MED437
KING SAUD UNIVERSITY

Please check the editing file to see if there are any changes

MICROBIOLOGY
437

Viruses Causing Respiratory Infection (I)

غيداء آل مصمع
عبدالرحمن الحيسوني
Revised by

Important!
Doctor's Notes
Only found in females' slides
Only found in males' slides
Extra Notes

" I'm not telling you it's going to be easy. I'm telling you it's going to be worth it."

Objectives

- Introduction to respiratory viral infections
- Characteristics of respiratory viruses (*Orthomyxoviridae*, *Paramyxoviridae)*
- Mode of transmission
- Clinical features
- Lab diagnosis
- Treatment and prevention

Respiratory Tract Infections

- Are the commonest of human infections and cause a large amount of morbidity and loss of time at work (sick leave).
- Are common in both children and adults.
- Mostly caused by viruses.
- Mostly are mild and confined to the upper respiratory tract (URT). (if it got to the lower respiratory tract it became severe)
- Mostly are self-limiting disease. (a disease that tends to go away on its own, without treatment)
- URT-infection may spread to other organs causing more severe infection and death.

Clinical Manifestations (symptoms)

- Common cold (rhinitis).
- Pharyngitis.
- Tonsillitis.
- Sinusitis & otitis media.
- Croup (acute laryngotracheobronchitis).
- Acute bronchitis.
- Viral pneumonia.

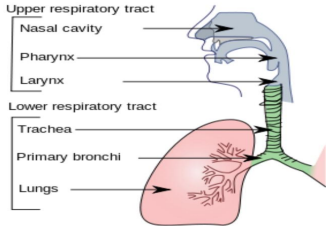
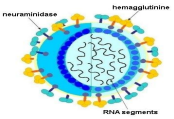


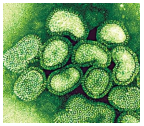
Table 22.1 Respiratory illnesses and their common viral causes*

Respiratory illness	Main causal viruses
Rhinitis (common cold)	Rhinoviruses (100 serotypes) Coronaviruses (3 serotypes)
Pharyngitis	Influenza A and B viruses Parainfluenza virus (types 1–3) Adenoviruses B, C, E Coxsackie A virus
Laryngotracheobronchitis (Croup)	Influenza virus Parainfluenza virus (types 1 & 2)
Bronchitis	Respiratory syncytial virus Parainfluenza virus (usually type 3) Influenza virus
Bronchiolitis	Respiratory syncytial virus Human metapneumovirus Parainfluenza virus (usually type 3)
Pneumonia	Influenza virus Respiratory syncytial virus Human metapneumovirus Parainfluenza virus (usually type 3) Adenoviruses B, C, E

*Other viruses can cause respiratory illness as part of a systemic infection, e.g. measles, pneumonia and pharyngitis in primary Epstein–Barr virus infection.

Influenza Virus





Family:

Orthomyxoviridae

Structural features:

Enveloped virus with 2 projecting glycoprotein spikes:

- Haemagglutinin (H)
- Neuraminidase (N)

Genome:

8 Segmented - polarity ssRNA

★ This virus is highly susceptible to mutations and rearrangements within the infected host.

Influenza viral proteins:

Haemagglutinin (H)	Neuraminidase (N)
❑ Attachment to the cell surface receptors. ❑ Antibodies to the HA is responsible for immunity. ❑ 16 haemagglutinin antigenic type, H1 – H16. ❑ Human associated H antigenic type are H1, H2, and H3. Other H from nonhuman source.	❑ Responsible for release of the progeny viral particles from the infected cell. ❑ 9 neuraminidase antigenic type, N1 – N9. ❑ Human associated N antigenic type are N1 and N2. Other N from nonhuman source.

Types of influenza virus

A

- Infects human and Animal
- Causes epidemic(1) and pandemic(2) +outbreak
- Causes epizootic in animal
- Antigenic drift → minor change
- Antigenic shift → major change

