds in the surface layer, are greater in children ($p < 0.1$) with gestational age = 22–32 weeks: (5.1 ± 1.6) × 103 N/m, whereas with gestational age = 33–36 weeks - (4.00 ± 0.52) × 103 N/m.

In contrast to the previous indicator, s, on the contrary, is greater at a shorter gestational age ($p < 0.1$): in children with gestational age = 22–32 weeks - (44.9 ± 2.7) × 103 N/m, and in premature newborns with GA = 33–36 weeks - (46.50 ± 0.89) × 103 N/m.

The values of the rate constant for the adsorption of low-molecular compounds into the surface layer (k1), on the contrary, have a clear tendency to increase with gestational age and amount to 7.9 ± 4.1 s–1 in premature newborns with GA = 22–32 weeks , whereas in children with GA = 33–36 weeks - 8.4 ± 4.6 s–1.

Conclusion

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Thus, the studied tensiometric blood parameters in the group of premature newborns with VUP and RDS suggest that they have congenital intrapartum pneumonia. When Ds2 < 4.2 × 103 N/m and k2 > 3.3 × 103 s–1, it can be stated that a premature newborn with respiratory disorders has VUP. We recommend using these indicators in the early and differential diagnosis of intrauterine pneumonia. More pronounced shifts in dynamic surface tension, caused by the presence of biologically active substances in the umbilical cord blood, were observed in low-birth-weight infants with a gestation period of 22–32 weeks, compared to newborns whose gestational age was 33–36 weeks

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