Host-Pathogen Interaction (Immunology)

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Lecture – 1
History of Immunology - 1

Hi. So, I am Professor Himanshu Kumar and I work in Indian Institute of Science Education and Research Bhopal and my work focus on infectious diseases. So, we mainly work with various kind of RNA viruses. We do work with some DNA viruses and I teach Immunology as a as a main subject and besides this I also talk some part of a viral immunology and we basically work on various aspects of antiviral mechanism which is existing in our body.

So, I am going to talk about this whole course you can see the name it is a host pathogen interaction and Immunology. So, in this course we will first study various aspects of Immunology basic immunology which is very much needed in order to learn the host pathogen interaction. In fact, I will take you in quite great detail about various topics in Immunology and broadly~~probably~~ we will study the various aspects of Immunology which includes we will talk about some unique properties of Immunology.

We will take up various immune organ, immune cells and the mediators which is integrating the immunity and then we will categorically study the natural immunity which also we call it as a innate immunity and then we will study adaptive immunity. And after this, we will take the various topic like host pathogen interaction like virus and host interaction and we will take some model viruses which is quite common.

And we will study in great detail about those virus and viral diseases, we will look at lot of molecular aspects and then we will take the some bacterial diseases, we will take few parasite diseases and in that way we will finish the course. I hope you will enjoy this journey with me and you will learn a lot about your own defence system which is very important not only for or against infectious diseases.

But it is playing very important role in our all those diseases which is caused by some or other problem in our body, intrinsic problems. So, let us begin with history of immunology

and history of Immunology it has a very long history and if you are interested in history probably you may know that there was, in past there was various plagues and few plagues are very well known which cause massive death around the world.

And now I think you are the best person who can understand the meaning of pandemic in which we are still going on right. So, this pandemic, the SARS Covid-2 pandemic that affected whole world right many people died. But we should thank the immunologists or virologist who has created the vaccine in quite short time and we all get vaccinated and we all are protected against this virus.

A quite good amount of protection, we have but generally this vaccine discovery and vaccine creation and vaccine a~~A~~dministration this takes a decade time but due to the knowledge of science we are able to do it. You will see all these things in my today's session that how the vaccine and Immunology both get evolved.

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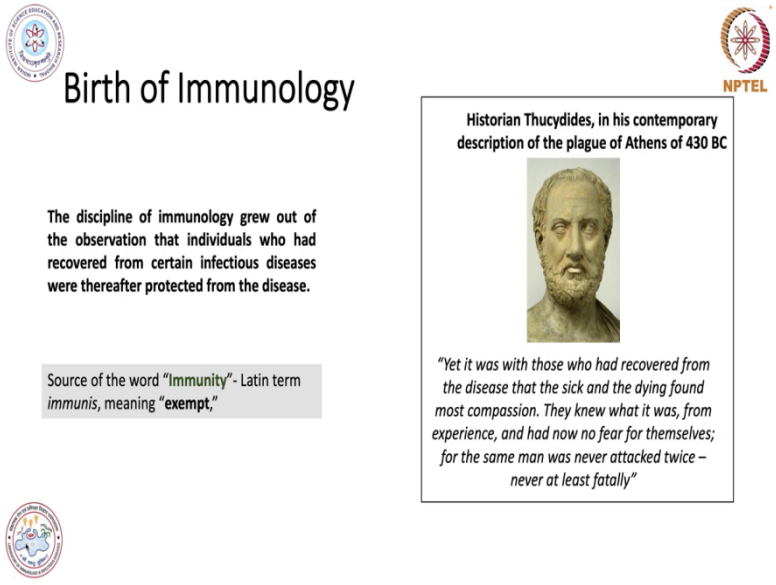

So, let us begin, so there is a one historian his name is ~~Cutesius~~Thucydides and he basically gave this kind of ~~uh~~ observation or concept. And he was a person who basically tell that there is a ~~-~~some kind of defence. As you can see in this slide the discipline of Immunology grew out of the observation that individuals who had recovered from certain infectious diseases were thereafter protected from the disease.

