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COVID-19: Epidemic Prognosis using Deep Learning Approach

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Abstract

This paper briefly describes the about COVID-19. It also describes the experiments that take place on the patients suffering with NCP (Novel Coronavirus Pneumonia). As the Coronavirus is spreading at a very fast rate so we all must be aware of imaging stretch of this pathogen. Deep learning used for image processing to classify Corona virus is also covered in brief.

Keywords: TCM, NCP, MERS ToV, SARS ToV, CAP, ResNet.

Introduction

Corona Virus or COVID-19, the most popular and dangerous virus among humans these days is a type of a virus or microbe and according to latest reports, the virus has now spread its wings all over the world [7]. It was first diagnosed in the capital city of Hubei province in China, in WUHAN. From Wuhan it spread rapidly all over the world. This disease was initially to be named as Cold Dampness Pestilence, however, some other entitled it as disease pulmonary pestilence because it is related to pneumonia and finally according to the Traditional Chinese Medicine (TCM) it was named as Novel Coronavirus Pneumonia (NCP).

SARS- CoV-2 is the reason for the novel virus. It activates the septicity in respiratory system. There are basically seven types of the coronavirus of which SARS-CoV-2 is the most dangerous one as it is the reason for the damage of respiratory system. Except SARS-CoV-2, other coronavirus that are present do not havea serious impact on the human body, rather they only cause a regular flu or cold which does not cause a serious damage to human respiratory system, but SARS-CoV-2 can damage both the upper as well as lower respiratory portion [2].

Fig 1: COVID-19

It was declared as an outbreak and a public health emergency on 30 January 2020 by World Health Organization (WHO). It was still an epidemic before 30, March 2020 but has become a pandemic after that day. Until now (May 19, 2020) as

the report says, 318,500 people all across the world have died from Coronavirus and the confirmed cases are around 4.8 million in more than 188 countries and territories. However, 1.8 million people have recovered from COVID-19 until now.

Demographic and Pharmacological Examinations

These examinations were undertaken to understand the scientific and appropriate reason for COVID-19. In China, samples of people, symptoms, temperature of the body, their sex etc. were taken and to perform these examinations.

1. Demographic Determination:

T –test was taken and the effect of clinical medicine was also noted on different people. T-test is generally used to take the blood samples at multiple levels and it is tested until the patient is discharged from the hospital. Relation was found out among different types of signs that were seen [6].

2. Pharmacological Determination:

Information was collected using 21 types of medicines. COVID-19 was divided into five different stages - mild, moderate, severe, critical and the recovery stage. Three types of herbs were used to keep the record of different stages.To analyze the putative spot, Similarity EnsembleApproach was used by adding SMILES in the whole compound. For the advance examinations, Network Analyzer was used [6].

Results Based On Traditional Chinese Medicine

According to TCM it was found that Novel Coronavirus is an Epidemic disease and the pathogen first attack the lungs , it slowly show changes and eventually spread through the respiratory system and then start to damage the heart, liver and kidney. The pathogen creates disfunctionality in the body due to the broken Qi movement and can convert into cold dampness pathogen to conquer the central energizer. If a proper treatment is given than the dis functioning gets reduced and patient enters into the recovery stage. So the outcome of these examinations was that the dampness pathogen first enters into the human body and then destroys the malice functions, bit by bit wrecking the lungs, heart etc. Thus kickoff of the Qi moment and Ying Yang gets damaged [6].

