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SEVERE PERTUSSIS IN EARLY INFANCY, A CASE REPORT

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ВАЖКИЙ КАШЛЮК У РАНЬОМУ ДИТИНСТВІ, КЛІНІЧНИЙ ВИПАДОК

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Summary/Резюме

Pertussis remains a significant public health concern, particularly among young children who are at the highest risk of severe disease and complications. The aim of this study was to analyze the clinical features of pertussis in a 3-month-old unvaccinated infant and to compare the findings with current scientific evidence regarding diagnosis, treatment, and prevention. A bibliosemantic analysis of international scientific publications published between 2022 and 2026 was conducted using PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar databases. A clinical case of pertussis in a 3-month-old infant hospitalized in an infectious diseases department is presented. The diagnosis was established according to WHO criteria, based on characteristic clinical manifestations and laboratory confirmation by polymerase chain reaction (PCR). The disease manifested with typical paroxysmal spasmodic cough accompanied by post-tussive vomiting, episodes of apnea, and cyanosis in the absence of fever. Marked leukocytosis ($31.3 \times 10^9 /L$) with relative lymphocytosis (71 %) was detected. PCR confirmed the presence of *Bordetella pertussis*. No radiological signs of pneumonia were identified. Etiotropic therapy with azithromycin was administered in combination with supportive treatment and continuous monitoring of vital parameters. Positive clinical dynamics were observed during treatment, without the development of complications. The probable source of infection was the mother, who had a prolonged cough, suggesting intrafamilial transmission. This case confirms the typical features of pertussis in infants, including the absence of fever, the risk of apnea, and significant leukocytosis with lymphocytosis. Timely PCR-based diagnosis and early hospitalization are crucial for preventing complications. Vaccination remains the primary preventive measure, including maternal immunization during pregnancy and adherence to the routine childhood immunization schedule.

Key words: *pertussis, Bordetella pertussis, infant, paroxysmal cough, lymphocytosis, vaccination.*

Кашлюк залишається актуальною проблемою громадського здоров'я, особливо серед дітей раннього віку, які мають найвищий ризик тяжкого перебігу та ускладнень. Метою дослідження було проаналізувати особливості клінічного перебігу кашлюку у немовляти віком 3 місяці без вакцинації та зіставити отримані дані з сучасними науковими джерелами щодо діагностики, лікування та профілактики інфекції. Проведено бібліосемантичний аналіз міжнародних наукових публікацій за 2022-2026 рр. у базах PubMed/MEDLINE, Scopus, Web of Science та Google Scholar. Описано клінічний випадок кашлюку у 3-місячної дитини, госпіталізованої до інфекційного відділення. Діагноз встановлено відповідно до критеріїв ВООЗ на підставі характерної клінічної картини та лабораторного підтвердження методом ПЛР. Захворювання проявлялося типовим нападopodobним спастичним кашлем із посттусивним блюванням, епізодами апное та ціанозом за відсутності гарячки. Виявлено виражений лейкоцитоз ($31,34 \times 10^9 / \text{л}$) із відносним лімфоцитозом (71 %). ПЛР підтвердила наявність *Bordetella pertussis*. Рентгенологічних ознак пневмонії не встановлено. Проведено етіотропну терапію азитроміцином у поєднанні з підтримувальним лікуванням і моніторингом життєво важливих показників. На тлі лікування відзначено позитивну клінічну динаміку без розвитку ускладнень. Ймовірним джерелом інфекції була мати з тривалим кашлем, що свідчить про внутрішньосімейну передачу. Представлений випадок підтверджує типові особливості перебігу кашлюку у немовлят: відсутність гарячки, ризик апное та значний лейко-лімфоцитоз. Своєчасна діагностика з використанням ПЛР і рання госпіталізація мають ключове значення для запобігання ускладненням. Основним методом профілактики залишається вакцинація, включно з імунізацією вагітних та дотриманням календаря щеплень у дітей раннього віку.

Ключові слова: кашлюк, *Bordetella pertussis*, немовля, пароксизмальний кашель, лімфоцитоз, вакцинація.