So, overall the concept is that in past also there were outbreaks and these outbreaks were quite dangerous and when these outbreaks happened then some people survive from these

outbreaks. And all those individuals who survived from this outbreak whatever infection is there. So, they developed some kind of protection and at least when they get next time infected it was not so, fatal at least it is not taking their life.

So, that concept was or that observation was made and this observation we call it as a Immunology or immunity there is a word immunity. Basically, the immunity word is a Latin word and it is a Latin word immunis and the meaning is exempt. So, from there this Immunology word basically kind of started Immunology is basically studying the defence system.

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So, from where it all began it is basically begin quite early if you if you see this is slight there was a huge a pandemic at that time people used to call it as a plague. There are several kinds of plague. Plague is the one kind of situation or symptom or disease which is taking the life of individual. So, this was started with a small box, a small pox disease in Hindi we call it as a **(chechak~~FL~~)** right and it is also known as variola.

And so, the the evidences for this disease we still it is lying in the faces of mummies which is buried between 1570 to 1085 BCE. So, at that time there was a massive death about from this smallpox about four lakh lives per year was lost in Europe. So, I will tell more detail or more history of this smallpox and how we overcome the a small box. But before that just I want to give a glimpse about this smallpox disease in light of current knowledge and just a little information. So, that you will develop an interest and then you will you will go through the history.

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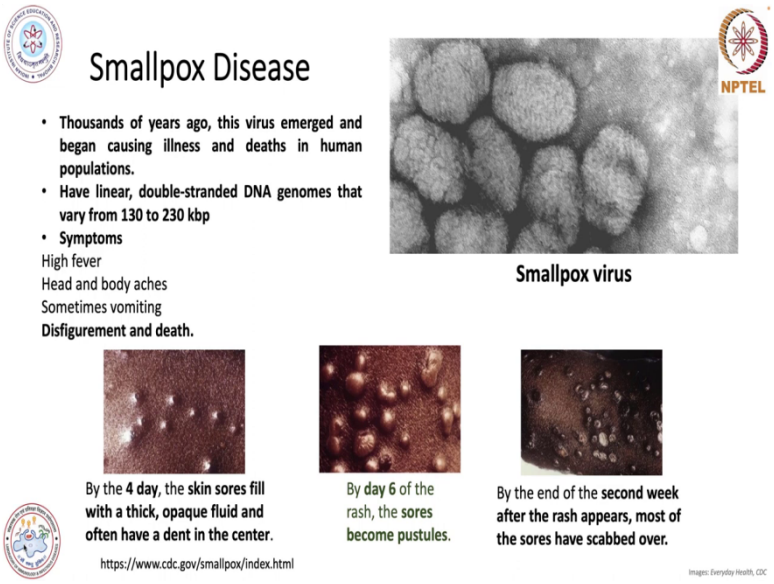

So, a smallpox is a disease which is here you can see that it is a thousands of year ago this disease was started and the virus emerged from emerged and beginning cause illness and death in human population. So, it was emerged and it caused so, many death this widest in current scenario you can understand these words. This virus has a linear double stranded DNA genome it is a DNA virus.

And that the size of genome varies from 130 to 230 kilobase pair and this virus cause it is a highly infectious virus we call it as a contagious. And this virus basically cause~~occurs~~ variety of symptoms such as high fever, head and body pain sometime it occurs vomiting and in worse scenario this cause disfigurement. And here you can see and this is the virus which is this is electron micrograph of a small pox virus.

So, when this virus in fact the incubation time means at the time of infection to the development of first symptom it basically varies from Individual to individual and in general it is 10 to 20 days it depends on the end user. The first symptom will appear maybe after 10 days or maybe around 15 to 20 days and after that so, after 20 days say after four days here four days means 24th day the skin sores~~urce~~ will appear on the on the skin and this sores~~source~~ will be filled with thick opaque fluid and often have a dent in center.

And by day six, I mean 26 day of this rash the sores~~source~~ become a pustules~~asture~~ you can see the there is a big pustules~~pestules~~ in Hindi we can we can understand like a **(Fafola~~FL~~).** And then this the symptom will go very deep and very complicated and then by end of

second week second week means after 14 days I mean around 20 plus 14 after 34 days the rash appear and most of the soressource have scabbed over.

