EPIDEMIOLOGICAL DYNAMICS OF MENINGOCOCCAL INFECTION SPREAD AMONG CHILDREN AND ADOLESCENTS

Kholmirzayeva N.Sh., Primova M.O., Abdumajidova P.A., Tashkent State Medical University, Faculty of medicine, 206th-group students.
Scientific supervisor: Mustanov A.Y., Senior Lecturer of the Department of Microbiology, Virology and Immunology.

Annotation.In recent decades, despite the global decline in the incidence of meningococcal infection, the possibility of new outbreaks, epidemics, and pandemics cannot be excluded. The previous global pandemic of meningococcal infection was registered in the 1970s, when the incidence rate reached 16–17 cases per 100,000 population.Meningococcal infection epidemics occur unexpectedly and are difficult to predict. Currently, meningococcal infection has been registered in more than 150 countries worldwide, including Uzbekistan.

Keywords: Meningococcal infection pathogen, inter-epidemic period, incidence dynamics, age structure, generalized forms, vaccine prophylaxis.

Introduction. Meningococcal infection occupies a leading position among infectious diseases in terms of its spread, especially in educational institutions and among organized population groups. In children, due to the incomplete formation of immunity, non-compliance with sanitary and hygienic rules, and insufficient preventive measures among the population, the risk of widespread transmission increases significantly. Therefore, identifying the factors contributing to the spread of meningococcal infection and developing hygienic preventive measures remain urgent public health issues.

In many countries around the world, the threat of meningococcal infection has persisted over the last decade, particularly among specific population groups and organized communities. Analysis of the global epidemiological situation in 2005 demonstrated that serogroup A meningococcus was dominant in countries located within the African “meningitis belt.” In these regions, the incidence ranged from 100 to 800 cases per 100,000 population, while mortality reached 14%.

International organizations monitoring meningococcal infection predict an increase in the number of outbreaks and epidemics in many regions of the world. In recent years, outbreaks of serogroup C meningococcal infection have been reported in several universities in the United States, as well as in Nigeria, Liberia, and China. In Saudi Arabia, Burkina Faso, and Brazil, there has been an increase in the circulation of serogroup W-135 strains.

International epidemiological communities also emphasize the increasing prevalence of meningococcal infections associated with W135 and other serogroups such as X and W135 [Ali A., Jafri R.Z., Messonnier N. et al., 2014].

According to WHO statistical data, this disease is most prevalent in sub-Saharan African countries. The causative agent of meningococcal infection is Neisseria meningitidis, a gram-negative diplococcus that belongs to the group of human pathogens.

The clinical manifestations of meningococcal infection are diverse. Nasopharyngitis is considered one of the dangerous forms, while generalized forms are characterized by high mortality and severe complications such as limb amputations, hearing loss, neurological disorders, and other long-term consequences. Meningococcal infection affects multiple age groups; however, the highest incidence is observed among infants, children under five years of age,

adolescents, military recruits, and populations living in crowded conditions [Batista R.S., Gomes A.P., Dutra Gazineo J.L. et al., 2017].

Due to the asymptomatic carriage of meningococcal infection, accurate epidemiological data remain insufficient. Therefore, improving early diagnosis, treatment, and preventive strategies remains one of the most pressing challenges for healthcare professionals.

Worldwide, including in Uzbekistan, scientific studies are being conducted to improve the effectiveness of preventive measures for early diagnosis, treatment, and prevention of meningococcal infection.

These studies focus on identifying and reducing environmental risk factors, improving methods of diagnosis and treatment, conducting retrospective analyses, assessing transmission routes and epidemiological features, and enhancing epidemiological surveillance systems [P. Křížová, M. Honskus, Z. Okonji et al., 2015; M.J. Whaley, S.J. Joseph, A.C. Retchless et al., 2018].

Purpose of the Study: The purpose of this study was to conduct a comprehensive analysis of the epidemiological dynamics of meningococcal infection among children and adolescents according to territorial distribution and age groups, as well as to identify its seasonal and socio-hygienic characteristics.

