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PATHOGENS OF CHILDREN'S VIRAL INFECTIONS
(measles, rubella, chickenpox and mumps virus)
(Part II)

(illustrated textbook)

Shymkent 2021

Illustrated textbook " Children's viral infections (measles, mumps, rubella and chickenpox virus)"prepared as an information support for the independent work of students studying private virology. The textbook is prepared in accordance with the requirements of the working programs in microbiology and virology.

The illustrated textbook provides information about the taxonomic position, morphological features of the structure of excitators of children's viral infections, the clinic, diagnosis, treatment and prevention of diseases caused by them. The manual contains questions to control the assimilation of the material and test tasks. The manual is provided with illustrations to help you learn the material you are studying.

The illustrated textbook is intended for students and teachers of medical universities.

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List of abbreviations

IgG – class G immunoglobulins

IgM – class M immunoglobulins

CRI - congenital rubella infection

DNA - deoxyribonucleic acid

EIA - enzyme immunoassay

SSPE - subacute sclerosing panencephalitis

PCR – polymerase chain reaction

IFR– immunofluorescence reaction

NR – neutralization reaction

RNA – ribonucleic acid

IPHR – indirect (passive) hemagglutination reaction

CFT – complement binding reaction

HIR - hemagglutination inhibition reaction

CSF – cerebrospinal fluid

ESR – erythrocyte sedimentation rate

AIDS – acquired immunodeficiency syndrome

CVS – cardiovascular system

CRS – congenital rubella syndrome

CNS – central nervous system

CPE – cytopathic effect

Introduction

It is believed that infectious diseases that occur more often in children are called childhood infections, although they can also occur in adults. This is due, on the one hand, to the immaturity of the immune system of the child's body, and on the other-to the fact that children who have had such infections form a strong (almost lifelong) immunity that protects them from re-infection. This ensures that adults are immune to the relevant microorganisms.

The main successes in the centuries-old human struggle against infectious diseases almost entirely belong to the XX century. It was then that laboratory methods for identifying pathogens were developed, and antibacterial therapy and vaccination were introduced into medical practice. At the same time, it is largely because of this that changes have occurred in the structure of infectious diseases. If in the first half of the XX century the leading role belonged to bacterial infections, then in the second half of the same century and at the beginning of the XXI century viral infections began to dominate.

This tutorial describes the pathogens of viral diseases such as measles, rubella,chickenpox, and mumps.

1. Measles virus

Measles is an acute viral disease characterized by catarrhal inflammation of the mucous membranes of the upper respiratory tract, conjunctivitis, fever, and spot-papular skin rash.

The English name of the disease measles comes from the Latin word *misellus*, which means "unhappy".The disease is also called *rubeola* (from the Latin word *rubeolus* – reddish) and *morbilli* (from the Latin word *morbus* – disease).

Historical background.

The history of measles, like many other diseases, is not known for certain. However, humanity has been familiar with it since ancient times. One of the first symptoms of measles was described by the Arab scientist and doctor Razes in the IX century. It is worth noting that at this time the Arab world was advanced in terms of the development of science and medicine. Razes assumed that measles is a mild form of smallpox and gave it the name"Small disease" (morbilli) in contrast to smallpox, which was called, respectively, "big disease" (morbus). To distinguish measles into a separate disease and describe the symptoms in the 17th century, they tried in France and in England. Measles epidemics at that time occurred every two to three years, including in developed countries. By the age of 10, more than 90% of children were infected with measles in one form or another, most of them with clinical manifestations. In 1911, Anderson and Goldberg proved the etiology of measles, which brought the full discovery of the viral disease closer. This was done by infecting experimental monkeys with human nasopharyngeal mucus and blood filtrate from sick patients. The culture of the causative agent of measles was discovered only 43 years later. Until that time, prevention with human blood serum (seroprophylaxis) helped to reduce mortality from this disease. This method was first used by R. Degkvitz in 1919. Before the invention of the vaccine, the introduction of measles seroprophylaxis was a real salvation for children around the world.

In 1954, J. Enders and T. K. Peebles isolated the measles virus. In 1967, due to the presence of high titers of anti-measles antibodies in the blood serum and cerebrospinal fluid of those who died from subacute sclerosing panencephalitis, an opinion was expressed about the measles nature of this deadly disease (J. H. Connolly). In 1969, a direct proof of the correctness of this assumption was obtained: from the brain cells of those who died from subacute sclerosing panencephalitis, a virus was isolated that did not differ in its morphological, serological, and molecular biological properties from the measles virus.


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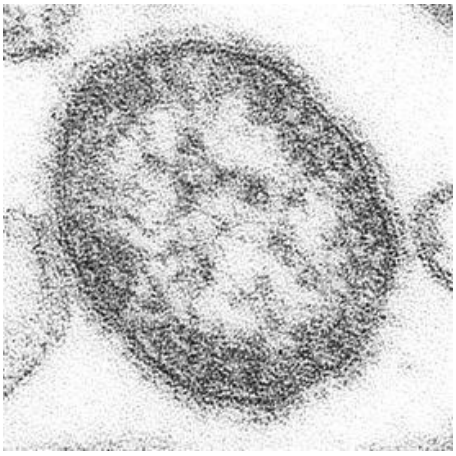
A - John Enders (JohnFranklinEnders, 1897-1985); B-Thomas Peebles (ThomasChalmersPeebles, 1921-2010). Borrowed from Internet resources.

Taxonomic position. Measles virus(Measlesmorbillivirus–MeV) is an RNA-containing virus of the order Mononegavirales of the family Paramyxoviridae of the genus Measlesmorbillivirus.The composition of this genus includes 7 species, of which only the causative agent of measles is pathogenic for humans, the rest of the representatives of this genus affect animals.

The measles virus has one serotype and more than 20 genotypes. When the measles virus persists in the human central nervous system, it causes the development of subacute sclerosing panencephalitis (PSPE).

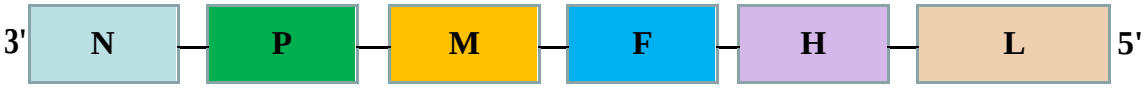
Morphological and tinctorial properties.

The morphology of the measles virus is typical of paramyxoviruses:The virion is spherical, the virion diameter is 150-250 nm, the outside of the virion is covered with a lipoprotein supercapsid with spikes up to 8 nm long.



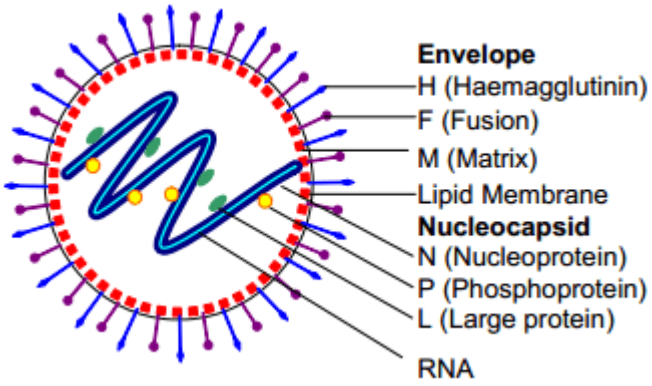
Measles virus, electron microscopy. Taken from Internet resources.

The genome of the measles virus is a single-stranded, non-fragmented minus-RNA molecule. The virus genome contains information about 6 structural proteins: N, P, M, F, H, and L.



The genome of the measles virus and the structural proteins encoded by it.

On the outside, the virus particle has a supercapsid-a lipid bilayer. The composition of the supercapsid includes proteins H (hemagglutinin) and F (fusion protein), which form spikes on the surface of the shell. From the inside, the matrix protein M is attached to the supercapsid. In the center of the viral particle, a spiral-type nucleocapsid of symmetry is located. The nucleocapsid contains a nucleoprotein (protein N), a phosphoprotein (P-protein), and an L-protein. The P and L proteins are associated with RNA-dependent RNA polymerase.

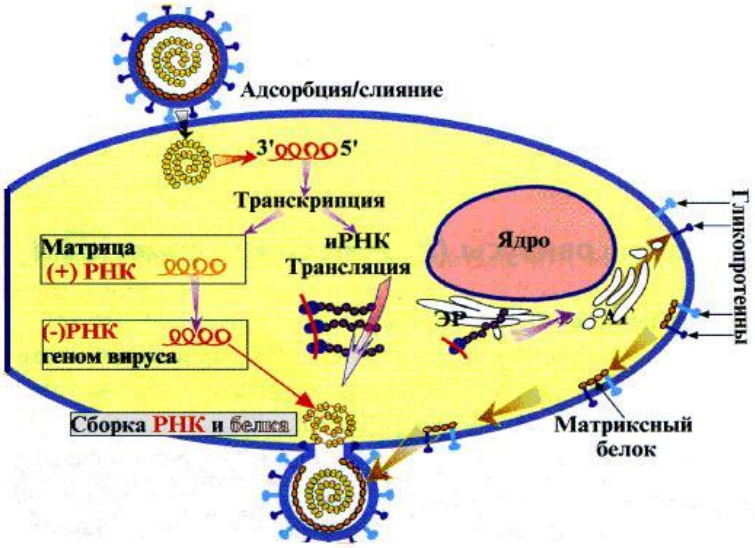


The structure of the measles virus. Borrowed from the ViralZone website.

The measles virus has hemagglutinating and hemolytic activity.Neuraminidase is absent.

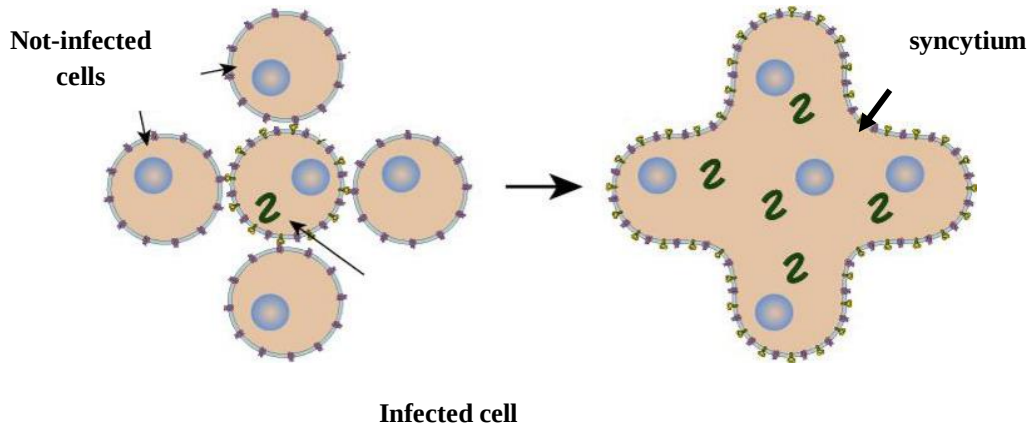
The life cycle of the measles virus also occurs in the cytoplasm of the infected cell. Initially, the virus interacts with the receptors on the cell surface using the H-protein (hemagglutinin). After adhesion, the F-protein (fusion protein) causes the fusion of the virus ' supercapsid envelope with the cell membrane. As a result, the nucleocapsid penetrates into the cell. In the cytoplasm of the cell, the virus is stripped and the viral RNA is released.