B

- Infects human only
- Causes outbreak

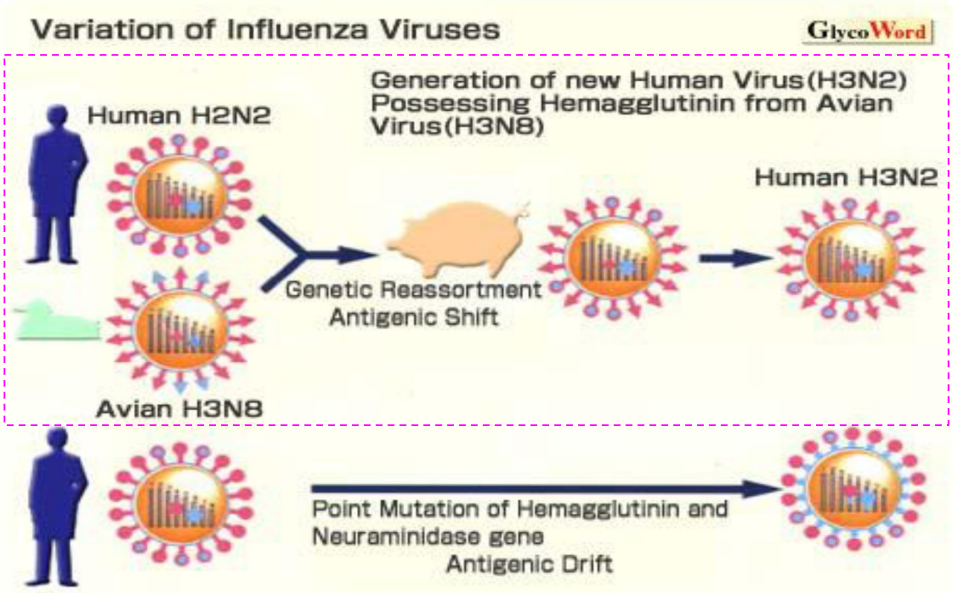
  محصور بمنطقة معينة
- Antigenic drift only

C

- Infects human only
- Causes mild illness

(1): يكون بدولة
(2): يكون بقارة كاملة أو أكثر من دولة بنفس القارة حول العالم

Reassortment



الفايروسات اللي تصيب الإنسان فقط ما تقدر تصيب الطيور والعكس صح H2 Receptors والحيوانات لأن ما عندها الفايروسات اللي بس تصيب الطيور والحيوانات ما تقدر بس H3 Receptors تصيب الإنسان لأن الإنسان ما عنده الخنزير حاله خاصه لأن عنده كل الريسبتورز ويقدر يستقبل كل أنواع الفايروسات. فلما يصاب الخنزير بفايروس من انسان ومن طير او حيوان راح يجمعهم سوا ويغير بالجينات حقتهم بحيث راحي يطلع بالنهايه فايروس جديد ويصاب فيه الانسان والحيوانات والطيور

This process called Genetic Reassortment or Antigenic Shift (the change will mainly be in the Hemagglutinin)

Influenza Virus

- Divided into subtypes based on the haemagglutinin and neuraminidase proteins.
- The currently circulating strains are: H1N1 & H3N2.

*Incubation Period

Pathogenesis	Transmision	I.P*	Symptoms	Prognosis
The virus infects the epithelial cells of the nose, throat, bronchi and occasionally the lungs.	Inhalation of infectious aerosol droplets.	1-4 days	Fever, malaise, headache, cough, chills, sore throat, and generalized pain.	Usually self-limiting disease.

Complication	Lab diagnosis	Other Detection Methods	Treatment
❖ Primary influenza pneumonia ❖ Secondary bacterial pneumonia ❖ Reye's syndrome (fatty degeneration of CNS and Liver by use of Aspirin (never use aspirin during influenza!)	routine testing by Direct detection of Influenza A or B virus from sputum, nasopharyngeal swab aspirate (NPA)* or respiratory secretion by direct immunofluorecent assay (IFA).	Cell culture & PCR ***Golden specimen for detection of influenza or any viral respiratory infection**	❖ Amantadine is effective against influenza A virus only. ❖ Rimantadine, Oseltamivir (Tamiflu) or Zanamivir (Relenza) are effective against both influenza A & B viruses and can be used as <u>treatment and prophylaxis.</u>

Influenza Virus

Prevention

Influenza vaccine: Two types of vaccines available:

1. The flu **shot** vaccine: Inactivated (killed vaccine) Given to people older than 6-months, including healthy people and those with chronic medical conditions.
2. The nasal **spray** flu vaccine (Flumist): Live attenuated vaccine Approved for use in healthy people between 5-49 years of age. (the patient has to be normal with no disease)

Both vaccines contain two strains of the current circulating influenza A virus and the current circulating strain of influenza B virus.

Vaccine should be given in October or November, before the influenza season begins.

Avian flu (bird flu)

Family

Typical orthomyxovirus.

Epidemiology

Wild birds are the natural reservoir for the virus. They shed the virus in saliva, nasal secretion and feces.

Features

- All domestic poultry are susceptible to infection.
- They become infected, when they eat food contaminated with secretion or excretion from infected bird.
- Avian influenza viruses do **not** usually infect human.
- High risk group includes those who working in poultry farms and those who are in close contact with poultry.

Viral Etiology

Avian influenza type A virus (H5N1).

Symptoms in human:

- Ranges from typical flu to severe acute respiratory disease.
- Diarrhea, abdominal pain and bleeding from the nose have been reported.

Lab diagnosis

PCR, detection of the viral RNA in throat swab.

Treatment

- Should be initiated within 48 hours.
- Oseltamivir and Zanamivir are used.

