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THE INCIDENCE OF WHOOPING COUGH IN CHILDREN IN THE ASTRAKHAN REGION: A RETROSPECTIVE STUDY

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ЗАБОЛЕВАЕМОСТЬ КОКЛЮШЕМ У ДЕТЕЙ В АСТРАХАНСКОЙ ОБЛАСТИ: РЕТРОСПЕКТИВНОЕ ИССЛЕДОВАНИЕ

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Objective. To determine the dynamics of whooping cough incidence in children in the Astrakhan region (AR) for the period 2000–2023.

Materials and methods. The sources of information were statistical data from the Center for Hygiene and Epidemiology on the incidence of whooping cough in the territory of AR for 2000–2023, a retrospective

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analysis of 40 medical histories of infants with a confirmed diagnosis of whooping cough hospitalized to the Regional Infectious Diseases Hospital named after A.M. Nichoga for the period 2020–2023 was carried out.

Results. It was determined that the total number of infants diagnosed with whooping cough in the AR in the period 2000–2023 was 770 cases, 134 (17.4 %) of them with an average number of 22.3 ± 4.1 (2.9 %) cases per year were revealed in 2000–2005; 198 (25.7 %) – in 2006–2010, i.e. – 39.6 ± 4.8 (5.1 %) per year; 54 (7 %) – 13.5 ± 3.7 (1.7 %) in 2011–2014; 208 (27 %) – 41.6 ± 8.5 (5.4 %) in 2015–2019; 20 (2.6 %) – 6.7 ± 4.2 (0.87 %) per year in 2020–2022; and 156 (20.3 %) cases in 2023. It can be assumed that the increase in the incidence of whooping cough was accompanied by its decrease in subsequent years due to an increase of the immune layer in infants and collective immunity of other age groups. The low incidence of whooping cough in 2020–2022 could contribute to a decrease in collective immunity among the population of the region and, as a result, an increase in the incidence of the disease in children. The incidence rate of whooping cough in 2023 was 49.2 per 100,000 people, which is 1.4 times higher than the national rate. According to the results of the analysis of the clinical symptoms of whooping cough in infants, severe forms of the disease were found in 22 (55 %) of the 40 patients included in the study.

Conclusions. Severe forms of whooping cough in infants were observed in 55 % of cases, complicated – in 40 %. The decrease in pertussis vaccination coverage for children and adults in contact with infants is one of the reasons for the decrease in collective immunity and the increase in the incidence in infants of the region.

Keywords. Whooping cough, infants, incidence, clinic, treatment.

Цель. Установить динамику заболеваемости коклюшем у детей в Астраханской области (АО) за период 2000–2023 гг.

Материалы и методы. Источниками информации являлись статистические данные центра гигиены и эпидемиологии о заболеваемости коклюшем на территории АО за 2000–2023 гг., проведен ретроспективный анализ 40 медицинских историй болезни детей грудного возраста с подтвержденным диагнозом коклюша, госпитализированных в ГБУЗ АО «Областная инфекционная больница им. А.М. Ничоги» г. Астрахани за период 2020–2023 гг.

Результаты. Установлено, что общее количество детей грудного возраста, заболевших коклюшем в АО в период 2000–2023 гг., составляло 770, в том числе в 2000–2005 гг. – 134 (17,4 %) случая при среднем количестве в год $22,3 \pm 4,1$ (2,9 %) случая; 2006–2010 гг. – 198 (25,7 %), т.е. $39,6 \pm 4,8$ (5,1 %) в год; 2011–2014 гг. – 54 (7 %) – $13,5 \pm 3,7$ (1,7 %); 2015–2019 гг. – 208 (27 %) – $41,6 \pm 8,5$ (5,4 %); 2020–2022 гг. – 20 (2,6 %) – $6,7 \pm 4,2$ (0,87 %); 2023 г. – 156 (20,3 %) случаев. Можно считать, что рост заболеваемости коклюшем сопровождался в последующие годы ее снижением за счет увеличения иммунной прослойки у детей грудного возраста и коллективного иммунитета у населения других возрастных групп. Низкая заболеваемость коклюшем в 2020–2022 гг. могла способствовать снижению коллективного иммунитета у населения региона и, как следствие, росту заболеваемости у детей. Показатель заболеваемости коклюшем в 2023 г. составлял 49,2 на 100 тыс. населения, что выше показателя по стране в 1,4 раза. По результатам анализа клинической симптоматики коклюша у детей грудного возраста установлено наличие тяжелых форм болезни у 22 (55 %) из 40 пациентов, вошедших в исследование.