So, this pustule will dry up or it will come out and this is smallpox, of course it is affecting various important organ beside this make the skin very bad if you Google the images for a smallpox patient. So, then you can find out that there is a it makes the skin very bad and it mainly affect face hand and other parts of the body but the main target is hand and face. And once the individual is having this smallpox his or her face will be look very not so good. So, this is a just a brief introduction about the small pox disease.

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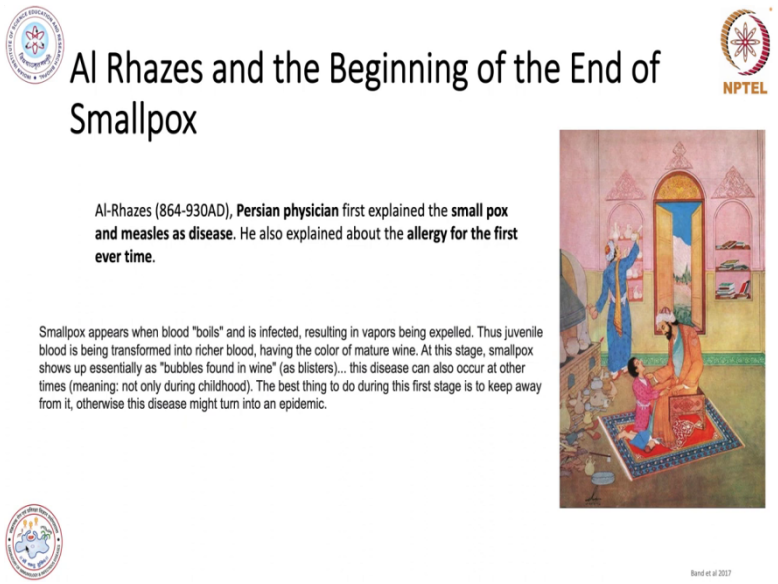

Now we will move on how this smallpox disease was there but how this there was a beginning of the end of a small box. So, this was a initiated by Al-Razzi please note that before this his concept before the concept of Al-Razzi the people who are thinking that this is a some kind of curse from the God. Those who are developing this disease and then it is spreading like anything because it is a highly contagious.

So, it is basically a god wishes or God curse to the people because there must be something wrong and people were not thinking about other than this. So, after the work of Al-Razzi the people list he is a basically a Persian physician and first explained the small pox and measles it is a disease it is not some kind of curse. He also explained about the allergy for first ever time and he was about a smallpox he said that a smallpox appears when blood boils.

So, try to understand they do not had any scientific information. So, in that scenario he at least gave that this is a disease caused by something not by curse of god. So, so in a very simpler word he explained a small box a small box appears when blood boils and is infected resulting in vapour being expelled thus juvenile blood is being transformed into richer blood having the colour of mature wine.

At this stage a smallpox show up especially as a bubbles. So, you have noted in my previous slide when there is a small box then there will be a big pustules. So, that what he explained showed up essentially as bubbles found in wine the blisters or the pustules. This disease can also occur at other time other times meaning not only during childhood means throughout their life. The best thing to do during this first stage is to keep away from it hence means and now we have a one term known as quarantine.

So, otherwise this disease might turn into the epidemic. So, he gave some idea at least how to protect from this disease.

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So, practice followed to prevent this smallpox. So, by that time when this disease was quite dominant at that time people have learned something about this disease by observation and this was also observed in India. So, in India inoculation was performed by dipping a sharp iron needle into a smallp box pustules. So, so they understood that if you take out this pathogen or this wire at that time pathogen or virus world was not there if you take this pustule fluid or material and if you inoculate in some in the individual then that individual may be protected from the smallpox.

So, in India also there was some practice. So, there is a smallpox pustule and then punctured the skin repeatedly in a small circle. So, they basically take and then they make a they they transfer this or they inoculate in upper arm and this practice was documented in Bengal as a ritual to worship the goddess sheetla Mata and this was mainly performed by tikadhars. So, they are they are kind of specialized person or maybe they are priest because the god thing is also there.