In the cytoplasm of the cell, mRNA is synthesized on the basis of viral minus-RNA using viral RNA-dependent RNA polymerase, and then copies of plus-RNA are synthesized. Plus-RNA acts as a matrix for the synthesis of minus-RNA daughter virions. At the same time, mRNA is synthesized on the basis of viral minus-RNA, which serves as a matrix for the synthesis of viral proteins. The assembly of daughter virions also occurs in the cytoplasm of the cell. First, a nucleocapsid with P - and L-proteins is formed, which is transported to the pre-modified parts of the cell membrane. In these areas, proteins H and F are embedded on the outside, and protein M is embedded on the inside. The exit of daughter virions from the cell is carried out by budding.



Scheme of reproduction of the measles virus (Vorobyev A. A., Bykov A. S., 2003).

In measles, the formation of giant multinucleated cells (Worthin-Finkelday cells) is possible in the body as a result of the fusion of an infected cell with uninfected cells. As a result, a multi-core syncytium characteristic of measles infection is formed. This process promotes the movement of the virus from an infected cell to a healthy cell against the background of high antibody titers without entering the extracellular space.



Scheme of syncytium formation. Taken from Internet resources.

Cultivation. Measles is reproduced only on monkeys with the development of their clinical manifestations. The measles virus is cultured on primary-trypsinized cultures of monkey and human kidney cells, transplanted cultures of Hela and Vero cells. During its reproduction, giant multinucleated cells – symplasts are formed; cytoplasmic and intranuclear inclusions appear. Protein F causes cell fusion.

Resistance. Low resistance in the environment: at room temperature, it is inactivated after 3-4 hours. Quickly dies from sunlight, UV rays. It is sensitive to detergents and disinfectants. It is quickly inactivated at a temperature of 56°C

(after 30 minutes), In drops of mucus at an air temperature of 12-15°C persists for several days. Low temperature tolerates well: the patient's blood, frozen at-72 °C, retains its contagiousness for 14 days. A distinctive feature of the causative agent of measles is its ability to persist for life in the body of the victim of the disease and the ability to cause a special form of the infectious process-a slow infection (subacute sclerosing panencephalitis).

Pathogenicity factors. The virus agglutinates only the red blood cells of monkeys (rhesus macaques), because they have specific receptors that are not present in the red blood cells of other animals.

The main antigens are the surface glycoproteins F, H and the nucleocapsid protein NP. All known strains of the measles virus are identical in antigenic terms.

Epidemiology. Measles is an anthroponotic infection.The disease is widespread everywhere. Human susceptibility to infection is high. Children aged 4-5 years are more likely to get measles. **The source of infection** in measles is a sick person who is contagious to others from the last days of the incubation period and up to 4 days after the appearance of the rash. From the 5th day of the rash, the patient is considered non-infectious. The main mechanism of transmission of infection is aerogenic, **the path of infection** is airborne. The pathogen is released into the external environment by a sick person with mucus during coughing, sneezing. The entrance for the measles virus is the mucous membranes of the respiratory tract and the conjunctiva.

Pathogenesis. The target cells for the measles virus are alveolar macrophages and dendritic cells of the respiratory tract. Infected cells migrate to the lymphoid organs, where primary replication and accumulation of viruses occur. From the lymphoid organs, the pathogen enters the blood (primary viremia on the 2-3 day of the incubation period). The amount of virus in the blood during primary viremia is small, so it can be neutralized by the introduction of gamma-globulin. This is the basis for passive immunization carried out in the foci of measles infection.

From day 3 of the incubation period, giant multinucleated Worthin-Finkelday cells are found in the lymph nodes. Reproduction of the virus in the lymph nodes leads to the development of secondary viremia on 5-7 days after infection. The duration of secondary viremia is 4-7 days. At this time, the endothelium of the capillaries is affected, resulting in a skin rash.

The measles virus is also able to reproduce in the cells of the skin, conjunctiva, gastrointestinal tract, and genitals.

Clinical manifestation. The incubation period of measles is on average 7-14 days, after which the first signs of the disease appear.

The development of measles in the classic form (typical form) occurs in 3 stages – period) - catarrhal, rashes and convalescence.

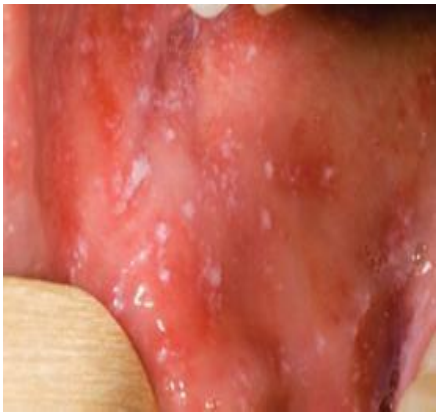
Periods (stages) of measles:

Stage 1 of measles - (catarrhal period) manifests itself after the incubation period of the virus and is characterized by an acute onset. The first signs of measles are general malaise, weakness, headaches, redness of the eyes (conjunctivitis), loss of appetite. Additionally, the body temperature increases, which in severe cases reaches 39-40 °C. Then there is a plentiful runny nose, in which even purulent discharge, dry cough, hoarseness of the voice, stenotic breathing (in some cases), photophobia, hyperemia and granularity of the mucous membranes of the oral cavity and pharynx, granularity of the posterior wall of the pharynx may be present.

Measles in adults is characterized by more pronounced signs of intoxication of the body, an increase in the lymph nodes, mainly cervical (lymphadenopathy), wheezing in the lungs when breathing.

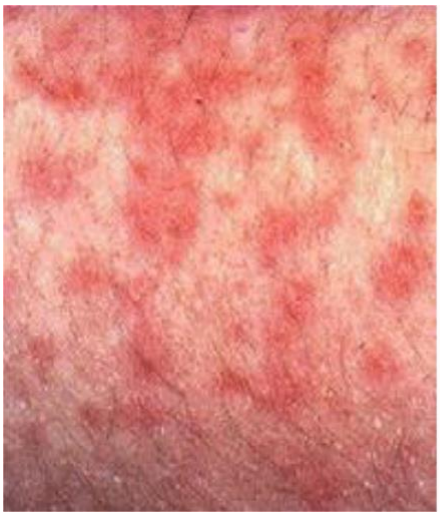
One of the main signs of the catarrhal period is also the Filatov-Koplik-Belsky spots, which are white, slightly protruding seals, with red edges, located on the mucous membranes of the oral cavity, more often - on the cheeks opposite the small molars, less often-on the lips and gums. Before these spots, or in time with them, a cortical enanthema appears in the sky – small red spots that merge with the general hyperemia of the oropharyngeal mucosa after a couple of days.

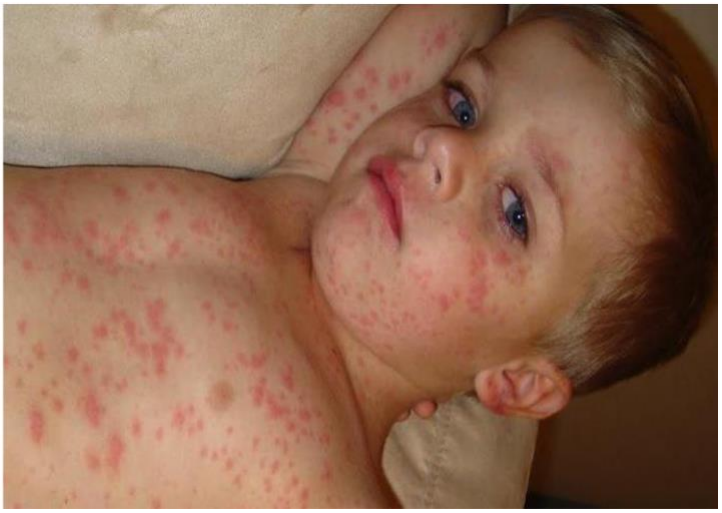
The duration of the catarrhal period of measles is 3-5 days, in adults-up to 8 days.



Spots of Belsky-Filatov-Koplik in measles on the oral mucosa. Taken from Internet resources.

Stage 2 measles - (period of rash). On the 3-4 day of the disease, a spotty-papular rash appears on the skin of the face. After a day, the rash spreads to the torso, and after another day-to the hands and feet. The most dense elements of the rash are located on the face, neck and upper torso. The rash is a small papule with a diameter of about 2 mm, surrounded by an irregular spot with a diameter of more than 10 mm.





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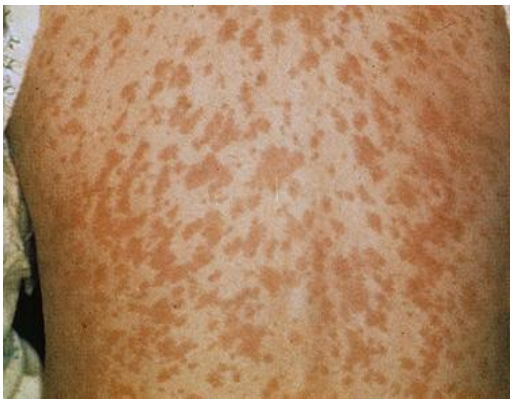
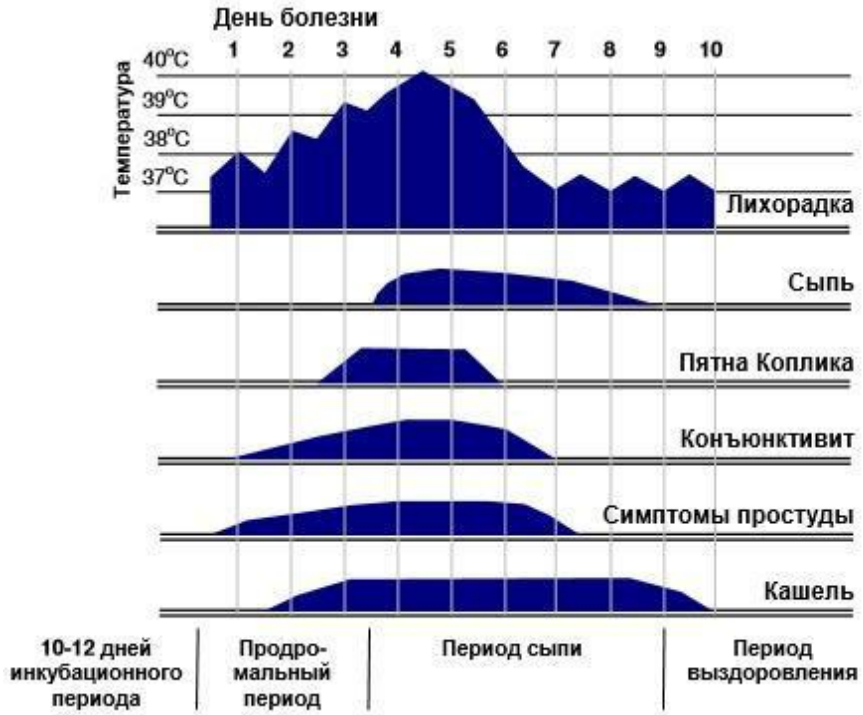
The type of rash (a) and its spread on the skin (b) in measles. Borrowed from Internet resources.

