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A Study on the prediction dyspnea-induced attributes of linear regression-based Article

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Abstract

According to the World Health Organization, the top 10 causes of death worldwide include heart disease. Heart diseases include coronary disease, which induces acute myocardial infarction. Ticagrelor drugs are being used to treat acute alliances, but it has become difficult to breathe due to the drugs. In a related study, Tobias predicted that uric acid causes acute respiratory distress independently of other factors, including BNP. And in the Ahmad study, serum uric acid numbers were related to the left ventricle depending on the level of uric acid. Experimental data are data used after 155 patients who received coronary intervention took ticagrelor. The research methods were leveraged by gradient decent algorithm and linear regression. In order to avoid overfitting in the experiment, training data and test data were separated into 70 and 30 percent respectively. The experimental results lacked the predictability of other attributes except DT in the correlation coefficient and crystal coefficient. However, all attributes related to dyspnea other than DT are determined to be related to causing relaxation of the heart in the left ventricle. Therefore, the attribute causing dyspnea is determined to be an attribute causing relaxation of the heart of the DT and left ventricle.

Keywords: Ticagrelor, Dyspnea Myocardial Infarction, Linear Regression, Uric Acid

1. Introduction

Heart disease is included in the top 10 categories of causes of death worldwide, based on 2016, and heart disease has coronary artery disease, triggering acute myocardial infarction (WHO, 2019).

Acute myocardial infarction can cause fatal damage to the heart over time and cause the patient to be at risk of life because the coronary artery is largely closed by hardening, thrombus, and the heart is necrotic. Non-forming symptoms of myocardial infarction include dyspnea, misjudgment, vomiting, fatigue and syncope, and clinical factors include diabetes, hypertension and coronary artery disease (Kim, Kim and Jang, 2000).

Coronary artery disease is a disease in which fat components such as cholesterol are deposited in blood vessels, and vascular endothelial cells become diseased, resulting in changes in the structure and function of blood vessels, resulting in poor blood circulation. Percutaneous coronary intervention is applied as a treatment method for coronary artery disease. This treatment has a high success rate and is applied to many patients (Yeo and Sung, 2016).

After treatment of acute coronary artery syndrome, treatment of perfumed blood platelets is essential. In the past, the fusion therapy of aspirin and clopidogrel is standard, and in recent years, new drugs such as prasugrel and ticagrelor are introduced (Yoon and Cho, 2017).

Ticagrelor is a standard treatment for patients with acute myocardial infarction. There are undefined problems related to the nature, size and clinical significance of various side effects (respiratory distress, ventricular arrest) on Ticagrelor, and there are insufficient clear benefits. However, the results show that patients with myocardial infarction are efficient, and they use Ticagrelor (Kang and Jang, 2013).

Dyspnea is the chief complaint of respiratory and circulatory patients, and can occur in a variety of conditions ranging from patient self-control to life threatening. When patients with dyspnea develop, they should mediate to increase survival rates so that the symptoms of dyspnea become less severe. After that, it should investigate the cause, which will increase the survival rate and cause breathing difficulties (Booker, 2004).

This paper predicts the causes of dyspnea (clinical attributes) by using linear regression with data after taking Ticagrelor of 155 patients who have received coronary artery disease.

2. Related research

Tobias Reichlin et al (2009) predicted long-term prognosis for all patients whose uric acid measured upon admission or discharge was acute respiratory distress, independent of other factors, including BNP. When analyzing a subgroup of the causes of dyspnea, uric acid was maintained independently of the polydegenerative analysis of acutely decomposable heart failure patients, but non-cardiac patients were not. Since two years of follow-up measures, these patients have a lower mortality rate than those with acute decomposable heart failure. The reason was found to be mainly due to decreased cardiovascular risk. Therefore, in predicting the mortality rate, it can be estimated that the added value of uric acid appears in a patient having the highest cardiovascular risk such as a patient with acute decomposable heart failure than other prediction variables and signs.

Ahmad, Farveh & Majid (2011) also studied the relationship between liver function tests, serum uric acid values, and clinical and tubodynamic profiles through heart failure., The study determined that the level of uric acid was related to the left ventricle.