Выводы. Тяжелые формы коклюша у детей грудного возраста составляли 55 %, осложненные – 40 %. Уменьшение охвата вакцинацией против коклюша детей и взрослых, контактирующих с грудными детьми, является одной из причин снижения коллективного иммунитета и роста заболеваемости в регионе грудных детей.

Ключевые слова. Коклюш, дети грудного возраста, заболеваемость, клиника, лечение.

INTRODUCTION

Whooping cough is an acute highly contagious infectious disease caused by *B. pertussis*, characterised by prolonged bouts of spasmodic coughing and severe course in infants. The genus *Bordetella* consists of nine species, four of which cause respiratory diseases (*B. pertussis*, *B. parapertussis*, *B. bronchiseptica* and *B. holmesii*). The bacterium is highly sensitive to environmental factors: it dies when dried, exposed to direct sunlight, and heat. When sputum dries, the bacterium dies within an hour. The source of infection is a sick person who releases the pathogen through various types of forced breathing (coughing, sneezing, crying, speaking loudly) [1; 2]. The absence of innate immunity for whooping cough contributes to the development of the disease in infants [3].

The incidence of whooping cough among infants in the Russian Federation remains high — up to 80 or more per 100 thousand population. This may indicate an epidemic problem and is caused by a decline in collective immunity due to refusal of vaccination [4]. The clinical picture of whooping cough consists of consecutive periods (catarrhal, spasmodic cough and the period of resolution), the duration of which depends on the patient's age, severity of the disease and the presence of concomitant pathology. In particular, in young children, the catarrhal period of the disease can last for 3–5 days, and the spasmodic period can last up to 2 months. Quite often, whooping cough in infants is severe, with attacks of apnoea, and the development of various complications such as pneumonia, atelectasis, encephalopathy, etc. [5–7]. The difficulty in diagnosing whooping cough in the catarrhal period is the

absence of specific symptoms of the disease. In addition, in most patients, whooping cough is diagnosed only during the period of spasmodic cough, which causes untimely isolation of the patient and the start of antibacterial therapy [8].

Whooping cough is widespread despite the introduction of vaccination prevention and a high percentage of immunization rate among the population. Outbreaks of the disease among children and adults occur cyclically every 3–5 years. According to WHO, 38,754 cases of whooping cough were registered in the European Union in 2016, and in 2019, there were 43,241 cases of whooping cough. There was a decline in the incidence of whooping cough in 2017 and 2018.

MATERIALS AND METHODS

The sources of information were the statistical data from the Centre for Hygiene and Epidemiology on the incidence of whooping cough in the Astrakhan Region (AR) for 2000–2023, and medical records (inpatient cards) of 40 infants with a laboratory-confirmed diagnosis of whooping cough (by bacteriological method, PCR, and ELISA) treated at the AR Regional Infectious Diseases Hospital named after A. M. Nichoga, Astrakhan, between 2000 and 2023.

Statistical data analysis was performed using the Microsoft Office Excel software (Microsoft, USA). The generally accepted medical threshold of $p < 0.05$ was considered to determine the statistical significance of the results.

RESULTS AND DISCUSSION

It was found that the incidence of whooping cough in infants in the Astrakhan Region

during the study period was characterised by periods of rise and fall (Fig. 1).