Stage 3 of measles - (the period of pigmentation) usually occurs on 4-5 days after the rash-is characterized by a decrease in the signs of measles, an improvement in the patient's well-being, a decrease in body temperature, which occurs due to the production of antibodies by the immune system that neutralize the measles virus.

The rash on the body, again, starting from the head and up to the lower part of the body, begins to turn pale, turning into light brown spots, which in turn, after 7 days disappear. In their place, mainly on the face, there is a bran-like peeling and pigmentation of the skin, which subsequently disappear, leaving no traces.



Measles rash in the pigmentation stage. Borrowed from Internet resources.

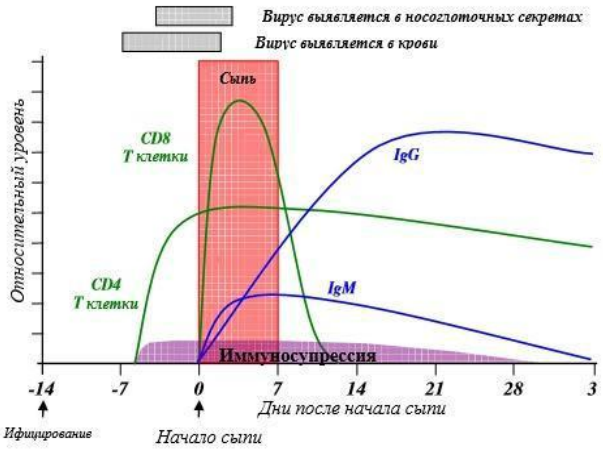


Typical clinical manifestations of measles (WHO Guidelines for Laboratory Diagnosis of measles and Rubella. Second edition, 2007).

There might be complications of measles such as pneumonia, otitis media, rarely encephalitis and SSPE (subacute sclerosing panencephalitis).

SSPE is a slow viral infection with a fatal outcome as a result of the destruction of the nervous system with the death of neurons and the development of motor and mental disorders. The disease is caused by the persistence of the virus in the cells of the neuroglia without the formation of full-fledged virions. In defective virions, the formation of the shell is disrupted, the protein F changes, and the protein M is absent. In the blood and CSF of patients, anti-measles antibodies are detected in the titer up to 1:16000, and in the brain cells - viral nucleocapsids.

Immunity. After suffering from measles, a humoral persistent life-long immunity develops. Repeated illnesses are rare. Passive immunity, transmitted to the fetus from the mother through the placenta, protects the newborn during the first 6 months after birth.



Immune response in acute measles infection (WHO Guidelines for Laboratory Diagnosis of measles and Rubella. Second edition, 2007).

Laboratory diagnostics. The evidence for measles is the isolation of the selected measles virus, the detection of specific IgM antibodies, or the increase in the titer of IgG antibodies in the blood serum. **The test material** is flushing from the nasopharynx, scraping from the elements of the rash, blood, urine. In the test material, the pathogen can be detected using IFR, HIR, and RN. To determine antibodies to the measles virus, the radial hemolysis reaction (RHR), the immunofluorescence reaction ((IFR), the lectin-neuraminidase test (LNT), and most widely – the hemagglutination inhibition reaction (HIR) and the neutralization reaction (NR) are used. The most preferred method is the ELISA method. A sensitive diagnostic method is the detection of the virus genome in the test material using PCR.

Treatment. No drugs have been developed for specific treatment. Symptomatic agents are used (anti-inflammatory drugs, antipyretics and expectorants).

Prophylaxis. Specific measles prevention is carried out using live measles vaccines from attenuated strains or associated vaccines (against measles, mumps, rubella - MMR) in accordance with the calendar of preventive vaccinations.

According to the Decree of the Government of the Republic of Kazakhstan No. 2295 of 30.12.2009 and with amendments and additions of 12.02.2013, planned preventive vaccinations for children are carried out in accordance with the National Vaccination Calendar of the Republic of Kazakhstan, vaccination against measles is subject to:

- children at the age of 12 months and again at the age of 6 years. Adults aged 18-35 years who have not had measles, who have not been vaccinated before, or who do not have information about measles vaccination should also be vaccinated (immunization is carried out twice with an interval of at least 3 months between vaccinations). Vaccination is necessary for all those who have come into contact with a measles patient who do not have reliable information about the measles vaccination or measles that they have had in the past. Measles vaccines

create a reliable immune system that lasts for more than 20 years. Vaccination prevents the development of measles, even if it is carried out during the deterioration of the epidemic situation.

1. Mumps

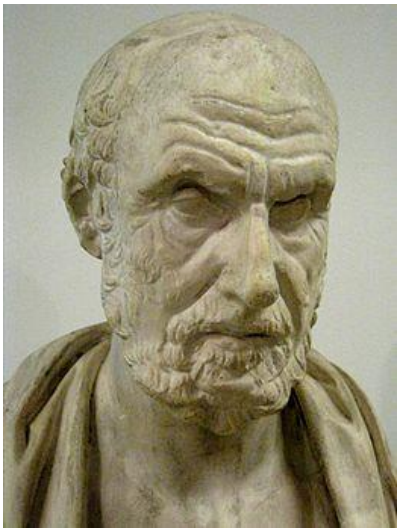
Mumps (synonym: "earwax", "mumps") is an acute infectious viral disease, accompanied by a predominant lesion of glandular organs that have a common embryonic origin, the nervous system and other organs, accompanied by fever and intoxication.

Historical background. The description of mumps was first given by Hippocrates in the *Corpus Hippocraticum* . He described in detail the symptoms of the disease during the outbreak on the island of Thassos, which is located in the northern part of the Aegean Sea.

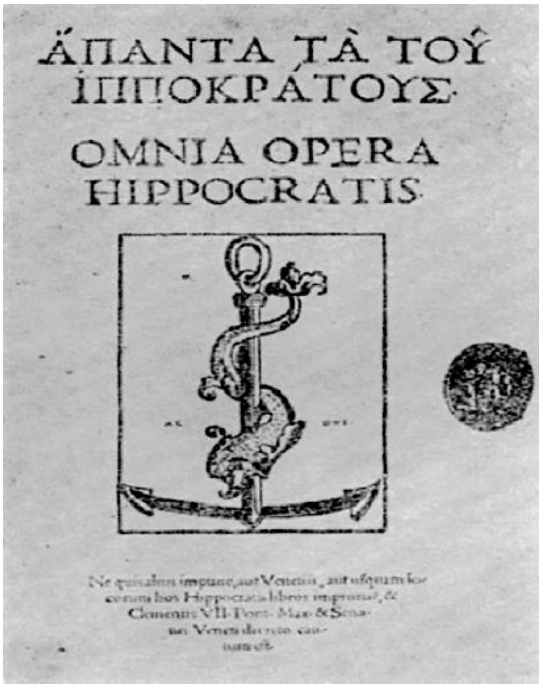
Here is what Hippocrates ' description of mumps looked like:

"The resulting tumors around the ears, in many on both sides, and in the greatest number on both sides, were not accompanied by fever, so that the patient was bedridden; in all cases they disappeared without causing problems, and none of them reached suppuration, as is often the case with tumors caused by other causes. They had a weak, large, diffuse character, without inflammation or pain, and they disappeared without any critical signs. They captured children, adults, and mostly those engaged in the exercises of the palaestra and gymnasium, but rarely attacked women. Many had a dry cough without phlegm, accompanied by hoarseness of voice. In some cases earlier, and in others later, the inflammation with pain sometimes seized one of the testicles, and sometimes both; some of them were accompanied by fever, and some were not; most of them were accompanied

by great suffering. Otherwise, they were not ill and did not need medical attention.»



Hippocrates (III-IV BC).



The title page of CorpusHippocraticum — the first book to describe an outbreak of mumps. Edition of Fr. Asulanus, Venice, 1526.

Although Hippocrates managed to describe the clinical picture of mumps with accuracy and detail, he could not, of course, judge the cause of the disease. References to mumps were found in the works of A. Celsus and C. Galen. Major

epidemics of this disease were observed in Europe in the XVI – XVIII centuries, and in the XIX century there were a large number of reports of outbreaks of the disease in the Scandinavian countries, Asia, Africa, etc. In Russia, in 1883, I. V. Troitsky described 12 epidemics, and in 1894, A.D. Romanovsky proved the existence of a nervous form of mumps. The viral etiology of the disease was proved only in 1934 by Claude D. Johnson and Ernest W. Goodpascher. They obtained a filtered cytotropic virus from samples of saliva from sick people and injected it through the duct into the parotid salivary glands of macaques. The animals developed a similar clinical picture. The resulting virus was not similar to any studied at that time and was not detected in the saliva of healthy people. The material used to infect the macaques did not contain any other known pathogens. After this experiment, there was no doubt that mumps is a viral disease with its own unique pathogen.

Ernest William Goodpasture (October 17, 1886-September 20, 1960). Taken from Internet resources.

Taxonomic position. Mumps virus is a virus with a " - " single-stranded RNA genome, belongs to the genus Rubulavirus of the family Paramyxoviridae.

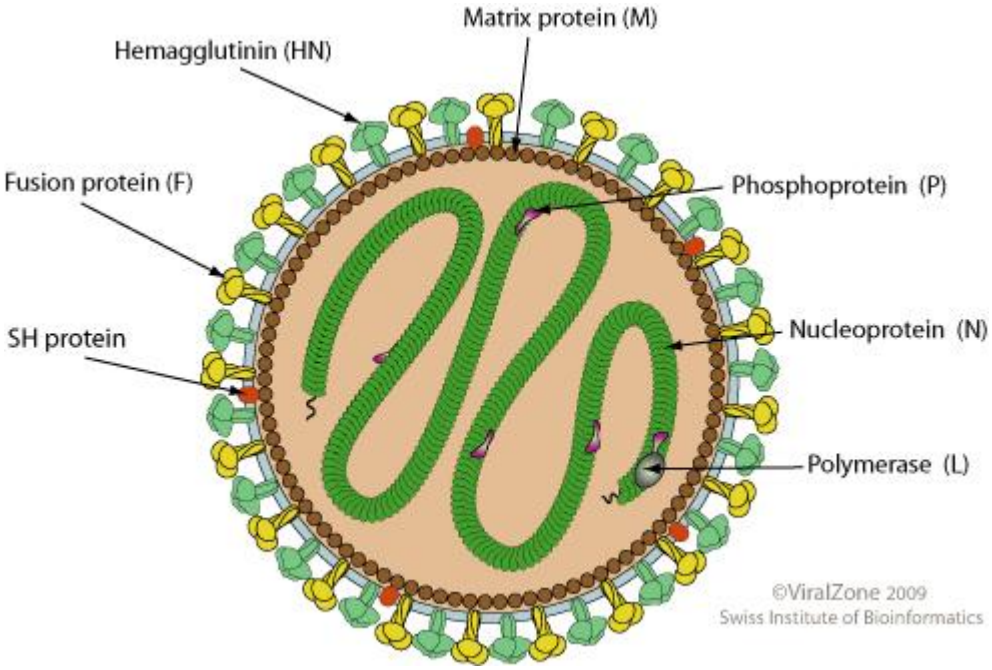
Viruses of the Paramyxoviridae family are characterized by a linear genome represented by the RNA minus chain. This group of viruses has a special affinity for mucopolysaccharides and glycoproteins, in particular, for cellular receptors containing sialic acid.