So, there are some priest who is doing this thing and the result was that many kids or many people they are protected from the smallpox. So, there was a one kind of practice if the baby or the individual will develop a mild fever after doing this procedure then they used to say that Mata Sheetla blessed that individual and now he or she will be protected from smallpox. There was also similar kind of thing going on in China and in China also there was a some practice of inoculation.

So, what they used to do it they make a powder from this pastule and then they basically transfer into the nose or they take this pustule in cotton and put it in the nose. So, these were the practice in order to protect from the smallpox.

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This since this was in whole world. So, people around the world is a quite quite means they were quite suffering and people are dying. So, this concept came up this variolation. So, variolation is nothing it is a just inoculation of these pustule from deceased individual to the healthy individual in order to protect the healthy individual from this disease. smallpox. So,

there is a little story here I will just narrate you narrate for you because so, at that time the there was a so, many death.

And one one person her name is Lady Mary Woratley Montaegue she or her family was died by a small pox her brother was also died in a smallpox. Then she decided something that she will try to control this disease and then at that time there was a Ottoman Empire and this Ottoman Empire is a quite powerful if you if you see the history. Then this Lady Mary Wortley lady Marry Whatley she got married with one person in that Empire it is basically in Istanbul.

And then because in Istanbul this practice was there inoculation practice was there like giving it a nose putting under the skin by making a small cut but there was a some serious problem with this inoculation. The serious problem is that many people are not many occasionally some people they die by this in inoculation. Try to understand at that time dose and amount or root was not defined.

That is why in some individual when they receive more inoculation then they die. So, in order to overcome so, she was aware that in Istanbul this kind of thing is there and many people get protected but some people get infected and die by this kind of inoculation. So, what she did is she hired since she got married with a quite big person then she had all power. So, she assigned some surgeon here you can see the there are two surgeon Royal surgeon they call it as a royal surgeon.

And these royal surgeons in this in this image you can see that there are some surgeons over there. So, she hired and then she said to study this thing and standardize this inoculation and amount and root. Then you will be little this thing that puzzled that how they perform this experiment. So, basically at that time there was a prisonersprisoner. So, at that time they do not use animal they indirectly use a human. So, she basically assigned six prisoner and on those prisoners they made an experiment they standardized various thing and then eventually those prisoners were protected from the smallpox.

Then she at that time she had a son and her son got inoculated and later on her daughter also got inoculated in presence of Royal surgeons. So, in that way this variolationirulation thing came and this variolationrelation is later on you have seen that it moved to India, China and

various countries and the people got protected. So, if you see all this thing it took us so, many years but if you compare with current scenario.

Then you can understand that in current scenario we made a SARS CoVvid 2 vaccine quite fast or I will say extremely fast and we got protected.

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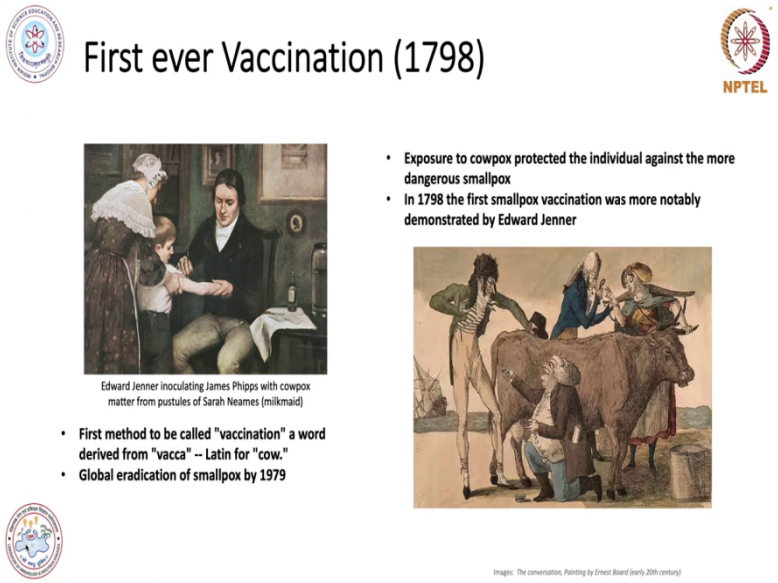

So, after that there was lot of work and then there was a this vaccine came in 1798 and you know this name is very much familiar to you probably the name of Edward Jenner. So, Edward Jenner he observed that the person who is providing milk to his family that person has some pustules and this pustules basically and that person is basically protected from the smallpox. So, this observation result to the discovery of now we call it as a vaccinia virus or cowpox virus.