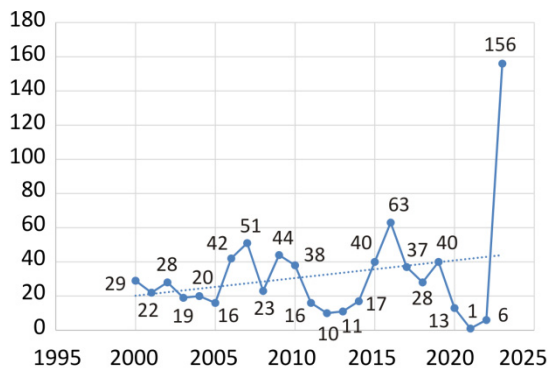


Fig. 1. Dynamics of the incidence of whooping cough among infants in the Astrakhan Region for 2000–2023

The total number of infants who fell ill with whooping cough in the Astrakhan Region between 2000 and 2023 was 770 cases, including 134 (17.4 %) cases between 2000 and 2005, with an average of 22.3 ± 4.1 (2.9 %) cases per year; 198 (25.7 %) cases between 2006 and 2010, i.e. 39.6 ± 4.8 (5.1 %) cases per year; 54 (7 %) cases between 2011 and 2014, i.e. 13.5 ± 3.7 (1.7%) cases per year; 208 (27 %) cases between 2015 and 2019, i.e. 41.6 ± 8.5 (5.4 %) cases per year; 20 (2.6 %) cases between 2020 and 2022, i.e. 6.7 ± 4.2 (0.87 %) cases per year; and 156 (20.3 %) cases in 2023, as a percentage of the total number of patients 208 (27 %) cases between 2015 and 2019, i.e. 41.6 ± 8.5 (5.4 %) cases per year; 20 (2.6 %) cases between 2020 and 2022, i.e. 6.7 ± 4.2 (0.87 %) cases per year; and 156 (20.3 %) cases in 2023, as a percentage of the total number of patients.

Whooping cough was more often recorded among children living in the city of Astrakhan. During the study period, 466 cases (60.5 %)

were recorded in the city, and 304 cases (39.5 %) in rural areas, including 71 cases (9.2 %) in the Volodarsky district of the Astrakhan region, 66 cases (8.6 %) in Privolzhsky, 49 cases (6.3 %) in Narimanovsky, 35 cases (4.5 %) in Ikryaninsky, 17 cases (2.2 %) in Enotaevsky, 14 cases (1.8 %) in Kamyzyaksky, 13 cases (1.7 %) in Limansky, 13 cases (1.7 %) in Krasnoyarsky, 12 cases (1.5 %) in Akhtubinsky, 6 cases (0.8 %) in Kharabalinsky, 5 cases (0.6 %) in the closed administrative-territorial formation of Znamensk, and 3 cases (0.4 %) in Chernoyarsky, as a percentage of the total number of patients (Fig. 2).



Fig. 2. The incidence of whooping cough among infants in rural areas of the Astrakhan Region for 2000–2023

The data indicate that the incidence in rural areas of the Astrakhan Region that are closer to the city is significantly higher than in remote northern areas (Znamensk, Chernoyarsky District).

The incidence of whooping cough in infants in the Astrakhan Region in 2020–2022 was sporadic – only 20 cases (2.6 %), including 13 cases (1.7 %) in 2020, one case (0.1 %) in 2021, and 6 cases (0.78 %) in 2022. The disease was registered mainly in Astrakhan – 16 cases (2.1 %) of the total number of patients. In 2023,

there was a sharp increase in the incidence of whooping cough in infants – 156 cases (35 %), including 87 cases (19.5 %) in children living in Astrakhan and 69 cases (15.5 %) in the districts of the Astrakhan Region.

Thus, in 2023, out of 69 cases in the districts of the Astrakhan Region, 16 cases (23.2 %) were registered in the Privolzhsky district, 14 cases (20.3 %) in the Volodarsky district, and 13 cases (18.8 %) in the Ikryaninsky district. Next is the Narimanovsky district with 8 cases (11.6 %), the Enotaevsky district with 4 cases (5.8 %), the Kamyzyaksky and Akhtubinsky districts with 3 cases (4.3 %) each, the Krasnoyarsky, Limansky, and Kharabalinsky districts registered 2 cases (2.9 %) each, and one case (1.4 %) each in the Chernoyarsky district and the closed administrative-territorial formation of Znamensk.

