Original Research Article

Is artificial intelligence better than manual methods in diagnosis of electrocardiograms (ECGs) or not?

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ABSTRACT

Background: Now artificial intelligence is used extensively to diagnose ECGs. Artificial intelligence is the point where the doctors and engineers meet to decrease the misdiagnosis of cardiac diseases. So, we thought it worthwhile to compare and contrast the ECG diagnosis by artificial intelligence and skilled physicians. This paper exposes the potential of diagnosis of each ECG by artificial intelligence and skilled physicians.
Methods: The research was done on 30 ECGs and their diagnosis was compared by both the methods.
Results: The result was divided into 3 categories: absolutely misdiagnosed, relatively misdiagnosed and correctly diagnosed. Out of these 33% ECGs are absolutely misdiagnosed, 44% ECGs are relatively misdiagnosed and 23% ECGs are correctly diagnosed. This research also focuses on those numbers of diseases which were not correctly diagnosed by artificial intelligence. Out of 23 ECGs 21% cases were of ischaemic heart disease, 26% cases were of early repolarisation syndrome and 17% cases were of atrial flutter/fibrillation (af).
Conclusions: Our study concludes that artificial intelligence needs human intervention as well. A combination of human brain and artificial intelligence has made wonders; thus, diagnosis and treatment planning can be enhanced.

Keywords: Artificial intelligence, Cardiac diseases, Electrocardiograms, Skilled physicians

INTRODUCTION

Artificial intelligence is the science and engineering of making intelligent machines especially making intelligent computer programs. Heart diseases are the most common diseases that affect human beings worldwide. Early detection and timely treatment can prevent them.[1] Manually, there are several chances of missed or mis diagnosis. With the help of artificial technology researchers have for the first time found that this artificial intelligence has the ability to diagnose heart attacks. According to several studies, the "Neural network" is designed to draw knowledge and decision-making capabilities through experience.[2]

The technology still won't replace a skilled physician who understands the fine points of "the art of medicine" and the ECG reading. The burden of ECG diagnosis has increased tremendously.[3] This increased burden reflects on the efficiency of physicians inspecting ECG strips. On the other hand, artificial intelligence also occasionally misses some diagnostic points in complicated cases.[4] Therefore, it would be worthwhile to compare the diagnosis made by artificial intelligence and manually by doctors. We thought it interesting to test it on the touchstones of real time research and scientific basis as to which has less margins of better error, more so when ECG and heart diseases are both so common these days.

The practice of medicine remains an art but its colors can be mixed by an algorithm if the painter is still a human. Hence the present study was planned with the aim and objective of comparing the results of ECG diagnosis between Artificial intelligence and doctors.5 Objectives

were to establish the diagnosis in each ECG by a doctor at least after consulting the doctor of the rank of M.D (medicine) and to determine the percentage of ECG in which diagnosis by skilled physician and by artificial intelligence is same and different and to document those diseases

METHODS

The material consists of 30 ECGs which were selected by random sampling method, out of which 16 are of males and 14 are of females. The study of 30 ECGs was done in medical college Gujarat for 6 months. Before the conduction of study Ethical Clearance certificate was taken from the Ethical Committee of the institution. All the participants were prior informed about the study and written consent was taken. Those who signed were included in the study

Inclusion criteria: All the ECGs which were diagnosed by artificial intelligence as well as manually by skilled physicians.

Exclusion criteria: All those ECGs were excluded which were having artifacts.

These ECG were first diagnosed by artificial intelligence and then manually by skilled physicians under the guidance of a doctor not below the rank of M. D (medicine). Studies were done by both the methods and interpretation was made later on.

Following the interpretation by both methods the subjects were then shortlisted as: CATEGORY-1 Correctly diagnosed, CATEGORY-2 Relatively misdiagnosed, CATEGORY-3 Absolutely misdiagnosed. Those ECG in which diagnosis was the same by both artificial intelligence and manually by doctors were categorized as "correctly diagnosed". Those ECG in which there was relatively few differences in the diagnosis done by artificial intelligence and manually by doctors were categorized as "relatively misdiagnosed". Those ECG in which major differences were found in the diagnosis by artificial intelligence and manually by doctors were categorized as "absolutely misdiagnosed".

RESULTS

The research was done on 30 ECGs out of which the observation of 3 ECGs of each category i.e., absolutely misdiagnosed, relatively, misdiagnosed, correctly diagnosed are shown below.

The ECG given below shows (Figure 1):

Misdiagnosis by artificial intelligence - inferior ischemia. Interpretation by skilled physicians - normal ECG.
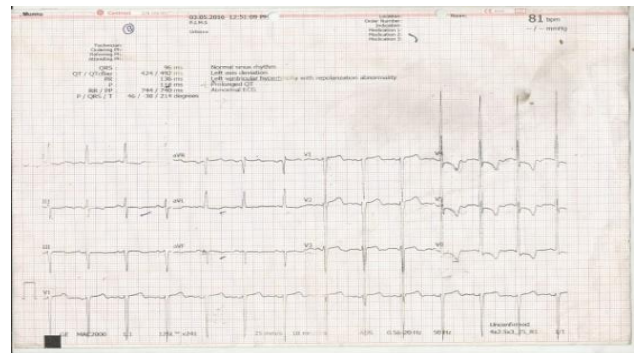
The ECG given below shows (Figure 2):

