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In relation to influenza virus as you see in the previous picture the genome is composed of 8 RNA segments and two specific antigenic glycolproteins structures which are hemagglutinin and neuraminidase in addition to a lipid bilayer, M1 and M2 which contribute in the attachment of the virus and enhance virus invasion and multiplication etc.

Now in relation to antigenic subtypes, the antigenic part the virus -which is the envelope and its NA and HA- we have 15 HA and 9 NA. Both NA and HA contribute in the virus attachment to the ciliated epithelial cells of respiratory tract mucosa, HA produces a bond and NA breaks this bond (one attach and the other release) this relationship is in order HA not to fixate or attach firmly to the cell receptors and this will prevent the genome of the virus to enter the cell later because of the bond here, Therefore NA cut part of this bond allowing a second bond to induce mechanism of invasion the cell to develop necessary DNA for transcription and translation inside the infected cell etc.

As we said in previous lec we have 3 major types of influenza virus: A,B,C

A often with B are responsible for the outbreak of influenza, Not necessary together. The majority is caused by A and less by B but sometimes it's caused by both A and B together.

B is only associated with humans while A is associated with humans, water birds and pigs commonly. The importance of this in relation to birds is A is the most dangerous and susceptible to mutation which lead to multiple subtypes of H1N1 viruses, this happens in birds more than humans.

We have two types of genetic mutations:

* **Antigenic Drift:** mild change nucleotide sequence of the RNA, but this change isn't big and not associated with developing new types instead it develop subtypes for example: H1N1 become H1aN1 which means a slight mutation in the antigenic structure which result eventually a change in the structure of hemagglutinin "receptors" which will change the immune response of the infected host. Because this mutation result a new hemagglutinin and our humeral immune system specially Igs won't recognise it in the same efficiency, it result in decreased recognition by the immune system.
* **Antigenic shift:** more serious mutation, associated with re-assortment of the RNA segments, which means the larger segments of RNA will be separated and combined with other RNA segments from the same strain or clone " I checked online from different resources and it says that antigenic shift is the process by which two or more different strains of a virus, or strains of two or more different viruses, combine to form a new subtype having a mixture of the surface antigens of the two or more original strains"

And this mutation will result in a change in the main structure of H and N and as an example converted from H1N1 to H2N2 or H2N1. And our body won't be immuned against this mutated subtype of influenza, and that's why each year we'll be susceptible to new infections and need to retake vaccinations against influenza virus.

So basically antigenic drift is a slight mutation while antigenic shift is more serious result in developing new types of influenza.

Pandemic Outbreaks Influenza A:

* First outbreak in 1918, its classification is H1N1.. Swine-like Spanish Influenza ( Killed 20-40 millions)..mostly in Europe countries
* 1957-H2N2 (caused by an antigenic shift) Asia –Influenza..Few millions deaths, World-wide .. Recorded in Jordan & Arab countries.
* 1968-H3N2 (antigenic shift) Hong Kong influenza..1-2 millions, World-wide

 And so on, this outbreaks are always associated with a genetic mutation of RNA segments resulting in new types of the virus. Influenza segmented RNA plays an important role in its many mutations – unlike most viruses as we will see later have a single strand of RNA which makes them more stable and less susceptible to mutations.

* 1997: Outbreak Avian Influenza strain in Jordan and many other countries, and this in fact is due to a change not from a human host but in aqua birds specially Ducks and Chickens which will cause a mutation between different strains and result in a new clone or strain ( as H7N2, H7N7, H9N2 and so on)

This outbreak has started from China and only related to chicken later it transmitted to humans to eventually can transmit from one human to another, at first they said its only one way infection ( from chicken to chicken or to human ) but later has been proven that the infection can spread from a human to human.

Suddenly this strain disappeared and since then this strain has not developed.

There are 300 virus in the world recorded for producing influenza in humans , chickens ,aqua birds etc. By central offices in Copenhagen Denmark to identify the types of influenza circulating the world each year for two reasons:

* To study the immunology of the virus spread in humans
* To collect certain smears to the pharmaceutical industrial companies to produce a vaccine, and each year we produce a new vaccine in case of any change in the H or N of the virus

And this usually should be available at the end of September each year because from October till November its recommended to take this vaccine specially if this person is susceptible for developing severe influenza – has an underlying disease, immunosuppressed conditions etc.

**Virus B & C Influenza**

* Influenza virus-B: Infect Only human. Less common than type A and rarely associated with severe forms of influenza alone. But when associated with A might lead to a severe form of influenza. Rarely undergoes mutation
* Influenza virus C:Found mostly in animal but might under certain conditions produce infection in humans and produce mild form of influenza

\*\* Type A is the most important in producing severe type of clinical influenza

Recently in April 2009 there was an outbreak of new influenza virus, at the beginning they thought it's the classical type H1N1 which has been recorded in 1918 " the first one which killed a huge number of ppl" but after that they found that they are not very similar there is some changes but these changes are not a change of the type like from H1N1 to H2N1 or something like that, the change caused only a subtype. Started in swine in new Mexico killed a huge no. Of animals then transmitted to humans who were in contact with these infected animals and within 6 months the virus has spread over the world. Mortality at first was very high and gradually the virus became less dangerous, Maybe related to an immunological change in the part associated with the production of glycoprotein H and N

* Influenza virus love to live in cold environments, in a temperature less than 30c, and can be stable at lower temp. Between 0-4C. It can survive in respiratory droplets " which are released during sneezing " for few hours , if there was an organic material on epithelial cells it can survive for 2 hours also in our clothing if it was contaminated with organic compounds , in the saliva it might survive up to 24 hrs

Here you have to keep in mind that during acute infection you can easily recognise an infected individual with influenza but after atleast one week after recovery "with no clinical symptoms" still the virus in available in the respiratory mucosa and saliva, that means he is still infectious to others.