Research Methods. The following research methods were used: Sanitary-hygienic examination method; Socio-hygienic method; Epidemiological method; Serological method; Bacterioscopy; Molecular genetic method (PCR); Analytical method; Sanitary-statistical method.

For the first time, factors influencing the spread of meningococcal infection in organized educational institutions (preschool institutions, schools, and technical

colleges) were systematically evaluated using hygienic and epidemiological approaches, and their relative significance as risk factors was determined.

Indicators of knowledge, attitudes, and practices regarding meningococcal infection among children and adolescents were also assessed for the first time, and behavioral risk factors associated with infection transmission were scientifically substantiated.

The influence of sanitary and hygienic conditions in educational institutions, including ventilation, overcrowding, and personal hygiene, on the spread of meningococcal infection was demonstrated based on evidence.

Based on the obtained results, comprehensive hygienic recommendations and preventive algorithms for children's institutions aimed at preventing meningococcal infection were developed.

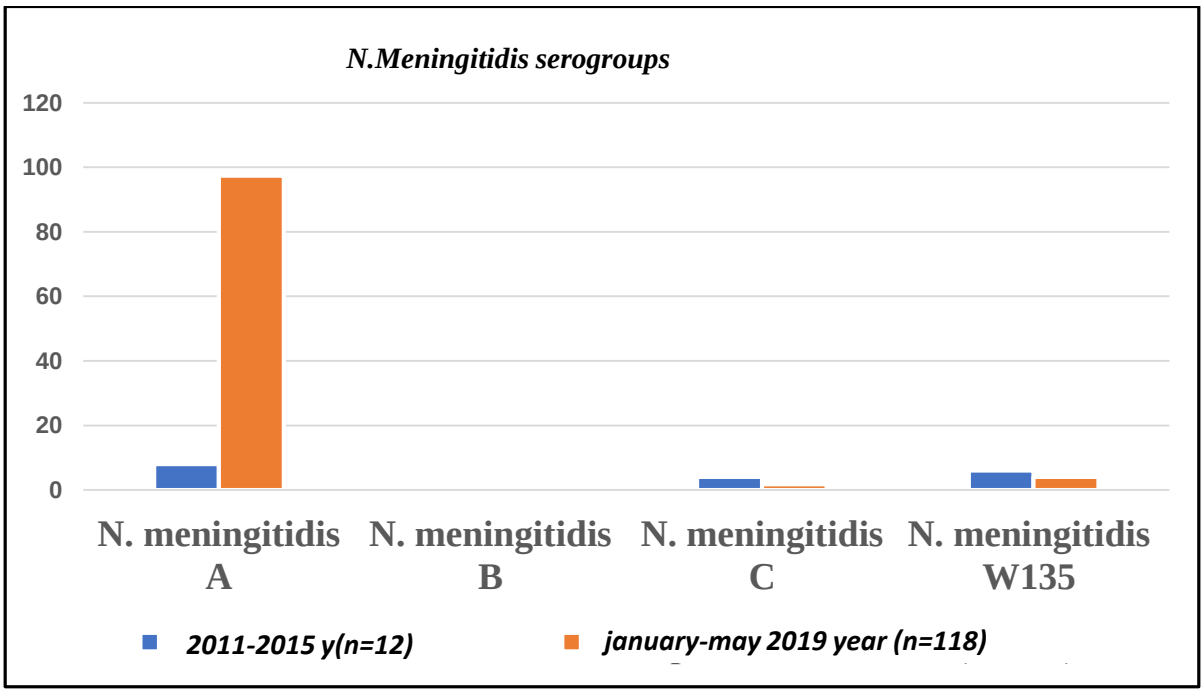
All of the above confirms the necessity for further research to solve this important public health problem.

Results of the Study. The results of our study demonstrated that since the beginning of the increase in morbidity (January 2019), serogroup A occupied the leading position (97.4%), while serogroup C accounted for 1.7%, and only one case (0.9%) was associated with serogroup W135.