Bordetella pertussis, a Gram-negative bacterium, was first discovered in 1906 and spread through respiratory droplets and incubation period of 1-3 weeks is very contagious [1]. Pertussis has classical clinical manifestation such as paroxysmal cough, post-tussive vomiting, and apnea especially in young children [2, 3]. Pertussis used to be one of the causes of childhood morbidity and mortality before the introduction of mass immunization. The use of whole-cell vaccines in the latter part of the 20th century significantly decreased the occurrence and severity of the disease, but since then there has been evidence of a pertussis resurgence probably because of a reduced post-vaccination immunity and inadequate booster immunity [4, 5]. In the COVID-19 pandemic, a decrease in reported pertussis cases was observed, which was likely due to measures to social distancing, use of masks, school closing, and a decrease in the intended use of healthcare [6]. The war in 2021-2022 in Ukraine also

affected the epidemiological indicators due to massive migration and population drop to record low reported incidences.

Infants and young children continue to demonstrate the highest incidence rates of pertussis compared to older pediatric age groups [7]. This age-related distribution highlights the particular vulnerability of children in the first years of life, especially those who have not yet completed the primary immunization schedule [8]. Although fluctuations in reported cases may occur due to demographic changes and limitations in epidemiological calculations, pertussis remains a relevant public health concern. Periodic declines in incidence may reflect temporary post-epidemic immunity within the population; however, such decreases should not lead to complacency [9]. These observations underscore the importance of strengthening immunization strategies, including timely administration of primary doses and booster vaccinations. Sustained

high vaccination coverage is essential to protect the most vulnerable groups, particularly infants who are at risk of severe disease and complications.

Equally important is the active involvement and medical awareness of parents. Parental adherence to vaccination schedules, timely medical consultation in the presence of prolonged cough, and understanding of preventive measures play a decisive role in reducing disease transmission and preventing severe outcomes. Strengthening parental medical engagement should therefore be considered a key component of comprehensive pertussis prevention programs [10, 11, 12, 13, 14].

The purpose of the research is to assess the clinical outcome of the pertussis disease in young children in general, and especially in an unvaccinated 3-month-old infant, and to compare the results with the existing literature, i.e. clinical manifestations of the disease, laboratory parameters, dynamics of the disease, effectiveness of the therapeutic interventions, and importance of the timely vaccination and prevention of intrafamilial spread.

Materials and Methods

A thorough bibliosemantic analysis of international scientific literature in the present has been done to give theoretical justification and contextual comparison of the findings. Through systematic searches on key scientometric databases, such as PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar, relevant publications were located within the period 2022-2026. The search condition included the following words: *Bordetella pertussis*, infant pertussis management, pertussis PCR diagnostics, acellular pertussis vaccine efficacy, and lymphocytosis in whooping cough. High-level sources of evidence were given priority such as systematic reviews and clinical guidelines.

The research content included a clinical case about pertussis in a 3-month-old child who was admitted to an infectious

diseases department. Parental refusal had not allowed the child to be vaccinated against pertussis, diphtheria, and tetanus (DTaP), which is an indication of the current problem of falling herd immunity.

The diagnosis was determined in WHO criteria, that is based on a complex of typical clinical manifestations and lab confirmation. The patient had recurrent paroxysmal coughing (more than 15 times per day) clinically associated with perioral cyanosis, post-tussive vomiting, and brief periods of apnea instead of the typical inspiratory "whoop." The etiological verification was conducted with a molecular genetic technique: *Bordetella pertussis* DNA was detected in nasopharyngeal swabs using the real-time polymerase chain reaction (PCR) method, which is regarded as a diagnosis gold standard in infants because of its high sensitivity (> 90) in the initial weeks of the illness. The hematologic analysis was conducted with the help of the automated analyzer, especially the leukocytosis and absolute lymphocytosis that are considered to be typical indicators of severe pertussis in children of early age because of the action of pertussis toxin. In order to evaluate the state of the lower respiratory tract and rule out pneumonia, the frontal projection of the chest radiography was used.

Descriptive statistics were used to systematize clinical symptoms and laboratory findings. The received data were correlated with the modern scientific evidence on the clinical course of pertussis in infants. The existing sources state that the symptoms of pertussis in this age group include apnea, cyanosis, post-tussive vomiting, and severe leukocytosis, which in most cases requires hospitalization and has a high likelihood of complications and within-family transmission.

Results and Discussion

An infant of 3 months was brought to the infectious diseases department complaining of recurrent paroxysmal coughing episodes by the mother who complained of more than 15 paroxysmal

coughing episodes in clusters, and the infant had the attacks mainly during the night. It was spasmodic and was accompanied by facial and perioral cyanosis, short spurts of apnea and post-tussive vomiting. The body temperature was maintained at the normal level during the disease. There was also irritability, sleep disorder, loss of appetite and breastfeeding impairment that was reported by the mother.