Parainfluenza Virus

Family	Structural features:	Transmission:
Paramyxoviridae.	Enveloped virus with - polarity ssRNA genome, with 5 serotypes.	Inhalation of infectious aerosol, droplets mainly in winter.

Clinical syndrome: VERY IMPORTANT!

a. Croup or acute laryngotracheobronchitis. PIV Type-I, II affect mainly in infants and young children. Fever, harsh cough, difficult inspiration can lead to airway obstruction which may require hospitalization and tracheostomy.	b. Bronchiolitis and Pneumonia: PIV Type-III in young children.

Croup can either be Viral or Bacterial.
Viral is Parainfluenza type I and II.
Bacterial is H. influenza.
How can we differentiate? We do CPC and if there is a) high number of Lymphocyte → viral croup
b) high number of Polymorph → bacterial croup

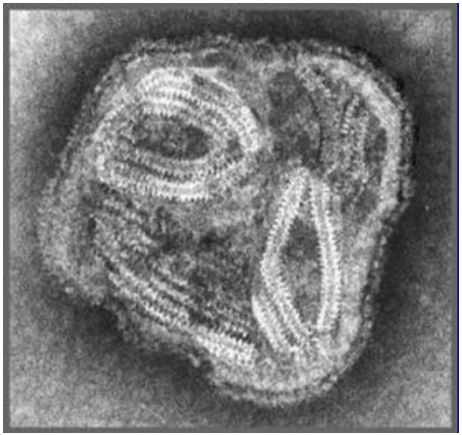
Parainfluenza Virus

Lab diagnosis: routine testing by

-Direct detection of the virus from sputum -
-Nasopharyngeal swab, aspirate (NPA)
-Respiratory secretion by direct immunoflourecent assay (IFA).

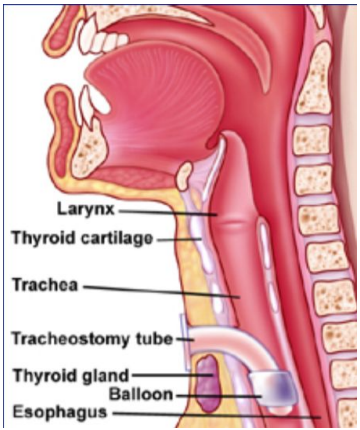
Other detection methods:

Tissue culture, PCR.



Treatment and prevention:

Supportive treatment, No specific treatment or vaccine available.



Respiratory Syncytial Virus (RSV) & Human Metapneumovirus

Family:	Structural features:	Transmission:
Paramyxoviridae	Enveloped virus with - polarity single stranded RNA genome.	Inhalation of infectious aerosols mainly in winter.

Clinical syndrome: VERY IMPORTANT!

a. Bronchiolitis: Life-threatening disease in infant especially under 6 month of life with respiratory distress and cyanosis (البيبي راح يبدأ لونه يزرق عشان ما فيه اوكسجين كفايه) can be fatal and can lead to chronic lung disease in later life.

b. Pneumonia: can also be fatal in infant.

Respiratory Syncytial Virus (RSV) & Human Metapneumovirus

Lab diagnosis: routine testing by

- Direct detection of the virus from sputum, nasopharyngeal swab, aspirate (NPA) or respiratory secretion by direct immunofluorescence assay (IFA).

Other detection methods:

Isolated of virus by cell culture from N.P.A with multinucleated giant cell or syncytia as cytopathic effect (C.P.E); PCR.

Treatment and prevention:

Ribavirin administered by inhalation for infants with severe condition.

Vaccine:

No vaccine available, but passive immunization

immunoglobulin can be given for infected premature infants.

Measles Virus(1) VERY IMPORTANT!

Family:

Paramyxoviridae

Structural features:

Enveloped virus with (negative polarity , ss-RNA) genome.

Transmission:

Inhalation of infectious aerosol droplets

Epidemiology:

- Infects human only.
- Most cases in preschool children.
- Very infectious, infection occur mainly in winter and spring

pathogenesis:

➔ The virus infects first epithetical cells of upper respiratory tract.

➔ then spread to the blood causing viremia(2) and infect the endothelial cells of the blood vessels.

➔ The virus reaches the lymphoid tissue where it replicates further and disseminates the skin causing maculopapular rash(3).

1- فيروس الحصبة
2- virus in bloodstream.
3-flat, red area on the skin that is covered with small confluent bumps.