Diagnosis by artificial intelligence- left ventricular hypertrophy with repolarization. Interpretation by skilled physicians- anterolateral wall angina

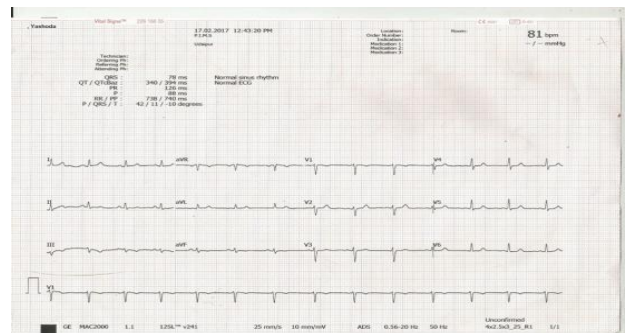The ECG given below shows (Figure 3):

ECG was correctly diagnosed by both- artificial intelligence and skilled physicians.
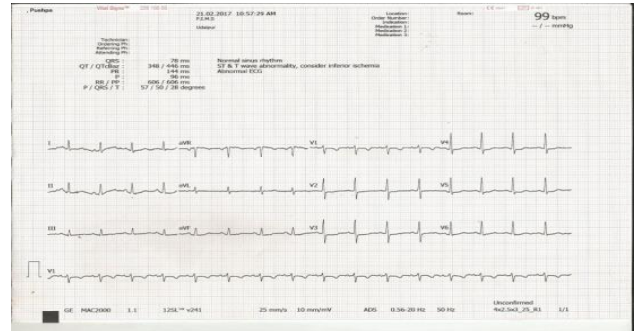
Figure 1: Absolutely misdiagnosed ECG.

Figure 2: Relatively misdiagnosed ECG.

Figure 3: Correctly diagnosed ECG.

Out of 30 ECGs; 7 ECGs that were correctly diagnosed were not included. Now, out of 23 remaining ECGs the major diseases which were misdiagnosed by artificial intelligence were analyzed. The result showed 21.7% Ischemic heart diseases, 26 early repolarization syndromes and 17% atrial flutter and fibrillation were not diagnosed by artificial intelligence. The difference in the percentage of category of the ECG diagnosis was found

to be statistically significant as calculated by standard statistical methods.

Table 1: The analysis of ECGs by artificial intelligence and its interpretation by doctors.

Category of ECG diagnosis	Percentage
Correctly diagnosed	23%
Relatively misdiagnosed	44%
Absolutely misdiagnosed	33%

Out of 30 ECGs that were studied, 23% were correctly diagnosed, 44% were relatively misdiagnosed and 33% were absolutely misdiagnosed.

Table 2: Diseases misdiagnosed by artificial intelligence.

Diseases which were not diagnosed	Percentage
Ischemic heart disease	21.7% (5 of 23)
Early repolarization syndrome	26% (6 of 23)
Atrial fibrillation and flutter	17% (4 of 23)

DISCUSSION

An electrocardiogram (EKG or ECG) is a test that checks for problems with the electrical activity of your heart. An EKG shows the heart's electrical activity as line tracings on paper. The spikes and dips in the tracings are called waves.[5,6]

Artificial Intelligence is breaking into the health care industry by assisting the doctors. In cardiology, artificial intelligence has been successfully applied to problems in the diagnosis and the treatment of several diseases like ischemic heart disease, early repolarization syndrome, atrial flutter/fibrillation (AF), bundle branch block diseases etc.[7] The basic idea of the study was to compare both the methods and to know which has less margin of error. Commonly it is thought and believed even by the skilled physicians that the diagnosis of ECG by artificial intelligence is absolutely correct but surprisingly out results have proved it otherwise. Even the best artificial intelligent machines cannot equalize the human neurons as is the case till date.

On the other hand, physicians need to be adequately trained to diagnose ECGs. The criteria include the division of the diagnosis of ECGs into 3: correctly diagnosed, relatively misdiagnosed and absolutely misdiagnosed.[8] In the observation it is seen that artificial intelligence diagnosis has more chances of errors that is out of 30 ECGs which were studied by random sampling method 23 were misdiagnosed. It was also seen that several diseases were misdiagnosed. To know the reason behind the misdiagnosis we need to carry out further

studies. With recent advancements, the lifestyle of the people is also changing these changes and variations are not detected by artificial intelligence. Therefore, coordination between both the methods is needful. Making diagnosis is an art. Part of the diagnosis looks at whole human body. The way patient walks, speaks, smells or think are also important to make the final diagnosis. We doctors are not machine products and thus measuring a few parameters and tweaking a few knobs will not diagnose and cure the diseases

CONCLUSION

Our study concludes that artificial intelligence needs human intervention to diagnose ECG as well. A combination of human brain and the artificial intelligence has made wonders, also the diagnosis and treatment planning can be enhanced. So, relying only on artificial intelligence as a tool for diagnosis is not an appropriate technique. The skilled doctors have the knowledge and art which helps in understanding the clinical signs and symptoms. The key is cooperative relationship between physician and artificial intelligence making tool.

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