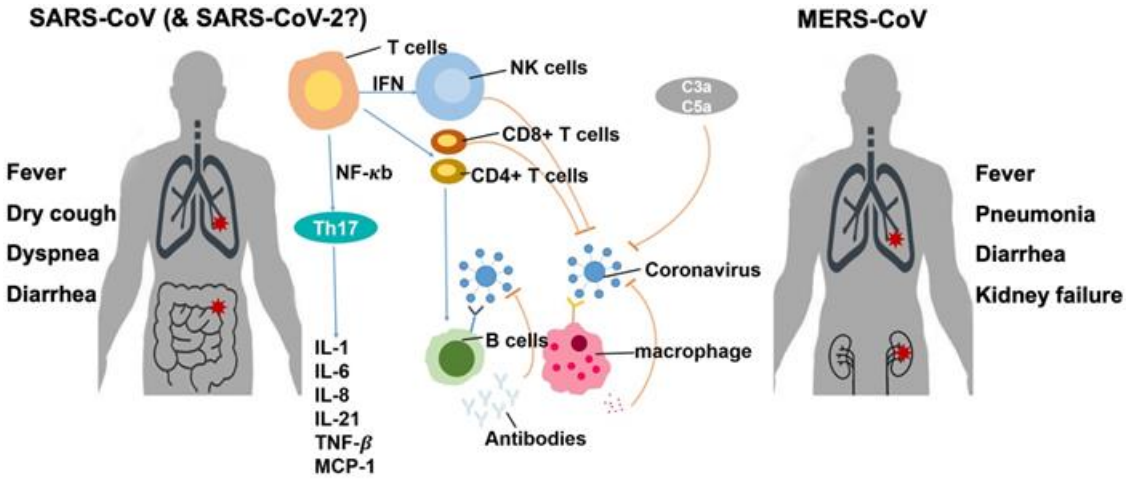

Fig 2: Immune Response of Patients

Distinguishing Features of Coronavirus

1. Period of Maturation

Maturation period is defined as the time lag between which a human comes in contact with the microbe and when the body starts to show some symptoms of the virus. The maturation period is between 2 to 14 days according to the centers for disease control and prevention. The new research says that the symptoms can be seen even after 12 days of the contact with other infected person or virus itself. Hence, Quarantine days are 14 days withinwhich a healthy person may shows the signs of COVID-19 [2].

2. Time lag of the infection

RNA which is present in respiratory system shows some signs of coronavirus but not always these signs represent this virus. Sometimes these may be simply the sign of common cold or a type of flu. Up to thetenth day also, the RNA seems to test negative in more than 90% of the cases. Outcome of thetest is positive only in most serious conditions [2].

3. Different Modes of Transmission:

The virus gets transmitted through droplets of different sizes. According to a research, COVID-19 can spread from respiratory droplets which are of size between 5 to 10 μm in diameter. It may also cause infection in intestine as shown by some of the evidences [2].

4. Statistics

Age statistics of death from coronavirus

Age	No. of deaths	Share of death	With underlying condition	Without underlying condition	Share of death of both w/o condition
0-18 years	10	0.06%	6	4	0.02%
19-45 years	605	3.8%	480	20	0.9%
46-65 years	3,415	22.5%	2,860	80	3.9%
66-75 years	3,790	24.7%	2,800	6	6.6%
76+years	7,423	48.9%	5,245	4	14.6%
Total	15,234	100%	11,391	114	26.02%

Sex ration statistics

Sex	Death Rate Confirmed Cases (Round Figure)	Death Rate All Cases
Male	5%	3%
Female	3%	2%

5. Diagnosis

Symptoms in different people may differ on the basis of climatic conditions, temperature and even the area one resides in. So in every country the factors to check if a person is suffering from coronavirus may vary. A pad or a piece also called swab is generally used to take samples. Then this sample is sent to laboratories for checking if the patient is positive or not [2].

Some Indications And Demonstrations

Deaths due to COVID-19 vary widely depending upon different indications. These indications are not definitive. These signs vary from person to person. Common symptoms that are seen in the patients suffering from corona are: Fever (99%),Phlegm (28%), and Shortness of breath (31.5%), Body aches (36%), and Drycough (60%), Loss of Appetite (40.5%). Other frequent signs are faster breath and bluish lips [3].