Measles Virus

Clinical features:

- Incubation period: 7-14 days.
- Prodromal symptom: fever, cough, conjunctivitis and running nose.
- Koplik's spot: small red papules with white central dots appear mostly in buccal mucosa(1).
- Rash:
  - Maculopapular rash first on face, trunk then the extremities.
  - The rash is red, become confluent(2), last for 4 or 5 days.
  - Then disappears leaving brownish discoloration of the skin and final desquamation(3).
- Recovery complete in normal children with life long immunity.
- Complication also can occur. (next slide)

Koplik's spot

Measles

1- refers to the inside lining of the cheeks and floor of the mouth.
2- flowing together or merging
3- التقشير

Measles Virus

Complication:

1- Encephalitis(1): Acute or subacute sclerosing panencephalitis (SSPE).

2- Giant cell pneumonia(2): rare, affects immunocompromised children(3) due to direct invasion of measles virus to the lung tissue.

Lab diagnosis:

- Serology(4) by detection of IgM antibodies using ELISA(5)
- In case of SSPE detection of measles antibodies in CSF(6) or detection of viral RNA using PCR

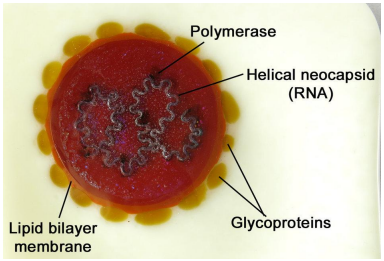
Treatment and prevention:

- No specific treatment
- Prevention by giving live attenuated vaccine (MMR) for Measles, Mumps and Rubella (given to children 15 month and booster dose at school entry) give excellent long last protection.

1-Inflammation of the brain.
2-The lung tissue shows multinucleated giant cells lining the alveoli.
3-Suffering from leukemia, HIV or AIDS.
4-the scientific study or diagnostic examination of blood serum.
5- enzyme-linked immunosorbent assay.
6-Cerebrospinal fluid.

Mumps Virus

Mumps: is an acute benign viral **parotitis.**



Parotitis:

- (painful inflammation and swelling of salivary gland and mainly parotid glands)
- disease of children (5-15 years)
- but also can be seen in young adult with more complicated feature.

Family	Structural Features	Transmission	Epidemiology
Paramyxoviridae	❖ Enveloped virus with - polarity ss-RNA Genome. ❖ The viral envelope is covered with two glycoprotein spikes, hemagglutinin and neuraminidase.	Inhalation of infectious aerosol droplets during sneezing and coughing, direct contact with saliva.	❖ Mumps virus infects human only. ❖ Highly infectious, peak in winter. ❖ Long incubation period 18-21 days.

Mumps Virus

Pathogenesis | **Clinical Features** | **Complications** | Lab Diagnosis | Treatment & prevention

Infection **started** in the epithelial cells of upper respiratory tract, **then** virus spread by viremia to **parotid gland** mainly and to other organs as: **testes, ovaries, pancreas and CNS.**

- Classic mumps starts with moderate fever, malaise, pain on chewing or swallowing, particularly acidic liquids.
- Sudden onset of fever and painful swelling of parotid gland.
- Self-limiting disease resolve within one week.
- Solid and long life immunity developed.

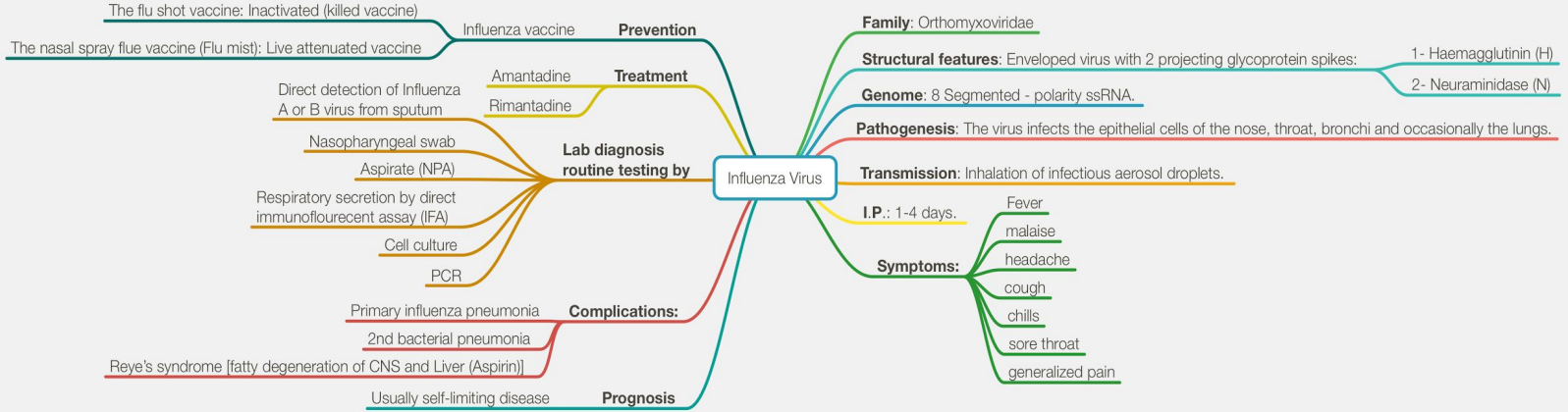
Aseptic meningitis, Encephalitis, Pancreatitis, Thyroiditis.
After puberty:

