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RAPID COMMUNICATION

Relationship between onset of peptic ulcer and meteorological factors

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Abstract

AIM: To discuss the relationship between onset of peptic ulcer (PU) and meteorological factors (MFs).

METHODS: A total of 24 252 patients were found with active PU in 104 121 samples of gastroscoic examination from 17 hospitals in Nanning from 1992 to 1997. The detectable rate of PU (DRPU) was calculated every month, every ten days and every five days. An analysis of DRPU and MFs was made in the same period of the year. A forecast model based on MFs of the previous month was established. The real and forecast values were tested and verified.

RESULTS: During the 6 years, the DRPU from November to April was 24.4 -28.8%. The peak value (28.8%) was in January. The DRPU from May to October was 20.0 -22.6%, with its low peak (20.0%) in June. The DRPU decreased from winter and spring to summer and autumn (P < 0.005). The correlated coefficient between DRPU and average temperature value was -0.8704, -0.6624, -0.5384 for one month, ten days , five days respectively (P < 0.01). The correlated coefficient between DRPU and average highest temperature value was -0.8000, -0.6470,-0.5167 respectively (P <0.01). The correlated coefficient between DRPU and average lowest temperature value was -0.8091, -0.6617, -0.5384 respectively (P <0.01). The correlated coefficient between DRPU and average dew point temperature was -0.7812, -0.6246, -0.4936 respectively (P <0.01). The correlated coefficient between DRPU and average air pressure value was 0.7320, 0.5777, 0.4579 respectively (P <0.01). The average temperature, average highest and lowest temperature, average air pressure and average dew point temperature value of the previous month, ten days and five days could forecast the onset of PU, with its real and forecast values corresponding to 71.8%, 67.9% and 66.6% respectively.

CONCLUSION: DRPU is closely related with the average temperature, average highest and lowest temperature, average air pressure and average dew point temperature of each month, every ten days and every five days for the same period. When MFs are changed, the human body produces a series of stress actions. A long-term and median-term based medical meteorological forecast of the onset of PU can be made more accurately according to this.

Key words: Peptic ulcer; Meteorological factors; Temperature

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INTRODUCTION

The onset of peptic ulcer (PU) is characterized by seasons, with a high incidence in winter and spring and a low incidence in summer[1-8]. We made a correlated analysis of the relationship between detectable rate of PU (DRPU) from 1992 to 1997 in Nanning and a regressive analysis of the meteorological factors (MFs) in the same period. We found that DRPU was closely related to the seasons and MFs.

Table 1 The 7 meteorological factors

MF	Symbol	Unit
Average temperature of 1 month, ten days and five days	Tpj	^{0}C
Average highest temperature of 1 month, ten days and five days	Tmax	^{0}C
Average lowest temperature of 1 month, ten days and five days	Tmin	^{0}C
Average air pressure of 1 month, ten days and five days	P	hPa
Average relative humidity of 1 month, ten days and five days	FF	%
Average dew point temperature of 1 month, ten days and five days	Td	^{0}C
Average total amount of precipitation of 1 month, ten days and five days	RR	mm

MATERIALS AND METHODS

Materials

A total of 24 252 patients with active PU were found from 17 hospitals in Nanning from 1992–1997. We then calculated the detectable rate of peptic ulcer in every season, every month, every ten days and every five days. The average value of the 7 MFs was provided by Guangxi Meteorological Observation Station (Table 1).

Methods

We used detectable rate of peptic ulcer (DRPU) to represent the incidence. The detectable rate of a disease was higher than the incidence of its natural multitude, but the variation of both was similar as previous;y described[8].
(DRPU = number of persons of PU at the same period of time /total number of persons of gastroscopic examination at the same period of time × 100%).

Statistical analysis

We made a correlated analysis of the DRPU of 1 month, ten days and five days and the 7 MFs in the same period in Nanning. On the basis of it, we carefully chose the meteorological factors. A regressive effect F value test was made for all the independent variables and factors. A multiple linear regressive mathematical model was established for DRPU forecast equation[9].

RESULTS

Relationship between DRPU and seasons

From 1992 to 1997, the average DRPU in Nanning was 23.29%. The average DRPU from November to April was 24.2-28.8%, with its peak value being 28.8% in January. The average DRPU from May to October was 20.0-22.6%, with its low peak value being 20.0% in June. The DRPU in winter was 26.48%, 24.98% in spring, 21.10% in summer, and 20.91% in autumn. The seasonal DRPU was χ^2 = 343.3004 (*P* <0.005), indicating that the DRPU differed remarkably in seasons. When the DRPU in winter and spring was compared with that in summer and autumn, χ^2 = 327.4435 (*P* <0.005). When the DRPU in winter was compared with that in spring, summer and autumn, χ^2 = 194.0589 (*P* <0.005). When the DRPU in spring was compared with that in summer and autumn, χ^2 = 153.8931 (*P* <0.005). When the DRPU in summer was compared with that in autumn, χ^2 = 0.2744 (*P* >0.750). The above values showed that the onset of PU was as follows: winter and spring>summer and autumn, winter >spring >summer and autumn. The difference was significant.