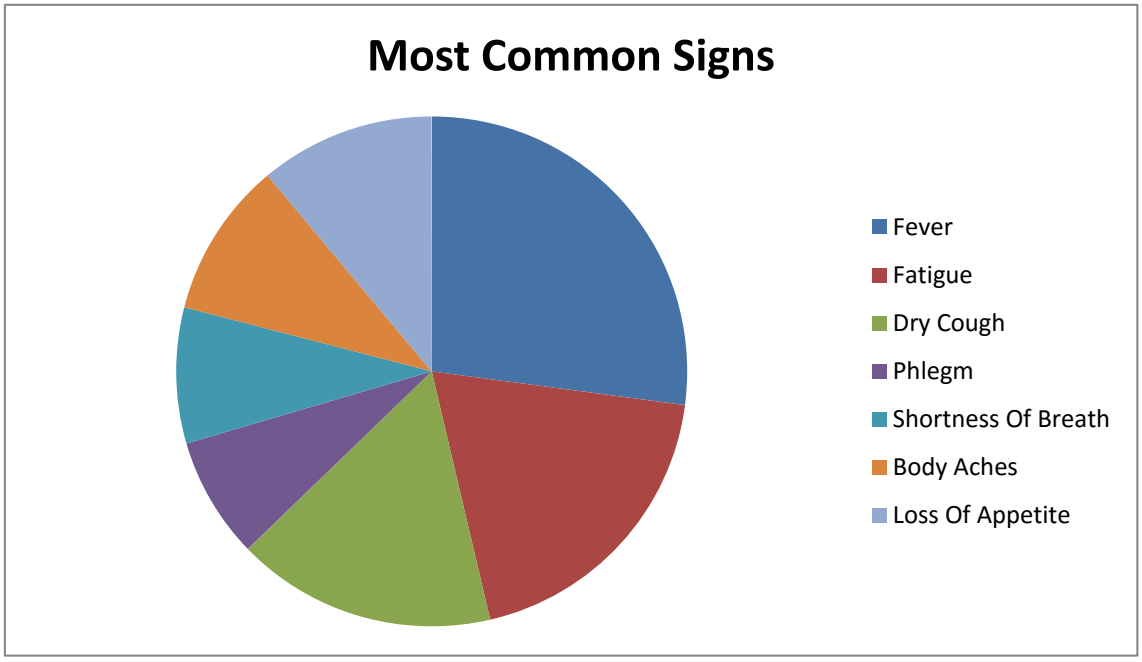

Fig 3: Symptoms of Covid-19 as compared to adult.

Use of Deep Learning Model In Corona Detection

Corona virus has been named so due to the spikes on the virus giving it a crown like appearance.

There are basically four categories of spikes:

- Alpha
- Beta
- Gamma
- Delta

This virus is of zoonotic nature i.e. the virus can be transmitted from animal to human and vice versa. Till date, 7 different kinds of corona virus are known most of them leading to light illness. However, from the last two decades the virus tends to have following syndromes in the human body which lead to death as well. These syndromes are:

- Severe Acute Respiratory Syndrome Coronavirus (SARS CoV)
- Middle East Respiratory Syndrome Coronavirus (MERS CoV)[1]

The common lab technique used to detect the presence of virus is time consuming as it is based on the blood samplesthat go through different chemical reactions.To overcome this problem and to speedily detect the corona virus in a patient, a learning model known as COVNet was developed and it works with 85% accuracy in recognizing the presence of corona virus in a person with the help of image processing of the 3-D CT scan report. The model works as follows [4]:

It consist of RestNet(50) as the main part of the 3-D network that detects the corona patients apart from the other lung diseases such as pneumonia, which affects a person in a similar manner as the corona virus does [4].

The research says that community acquired pneumonia (CAP) and other lung diseases lead to formation of nodules in the lungs which is seen in the CT scan report which is approximately of less than3 mm. in size but in the case if the person suffers from the corona disease, the size of that nodule gets larger than 3 mm and leads to lung failure and consequent multiple organ failure [4].