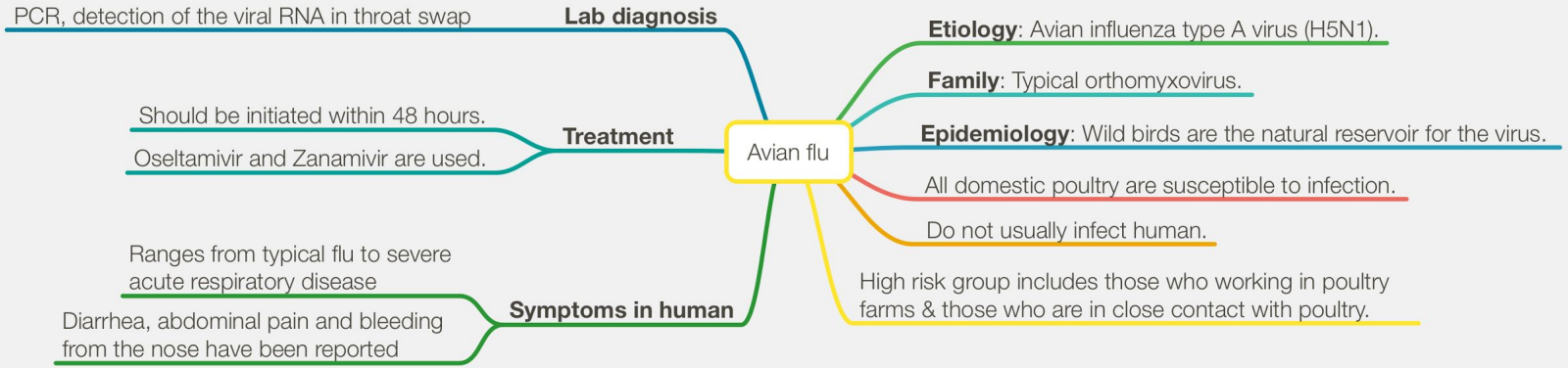
Orchitis: inflammation of one or both testicles. usually unilateral, rarely leads to sterility.

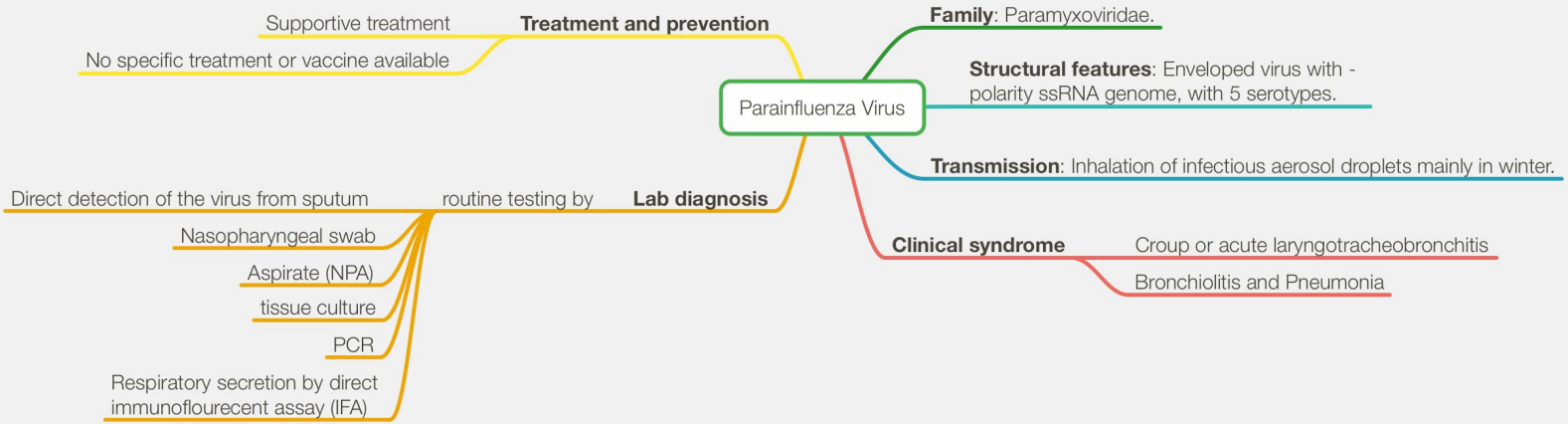
Oophoritis: inflammation of ovaries.