Morphological and tinctorial properties. The mumps virus has a spherical shape, the diameter of the virions is 150 nm. The virus particle has a structure similar to other paramyxoviruses. Inside the virion is a genome (a molecule of single-stranded non-segmented minus-RNA). The genome of *Rubulavirus viruses* and encoded structural proteins.

The genome of Rubulavirus viruses and the structural proteins encoded by them.

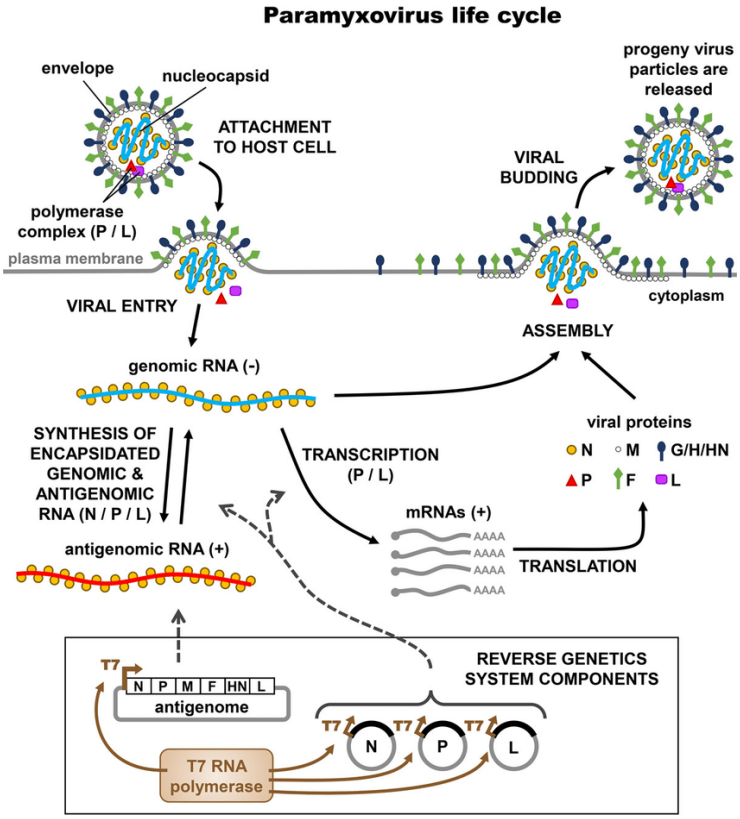
RNA with a nucleoprotein forms a helical-type symmetry nucleocapsid. The nucleoprotein is bound to phosphoprotein P and protein L, which form an RNA-dependent RNA polymerase. On the outside, the viral particle has a lipid bilayer with embedded spikes formed by hemagglutinin HN and fusion protein F. The matrix protein M is located between the nucleocapsid and the outer membrane.

The outer membrane of the mumps virus also contains a small transmembrane protein SH (an inhibitor of the induction of tumor necrosis factor in infected cells). It has hemolytic, hemagglutinating and neuraminidase activity.



The structure of viruses of the genus *Rubulavirus*. Borrowed from the ViralZone website.

The life cycle of the mumps virus occurs in the cytoplasm of the infected cell.The virus that has entered the body binds with HN spikes to the sialic acid of the cell membrane. Then, using the F-protein, the virus envelope merges with the cell membrane, and the nucleocapsid penetrates the cell cytoplasm without forming endosomes. Transcription, protein synthesis, and genome replication occur directly in the cell's cytoplasm. The genome is transcribed into mRNA for the synthesis of viral proteins and a complete plus matrix for the formation of genomic RNA. The daughter genomes interact with L -, P -, and NP-proteins, resulting in the formation of nucleocapsids. At the same time, the HN and F proteins are embedded in the cell membrane, and the M protein is located opposite them on the inner side of the cell membrane. The nucleocapsids are then surrounded by a supercapsid shell made of a pre-modified cell membrane. The release of virions from the cell is carried out by budding.



Mumps virus life cycle (Moss, Griffin, 2006).

Cultivation. The virus reproduces well in chicken embryos, cell cultures of monkeys, guinea pigs, hamsters, as well as in the culture of fibroblasts of chicken embryos or Japanese quail embryos. Among laboratory animals, monkeys are the most sensitive.

Resistance. The virus is relatively stable in the external environment, at 18-20 ° C it persists for several days, at low temperatures-up to 6 months. Hemagglutinin, hemolysin and the infectious activity of the virus are lost in the case of warming up at 56oC for 20 minutes. Allergen and CS-antigen are more resistant to heat, withstand temperatures of 65oC and 80oC, respectively, up to 30 minutes. The virus is inactivated by UV radiation, 1 - % lysol solution, 2 - % formalin solution.

Epidemiology. Mumps infection is an anthroponotic infection. The source of infection is patients with manifest or asymptomatic forms of infection from the last 1-2 days of the incubation period to the 9th day of the disease, especially in the first 3-5 days of the disease. The mechanism of infection transmission is aerogenic. The path of transmission of the pathogen is airborne. Sometimes it is possible to

get infected through household items (for example, toys) contaminated with the patient's saliva. Children from 5 to 15 years old are most susceptible, but adults can also get sick. The susceptibility to infection is high-70-80%. The disease is found everywhere. This disease is characterized by a certain seasonality: the maximum number of cases is recorded in March-April. Men are 1.5 times more likely to get sick than women.

Pathogenesis.The entrance gate of the pathogen, the place of its primary localization are the mucous membranes of the upper respiratory tract. Further, the virus enters the blood (primary viremia) and spreads throughout the body, getting hematogenically into the salivary glands and other glandular organs.

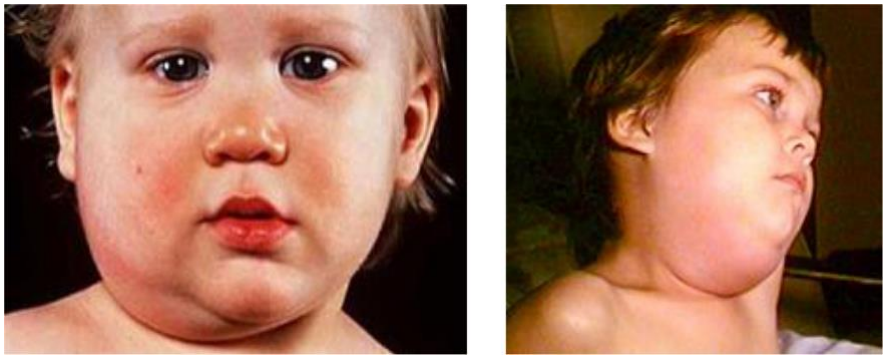
A favorite localization of the virus is the salivary glands, where its greatest reproduction and accumulation occurs. The release of the virus from the salivary causes an airborne pathway of infection transmission. Primary viremia is not always clinically apparent. In the future, it is supported by a repeated, more massive release of the pathogen from the affected glands (secondary viremia), which causes damage to numerous organs and systems: the central nervous system, pancreas, genitals, etc. Clinical symptoms of a lesion of a particular organ may appear in the first days of the disease, simultaneously, or sequentially. Virosemia, which persists as a result of repeated entry of the pathogen into the blood, explains the manifestation of these symptoms in the later stages of the disease.

Morphological changes in mumps infection occur mainly in the interstitial tissue of the salivary glands. Foci of inflammation are localized mainly near the excretory ducts, around the blood vessels. The glandular tissue of the organ is practically not involved in the pathological process.

At the same time, with orchitis, inflammatory degenerative changes can be quite pronounced, moreover, there may be foci of glandular tissue necrosis with blockage of the tubules, followed by testicular atrophy.

In meningitis, there is cerebral edema, hyperemia, and lymphocytic infiltration of the soft meninges.

Clinical manifestation. The incubation period for mumps is 14-21 days.The disease begins acutely with an increase in temperature to 39-40OC, headache, malaise. Then there is an inflammation and an increase in one or both parotid glands - mumps. Usually, the process begins on one side, and then after 1-2 days, the second gland is affected. At the same time, a new rise in body temperature is noted. Inflammation of the parotid salivary gland in mumps infection is accompanied by the appearance of soft tissue edema located in front of the ear, at the apex of the angle formed by the ascending branch of the lower jaw and the upper 1/3 of the sternocleidomastoid muscle. In the center, the swelling is elastic-elastic, and to the periphery - a dough-like consistency, so in most cases there are no clear boundaries. The skin above it is not changed, palpation causes moderate soreness. One of the signs of the disease is the Filatov symptom: soreness when pressing on the tragus, soreness behind the ear lobe, when pressing on the mastoid process. Sometimes the swelling spreads to the face, neck, and subclavian region. During the examination of the inner surface of the cheek of a patient with mumps, you can detect hyperemia and edema of the mouth of the excretory duct of the parotid salivary gland – a symptom of Moursou. The latter is not specific for mumps infection, but in combination with other symptoms allows you to make a diagnosis, since it appears already in the prodromal period. Salivation is reduced, saliva viscosity is increased, but saliva is transparent.



Clinical picture of mumps in children. Borrowed from Internet resources.

Other salivary glands (submandibular, sublingual) may be involved in the pathological process. Inflammation and enlargement of the salivary glands is accompanied by pain. The duration of the disease is about a week.

In severe and moderate forms of the disease, about 50% of boys over 14 years of age and adults develop mumps orchitis (inflammation of the testicle) on the 5-7 day of the disease, which can later lead to infertility.

Also, complications of mumps can be meningitis, meningoencephalitis, pancreatitis. Possible asymptomatic course of the disease.

Immunity. After the infection is passed down3-4 weeks, a stable lifelong immunity is formed,repeated diseases are recorded extremely rarely. IgM is detected in the patient's blood at the end of the first week of the disease and is recorded within 60-120 days. A little later, IgG is detected, the titer of which increases by 3-4 weeks and persists throughout life. A certain role in the formation of immunity belongs to the cellular link of immunity, as well as secretory immunoglobulins.

Laboratory diagnosis is rarely performed,since the clinical picture of the disease is very characteristic. The test material is saliva, salivary gland punctates, cerebrospinal fluid, urine, and blood serum. Diagnostic methods:

1. **Virological method**-infection of 5-7-day-old chicken embryos, chicken fibroblast cell cultures, monkey kidneys, etc. The indication in the chicken embryo is carried out using a hemadsorption reaction, and in cell culture – on the basis of CPD (formation of symplasts, complete destruction of the cell monolayer). The virus is identified using RTGA, RIF, PH, and RSC.

2. **Serological method**-determination of antibodies in paired blood sera using ELISA, RSC, RTGA. RSC, as well as RTGA and PH, are put with paired serums at intervals of 10-14 days. For a diagnostic increase, an increase in the level of antibodies by 4 times or more is taken.

ELISA is the most promising method for determining a specific immune response. Specific IgM antibodies are detected at the beginning of the infectious process and in the acute period, as well as in atypical forms, in isolated localities (orchitis, meningitis, pancreatitis), specific IgG antibodies indicate a latent period and a period of convalescence, this class of antibodies persists for many years.

3. **The molecular biological method is** PCR.

