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Influence of meteorological factors in the incidence of upper gastrointestinal bleeding in Beijing

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INTRODUCTION

Upper gastrointestinal bleeding (UGIB) is defined as a hemorrhage from mouth to the ligament of Treitz. With a considerable morbidity and mortality, as well as the financial burden, UGIB has become a global concern. The relationship between UGIB and meteorological factors remains controversial. Such inconsistent conclusions may be related to the study area, etiology of UGIB and time period division. In this study, we aimed to determine the onset rhythms of UGIB caused by different etiologies and to assess their correlations with climatic factors by using solar terms. Results showed that non-NSAIDs-related peptic ulcer bleeding showed two peak onsets, and gastroesophageal varices (EGV) bleeding occurrence had one peak period. Peak onset of UGIB was observed when the temperature reached 10 °C. Relative humidity was associated with the risk of EGV bleeding. In conclusion, UGIB caused by different etiologies has various onset regularities. Determining the correlation between UGIB and meteorological factors can aid in improving prevention and therapeutic strategies.

AIM

In this study, we aimed to determine the onset rhythms of UGIB caused by different etiologies and to assess their correlations with climatic factors.

METHOD

- **Single-center retrospective study**: we retrospectively reviewed patients admitted to our hospital from 2014 to 2018.
- Patients whose UGIB was caused by non-steroidal anti-inflammatory drugs (NSAIDs)-related peptic ulcer, non-NSAIDs-related peptic ulcer, or gastroesophageal varices (EGV) were included.
- The frequency of UGIB was evaluated based on solar terms.
- Circular distribution test was performed to investigate the central trend of bleeding onset. Generalized additive models (GAMs) were applied to analyze the correlations between UGIB onset and climatic factors.

RESULTS

Six hundred and sixty-four patients (515 (77.56%) men and 149 (22.44%) women) who had UGIB caused by non-NSAIDs-related peptic ulcer (non-NSAIDs group, n=345), NSAIDs-related peptic ulcer (NSAIDs group, n=161) or EGV (EGV group, n=158) were enrolled in the study. All patients had hematemesis and/or melena or hematochezia with/without hemodynamic instability, and the diagnosis of UGIB caused by different etiologies was confirmed by endoscopy and their medical history. We clarified the stability of meteorological factors from January 1, 2014 to December 31, 2018. Meteorological factors included daily average temperature, atmosphere pressure, relative humidity, wind speed and daily temperature range (Figure A-E). There were no significant difference among the 5 years (P>0.05), so we could pooled the 5-year data together and analyze the correlations between UGIB onset and climatic factors.

The UGIB cases in 24 solar terms (Table) during the five-year period are shown in Figure F. Significant difference was found in non-NSAIDs and EGV groups (P=0.013 and P=0.008, respectively) but not in NSAIDs group (P =0.142). To determine the specific onset pattern, circular distribution analysis was performed on non-NSAIDs and EGV groups. EGV group showed central trend on case occurrence ($Z > Z_{0.05}$). The peak period was from the Great Heat last year to the Spring Equinox this year. However, no central trend was found in non-NSAIDs group ($Z < Z_{0.05}$), because the occurrence of non-NSAIDs-related peptic ulcer bleeding was multimodal distributed (peaked in the Great Snow and the Waking of Insects).

To analyze the relationship between UGIB occurrence and meteorological factors, we used GAM, which allowed non-linear relations between the response variable and each explanatory variable, and added interaction between variables to further analyze the data. The optimal model, which had the minimum AIC value, contained time and average temperature. Non-NSAIDs-related peptic ulcer bleeding had peak onset when the average temperature reached 10 °C, then turned into a descending trend when temperature got higher (Figure G). As for EGV bleeding, the model with the minimum AIC contained average temperature and relative humidity. Based on this model, when the average relative humidity of solar term was constant, the incidence increased by 3% when the average temperature decreased by 1 °C, and when the average temperature was constant, the average relative humidity increased by 1%, the incidence increased by 1.3%. The incidence of NSAIDs-related peptic ulcer bleeding showed no correlations with meteorological factors.

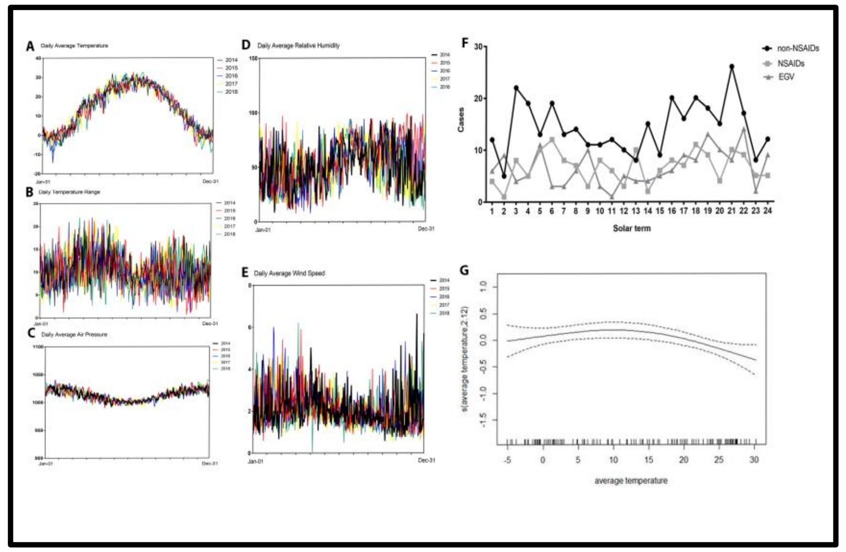

Figure. (A-E) Daily data of Meteorological factors from January 1, 2014 to December 31, 2018. （F）UGIB incidence in 24 solar terms. (G) Generalized additive model (GAM) for non-NSAIDs-related ulcer bleeding and meteorological factors.

Name and beginning day of each solar term from 1 to 24.		
	Solar terms	Beginning date[a]
1	the Beginning of Spring	Feb. 3rd-4th
2	Rain Water	Feb. 18th-19th
3	the Waking of Insects	Mar. 5th-6th
4	the Spring Equinox	Mar. 20th-21th
5	Pure Brightness	Apr. 4th-6th
6	Grain Rain	Apr. 19th-20th
7	the Beginning of Summer	May. 5th-6th
8	Grain Full	May. 20th-22nd
9	Grain in Ear	Jun. 5th-6th
10	the Summer Solstice	Jun. 21st-22nd
11	Slight Heat	Jul. 7th-8th
12	Great Heat	Jul. 22nd-23rd
13	the Beginning of Autumn	Aug. 6th-9th
14	the Limit of Heat	Aug. 22nd-24th
15	White Dew	Sep. 7th-8th
16	the Autumnal Equinox	Sep. 22nd-24th
17	Cold Dew	Oct. 7th-9th
18	Frost's descent	Oct. 23rd-24th
19	the Beginning of Winter	Nov. 7th-8th
20	Slight Snow	Nov. 22nd-23rd
21	Great Snow	Dec.7th-8th
22	the Winter Solstice	Dec. 21st-23rd
23	Slight Cold	Jan. 5th-6th
24	Great Cold	Jan. 19th-21st

[a]As the beginning day of each solar term varies slightly every year, the dates given here are just indicative range.

CONCLUSIONS

UGIB caused by different etiologies has various onset regularities. Determining the correlation between UGIB and meteorological factors can aid in improving prevention and therapeutic strategies.

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