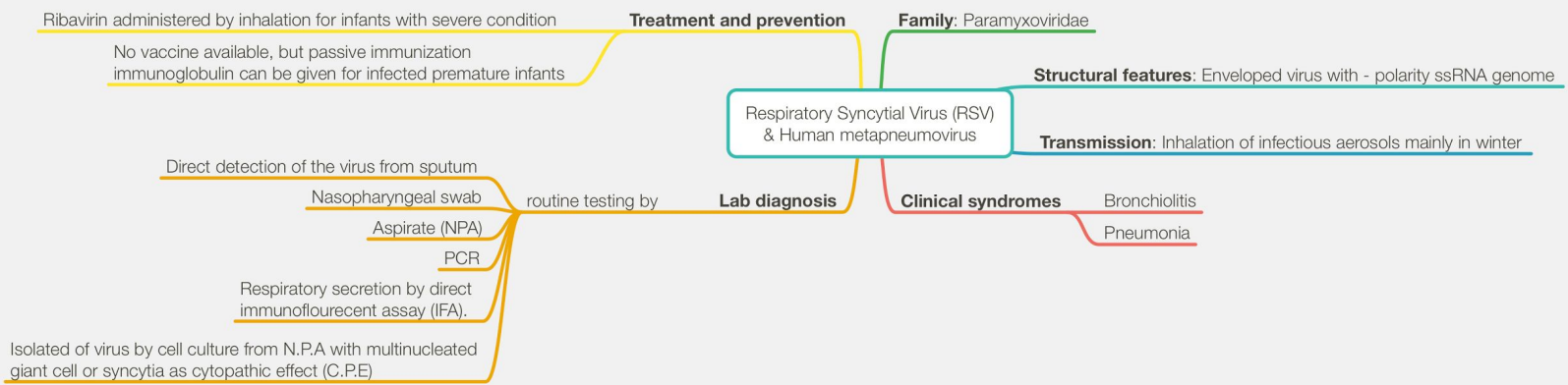
Serology by detection of IgMAb using ELISA, cell culture and isolation of the virus from saliva or detection of viral NA using PCR.

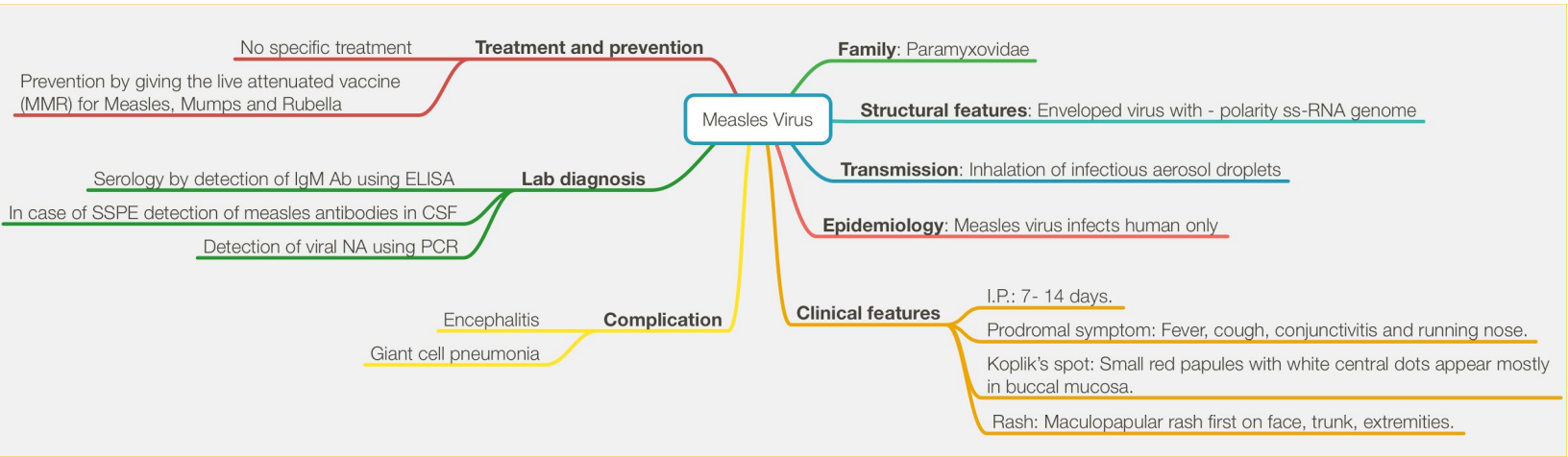
- No specific antiviral treatment.
- MMR: Live attenuated vaccine for Measles, Mumps and Rubella given to all children 15 month and booster dose at school entry. Give excellent long last protection.