Treatment. On an outpatient basis, the treatment of erased and mild forms of epidemic mumps is carried out. Children with moderate to severe severity and epidemiological indications are referred for inpatient treatment. There is no specific treatment for the disease. Symptomatic therapy is used, which provides for the prevention of bacterial infection: oropharyngeal rinsing, dry heat on the affected salivary gland. The food is liquid, semi-liquid, high-calorie and rich in vitamins. Oral care, mouthwash after meals (warm boiled water, 2% sodium bicarbonate solution or 1:5000 furacillin solution) 4-6 times a day.

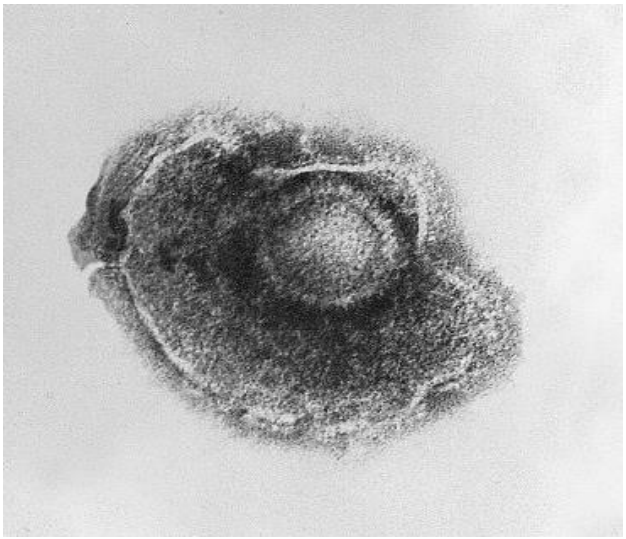
Prophylaxis. Active immunization is a reliable method of prevention. For vaccination in the Republic of Kazakhstan, a live attenuated associated vaccine against measles, mumps and rubella is used. This vaccination is included in the National Vaccination Calendar of the Republic of Kazakhstan. It is performed at the age of 12 months and again at 6 years.

Mumps vaccines. Borrowed from Internet resources.

1. Chickenpox

Chickenpox (varicella) is an acute anthroponotic viral disease caused by a virus from the family Herpesviridae, transmitted by airborne droplets, accompanied by moderate fever and symptoms of intoxication, damage to the skin and mucous membranes in the form of a macular-papular-vesicular rash. It is characterized by a benign course and a long-term latent persistence of the virus in the body of a person who has been ill.

Historical background. Chickenpox has been known since ancient times, but it has been diagnosed as a mild variant of smallpox. The disease was described by the Italian physician and anatomist G. Vidus (Vidius) in the middle of the XVI century. The name varicella, which distinguishes the disease from smallpox (variola), was first introduced by the German doctor O. Vogel (1772). After the epidemic of 1868-1874, the disease was considered a separate nosological form. The causative agent was identified by the Brazilian doctor E. Aragao (1911), who found elementary bodies of the virus (Aragao corpuscles) in the contents of the vesicles. The virus was isolated from them in the 40s of the XX century.



Varicella zoster virus, electron microscopy. Borrowed from Internet resources.

Taxonomic position.

The Kingdom of Vira

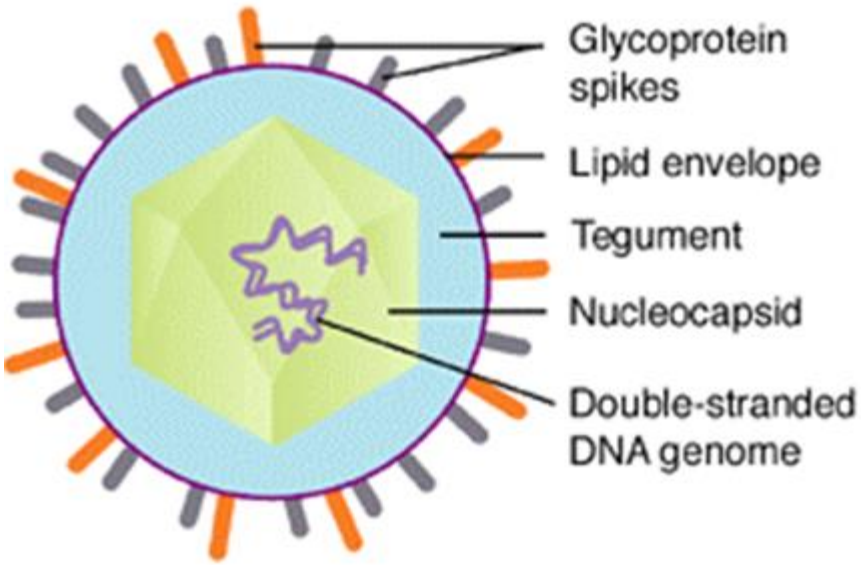
Family Herpesviridae

Subfamily Alphaherpesvirinae

Genus Varicellovirus

Representative of Varicella-zostervirus (VZV)

Morphological and tinctorial properties. The virion has a spherical shape, size 100-200 nm, consists of a core containing linear double-stranded DNA, and a supercapsid with glycoprotein protrusions (spines). There are internal core and external antigens. The virus does not have hemagglutinating properties, it has a complement-binding antigen.



Structure of the chickenpox virus.

Cultivation. The virus multiplies in human cell cultures with the formation of intracellular inclusions. It causes a cytopathic effect, forms giant multinucleated cells-symplasts. It is non-pathogenic for animals.

Resistance. The virus is unstable in the environment, sensitive to UV radiation and disinfectants; at 60 °C, it dies within 30 minutes, tolerates low temperatures, repeated freezing and thawing.

Epidemiology. The source of the infection is a sick person. A patient with chickenpox is dangerous a day before the appearance of rashes, the entire period of

rashes and 3-5 days after the appearance of the last vesicles. The source of infection can also be patients with herpes zoster. The greatest epidemiological danger is represented by patients with mild and erased forms of chickenpox, since in such cases the body temperature does not rise, there are isolated rashes, and the disease is not recognized, and the patients, therefore, are not isolated. Chickenpox is highly contagious. The mechanism of transmission of the pathogen is aerosol, the transmission path is airborne. The patient releases a huge amount of viruses into the surrounding air when talking, coughing, sneezing. The exciter with an air current can be transferred to neighboring rooms, through corridors, ventilation systems to other apartments and to other floors. Due to the low resistance of the virus in the external environment, infection through household items and through third parties is unlikely. Possible transplantental transmission of the virus from the mother to the fetus. The susceptibility to chickenpox is almost absolute, which causes a high incidence among children. Children of pre-school age, who usually attend pre-school institutions, are mostly ill. Children of the first 2-3 months of life, who are naturally fed, rarely get sick, since they receive antibodies from their mother with milk. But in cases of lack of immunity in the mother and in the presence of contact with a patient with chickenpox, newborns can also get sick. The disease occurs with the same frequency, both in men and in women. After the disease, a strong immune system remains. Repeated chickenpox infections are rare. However, the virus persists in the body for life and, with a decrease in the protective forces of the macroorganism, causes the development of herpes zoster.The greatest number of diseases is registered in the cold season (autumn-winter seasonality). In the summer, the incidence decreases.

The virus can infect cell nuclei with the formation of eosinophilic intracranial inclusions, and can also cause the formation of giant multinucleated cells, which can be detected by morphological examination of biological material taken from patients with OG (vesicle contents, scraping from the bottom of erosions), stained by the Romanovsky-Giemza method.

Pathogenesis. The virus enters the human body through the upper respiratory tract, where it is fixed on the cells of the mucous membrane and is introduced into them. In the cells of the respiratory tract mucosa, the primary reproduction and accumulation of the virus occurs. Then the virus enters the appropriate parts of the lymphatic system and at the end of the incubation period penetrates the blood and spreads throughout the body. Virosemia occurs. Having a tropicity to the epithelium of the skin and mucous membranes, the pathogen is fixed in the epithelium of the surface layer of the skin. At the site of fixation of the virus, a local expansion of the blood capillaries occurs, serous edema appears, the epidermis is detached, which causes the formation of a spot-papule-vesicle. It should be noted that the vesicles formed in chickenpox are single-chamber and in some cases can pass into the pustule. When the vesicles dry out, crusts form in their place, after which the epidermis is restored without scarring (unlike smallpox). Simultaneously with the defeat of the skin and mucous membranes, patients experience an increase in body temperature, headache and other intoxication phenomena, which may be due to the accumulation of toxic metabolites of the virus reproduction in the blood, as well as the occurrence of an allergic rearrangement of the body. People with immune disorders can develop severe forms of chickenpox with damage to internal organs. Pathoanatomical changes in chickenpox have not been sufficiently studied, since deaths are very rare and are possible against the background of other diseases or with its visceral forms. Visceral lesions in chickenpox are rare and are usually diagnosed only at an autopsy. They are characterized by the detection of smallish-white foci of necrosis in the liver, lungs, kidneys, spleen, and pancreas, histologically similar to chickenpox rashes on the skin.

Clinical manifestation. During the course of chickenpox, the following periods are distinguished: the incubation period, the prodromal period, the periods of rashes and the formation of crusts.

The incubation period for patients aged from 30 years is 11-21 days, up to 30 years 13-17 days.

The prodromal period occurs within 1-2 days before the onset of the rash (in some cases, the prodromal period is absent and the disease manifests itself with the appearance of a rash).

Prodromal phenomena in children may not be pronounced. In adults, prodromal phenomena are more frequent and more severe (headache, lumbosacral pain, fever).

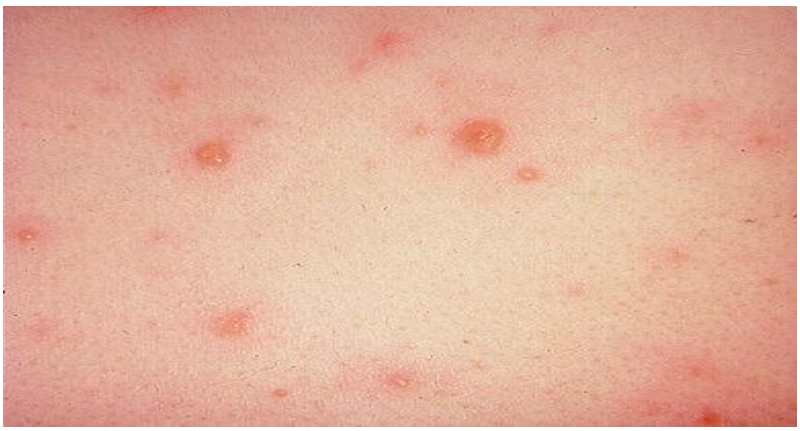
The period of rash in most children proceeds without any special violations of the general condition, the febrile state coincides with the period of mass appearance of the rash, the rashes appear in a jerky manner, so the fever can be undulating.

In adults, the rash is often massive, accompanied by an increase in body temperature, general toxic phenomena, and severe itching. The resulting rash has the appearance of pink spots 2-4 mm in size, which within a few hours turn into papules, some of which, in turn, become vesicles. The vesicles are single-chambered, surrounded by a corolla of hyperemia. After 1-3 days, they dry out, forming surface crusts of dark red or brown color, which fall off at 2-3 weeks. Since the rashes appear repeatedly, the rash has a polymorphic character, that is, in a limited area, you can see both spots, papules, vesicles and crusts.

