

THE PATTERN FOR DIFFERENTIAL DIAGNOSIS OF COPD AND COR PULMONALE

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ABSTRACT

In this paper, we study early diagnosis method of cor pulmonale by theory and method of fuzzy set. By method of degree analysis we have established the fuzzy pattern of disease diagnosis based on fuzzy set and frequency of numeration data of the samples. The pattern is applied to clinical diagnosis and we have got satisfactory results. The correct rate of diagnosis has reached 92.5%, but the correct rate of the clinic doctors has reached 75.6%. The method of fuzzy pattern is better than clinician diagnosis. Therefore, it has practical value of clinic.

1. Preface

In this paper, we study early diagnosis method of cor pulmonale by theory and method of fuzzy set. The cor pulmonale is a commonly encounter disease. Diagnosis and treatment of early cor pulmonale is good for control development of disease and recovery of the patients. However, it is very difficult and fuzzy that the clinician use experience himself to carry on differential diagnosis for early cor pulmonale. The Fuzzy Mathematics provides the tool of new mathematics for our study about simple diagnosis method of the cor pulmonale. By method of degree analysis we have established the fuzzy pattern of disease diagnosis based on fuzzy set and frequency of numeration data of the samples. The pattern is applied to clinical diagnosis and we have got satisfactory results.

2. Establishment of Mathematics Model

In the clinic practice we collected the patients with COPD and cor pulmonale. Not only was cardiac microtube examination performed for all of them but also chest x-ray film and ECG are shown in Z, X, E. They reflect the change of the lungs, the pulmonary vessel and the capacity of right ventricle. According to the clinic experience and position as well as function of every subset S_z, S_x, S_e in diagnosis of disease we affirm their relations as follows. $S = \underline{S_z} \cup \underline{S_x} \cup \underline{S_e}$. The S is the field therapy of diagnosis factor of the disease. If there are symptoms of n so that it forms factor set $S = \{S_1, S_2, \dots, S_n\}$ then we distinguish disease of m forms, that is $D = \{D_1, D_2, \dots, D_m\}$,

therefore it forms diagnosis set.

Each different disease is a fuzzy subset on S. In diagnosis the correspondence fuzzy subset of different illness has been respectively shown in D_1, D_2, \dots, D_m . Therefore, problem of disease turn out to be reckoning subordinate degree $\mu_{D_j}(X)$, that is Subordinate to fuzzy set D_j ($j=1, 2, \dots, m$). Based on principke of the maximum membership we affirm the patient subordinate to which disease, then we get the result of diagnosis.

1). Affirming Factor Set

It is very important that we affirm fator set in the diagnosis of illness based on characteristic of disease. We analyse that cardiac microtube examnation was performed in 118 patients with COPD and cor pulmonale. According to the result of PAMP the patients are divided into 2 groups: (1). group of pulmonary arterial high pressure ($PAMP > 20\text{mmHg}$). (2). group of emphysema ($PAMP < 20\text{mmHg}$). Based on PAMP we carry on statistics for clinic picture of patients. We take 12 targets which are of remarkable singnificant on statistics as differential diagnosis factor. That is, 1). shortness of breath and lower breath sound after walk. 2). $P2 > A2$. 3). heart beats (cardiac space) cardiac apex). 4). heart sound (heart space $>$ heart apex). 5). cross-diameter of down arterial of right lung $> 1.5\text{cm}$. 6). right ventricle increase. 7). pulmonayr arteial segment convex $> 3\text{mm}$. 8). $P > 0.22\text{mv}$ or 0.20mv and sharp +axis of $P > +80^\circ$. 9). right axis deviation $> 90^\circ$. 10). $V5 R/S < 1$. 11). $IPI - V1 > +0.03$. 12). right ventricle increase. 13). There is another parameter factor.

2). The Affirmed Method of the Weight of Every Factor

The weight of every fator is affirmed with maximum likelihood method as following :

$$A_i = \prod_{j=1}^m P_{iD_j}(X_i) q_{iD_j}(1-X_i) \quad (i=1, \dots, n; j=1, \dots, m.) \quad (1)$$

According to formula (1), we get the weight of every factor, such as A_i and let $\sum_{i=1}^n A_i = 1$. The weights are shown in vector $A = \{a_1, \dots, a_n\}$. It is fuzzy set on S.