And he also investigated this phenomena or this observation and finally he performed a very simple experiment not experimental it is a real trial you can say to his Gardener's boy and the name of boy is James Phillips. So, he just inoculated this cow pox pustules to that kid and then later on he infected with a smallpox and very interestingly and it is it is a huge news still we take this news as a huge news the kid was protected from this smallpox.

So, this was a one of very big discovery at that time and we still use this vaccinia virus in order to protect from the smallpox and you may aware that in 1979 or 1977 it was declared that smallpox is disappeared from the globe. So, this is his observation but please remember

this Edward Jenner's work was also practiced earlier but it was not reported some farmer used to do this kind of practice.

They take the pustules and put it in the individual it is a it is a something like a layman kind of thing and they get protected from the smallpox but the documentation and observation and presenting to the world is mainly started by the Edward Jenner. And you may be very much surprised that at that time by his this work he received 30000 pounds at that time 1798.

It is a huge money at that time and in order to continue his work plus in order to spread this his success and he ~~become~~became a member of all big society and all those things. So, this was the Edward Jenner's work.

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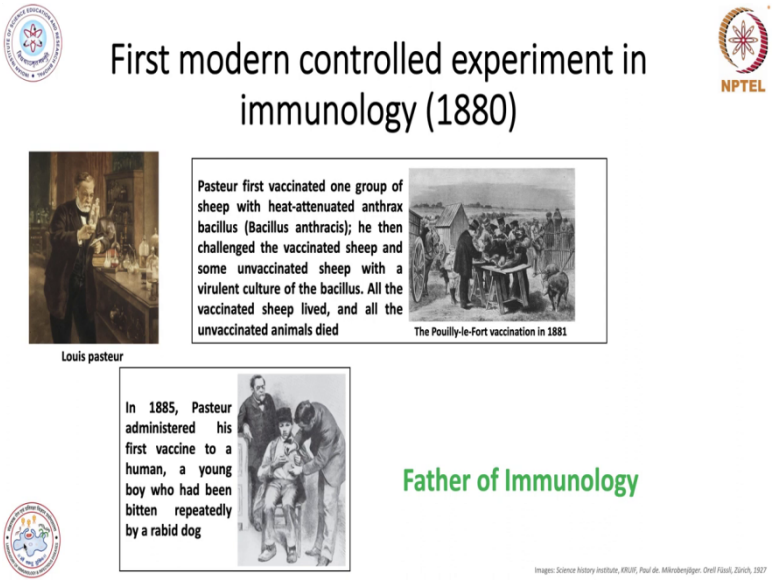

So, later on the first modern control experiment in Immunology was started in 1880s by Louis P~~p~~aste~~u~~r~~e~~. So, you know the Louis Pasteur ~~Lewis pasture~~ probably you may remember Louis Pasteur~~Lewis pasture~~ made various kind of work and he made a one very interesting observation he worked he was working with chicken and he used the one bacteria which caused diarrhea in the chicken that is a chicken cholera bacillus.

And this chicken cholera ~~caller~~ of bacillus is basically when they infect the chicken they cause the diarrhea. So, what he was doing he was he before going to the vacation in summer he forgot to keep some of his cultures in the at low temperature there was no refrigerator I am not aware how they were keeping at low a little low temperature. So, he forgot and he left those flasks over the bench.

And when he returned he continued his experiment and he thought that these bacteria is still alive and then he started his experiment he inoculated the chicken with those bacteria which is left out over the bench and then he found out that these chickens are not developing any diarrhea or any disease. So, what he thought something wrong is there. So, then he inoculated fresh bacteria this cholera bacillus to those chicken in order to develop the disease but interestingly they do not develop a disease.