3. Algorithm for predicting dyspnea

3.1. Data set

In this paper, the values of the dependent variables (uric acid) and independent variables (different clinical attributes) are included. The dependent variable selects attributes of high relevance through correlation analysis among 49 attributes. Clinical attributes selected are CPK, HDL cholesterol, IVSd, PWTd (PWD), LA diameter(A-T), LA volume index.

3.2. Gradient Descent Algorithm

The underlying algorithm was learned using the Gradient Descent algorithm in the Optimizer. This method is a theory that optimizes the clinical numerical parameter(θ). A value of a function defining a difference between a result value of a clinical numerical value called cost function or loss function and an actual result value is minimized by using a gradient. The formula is as follows.

$$\mathrm{W} \coloneqq \mathrm{W} - \alpha\left(\frac{1}{m}\right)\sum_{i=1}^{m}\left(Wx^{(i)} - y^{(i)}\right)x$$

3.3. Linear regression

Linear Regression is an algorithm for implementing a model predicted in a linear fashion. The technique creates several predictive data by the model, where x represents an existing uric acid number, and y represents dyspnea and significant clinical attributes. In this paper, we used linear regression to predict clinical attributes that could induce dyspnea. The formula is as follows.

$$y = \alpha x + b$$

4. Research procedure

4.1. Experimental Environment and Configuration

<Table 1> shows the experimental environment used to evaluate the performance of models to predict respiratory distress using clinical numerical data. The data used in the experiment is as shown in <Table 2>, and the data set consists of 1,328 sets, which experimented separately into training data of 70% and testing data of 30% to avoid overwriting.

Table 1. Simulation environment

Category	Value
OS	ubontu 16.4
CPU	Intel Core i5-6600
GPU	Geforce GTX 1080
Memory	32GB
Language	Python 3.7
Library	Tensor Flow, Numpy

Table 2. Selected Properties

Attribute	Properties Description
CPK	CPK levels in blood.
HDL cholesterol	HDL cholesterol in blood.
IVSd	Thickness of the septum of the left ventricular during relaxation in cardiac ultrasonography.
PWTd(PWD)	Thickness of the posterior wall of the left ventricle during the period of relaxation in cardiac ultrasonography
LA diameter(LA(A-T))	Diameter of the left atrium in the heart.
LA volume index	A left atrial volume measured by heart ultrasound. A numerical value obtained by determining the volume of the left ventricle by ultrasonic waves and dividing it by the body surface area of the patient.
RWT	Thickness of the heart that thickens during shrinkage (pump) in the cardiac relaxant
DT	The number is measured in cardiac ultrasound, but is used to see the relaxer function.

This study uses data through normalization to improve accuracy. Normalized data has applied with linear regression of each uric acid numerical value and clinical numerical attribute.