It should be noted that during the last decade, the incidence of meningococcal infection worldwide has remained relatively stable, although periodic increases have been associated with changes in dominant serogroups and decreases in herd immunity.

Mortality rates remain high, reaching up to 15%, which is associated with the severity of the pathological process, diagnostic errors, delayed hospitalization, and untimely initiation of appropriate treatment.

At the same time, increased global migration, travel, and religious pilgrimages contribute to the worldwide spread of meningococcal infection, promoting genetic variability of the pathogen and emphasizing the need for effective specific prophylaxis.



Analysis of Various Serogroups of N. meningitidis Isolated from Patients with Generalized Forms of Meningococcal Infection in Uzbekistan During 2011–2019

Bacteriological examination is used to identify the causative agent in various biological fluids and secretions. This test should preferably be performed before the initiation of antibacterial therapy. For meningococcal detection, blood and cerebrospinal fluid cultures are usually sufficient, although meningococci may also be identified in skin biopsies and pleural or synovial fluids [6].

After the initiation of antibacterial therapy, the significance of bacteriological methods decreases. In such cases, immunological methods become more appropriate.

To determine nasopharyngeal carriage of meningococcus, mucus samples from the nasopharyngeal mucosa were collected on an empty stomach or 3–4 hours after meals using sterile cotton swabs, followed by placement into transport media (Amies, Bio Mere, France).

For complete opening of the pharyngeal cavity, material was collected with mandatory pressure on the root of the tongue using a spatula.

After insertion of the swab, 2–3 movements were performed along the posterior wall of the nasopharynx behind the soft palate. The swab was then carefully removed without touching surrounding tissues such as teeth, oral mucosa, or tongue.

The collected material was delivered within four hours to a bacteriological laboratory in medical thermal containers automatically maintaining a temperature of +37°C. Studies showed that storage in transport media for more than five hours negatively affects microorganism viability [5].

Meningococci are highly demanding regarding nutrient media and growth conditions. Their growth requires humidity and elevated concentrations of carbon dioxide (5–10% CO_2). They are also sensitive to even minor temperature fluctuations, with an optimal growth temperature of +37°C.

As native protein sources, bovine serum, horse serum, or animal blood are recommended. The basis for preparing nutrient media includes Hottinger broth, erythritol agar, AGV agar, special dry nutrient agar, or aminopeptide media for microbiological purposes.

Dry nutrient agar and blood serum must обязательно be tested for suitability in cultivating meningococci using reference strains or freshly isolated cultures [4].

Identification of N. meningitidis is based on morphological, tinctorial, cultural, and biochemical characteristics. Meningococcal cells are round, bean-shaped diplococci measuring 0.6–1 μm, arranged in pairs with concave surfaces facing each other, and they do not form spores.

In cerebrospinal fluid or blood cultures obtained from infected material, encapsulated paired cocci may be observed. Sometimes cocci resemble coffee beans. In culture media, these features may disappear, and capsules are often not visible.

Meningococcal colonies on serum agar are colorless, smooth-edged, round, convex, and oily in consistency. Unlike non-pathogenic Neisseria species, they are stretchable, fragile, and easily removed from the nutrient medium using a loop.

Some strains isolated from cerebrospinal fluid may show weak fermentative activity toward glucose or maltose; however, these characteristics may recover after subculturing. Unlike pathogenic Neisseria species, many non-pathogenic Neisseria produce starch-like polysaccharides on serum agar containing 5% sucrose [5].

Determination of meningococcal serogroups in practical laboratories is mandatory because it is one of the important epidemiological surveillance measures.

Along with meningococcal infections, diseases caused by airborne transmission of Haemophilus influenzae also contribute to widespread dissemination.

The rarity of meningitis during the first months of life in children is explained by maternal antibodies against capsular antigen type “b.” Purulent bacterial meningitis in adults is more often associated with other serological types of Haemophilus.