It should be noted that in 2023, the total number of cases was 446, i.e. the proportion of cases in other age groups of children and adults was 290 (65 %) cases. The incidence rate per 100 thousand population among children and adults in the Astrakhan Region in 2023 was 49.2, which is higher than the rate for the Russian Federation – 36.15.

An analysis of 40 medical records (selected by random sampling) of infants who had whooping cough and were treated at the Astrakhan Regional Infectious Diseases Hospital named after A. M. Nichoga in the period 2020–2023 revealed contact with parents (22.5 %) and older children (74.6 %) who had been coughing for a long time and/or had whooping cough.

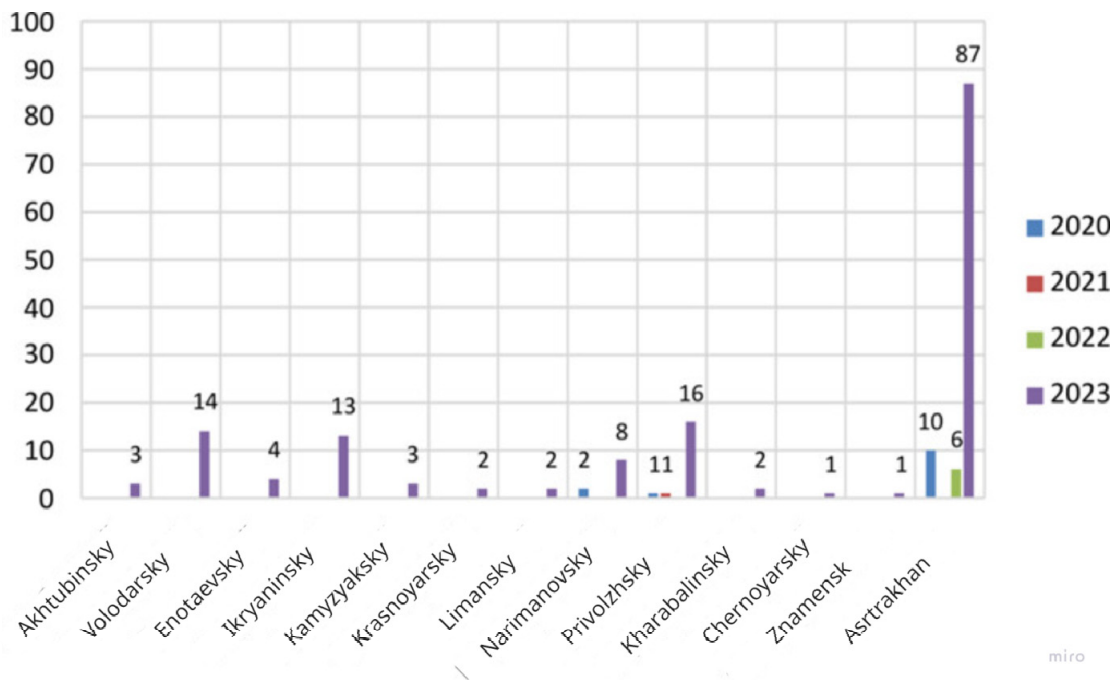


Fig. 3. The incidence of whooping cough in infants in the Astrakhan Region in 2020–2023

The average incubation period for patients with a known date of exposure was 5.4 ± 1.6 days. All children with whooping cough had the disease in its typical form, with severe forms predominating in 22 (55 %) patients. There were 4 (10 %) mild cases and 14 (35 %) moderate cases.