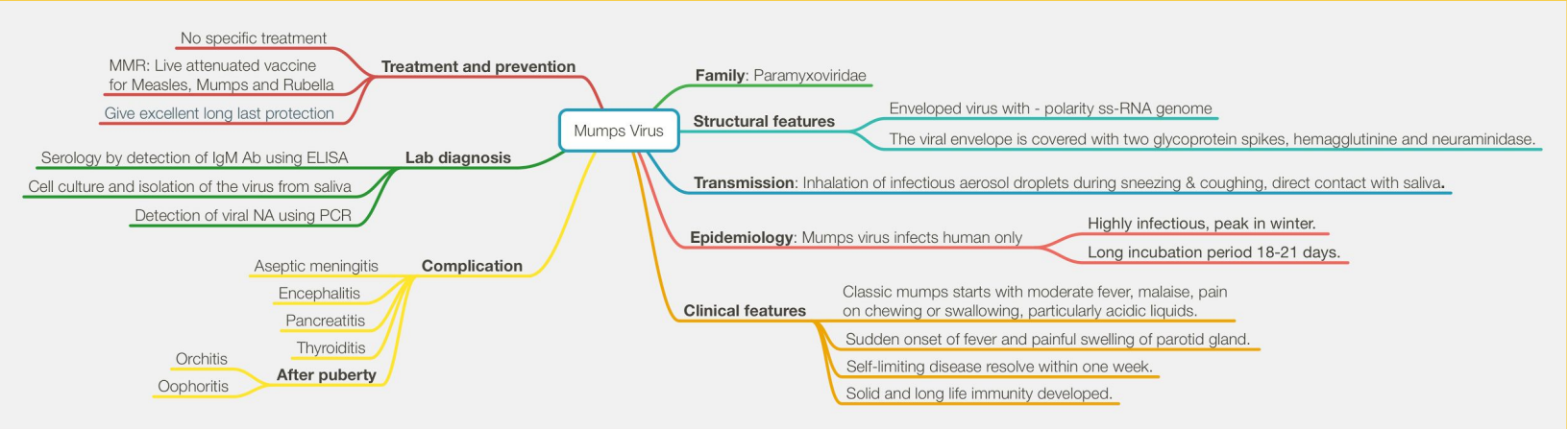

Influenza Virus
Prevention
Influenza vaccine
The flu shot vaccine: Inactivated (killed vaccine)
The nasal spray flue vaccine (Flu mist): Live attenuated vaccine
Treatment
Amantadine
Rimantadine
Lab diagnosis routine testing by
Direct detection of Influenza A or B virus from sputum
Nasopharyngeal swab
Aspirate (NPA)
Respiratory secretion by direct immunoflourecent assay (IFA)
Cell culture
PCR
Complications:
Primary influenza pneumonia
2nd bacterial pneumonia
Reye's syndrome [fatty degeneration of CNS and Liver (Aspirin)]
Prognosis
Usually self-limiting disease
Family: Orthomyxoviridae
Structural features: Enveloped virus with 2 projecting glycoprotein spikes:
1- Haemagglutinin (H)
2- Neuraminidase (N)
Genome: 8 Segmented - polarity ssRNA.
Pathogenesis: The virus infects the epithelial cells of the nose, throat, bronchi and occasionally the lungs.
Transmission: Inhalation of infectious aerosol droplets.
I.P.: 1-4 days.
Symptoms:
Fever
malaise
headache
cough
chills
sore throat
generalized pain


Avian flu
Lab diagnosis
PCR, detection of the viral RNA in throat swap
Treatment
Should be initiated within 48 hours.
Oseltamivir and Zanamivir are used.
Symptoms in human
Ranges from typical flu to severe acute respiratory disease
Diarrhea, abdominal pain and bleeding from the nose have been reported
Etiology: Avian influenza type A virus (H5N1).
Family: Typical orthomyxovirus.
Epidemiology: Wild birds are the natural reservoir for the virus.
All domestic poultry are susceptible to infection.
Do not usually infect human.
High risk group includes those who working in poultry farms & those who are in close contact with poultry.


Parainfluenza Virus
Family: Paramyxoviridae.
Structural features: Enveloped virus with - polarity ssRNA genome, with 5 serotypes.
Transmission: Inhalation of infectious aerosol droplets mainly in winter.
Clinical syndrome
Croup or acute laryngotracheobronchitis
Bronchiolitis and Pneumonia
Lab diagnosis
routine testing by
Direct detection of the virus from sputum
Nasopharyngeal swab
Aspirate (NPA)
tissue culture
PCR
Respiratory secretion by direct immunoflourecent assay (IFA)
Treatment and prevention
Supportive treatment
No specific treatment or vaccine available