Pneumococcal meningitis most frequently develops in individuals older than 15 years, especially middle-aged adults. Serogroup differentiation of pneumococci is based on the structure of the polysaccharide capsule, which serves as the main virulence factor. Among the 90 identified pneumococcal serovars, 18 are recognized as causative agents of meningitis [6].

Infections caused by Listeria monocytogenes during pregnancy often present with latent symptoms and may lead to fetal infection through transplacental transmission or aspiration of contaminated amniotic fluid, resulting in neonatal meningitis.

Like pneumococci and haemophili, meningococci are highly demanding regarding culture media. Blood is commonly used to improve growth conditions; therefore, chocolate agar is widely utilized for all these pathogens.

For laboratory diagnosis of purulent bacterial meningitis, pathological materials must be collected in sufficient quantities and delivered to laboratories under proper conditions

For primary inoculation, bacterioscopy, and serological examination, at least 1 ml of cerebrospinal fluid is required. For bacteriological culture amplification, 0.5 ml of cerebrospinal fluid is inoculated into 5 ml of semi-liquid enriched agar preheated to +37°C directly at the patient’s bedside.

As enriched media, Igla medium and medium 199 are used. Sterile pipettes are used to transfer 0.3–0.5 ml of cerebrospinal fluid sediment into the preheated medium. Thick smear preparations are used for bacterioscopy, while 5 ml of blood is inoculated into 50 ml of 0.1% semi-liquid enriched agar for culture growth [2].

Biomaterials for bacteriological and serological examinations are transported immediately to the laboratory in heated containers at +37°C. If immediate transportation is impossible, materials are stored in a thermostat at +37°C.

CONCLUSIONS. In recent years, the incidence of meningococcal infection has shown a tendency to increase. Moreover, the occurrence of the disease among adults has also relatively increased.

During the study, no pronounced seasonality was identified, and cases were observed throughout the year.

Among adults, the following complications were detected: cerebral edema, hemiparesis, blindness, monoparesis, infectious toxic shock, meningoencephalitis.

Used literature.

1. Bekmuradova Sh.Sh. (Shomansurova), Mavjudova V.S. The role of diagnostics in the epidemiological surveillance system of meningitis // Modern Aspects of Medicine. Proceedings of the First Scientific Conference of Young Scientists Dedicated to the 600th Anniversary of Mirzo Ulugbek. Tashkent, 1994. pp. 34–40.
2. Bekmuradova Sh.Sh. Epidemiological characteristics of meningococcal carriage // Collection of Scientific Works Dedicated to the 85th Anniversary of Academician I.K. Musabaev. Tashkent, 1995. pp. 41–45.
3. Nagibina M.V., Venerov Yu.Ya., Matosova S.V. et al. Generalized form of meningococcal infection caused by N. meningitidis serogroup W in Moscow during 2011–2016 // Infectious Diseases: News. Opinions. Education. 2018. Vol. 24, No. 1. pp. 100–105.
4. Maksina T.A. Epidemiological significance of meningococcal carriers in meningococcal infection foci: Dissertation of Candidate of Medical Sciences. Moscow, 2011. 175 p.

5. Mazankova L.N., Samitova E.R., Koroid N.V. et al. Rare generalized form of meningococcal infection caused by Neisseria meningitidis serogroup W // Journal of Infectology. 2020. Vol. 12, No. 1. pp. 111–118.
6. Mironov K.O., Platonov A.E., Dribnokhodova O.P. et al. Methodology for determining serogroups A, B, C, and W of Neisseria meningitidis using real-time PCR // Journal of Microbiology, Epidemiology and Immunobiology. 2014. No. 6. pp. 35–42.
7. Mironov K.O., Zhivotova V.A., Matosova S.V. Characteristics of Neisseria meningitidis serogroup W circulating in Moscow determined by massive parallel sequencing. 2017. Vol. 16, No. 4. pp. 33–38.
8. Determination of microorganism sensitivity to antimicrobial drugs: Clinical recommendations. 2021.