Relationship between DRPU AND MFs

We made a further correlated analysis of the DRPU and the 7 MFs in the same period. The results showed that the DRPU was not evidently related to the relative air humidity, but had a negative relation with the average temperature, average highest and lowest temperature, average dew point temperature (*P* <0.01) and a positive relation with the AAP (*P* <0.01, Table 2). We found that when the monthly average temperature ≤21℃, the monthly average highest temperature ≤26℃, the monthly average lowest temperature ≤18℃, the monthly average air pressure ≥ 1007 hPa,the monthly average dew point temperature ≤ 15℃, the average ten-day temperature ≤19℃, the average ten-day highest temperature ≤24℃, the average ten-day lowest temperature ≤17℃, the average ten-day air pressure≥1008 hPa, the average ten-day dew point temperature ≤14℃, the average five-day temperature ≤17℃, the average five-day highest temperature ≤20℃, the average five-day lowest temperature ≤14℃, the average five-day air pressure≥1008hPa,the average five-day dew point temperature ≤12℃. The correlated analysis of the high onset of DRPU of 1 month, ten days, five days and the above single factors corresponded to 75%-78%. The statistical relation between the factors, can be described by the multivariate linear regression equation:

$$\hat{y} = b_0 + b_1 x_{i1} + b_2 x_{i2} + \cdots + b_p x_{ip} \quad (i = 1, 2, 3 \cdots n)$$

where b_0, b_1, b_2…bp stand for regression coefficients; n is sample size; x_{i1}, x_{i2}, …, x_{ip} are predictors; $\hat{y}$ is the predicted value. The multiple linear regressive equation was established as follows:

YmonthDRPU=127.89366 + 0.95687Tpj - 0.46658Tmax-0.97166Tmin - .0929P-0.07886Td,
average error = 2.0051, complex relative coefficient = 0.8129, F month test value = 25.7068, F0.01 = 3.60, F month > F_a, thus *P*<0.01.
Yten-dayDRPU=62.93681 = 0.34811Tpj + 0.06056Tmax-0.18958Tmin-0.02957P + 0.0004Td, average error = 2.981, complex relative coefficient = 0.664, Ften-day test value = 33.1117, F0.01 = 3.40, F ten- day > Fa, thus *P* <0.01.
Yfive-dayDRPU=63.49121-0.76259Tpj+0.27832Tmax-

Table 2 Correlated analysis of DRPU and 7 MFs

Related DRPU	Group	Related coefficient	*P* value
Monthly average temperature	72	-0.8704	<0.01
Average ten-day temperature	216	-0.6624	<0.01
Average five-day temperature	432	-0.5384	<0.01
Average monthly highest temperature	72	-0.8000	<0.01
Average ten-day highest temperature	216	-0.6470	<0.01
Average five-day highest temperature	432	-0.5167	<0.01
Average monthly lowest temperature	72	-0.8091	<0.01
Average ten-day lowest temperature	216	-0.6617	<0.01
Average five-day lowest temperature	432	-0.5384	<0.01
Average monthly air pressure	72	0.7230	<0.01
Average ten-day air pressure	216	0.5777	<0.01
Average five-day air pressure	432	0.4579	<0.01
Average monthly relative humidity	72	-0.2334	>0.05
Average ten-day relative humidity	216	-0.1364	>0.05
Average five-day relative humidity	432	-0.0657	>0.05
Average monthly dew point temperature	72	-0.7812	<0.01
Average ten-day dew point temperature	216	-0.6246	<0.01
Average five-day dew point temperature	432	-0.4936	<0.01
Monthly precipitation	72	-0.2013	>0.05
Ten-day precipitation	216	-0.0916	>0.05
Five-day precipitation	432	-0,0418	>0.05

The results of regressive effect analysis indicated that the 3 multiple regressive equations based on DRPU and variation of the 5 MFs had remarkable effects.

0.06448Tmin - 0.03043P + 0.0764Td, average error = 4.0499, complex relative coefficient = 0.5434, Ffive - day test value = 35.6956, F0.01 = 3.07, F five - day >Fa, thus *P* <0.01.

Establishment of DRPU forecast equation and test of its significance

The correlated analysis of DRPU of 1 month, ten days, five days and 7 MFs of the previous month, ten days and five days indicated that the average temperature, average highest and lowest temperature, average air pressure and average dew point temperature of the previous month were also closely related to the DRPU of the present month, ten days and five days (Table 3). Thus if we made the 5 MFs of the previous month, ten days and five days and the DRPU of the present month , ten days and five days, the factors of three DRPU forecast equations could be established as follows:

YmonthDRPU=-358.09409-4.75833Tpj+2.08101 Tmax+2.97619Tmin+0.37869P-0.29906Td, average error=2.1138, complex relative coefficient=0.7907, F month test value= 21.6887, F0.01 =3.60, F month >Fa, thus *P*<0.01.