Clinical symptoms of the disease developed gradually — a cough that tended to increase during the course of the disease, in the absence of fever or with a low-grade temperature, and without physical changes in the lungs. This was the reason for the late diagnosis and hospitalization on average 14.9 ± 3.4 days after the onset of the disease in 18 (45 %) patients. Severe whooping cough was diagnosed in 22 (55 %) patients, moderate in 14 (35 %), and mild in 4 (10 %). With severe whooping cough, the number of coughing attacks reached 29.2 ± 4.5 times a day. Coughing fits were accompanied by facial cyanosis in all patients. Apnoea was recorded in 9 (40.9 %) patients, tonic-clonic convulsions in 3 (13.6 %), and vomiting at the end of coughing fits in 15 (68.2 %), with thick viscous sputum present in the vomit. The duration of the spasmodic period was 46.2 ± 4.5 days. Moderate whooping cough was diagnosed in 14 (35 %) children. The frequency of coughing attacks was 19.5 ± 6.3 per day. Coughing fits were accompanied by cyanosis of the nasolabial triangle and redness of the face. The duration of the spasmodic period was 34.2 ± 1.4 days. Reprises were observed in 6 (42.9 %) children, and vomiting after coughing occurred in 8 (57.1 %). Body temperature in 7 (50 %) patients rose to $37.4\text{--}37.9$ °C. With a mild form of whooping cough, brief attacks of spasmodic coughing were observed without cyanosis or deterioration of the general condition. The number of attacks was 14.2 ± 2.6 per

day. An increase in temperature was noted in 3 (75 %) children to 37.2 °C. The duration of the spasmodic period was 28.4 ± 2.8 days.

In the general blood test for uncomplicated whooping cough, leukocytosis was detected, up to $(21.2 \pm 3.7) \cdot 10^9/l$, and lymphocytosis, up to 62.4 ± 3.5 % ($p < 0.001$), compared with the indicators of the control group. Radiologically, emphysema of the lungs was detected in 31 (77.5 %) patients, and atelectasis in 12 (30 %), mainly in the right lung. These complications are associated with the accumulation of viscous sputum, which children in the first year of life are unable to effectively cough up.

Pneumonia was diagnosed in 4 (10 %) children and was accompanied by a deterioration in condition, worsening cough, shortness of breath, increased cyanosis, and an increase in body temperature to $38.2\text{--}38.8$ °C.

The following treatment was administered: antibiotics — azithromycin (10 mg/kg/day), roxithromycin (5–8 mg/kg/day), Augmentin (30–40 mg/kg/day) for 5–7 days. For severe forms, cephalosporins of the III–IV generations (cefotaxime, cefepime, ceftriaxone) were used at a dose of 100 mg/kg/day for 7–10 days.

To suppress cough, drugs acting on the cough center were used: Stoptussin (6–8 drops 3 times a day) and Sinecod (10 drops 3–4 times a day). For bronchospasm, Eufillin (4–5 mg/kg/day) was used, and for apnoea and encephalopathic disorders, glucocorticosteroids (prednisolone, dexamethasone), anticonvulsants (Seduxen), and oxygen therapy were used.

In our study, it was found that whooping cough in infants occurred with a predominance of severe forms in 55 % of patients, which is not contradictory to the results of other studies. According to V.V. Krasnov et al. (2018), severe forms of whooping cough accounted for 30.6 %,

and 19.6 % of patients required artificial ventilation [9]. Also, a study by A.V. Vasyunin et al. (2019) noted that complicated whooping cough in infants accounted for 79 % [10].

CONCLUSIONS

1. The epidemiological situation regarding whooping cough in the Astrakhan Region can be considered unfavourable, as evidenced by the high incidence rate among infants.

2. The incidence of whooping cough in children is characterised by periodic growth with an interval of 5.3 ± 0.8 years, which is caused by a decrease in collective immunity during the period of sporadic incidence.

3. Severe forms of whooping cough in infants accounted for 55 %, and complicated forms accounted for 40 %.

4. A decrease in the coverage of vaccination against whooping cough among children, healthcare workers, and employees of preschool, school, and social institutions is one of the reasons for the decline in collective immunity and the increase the incidence of whooping cough in the region, with the involvement of infants in the epidemic process.

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Contribution of the authors.

The authors declare that their authorship meets the international ICMJE criteria. All authors participated equally in the preparation of the publication: developing the concept of the article, obtaining and analysing physical data, writing and editing the text of the article, re-

viewing and approving the final version of the text of the article.

The study complies with the standards of the Declaration of Helsinki and has been approved by the ethics committees of all organisations.

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