Based on the medical history, the first symptoms were experienced two weeks before hospitalization and was in form of mild cough that gradually worsened and developed into typical paroxysms. The infant was admitted to the hospital since his coughing frequency and respiratory distress during an attack, as well as frequent vomiting, increased, which required additional examination and treatment. The child was born after the first normal pregnancy and it was delivered at term through spontaneous vaginal birth. The child has a birth weight of 3,200 g, length of 50 cm and an Apgar level of 8/9. The infant was only breastfed since birth, and his weight gain was appropriate, and his psychomotor development was age-specific. At the maternity hospital, immunization involved the use of the Bacillus Calmette-Guerin (BCG) and hepatitis B vaccinations. Nevertheless, the planned diphtheria-tetanus-acellular pertussis (DTaP) at 2 months was not done because parents did not agree.

The epidemiological history was also important: Two weeks before the infant developed symptoms, the mother had had a long-term history of paroxysmal cough with no fever, which was clinically suggestive of pertussis, pointing to the intrafamilial spread. The general condition of the infant was found to be moderately severe on admission. There was awareness and age-related responses to stimuli. Nutritional condition was good. The color of the skin was pink at rest and cyanosis of the perioral area was seen during coughing paroxysms. Body temperature was 36.8degC and heart rate was 140beats per minute with respiratory rate 40 breaths per minute and

in coughing cases it rose to 60 breaths per minute. There was partial obstruction of breathing through the nose with the discharge of mucous. The oropharynx was a little hyperemic with no exudates. The cough was paroxysmal and dry, and did not have a distinctly defined inspiratory "whoop." Auscultation showed reduced vesicular breath sounds with no wheezing and crackles. There were regular heart sounds that were clear. Abdomen soft, no tenderness; liver is non-enlarged. No edema on the periphery was present. The state of the infant was rather stable, in spite of the level of irritability, between paroxysms.

Laboratory diagnosis revealed significant leukocytosis ($31.3 \times 10^9/L$) with relative lymphocytosis (71 %) which is a hematological presentation typical of pertussis in early infancy and the influence of the pertussis toxin. RBA is within the age-related reference ranges of the erythrocyte count, hemoglobin level, and platelet count. Liver and renal hepatic tests and electrolytes found in the blood were normal, and there was no sign of metabolic disruptions.

A nasopharyngeal swab was real-time polymerase chain reaction (PCR) tested to etiologically confirm the presence of Bordetella pertussis DNA. Other respiratory pathogens were not identified by bacteriological culture. There were no focal infiltrates, consolidation, hyperinflation, or pneumonia or pulmonary complication present in the chest radiography. The electrocardiography showed sinus rhythm suitable at age, and no arrhythmias. Detailed differential diagnosis was carried out. Acute bronchiolitis was also possible, but no prolonged wheezing with lower respiratory signs, fevers, and intoxication syndrome, and the occurrence of typical paroxysmal cough and post-tussive vomiting, ruled out this diagnosis. There were no epidemiological risk factors, systemic intoxication symptoms, and radiographic abnormalities that disapproved of tuberculous bronchial lymphadenitis. The lack of allergic background, frequent wheezing, or supportive functional tests did

not mean that cough-variant asthma was impossible. Foreign body aspiration was eliminated due to the absence of abrupt onset, focal radiographic changes, or repeated focal inflammation. Instrumental and clinical support of gastroesophageal reflux disease was absent. Mycoplasma pneumonia was also ruled out as there was no fever, systemic symptoms, and radiological pulmonary involvement.

Accordingly, the constellation of typical clinical manifestations (paroxysmal spasmodic cough with post-tussive vomiting, predominance at night, no focal changes in the lungs), epidemiological evidence of the household exposure, lack of focal changes in the lungs, strong leukocytosis with lymphocytosis, and PCR analysis of *Bordetella pertussis* confirmed the diagnosis of typical pertussis in the spasmodic stage of the disease with moderate strength and an easy course. Based on clinical, epidemiological, differential and laboratory data, the diagnosis was confirmed: Whooping cough, typical form, spasmodic period, moderate severity, uncomplicated course.