Yten-dayDRPU=-45.84159-0.26677Tpj+0.05189Tmax-0.09075Tmin+0.07605P-0.04132Td, average error=3.0625, complex relative coefficient=0.6383, F ten-day test value= 28.7387, F0.01=3.40, F ten- day>Fa, thus *P*<0.01.

Yfive-dayDRPU=-0.826-0.13995Tpj-0.00568Tmax-0.24365Tmin+0.04104P+0.00342Td, average error=4.0629, complex relative coefficient=0.5362, Ffive-day test value=34.2292, F0.01=3.07, F five -day> Fa, thus *P*<0.01.

DISCUSSION

It is generally believed that the occurrence of PU is due to the effect of unbalance between the attacking factors such as hydrochloric acid in gastric juice and the defending factors of the mucosa. *Helicobacter pylori* (*H pylori*) infection is also an important cause of PU[10-25]. Treatment of hydrochloric acid in gastric juice and anti- pylorus bacteria can protect stomach duodenum mucosa, yet the occurrence of PU still has remarkable seasonal variations [8]. Therefore the influence of variations of meteorological factors on PU must be considered. Research has shown that the occurrence of PU in winter is related to the higher air pressure and temperature [8]. The high occurrence of PU

Table 3 Correlated analysis of DRPU and 5 MFs of the previous month, ten days, and five days

Related DRPU	Group	Related coefficient	*P* value
Average monthly temperature	71	-0.6621	<0.01
Average ten-day temperature	215	-0.6302	<0.01
Average five-day temperature	431	-0.5324	<0.01
Average monthly highest temperature	71	-0.6291	<0.01
Average ten-day highest temperature	215	-0.6097	<0.01
Average five-day highest temperature	431	-0.5123	<0.01
Average monthly lowest temperature	71	-0.6781	<0.01
Average ten-day lowest temperature	215	-0.6350	<0.01
Average five-day lowest temperature	431	-0.5348	<0.01
Average monthly air pressure	71	0.7628	<0.01
Average ten-day air pressure	215	0.5942	<0.01
Average five-day air pressure	431	0.4840	<0.01
Average monthly dew point temperature	71	-0.7220	<0.01
Average ten-day dew point temperature	215	-0.6171	<0.01
Average five-day dew point temperature	431	-0.5077	<0.01

The above analysis showed that the 3 forecast equations had good regressive effect. The real test values of the three forecast equations were 71.8%, 67.9% and 66.6%, respectively.

in summer is likely to be related to the lower air pressure. Our study also confirmed the seasonal onset of PU. Analysis of MFs has shown that special attention should be paid to PU patients in winter and spring [26]. Since increased air pressure and dry air result from the cold air, temperature plays a more important role [27]. When these meteorological factors are changed violently, a series of stress action take place, causing endocrinopathy. It was reported that severe cold and changing temperature result in acute stress actions in human body, causing excitation of sympathetic nerve and adrenal gland marrow and rapid secretion of adrenaline and noradrenalin[28]. Animal tests also showed that mouse hypertensin II is much higher compared with acute stress action, sub-acute stress action and other chronic stress action [28]. When human body is stimulated by acute or slow stress action, hypertensin II in plasma increases remarkably. Cold stimulation and oxygen shortage stimulation may accelerate secretion of endothelin. Adrenaline, hypertensin II and endothelin may cause contraction of duodenal mucosa and blood vessel, leading to mucosa blood flow fall and mucosa damage [29-30]. Stomach blood insufficiency may also stimulate the rise of endothelin [31]. Kou and Li [32] reported that the stomach mucosa blood vessels contract immediately after injection of endothelin. It has also been verified that plasma endothelin density of PU patients is related to the degree of damaged stomach mucosa [33]. Stress action may lessen the stomach mucosa mucus, and lower the stomach mucosa's protective function [28]. Furthermore cold stress action may lessen the secretion of inhibitable growth factors [34, 35]. When the secretion of the inhibitable growth factors becomes less, secretion of hydrochloric acid increases in gastric juice. Meanwhile endothelin can accelerate the secretion of hydrochloric acid in gastric juice. It has been verified that when endothelin is injected, plasma progastrin increases progressively [32]. When blood supply is insufficient in the duodenal mucosa and the protection barrier is damaged due to insufficient oxygen, the increase of hydrochloric acid in gastric juice accelerates the occurrence is of PU. Moreover, cold weather decreases human body's immunity function [28]. Some Japanese experts pointed out that from December to March, the number of human body outer lymph cells and B lymph cells is small [36], indicating lower body cell immunity and body fluid immunity function. Therefore when the temperature stimulates human body, adrenocorticotropin increases its secretion and hypertensin II rises, restraining the body immunity function and causing immunity functional disorder, and making it easy for the duodenal mucosa to be attacked by *H pylori* [37], which destroys the stomach mucosa protection barrier, impairs the stomach mucosa and then restrains secretion of inhibitable growth factors and stimulates secretion of progastrin[12-25].

In conclusion, acute, sub-acute and slow stresses on the human body are likely the cause of PU in winter and spring.

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