**Complications:**

* It can be recognised easily with a patient with any underlying disease specially including the lung. Like fibrosis, malignancy ,bronchitis , immune-suppressed conditions. In all previous situations the patient is susceptible for the infection because the cell mediated immunity is too weak and not easily develop Ab.
* It can be associated with bacterial pneumonia due to the presence of endogenous streptococcus or staph etc specially in children
* In elders associated with Myocarditis, Encephalomyelitis..

**Immunity** :

Immunity following a natural infection " cell mediated and humoral Ab (IgA & IgG), IgA is more important in relation to the mucosa due it prevents the attachment of the virus to the mucosa and by that prevent the infection. In addition cell mediated immunity enhance the production of Cytotoxic killer & T-cells, Interferons

In relation to immunity any natural infected person will be protected from 6 months minimum up to 1 year maximum. So, In the next year if there is a new type of influenza he might be infected like from H1N1 to H2N2 to H3…etc.

**Influenza Vaccine**:

Note: The doctor has been taking the influenza vaccine for 10 years and he can assure that it is protecting him.

When you take influenza vaccine you will develop mild form of influenza then you will be protected.

Influenza Vaccine compose of 2 important components only:

1. HA antigen

2. NA antigen

HA antigen is more important than NA antigen.

Recommendation for taking influenza vaccine:

The recommendation has changed, it was for people older than 60 years old and then they make it for people above 50 years old. Now, it can be given at any age above 6 weeks.

Influenza vaccine can be given to any person with underlying disease or any person with suppressed immunity.

Nowadays they developed a more effective type vaccine type, this type vaccine is 100% safe, and can be used for any person who might experienced severe influenza in the past.

Its' protection is not 100% but between (80-90%), but still once you are vaccinated you will develop a mild form of influenza.

Note: Swine flu originated exactly like other kind of influenza, but it was first discovered in swines that's why it is called swine flu. Then found it can infect humans and It is a very similar in antigenic structure (shift).

Note: There is a difference between a shift and a drift.

Shift: There is a slight change in the sequence of the RNA.

Drift: More mutation, more change in the sequence of the RNA.

(note : in the slides it is written the opposite I don’t know which is correct ).

In mutations there will be separation of nucleotide and then recombination, and If there was a change  in the code after recombination that will result in a more major mutation.

The virus can stay circulating in the world for around 10 years.

Generally if there is a new influenza type in the world it will not be associated with a more severe type of influenza to humans, because we will have certain limit of immunity against this type and our body will manage to produce immunity against this one (by producing antibodies), but our body will suffer from a mild form of influenza.

Any change in RNA lead to a change in glycoproteins. glycoproteins which are composed of HA and NA. The change first will occur in the genome then in the antigenic structure.

Other ways that help you prevent influenza:

-It is important to wear surgical masks when dealing with patient with influenza specially in dental practice.

-Use disposable tissue paper.

-It is important to wash your hands this prevents 80% of the diseased tissue.

**Paramyxovirus**:

Paramyxovirus is similar to orthomyxovirus which is classical .

Exactly similar to influenza virus in respect to route of infection( the same ) usually starts in the upper respiratory tract .

The change is important in relation of what we see with the gene , meaning in influenza virus we don’t have the A segment (a small segment of RNA in the genome ) also in paramyxovirus we have single multi folded RNA in a single piece not in 8 pieces , this means it’s a more stable RNA , and it cant easily mutate .

There is something different in relation to the spikes ,on the same spike we have hemagglutinin and NA , some have hemolysin and others might have a special protein .

Whereas in influenza virus we have each (hemagglutinin and NA) on a separated spike .

We have a special canal spike carry F (stands for fusion ) this allow the virus to easily fuse into the cell membrane of the infected mucosal cells , it allows the virus to release the receptor and enter into the cytoplasm and produce infection .

In general nucleocapsid is larger in comparison to influenza virus .

It contains polymerase which can also be found in influenza virus .

Concerning replication with the release of virus , its similar to influenza virus, replication is done in cytoplasm (in both) , complete virus of influenza is followed in the nucleus and later released from the nucleus whereas in paramyxovirus release is by the body (meaning cell membrane of cells )which means the cell will not be damaged .

All paramyxovirus in relation to influenza virus are less stable , they might die in the environment more easily than the influenza virus. But it can survive some medias and be a source of infection .

Also similar to influenza in relation to detergent, soap, disinfectant which kills both .

We have 3 types of viruses each are very similar in structure but cause different types of diseases (pathology) . 1- Influenza virus 2- mumps virus 3-newcastle disease virus .

-Newcastle disease virus has been discovered to affect poultry, produce exactly like human ?????????? (41:10-41:34)(I couldn’t hear it sorry ) very dangerous

Whereas influenza virus and mumps virus are related only to humans cant cause infection in any type of poultry or animals .

**Parainfluenza virus:**

contaminate different groups , produce infection related to influenza but generally considered minor , not associated with complications , not associated with more stability like influenza viruses , we have 4sertypes , serotype num 3 is responsible for the majority of infection in human .

They are common all over the area , its not related only to winter , it can be in summer , winter ,spring…..all seasons .

In general it causes mild influenza like disease.

Its not related to a group of people (all ages) children are more susceptible than adults but adults can also be infected and its occupation is 1-7 days, takes a longer time in comparison to influenza which is 1-3 days (occupation period) this may alarm our body to develop a form of general antibody .