The steps for the process consist of:

- First the 3D CT scan is being preprocessed considering the lung as the region of interest (ROI) and slicing the image by using the U-net based segmented method.
- The RestNet50 takes slices of the 3D CT scan scans for the nodule in that particular slice and give the corresponding output feature to each slice.
- Then using the max pooling operation, the featured output of each slice is combined and overall result is analyzed.
- At last the resultant features are fed into connected layer and softmax activation function is used to get the probability of COVID-19, pneumonia or other lung diseases [4].

The CT scans of the first person affected by Coronavirus are as below [5]:

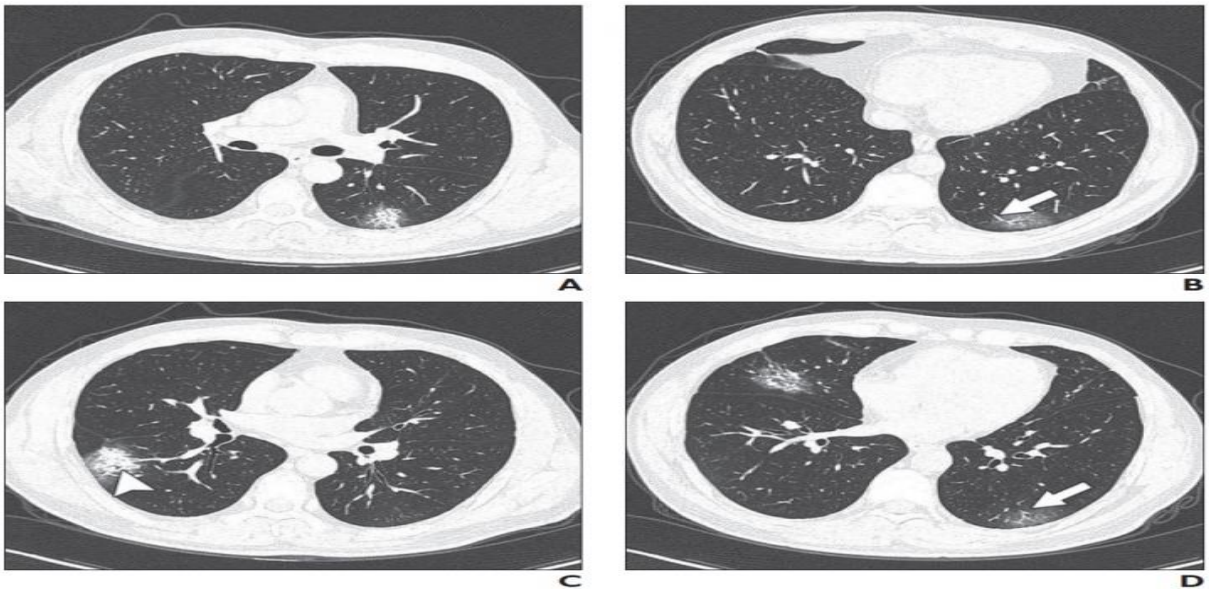

Fig 4: CT Findings in Patients of Coronavirus

Fig 5: CT scan after 4 days of being admitted

The first image was taken when the woman was admitted to the Wuhan hospital. It shows a marked minute nodule which generates even in the community acquired pneumonia and other lung diseases. And in the second image it shows the CT scan of the same person after 4 days, the size of the nodule increased to more than 3 mm in size, this is one of the most important symptoms and cause of the corona virus infection [5].

Result

Coronavirus is stretch very widely from a small respiratory problem to big problems in the body of patients like it causes failure of different organs and then they patient might also die. Nothing can be said until any vaccine is available, a person must remain cautious, maintain the social distancing. According to the data which is collected from chest CT exams there are more male patients as compares to female patients. Detection of AUC was 0.95 (95% of Cl)

Conclusion

Based on current situation, no clear conclusion can be given. But the TCM has given a proper efficacy based on NCPand according to the model based on NCP we can find the difference between the other respiratory disease and NCP.

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