Simultaneously with skin rashes, enanthema appears on the mucous membranes. These are bubbles that quickly macerate, turning into an ulcer with a yellowish-gray bottom, surrounded by a red rim. More often, the enanthema is limited to 1-3 elements. The enanthema heals within 1-2 days.

The febrile period lasts 2-5 days, sometimes up to 8-10 days (if the rash is very abundant and prolonged). Rashes can last from 2 to 5 days, and up to 7-9 days.

Usually chickenpox is benign, but with the development of bullous, hemorrhagic or gangrenous forms of the disease, complications such as encephalitis, myocarditis, pyoderma, and lymphadenitis are possible. The disease leads to death in 1 case out of 60,000.

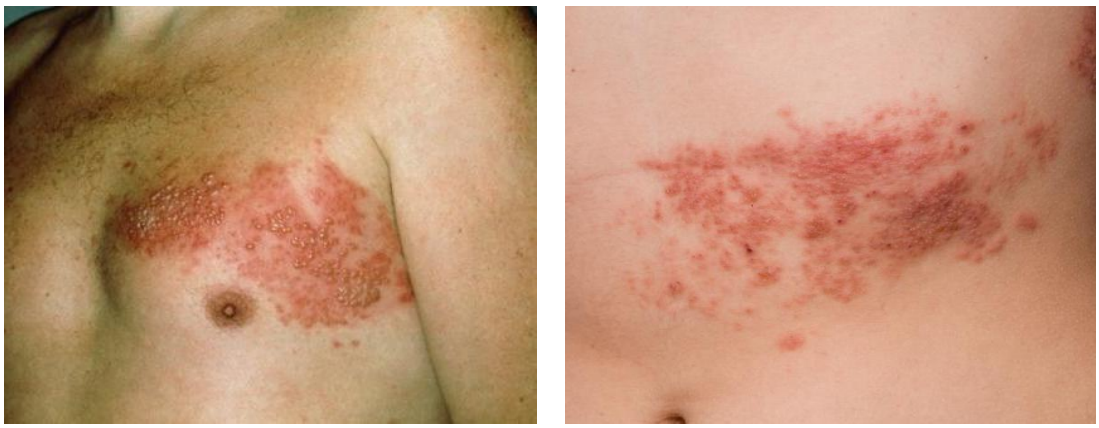


Chickenpox rash. Borrowed from Internet resources.

Immunity.

After the disease, there is a persistent (lifelong) immunity, but in some cases, with a sharp decrease in the intensity of immunity in adults who suffered from chickenpox in childhood, with infection, a repeat disease is possible. The varicella zoster virus can persist for life in the body of a convalescent in a latent state, localized in the intervertebral ganglia. In some cases, with the weakening of the body (stress, trauma, intoxication, chronic diseases, etc.), after many years, the activation of the virus with the manifestations of herpes zoster may occur, and the presence of Ig G antibodies in the blood does not protect against reactivation of the infection. The mechanisms of virus preservation in nerve cells and its possible activation are currently poorly understood.

Herpes zoster develops as a result of reactivation of the virus, preserved in the nerve ganglia. Reactivation of the virus is promoted by various diseases, hypothermia, overheating, injuries that reduce the overall resistance of the body. At first, indistinct pink spots with a diameter of 3-5 cm appear. After 18-24 hours, painful vesicles form on the spot, similar to a rash with chickenpox. However, the rash with herpes zoster is localized in a limited area, most often on one side of the chest or on the abdomen along the sensitive nerves.



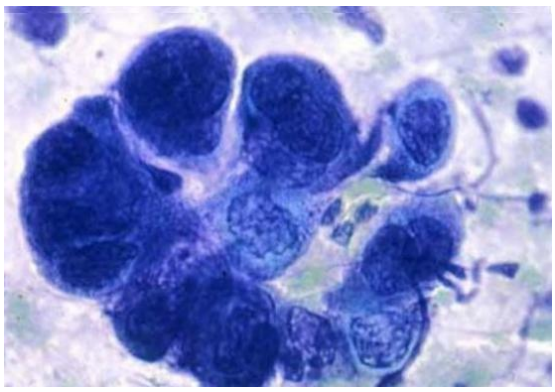
Localization of lesions in herpes zoster. Borrowed from Internet resources.

The disease is accompanied by a pronounced pain syndrome – burning pain on the affected area along the nerves. Since chickenpox rashes are localized throughout the body, the virus can persist in any nerve ganglia. Therefore, with herpes zoster, rashes along the trigeminal nerve, on the auricle and on other parts of the body are possible. The lesions disappear within 2-4 weeks. The disease ends with recovery.

A patient with herpes zoster is contagious. In non-immune individuals, after contact with a patient with herpes zoster, a typical chickenpox clinic develops.

Diagnostics.The general blood test is non-specific, there may be leukopenia, lymphomonocytosis, ESR, as a rule, remains normal. Express diagnostics: microscopic method-detection of Aragao bodies (virus accumulation) in smears of vesicle fluid stained with silver by Morozov using conventional or electron microscopy;

The virososcopic method is based on the detection of syncytium (Tsank cells) and intracranial inclusions (Lipschutz bodies) in the smears-prints stained according to Romanovsky-Giemse. **Tsanka cells** are giant rounded cells containing large nuclei. **Lipschutz corpuscles** are intracellular inclusions in the affected cell in chickenpox.



Multicore giant cells with intracellular inclusions. Taken from Internet resources.

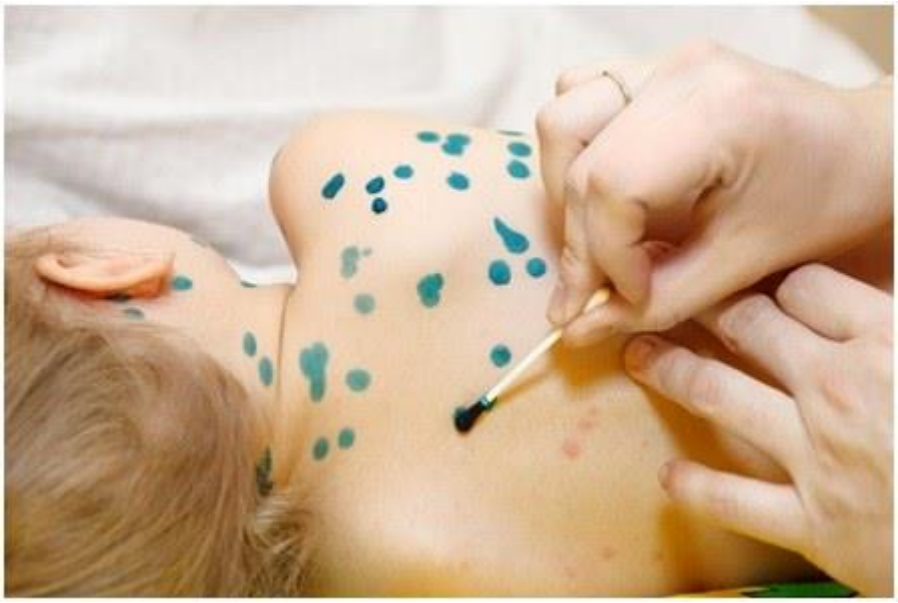
The virological method involves the cultivation of the virus in the fibroblasts of the human embryo, followed by identification using IFR, CFT, ELISA, and NR. Virological testing is not performed in clinical laboratories.

Serological diagnostics is based on the use of ELISA, CFT, IPHR. Diagnostic is the increase in the titer of specific antibodies by 4 times or more. But even these studies are rarely used.

The molecular genetic method (PCR) is aimed at detecting viral DNA in the test material.

Treatment can be carried out both on an outpatient basis and in a hospital setting. Patients require careful hygienic care to prevent the accumulation of purulent complications. As an etiotropic therapy for adolescents and adults, acyclovir can be used (800 mg orally 5 times a day for 5-7 days). It is believed that antiviral drugs should be prescribed only in patients with a severe course of the disease and in people with weakened immunity.

Therapeutic measures are mainly aimed at caring for the skin and mucous membranes. For faster drying of the bubbles and prevention of secondary infection, the elements of the rash on the skin are lubricated with a 1% aqueous solution of methylene blue or diamond green, a concentrated solution of potassium permanganate. To reduce itching, the skin is lubricated with glycerol or wiped with water with vinegar or alcohol. Prescribe antihistamines (loratadine, cetrin, telfast).



Prophylaxis. The patient is isolated until the 5th day after the appearance of the last element of the rash. In preschool children's institutions, children who were in contact with the patient are separated for 21 days. For the purpose of specific prevention, antiherpetic immunoglobulin (Ig VZV) and the chickenpox vaccine are used. In our country, vaccination against chickenpox is not included in the vaccination calendar. However, vaccinations for children older than 12 months can be carried out (once). Vaccination of children over 13 years of age-twice with an interval of 1 month. Indications for vaccination: chronic kidney failure, HIV/AIDS, bone marrow transplantation, primary immunodeficiency without T-cell damage.

1. Rubella

Rubella is an acute infectious disease characterized by small-spotted exanthema, generalized lymphadenopathy, moderate fever, and fetal lesions in pregnant women. The disease is usually observed in children.

Historical background. Rubella was first described in 1740 by the German physician F. Hofmann. In 1914, Alfred Hess, based on experiments with monkeys, suggested the viral nature of rubella, which was confirmed in 1938 by Japanese scientists Hiro and Tosaka. They conducted an experiment: a group of children

were infected with rubella using flushes from the nasal cavities of patients with acute signs of infection. Fetal damage caused during pregnancy was first formulated by Australian ophthalmologist Norman Gregg. In 1941. He published his hypothesis that rubella and congenital cataracts are interrelated. He described other rubella-related pathologies associated with congenital cataracts — which are now commonly known as *congenital rubella syndrome* (CRS). Gregg concluded that the fetus is more damaged when the mother gets rubella early in pregnancy.

In the first half of the 1960s, the rubella pandemic occurred in Europe. In the United States alone, 12.5 million cases of the disease were reported in 1964-1965. Rubella has affected 50,000 pregnant women, resulting in 11,000 miscarriages and the birth of 20,000 children with SVK. Of these, 2,000 were deaf, 3,580 were blind, and 1,800 were mentally retarded. That's when it became necessary to accelerate the development of a vaccine.