So, from that point the concept of attenuation came up attenuation means inactivation and this inactivation result to the protection from virulent pathogen. So, after that he performed several work. So, you can see that there he worked on Dbacillus aAnthracisx. Just for your note Bbacillus anthracisanthrus was a very very dangerous still it is a very dangerous pathogen and I do not know if you look at little early history or few or maybe 20 30 years back then this bacillus was used as a biochemical weapon probably you may remember the World Trade Center thing in U.S.

So, at that time after that this terrorist used to send the spores of this bacteria and this bacteria can be you can make a stable form and this bacteria when it is in feact and cause disease by that time it is a very short duration and you cannot detect this disease. So, this Bacillus anthracis bacillus anthrosis is used as a biochemical weapon and it is not good. So, he basically showed that sheep which received the attenuated and anthracisanthrax they are protected from the Bacillus anthracis bacillus anthraxes infection.

So that was his very important work beside this he also worked with rabies and he made this vaccine. And for his all this work he which he made during that time he is now in current literature he is considered as a father of Immunology. However I not I means the several scientific Community the immunologist they considered that at that time Robert Koch also did a lot of work in defence system.

So, ideally both should be the father of Immunology but these are the debates and there are some pros and cons and all those things. So, we are not here to resolve this thing just I am highlighting that point what the other immunologists think about the father of Immunology.

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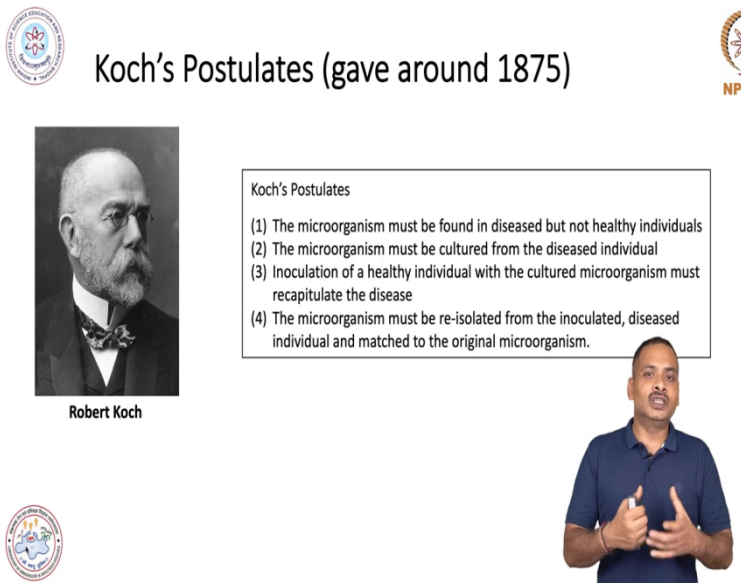

Now I will talk about the Koch's postulate. So, Robert Koch works. So, Robert Koch gave the Koch postulate in 1875. And ~~basically~~basically, he his model was a rabbit and he used the pathogen as a anthracis~~anthraxes~~ as you have seen in previous slide. So, what he has done he made a one very simple experiment now it looks very simple or trivial but at that time that was a great science. So, what he did he inoculated the ear of rabbit, healthy rabbit from the blood which he got it from the rabbit which died by anthracis~~Anthrax~~.

So, when he did then this rabbit developed the disease or the same sign and symptom and once this fully this rabbit developed a full-blown disease he took out this his lymph node and then he inoculated another rabbit and that also developed the disease. So, basically he gave the concept of infection and this we also call it as a Koch postulate and Koch postulate or jump theory all these things we can call it.

So, this postulate is as you can see in this slide the microorganism must be found in diseased but not in healthy individual this is the first postulate. Second is the microorganism must be cultured from the diseased individual and the third one is inoculation of healthy individual with the cultured microorganism must recapitulate the disease and the fourth is the microorganism must be re-isolated from the inoculated diseased individual and matched to the original microorganism.

So, this is a germ theory or Koch postulate now it is very well known probably you have learned the Koch postulate earlier.