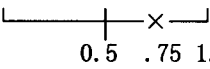

3). Membership Function Is Established

The membership function which between every factor and

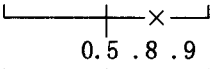
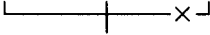
each disease is existed objectively. The membership degree between them is different. Here, with the method of degree analysis, based on above conditional probability and probability of which the illness takes place we reckon probability of $PAMP > 20\text{mmHg}$ and $PAMP < 20\text{mmHg}$ on the condition of which combination of symptoms and signatures exist. It is the membership degree.

Let $D1 = PAMP > 20\text{mmHg}$, $D2 = PAMP < 20\text{mmHg}$, $X_i (i=1, \dots, 13)$ show each factopr of diagnosis and $X \in S$. If they are independent with each other we can get membership degree $\mu_{D_j}(X_i)$ based on method of degree analysis.

The value of every target was obtained by mean of sheep answer. For example, the shortness of breath and lower breath sound after walk. It was divided into two condition that is " $PAMP > 20\text{mmHg}$ and $PAMP < 20\text{mmHg}$ ". If the patient have it then your reckon probability of $PAMP > 20\text{mmHg}$ and $PAMP < 20\text{mmHg}$ on the condition of which combination of symptoms and signatures exist. These targets were scored according to the docter evaluat (degree of Dr-confidence), meantime, we scored the degree of confidence of Dr-confidence. e. g

shortness of breath and lower breath sound after walk.	$PAMP > 20\text{mmHg}$	✓		0.75 (degree of Dr-confidence)
	$PAMP < 20\text{mmHg}$			1.0 (degree of confidence)

For example the heart beats (cardiac space) cardiac apex) of Dr-examination have had after chekeit.

heart beats (cardiac space) cardiac apex)	$PAMP > 20\text{mmHg}$	✓		0.8 (degree of Dr-confidence)
	$PAMP < 20\text{mmHg}$			0.9 (degree of confidence)

We similarly get the degree of confidence or Dr- confidence of targets. The degree of membership is the product of degree of confidence and degree of Dr-confidence. e. g. degree of Dr-confidence of shortness of breath and lower breath sound after walk ($PAMP > 20\text{mmHg}$) is 0.75, the degree of confidence is 1.0, the degree of membership is 0.75 ($0.75 \times 1.0 = 0.75$). this is degree of membership of $PAMP > 20\text{mmHg}$, then the $PAMP < 20\text{mmHg}$ is 0. At the same time we get degree of membership which is every factor relative to each class. We get the relation matrix R.

$$R = \begin{bmatrix} 0.75 & 0 \\ 0.80 & 0 \\ 0 & 0.72 \\ \dots & \dots \\ 0 & 0.43 \end{bmatrix}$$

4). Model of Diagnosis

In fact the diagnosis of disease is a problem of multifactorial evaluation. If S is factor set, D is diagnosis set, then the R is fuzzy relation between S and D . If a is fuzzy subset on S , B is fuzzy subset on D then we have $B=A \circ R$. Among them

$$D_j = \sum_{i=1}^n a_i \cdot r_{ij} \quad (2)$$

If $D_{j_0} = \max_{1 \leq j \leq m} D_j$, based on principle of maximum membership, the D_{j_0} is the result of diagnosis.

3.Application and Conclusion

In clinic practice, the results of diagnosis of fuzzy pattern are better than those of doctors. We make use of the method of fuzzy pattern to carry on clinic diagnosis for 40 patients with COPD and pulmonary heart disease. The correct rate of diagnosis has reached 92.5% but the correct rate of the clinic doctors has reached 75.6%. The method of fuzzy pattern is better than clinician diagnosis. The factor used diagnosis is easy to get with the method of conventional uninjured examination. There is not any equipment of cardiac microtube in some place, the method is helpful in diagnosis of early pulmonary heart disease. Therefore, it has practical value of clinic.

4. Reference

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