The child was admitted to the infectious diseases department due to his age (3 months), absence of vaccination against whooping cough, and high chances of developing complications. Therapy was holistic, consisting of the observed principles of preserving the essential functions, the etiotropic effect with regard to the pathogen, and the prevention of potential complications. Oxygen support was given during coughing attacks that were accompanied by bouts of hypoxia. Oral rehydration was conducted to achieve proper water and electrolyte balance considering the needs of the child depending on his age and the clinical condition of the child. The premise behind the etiotropic therapy was an antibacterial therapy using a macrolide drug, namely azithromycin: the starting dose was 10 mg/kg on Day 1 with 5 mg/kg administered in a single dose on Day 2-4. Macrolides will be used to eradicate *Bordetella pertussis* and

also to minimize the contagiousness of the patient. Oxygen saturation, heart rate and respiratory rate were monitored so as to preclude the occurrence of apnoea and hypoxia. When the child experienced severe coughing attacks, the bed was raised at the head of the bed thus making breathing easier and avoiding the possibility of respiratory aspiration. Symptomatic treatment incorporated preventive and therapeutic measures on post-tussive vomiting, routine washing of the nasal tubes and establishment of ideal microclimate in the ward (average air temperature, adequate humidity). Positive dynamics of treatment were observed against the background of the treatment, a slow reduction in the rate and intensity of coughing paroxysms, the disappearance of new episodes of apnoea, the stabilisation of saturation indicators and the improvement of the overall state of the child. Hunger and drowsiness were brought to normal, and symptoms of hypoxia in attacks were less emphatic. Therefore, the treatment was successful and provided the possibility of clinical progression without the emergence of complications.

Whooping cough is one of the main health concerns in the world despite decades of vaccination [15]. Infants in the first months of life who have not yet received the primary series of immunisation are the ones who are at the greatest risk of severe disease [16]. Apnoea, hypoxia and respiratory failure are the complications that characterize the disease in this age group. Marked hyperleukocytosis with absolute lymphocytosis caused by pertussis toxin as a pathogenetically significant factor can cause pulmonary hypertension and disorders of microcirculations in severe disease [17].

The catarrhal stage is the most responsive to etiotropic therapy, and in the spasmodic stage, macrolides decrease bacteria contamination and contagiousness, but do not influence the length of paroxysmal cough. This identifies the precedence of prevention measures. Isolation, post-exposure antibiotic

prophylaxis, and cocooning measures are non-specific measures that have not succeeded in the real-world setting. Hence the active immunisation is the most important mode of infection control [18, 19, 20].

Whole-cell vaccines of inactivated cells of *Bordetella pertussis* were highly immunogenic, but with higher levels of reactogenicity. Acellular vaccines, containing purified antigens of the pathogen (pertussis toxoid and other parts) and having a more favourable safety profile, have replaced them gradually. Meanwhile, acellular vaccines offer less durable post-vaccination immunity, and have to be boosted. Primary immunisation against common variants of pertussis is about 80-95 % although the immunity reduces over time leading to the spread of the pathogen among teenagers and young adults. The major part of modern prevention is the vaccination of pregnant women, which provides the transplacental transfer of the definite IgG antibodies, and the appearance of the passive immunisation in the newborn and the period of its development until the inception of individual immunisation. It is argued that the best moment to be vaccinated is at the end of the second or the onset of the third trimester; the practice has been proven safe even when done on consecutive pregnancies. The initial dose of vaccine is very critical towards the cultivation of individual and population immunity. High vaccination, booster vaccination and incorporation of vaccination of pregnant women into the vaccination programmes is a major aspect in morbidity mitigation and prevention of the severe manifestation of whooping cough in infants.

Conclusion

Pertussis is a highly dangerous infection that may afflict small infants, especially those who have not been immunized. The given example of a 3-month-old baby demonstrates the classic clinical patterns of early infancy pertussis-paroxysmal cough, apnea, post-tussive vomiting, no fever, and a significant

lymphocytosis with lymphocytosis and allows making a suitable diagnosis and treatment with the help of PCR. In spite of the fact that the antibiotic treatment causes the decrease of the spreading of bacteria, the prevention is considered to be the basis of the disease control.

The prevention of infant cases of *Bordetella pertussis* is necessary to provide immunity against the disease at the most critical stage of life, as well as to restrict the further spread of the infections in the community through high vaccination rates, prompt primary and booster immunizations, and maternal vaccinations in pregnant women.

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