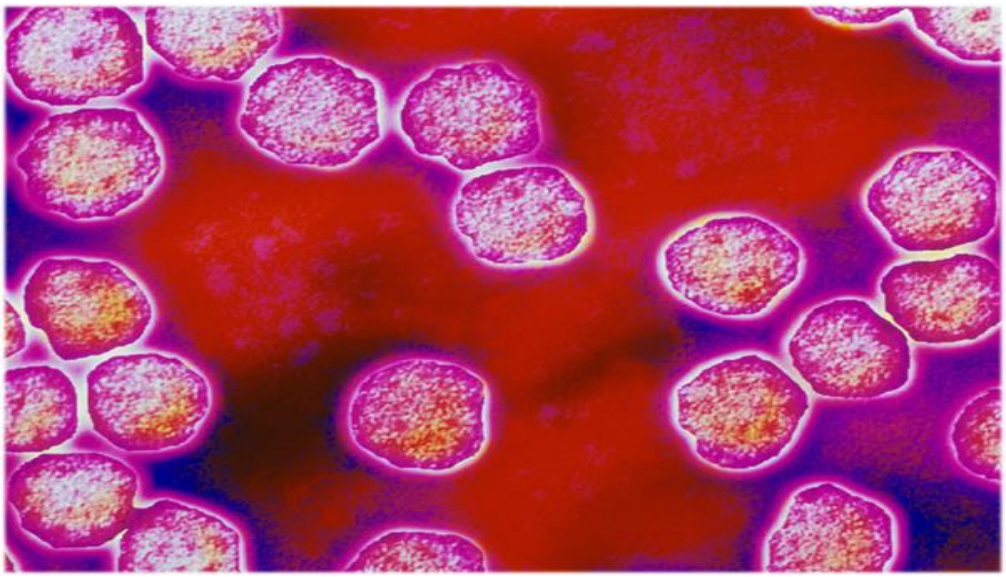
In 1962, the rubella virus was independently isolated by two groups of American scientists: the team of Paul Parkman infected the culture of kidney cells of the African green monkey with it, and the group of Thomas Weller — cells of the human amnion. So it was possible to show that the rubella virus can be maintained in a variety of cell cultures, which is very convenient for creating a vaccine.

Rubella Vaccine Developers —

Paul Parkman and Harry Meyer.

Borrowed from Internet resources

Taxonomic position. Rubella virus (Rubellavirus) is a genus of Rubivirus, which until April 2019 was assigned together with the genus Alphavirus to the family of togaviruses (from Lat. toga-bedspread). However, there is enough evidence to separate rubiviruses into a separate family, Matonaviridae, named after Georg de Maton, who first distinguished rubella from measles and scarlet fever.

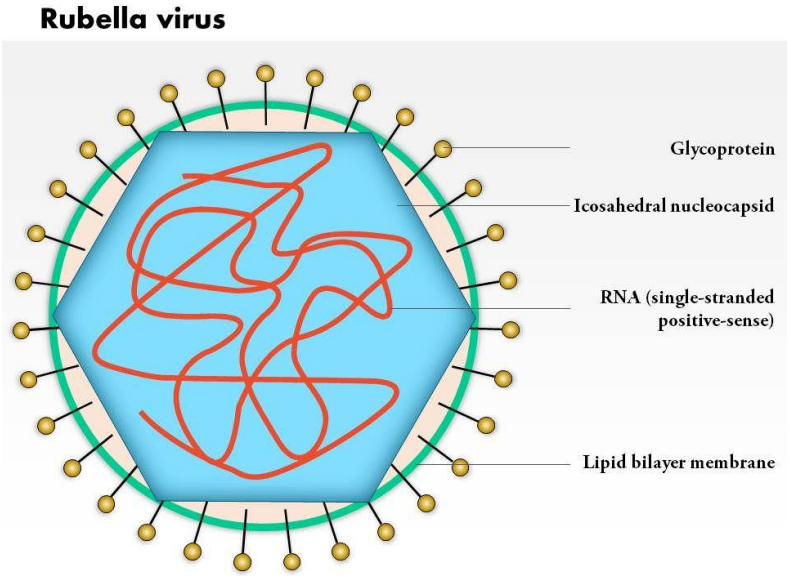


Rubella viruses. Computer microscopy.

Borrowed from Internet resources

Morphological and tinctorial properties. The rubella virus virion has a spherical shape, with a diameter of 60-70 nm. The virus genome is represented by a linear single-stranded + RNA, which is enclosed in a case — an icosahedral capsid with a diameter of 40 nm (an icosahedron is a regular polyhedron with 20 faces and 12 vertices). The capsid is surrounded by a lipid membrane. Spikes consisting of viral proteins E1 and E2 protrude above the surface of the membrane.

The E1 protein is a hemagglutinin and exhibits pronounced immunogenic properties, which is why it is used to create recombinant vaccines. The E2 protein acts as a receptor when interacting with the cell. Unlike other members of the Togaviridae family, the rubella virus contains neuraminidase.



Schematic representation of the rubella virus.

Borrowed from Internet resources

Source: drawing by Irina Efremova

Cultivation. The rubella virus is reproduced in primary cell cultures of the human embryo, as well as in a number of transplanted cell lines with pronounced CPD. The cycle of reproduction in cell cultures is completed in 12-15 hours. The virus reproduces in the cytoplasm of the cells, where eosinophilic inclusions are detected. Further maturation of virions occurs when budding through the membrane of the Golgi apparatus vesicles, and then when exiting through the outer membrane of the cell.

Resistance. The rubella virus is unstable in the external environment. It quickly dies under the influence of UV radiation, direct sunlight and disinfectants. At low temperatures in the frozen state, the virus retains its activity for years.

Epidemiology. Rubella is an anthroponotic disease. The sources of infection are: sick people, people with an asymptomatic form of the disease, as well as children with congenital rubella who release the virus into the environment for a long time (up to 2 years). The virus begins to be released 7-8 days after infection and within 7 days of the appearance of the rash. The release of the virus from the body occurs with the nasopharyngeal secret, as well as with urine and feces. The

main routes of transmission of the rubella virus are: airborne, contact, and transplacental. The entrance gate for acquired rubella is the mucous membranes of the upper respiratory tract. The incidence of rubella manifests itself mainly in the form of outbreaks. Children who attend organized groups are mostly ill.

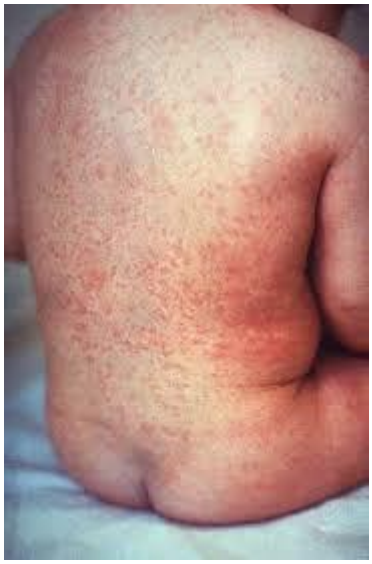
Rubella is especially dangerous for pregnant women, as it is possible to infect the fetus in utero with the subsequent development of birth defects. Rubella infection in the first trimester of pregnancy is particularly dangerous, since all the main tissues and organs of the fetus are formed during this period. About 25% of children infected during this period are born with symptoms of congenital rubella-the Gregg triad (congenital cataracts, deafness, heart defects), and 85% of children have other forms of developmental pathology.

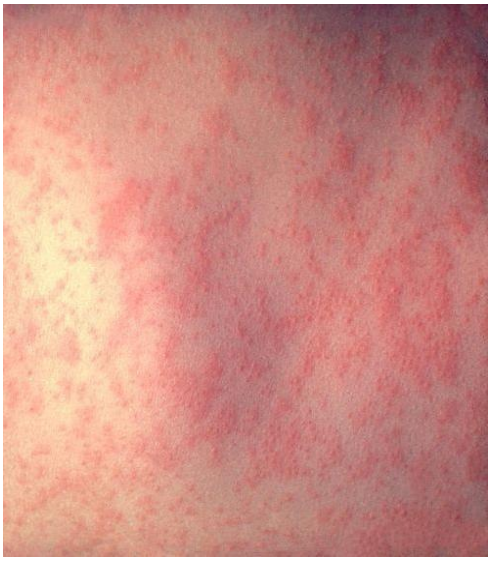
Pathogenesis. The rubella virus enters the body through the mucous membranes of the respiratory tract - this is the site of the entrance gate of infection, then enters the regional lymph nodes (occipital, posterior).In the lymph nodes, the virus multiplies, which leads to the development of lymphadenopathy(lymph nodes increase in size, become painful). From the lymph nodes, the virus enters the blood. Hematogenically, the virus spreads throughout the body, having dermatotropic properties, settles in the skin cells, where an inflammatory reaction develops, accompanied by the appearance of a spot-papular rash. After the rash appears, the virus continues to spread. In parallel, the titer of virus-neutralizing antibodies increases in the blood.The virus is released from the body of patients with the secret of the mucous membranes of the upper respiratory tract, with urine and feces. The virus disappears from the blood within two days after the appearance of the rash, but remains secret in the mucous membranes of the upper respiratory tract for 2 weeks.

Clinical manifestation. There is no generally accepted classification of clinical forms of rubella. There are two forms of the disease: acquired and congenital. In the acquired form, the incubation period lasts from 11 to 24 days (more often 16-20). The general condition of patients with rubella suffers little, so often the first symptom that attracts attention is exanthema. Patients report a slight

weakness, malaise, moderate headache, sometimes pain in the muscles and joints. The body temperature often remains subfebrile, although sometimes it reaches 38-39° and lasts 1-3 days.

On objective examination, mild symptoms of catarrh of the upper respiratory tract, slight hyperemia of the pharynx, and injection of conjunctival vessels are noted.From the first days of the disease, generalized lymphadenopathy appears. Especially pronounced is the enlargement and soreness of the posterior and occipital lymph nodes. Sometimes all these symptoms are poorly expressed, and the disease attracts attention only when a rash appears.The disease can occur in different forms.

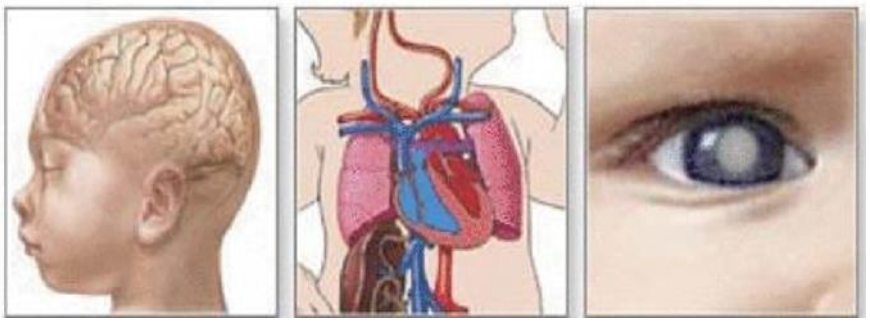




A rash on the body with rubella. Borrowed from Internet resources.

Congenital rubella syndrome (hereinafter referred to as CRS) is one of the possible outcomes of intrauterine infection with the rubella virus, especially in the first trimester of pregnancy. Birth defects associated with congenital rubella are called **Gregg's syndrome**, including heart disease (non-narrowing of the ductus arteriosus, pulmonary artery stenosis, damage to the valvular apparatus or any cardiac septum), eye damage (cataracts, decreased visual acuity, nystagmus, strabismus, microphthalmia or congenital glaucoma), hearing loss, long-term

mental retardation, hydrocephalus, non-narrowing of the soft and hard brain, neurological disorders.



Microcephaly **Heart defects** **Cataract**

Gregg's syndrome in congenital rubella. Borrowed from Internet resources.

Blindness in combination with deafness and CNS damage leads to mental retardation of the child. If intrauterine infection of the fetus did not lead to the development of birth defects, then this condition is called congenital rubella infection (VKI).

Rubella disease at 3-4 weeks of pregnancy causes congenital deformities in 60% of cases, at 9-12 weeks of pregnancy-in 15% of cases, at 13-16 weeks of pregnancy-in 7% of cases.

Immunity. After the infection, a persistent, intense, mainly humoral immunity is formed due to antihemagglutinins, complement-binding and virus-neutralizing antibodies.