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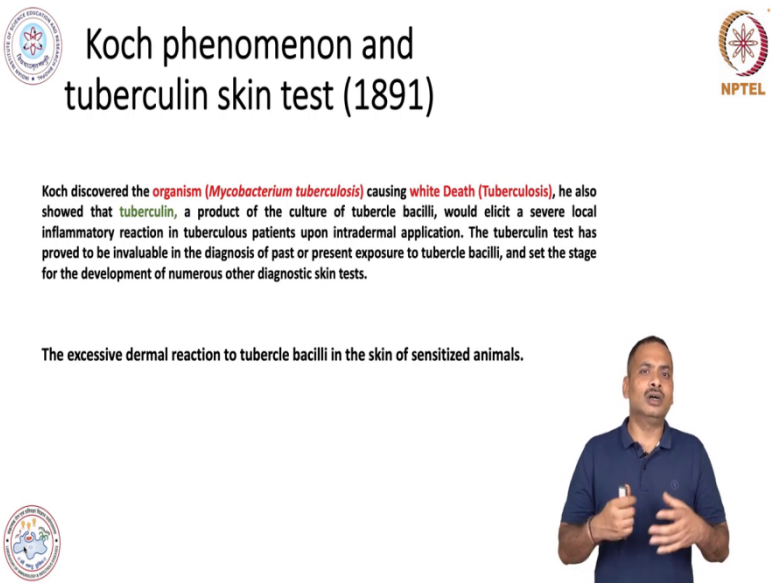

So, after that Koch also worked on variety of field and he basically the discoverer of Mmycobacterium tuberculosis and at that time tuberculosis we call it as a white death. So, he discovered Mmycobacterium tuberculosis he is a discoverer of a tuberculin test which is very powerful technique to test the tuberculosis classes or Mmycobacterium tuberculosis infection in the individual and it is a diagnostic right.

So, so Robert Koch made a lot of contribution and he basically did his work and along with this he has also developed some microbiology techniques like culturing and all those things. So, his work is also a lot.

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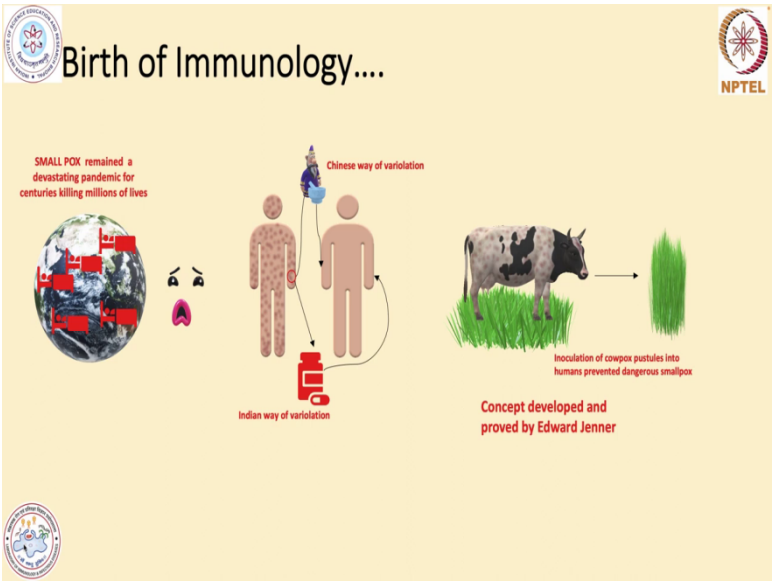

So, finally I would like to just sum up the birth of Immunology. Basically it is started with all this smallpox which caused a pandemic all over the world which kills millions of people

through ages. And then this disease was a kind of treated by a technique known as variolation and variolation~~varilation~~ is inoculation of a small pox from disease patient to the healthy patient in a controlled manner in order to protect and this was a there was an Indian way there was a Chinese way you have I have explained you.

And ~~finally~~finally, this was fully eradicated or eradicated by the work of Edward Jenner by using the cow pox now in modern time we call it as a vaccinia virus by inoculating the vaccinia virus. So, this is all about this first part of History I will take few more ~~session~~sessions about the history and towards end I will also talk about pandemic. How this pandemic thing came in picture and what is quarantine how this concept of quarantine came.

And I will also talk about some key contribution in immunology and those contributions also received the Nobel Prize, thank you.