Respiratory Syncytial Virus (RSV) & Human metapneumovirus
Family: Paramyxoviridae
Structural features: Enveloped virus with - polarity ssRNA genome
Transmission: Inhalation of infectious aerosols mainly in winter
Clinical syndromes
Bronchiolitis
Pneumonia
Lab diagnosis
routine testing by
Direct detection of the virus from sputum
Nasopharyngeal swab
Aspirate (NPA)
PCR
Respiratory secretion by direct immunoflourecent assay (IFA).
Isolated of virus by cell culture from N.P.A with multinucleated giant cell or syncytia as cytopathic effect (C.P.E)
Treatment and prevention
Ribavirin administered by inhalation for infants with severe condition
No vaccine available, but passive immunization immunoglobulin can be given for infected premature infants


Measles Virus
Family: Paramyxovidae
Structural features: Enveloped virus with - polarity ss-RNA genome
Transmission: Inhalation of infectious aerosol droplets
Epidemiology: Measles virus infects human only
Clinical features
I.P.: 7- 14 days.
Prodromal symptom: Fever, cough, conjunctivitis and running nose.
Koplik's spot: Small red papules with white central dots appear mostly in buccal mucosa.
Rash: Maculopapular rash first on face, trunk, extremities.
Complication
Encephalitis
Giant cell pneumonia
Lab diagnosis
Serology by detection of IgM Ab using ELISA
In case of SSPE detection of measles antibodies in CSF
Detection of viral NA using PCR
Treatment and prevention
No specific treatment
Prevention by giving the live attenuated vaccine (MMR) for Measles, Mumps and Rubella


Mumps Virus
Family: Paramyxoviridae
Structural features
Enveloped virus with - polarity ss-RNA genome
The viral envelope is covered with two glycoprotein spikes, hemagglutinine and neuraminidase.
Transmission: Inhalation of infectious aerosol droplets during sneezing & coughing, direct contact with saliva.
Epidemiology: Mumps virus infects human only
Highly infectious, peak in winter.
Long incubation period 18-21 days.
Clinical features
Classic mumps starts with moderate fever, malaise, pain on chewing or swallowing, particularly acidic liquids.
Sudden onset of fever and painful swelling of parotid gland.
Self-limiting disease resolve within one week.
Solid and long life immunity developed.
Complication
Aseptic meningitis
Encephalitis
Pancreatitis
Thyroiditis
After puberty
Orchitis
Oophoritis
Lab diagnosis
Serology by detection of IgM Ab using ELISA
Cell culture and isolation of the virus from saliva
Detection of viral NA using PCR
Treatment and prevention
No specific treatment
MMR: Live attenuated vaccine for Measles, Mumps and Rubella
Give excellent long last protection

Quiz

1- Which of the following types of influenza virus infects animal and human?

A. Type A
B. Type B
C. Type C

2- Amantadine is effective treatment against

A. Influenza A & B viruses
B. Influenza A virus only
C. Influenza B virus only

3- The correct family of Avian flu is :

A. Orthomyxoviridae
B. Typical Orthomyxovirus
C. Paramyxoviridae

4- Croup or acute laryngotracheobronchitis is a clinical syndrome of

A. Avian flu
B. Influenza virus
C. Parainfluenza virus

5- The correct family of RSV virus is :

A. Orthomyxoviridae
B. Paramyxovirus
C. Paramyxoviridae

6- A painful inflammation and swelling of salivary gland and mainly parotid glands

A. Mumps
B. Parotitis
C. Orchitis

SAQs

1. List four examples of viruses from Paramyxoviridae family.

2. What are Orchitis & Oophoritis, and when they happen?

3. Name two types of influenza vaccines.

4. What is the etiology of avian flu?

ANSWERS

- Q1. Parainfluenza virus, RSV virus, Measels and Mumps Viruses.
- Q2. Orchitis is an inflammation of one or both testicles, Oophoritis is an inflammation of ovaries, after puberty.
- Q3. The flu shot vaccine, the nasal spray flu vaccine (flu mis).
- Q4. Avian influenza type A virus (H5N1).

ANSWERS

1. A
2. B
3. B
4. C
5. C
6. B

Team Leaders

Alanoud Almansour & Omar Alsuhaibani

Team Members

Alanoud Alessa
Alhanouf Jaloud
Dana Alrasheed
Hadeel Awartani
Khulood Alwehaibi
Nada Alobaid
Norah Alkadi
Noura Alothaim
Rahaf AlShammari
Reema Aldihan
Reema AlEnezy
Sara Alsultan
Shouq Alqahtani

Adel Alsuhaibani
Saad Alhaddab
Khaled Aldosari
Abdurhman Alhayssoni
Saif Almeshari
Mohammed Almohaimeed
Abdulhakim Alonaiq
Sulaiman Alzomia
Anas Alsaif
Mohammad Alasqah
Hussien Alami
Khaled Aloqeely
Saad Alfouzan
Mohammed Aldwaghri

Please contact us if you have any suggestion, correction, or question:
Microbiology.med437@gmail.com

Special thanks to:
Reem Alqahtani