Diagnostics. Laboratory diagnosis of rubella is based on the use of the following methods:

- isolation of the virus from flushes from the mucous membrane of the nose and throat, blood, urine, less often-feces, as well as from the internal organs of dead children;

- detection of antibodies (IdM and IgG) in paired blood sera and in cerebrospinal fluid in congenital rubella and progressive rubella panencephalitis;

- PCR.

The virus is isolated by infecting sensitive cells, such as the lung cells of a human embryo.

The virus is identified in the RN, HIT, IFR, and ELISA. However, the virological method is rarely used, since this procedure requires a lot of time and special laboratory conditions.

To detect antibodies, RN, CFT, HIT, and ELISA are used. The main methods of rubella diagnosis are ELISA and PCR.

The ELISA method: the detection of specific antibodies of class IgM (with the exception of cases where the formation of IgM was caused by vaccination) in serum by ELISA (not earlier than 5 days from the start of the rash);

the increase in the titer of specific antibodies belonging to the IgG, 4 or more times under simultaneous analysis in the standard serological tests of paired serum samples (with an interval of 10-14 days from the date of first test) is the basis for the diagnosis of "rubella".

PCR method: from a sample of whole blood, separated nasopharynx or urine, detection of rubella virus RNA (taking samples within the first 3 days from the onset of the rash);

Treatment. Treatment of rubella is non-specific, since there is no etiotropic therapy. Treatment is carried out on an outpatient basis, the following groups of patients are subject to hospitalization:

- children with severe background pathology;
- patients with immunodeficiency;
- children with congenital rubella;
- patients with complicated rubella.

Treatment includes the use of antipyretics, local drugs, antihistamines, vitamins. Also, it is important to observe the regime, the patient should be at rest, the menu should be varied with products that contain vitamins and trace elements. A sufficient drinking regime is recommended. In some cases, antibacterial drugs are used if a secondary bacterial infection has joined.

Prophylaxis. Specific prevention of rubella in the Republic of Kazakhstan is carried out with the help of associated vaccines (against measles, mumps and rubella - KPP) in accordance with the calendar of preventive vaccinations.

According to the Decree of the Government of the Republic of Kazakhstan No. 2295 of 30.12.2009 and with amendments and additions of 12.02.2013, routine preventive vaccinations for children are carried out in accordance with the National Vaccination Calendar of the Republic of Kazakhstan, rubella vaccination is subject to:

-children aged 12 - 15 months and again - at 6 years.

Associated vaccines against rubella, measles, and mumps.

Taken from Internet resources.

Non-specific prevention measures include early detection and isolation of the source of infection for 5 days from the onset of the rash. Children who have been in contact with the patient remain in the team, but are subject to daily examination for 21 days; new persons who are not ill with rubella and are not vaccinated against infection are not accepted.

According to the Checklist of recommendations for preventive, anti-epidemic, sanitary and hygienic measures developed by the Infection control service of the BMC of the UDP of the Republic of Kazakhstan in accordance with the Resolution" On Sanitary and anti-epidemic measures " No. 05-03 / 22 of 21.11.2018 of the USEN of the MC of the UDP of the Republic of Kazakhstan, as well as the Order of the Minister of Health of the Republic of Kazakhstan No. 264

of April 27, 2007 "On improving epidemiological surveillance of the incidence of measles, rubella, congenital rubella infection and mumps " in hospitals, preventive measures are carried out aimed at preventing the occurrence and spread of these diseases among the population. Contact persons from rubella foci who have not been vaccinated and have not been ill before are not allowed to be admitted to planned hospitalization in non-infectious medical organizations and social organizations during the entire period of medical observation. Hospitalization of such patients during the period of medical observation in medical organizations of a non-infectious profile is carried out according to vital indications, while additional sanitary and anti-epidemic (preventive) measures are organized in the hospital in order to prevent the spread of infection.

Comparative characteristics of childhood infections

Features	**Measles**	**Rubella**	**Mumps epidemic**	**Chickenpox**
Transmission ways	airborne	airborne	airborne	airborne
Causative agent	measles virus	rubella virus	mumps virus	herpes virus
Incubation period (from the moment of infection to the appearance of symptoms)	from 7 to 14 days	from 14 to 21 days	from 12 to 21 days	from 14 to 21 days
Quarantine	10 days	14 days	21 days	21 days
Intoxication (headache, body aches, poor health, whims)	Observed	Moderate	From moderate to observed	From moderate to observed

Increase in temperature	40 C and above	up to 38 S	Up to 38,5 C	Up to 40 C and above
The nature of the rash	flat reddish spots of various sizes on a pale background (100%)	flat small pink spots on a pale background (in 70%)	no rash	red itchy spots that turn into bubbles with transparent contents, then open and cover with crusts (100%)
Rash prevalence	on the face and behind the ears, extends to the body and hands	on the face, spreads to the body	No rashes	on the face and body, spreads to the extremities, mucous membranes
Catarrhal phenomena	cough, runny nose, conjunctivitis precede the appearance of a rash	runny nose, cough-sometimes	not typical	not typical
Complications	pneumonia, otitis media, in rare cases - encephalitis	rarely-encephalitis	meningitis, pancreatitis, inflammation of the genital glands	encephalitis, meningoencephalitis, myocarditis, nephritis
Period of contagion	from the moment of the first symptoms and until the 4th day after the appearance of the first rashes	7 days before and 4 days after the appearance of the rash	from the last days of the incubation period until 10 days after the onset of symptoms	from the last days of the incubation period until the 4th day after the appearance of the last rashй

Questions to control the assimilation of the material

1. The taxonomic position of the measles virus.
2. The structure of the measles virus.
3. The life cycle of the measles virus.
4. Epidemiology, pathogenesis in measles
5. Measles clinic.
6. Laboratory diagnosis of measles.
7. Prevention and treatment of measles.
8. The taxonomic position of the mumps virus.
9. The structure of the mumps virus.
10. Epidemiology, pathogenesis and clinic of mumps.
11. Laboratory diagnostics of mumps.
12. Prevention and treatment of mumps.
13. The taxonomic position of the chickenpox virus.
14. Epidemiology of chickenpox.
15. Clinic of chickenpox and herpes zoster.
16. Diagnosis of chickenpox.
17. Prevention and treatment of chickenpox.
18. Taxonomic position of the rubella virus.
19. Structure of the rubella virus.
20. Epidemiology, pathogenesis in rubella
21. Rubella clinic.
22. Causes and manifestations of congenital rubella syndrome.
23. Laboratory diagnostics of rubella.
24. Prevention and treatment of rubella.

Training tests

1. Measles virus:

- requires disinfection

+has one serovar

- pathogenic to animals and humans

- pathogenic only for children

- stable in the external environment

2. Measles virus:

+ RNA-containing

- DNA-containing

- simple

- has a cubic type of symmetry

- large

3. Lifelong anti-measles immunity is formed:

- transplacental

- with the introduction of anti-acne gamma-globulin

- when the measles vaccine is administered

+ after a previous illness

- missing

4. Filatov-Koplik spots are typical for:

- herpes

+ measles

- rubella

- mumps

- parainfluenza

5. Rashes on the skin and mucous membranes are characteristic of:

- tick-borne encephalitis

+ measles

- parainfluenza

- polio

- rabies

5. The measles virus belongs to the genus:

- Pneumovirus

+ Morbillivirus

- Flavivirus

- Rubulavirus

- Paramyxovirus

6. Source of infection in measles:

+ sick person

- virus carrier

- wild animals

- pets

- birds

7. Transmission pathway for measles:

- food grade

- alimentary

- water

+ airborne - transmissive

9. Features of the epidemiology of measles (everything is true, to r o m e):

- contagiousness

+ only children get sick

- children and adults get sick

- no current and final disinfection is required
- lack of virus transmission

10. Features of pathogenesis in measles (everything is true, to r o m e):
- damage to the reticuloendothelial system
- development of secondary immunodeficiency (anergy)
+ spread of the virus through the nerve trunks
- complications (otitis media, pneumonia, etc.)
- pathognomonic sign-Filatov-Koplik spots on the cheek mucosa

11. The mumps virus belongs to the family:
- Coronaviridae
+ Paramyxoviridae
- Orthomyxoviridae
- Rhabdoviridae
- Flaviviridae

11. Mumps virus belongs to the genus:
- Avulavirus
- Respirovirus
- Feriavirus
+ Rubulavirus
- Henipavirus

12. The mumps virus is characterized by:
+ contains minus-RNA
- contains DNA
- just an arranged virus
+ a complex virus
- contains reverse transcriptase

13. The mumps virus is characterized by:

+ unfragmented minus-RNA

- plus-RNA

- fragmented minus RNA

- DNA-genome

+ the presence of a supercapsid

14. The source of infection in mumps:

- household items

- medical instruments

- virus carrier

+ sick person

- sick animal

15. The main route of infection transmission in mumps:

- water

+ airborne

- contact

- transplacental

- alimentary

16. For specific prevention of mumps, the following methods are used::

+ live vaccine

- killed vaccine

- subvirion vaccine

- inactivated vaccine

- antibiotics

18. Entrance gate for chickenpox:

- conjunctiva

- leather

+ upper respiratory tract

- gastric mucosa

- intestinal mucosa

19. Chickenpox virus:

- Causes disease in humans and animals

+ Refers to DNA-containing

-Forms cytoplasmic inclusions

- Localized in the cytoplasm

- Pathogenic to rabbits

20. Herpes zoster is:

- bacterial infection

+ relapse of chickenpox

+ herpetic rashes along the nerves on the skin

- fungal skin lesions

- chlamydia

21. Herpes zoster virus persists:

- in the capillary endothelium

+ in the nerve ganglia

- in the intestinal epithelium

- in hepatocytes

- in the bone marrow

22. The rubella virus belongs to the family:

- Retroviridae
- Reoviridae
- Picornaviridae
- Flaviviridae
+Matonaviridae

23. The rubella virus genome is represented by:
- linear DNA
- segmented minus-RNA
+ single-stranded plus-RNA
- unsegmented minus-RNA
- fragmented DNA

24. The rubella virus is characterized by:
+ the presence of a supercapsid
- no supercapsid
- the presence of DNA
- three-layer capsid
- reproduction in the cell nucleus

25. The rubella virus is characterized by:
+ reproduction in the cytoplasm of cells
+ the presence of a supercapsid
- the presence of DNA
+ presence of single-stranded plus-RNA
- presence of segmented plus-RNA

26. The rubella virus is characterized by:

- fecal-oral mechanism of infection

+ aerogenic mechanism of infection

- infestation waterway

+ transplacental infection

- injection route of infection

27. Congenital rubella syndrome is caused by:

+ transplacental infection of the fetus

- genetic factors

+ infection of the mother with the rubella virus during pregnancy

- lack of vitamins

- premature birth

28. Specific rubella prevention products:

- chemical vaccine

- inactivated vaccine

+ live attenuated vaccine

- DNA vaccine

- heterologous immunoglobulin

29. Which virus has the most pronounced teratogenic effect:

+ Rubella

- Flu

- Parainfluenza

- Herpesvirus

- Chickenpox

30. Rubella virus is cultivated:

- On chicken embryos.

- In the body of sucker mice.

+ On the interwoven tissues.

- On artificial nutrient media.

- In the body of guinea pigs.

Note: the “+” sign marks the correct answers.

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