4.2. Experimental process

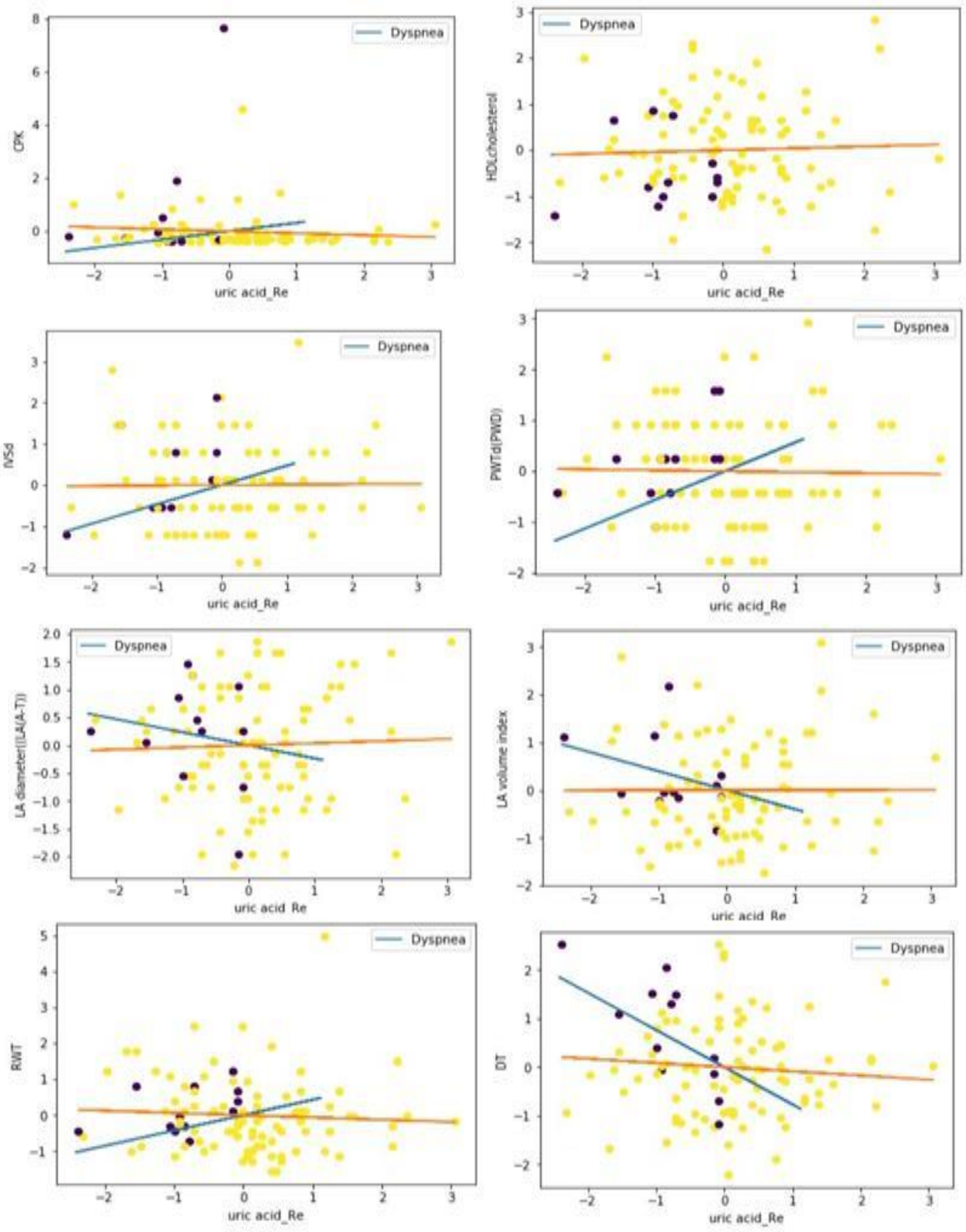

Figure 1. Results of linear regression

Using data from 155 patients, this experiment optimized the data of the uric acid and each attribute with the Gradient Descent algorithm with Optimizer and expanded the dataset of 1328. In order to improve the accuracy of the research, each of them was trained at 10, and they drew optimized linear regression graphs. Each graph looks like <Figure 1>.

4.3. The result of an experiment

The experimental results are the same as in <Table 3> below, and the attributes for predicting respiratory distress are DT, PWTd (PWD), IVSd, RWT, and LA volume index. Each attribute is expected to have DT : 58.5%, PWTd (PWD) : 32%, IVSD : 22.1% , RWT : 18.1% and LA volume index : 15.8% .

Table 3. Result value of linear regression

models	dyspnea	
	correlation coefficient	coefficient of determination
CPK	0.313	9.8%
HDL cholesterol	0,426	0.001%
IVSd	0.470	22.1%
PWTd(PWD)	0.566	32.0%
LA diameter ((LA(A-T)))	-0.235	5.5%
LA volume index	-0.397	15.8%
RWT	0.426	18.1%
DT	-0.765	58.5%

5. Conclusion

In this paper, we used linear regression to predict clinical numerical attributes that have data on patients taking ticagrelor and cause dyspnea. The algorithm used the Gradient Descent algorithm and the attributes used 49 attributes. It was difficult to obtain a good result value because patient data are widely distributed. The predicted results showed that DT, PWTd (PWD), IVSd, RWT, and LA volume index were the attributes that caused dyspnea, such as uric acid. Its predictive power is 58.5%, 32%, 22.1%, 18.1% and 15.8%, respectively, which are deemed to be lacking in predictive power for the other four properties except DT. However, since all four attributes are associated with the cardiac relaxation period or the area of the left ventricle, it is determined that there is an association with dyspnea.

The study looked for attributes that induce dyspnea through linear regression and Gradient Descent algorithm. Although the predictability of dyspnea is insufficient, the predicted attributes are all associated with the function of the cardiac relaxation period and the left ventricular area, so it is determined that they are associated with the relevance.

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