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ORIGINAL ARTICLE

Influence of meteorological factors on acute aortic events in a subtropical territory☆

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Summary *Background/Objective:* This study aims to examine the relationship between weather changes and acute aortic events in a subtropical territory.
Methods: A linear regression analysis was performed in a pan-territory epidemiological survey for a period of 10 years on the impacts of meteorological factors (ambient temperature, atmospheric pressure, relative humidity, amount of cloud, rainfall, number of lightning strikes, presence of typhoon, and thunderstorm warning) on the daily incidences of acute aortic dissections and ruptured aortic aneurysms. Meteorological variables were retrieved on a daily basis from a well-established observatory, and the daily incidences of aortic dissections and rupture of aortic aneurysms were retrieved from the Clinical Data Analysis and Reporting System.
Results: During the study period (January 2005 to December 2014), 3878 patients were identified as having acute aortic dissections, and 1174 patients had ruptured aortic aneurysms. Corresponding averaged daily incidences were 1.06 and 0.32, respectively. The incidences of aortic dissection and ruptured aortic aneurysm in a day could be predicted by ambient temperature in degrees Celsius using the following linear regression models: (1) incidence of aortic dissection $= 1.548 - 0.021 \times$ temperature; (2) incidence of ruptured aortic aneurysm $= 0.564 - 0.010 \times$ temperature. In addition, both high atmospheric pressure and absence of thunderstorm warning are positively associated with more aortic dissections. For rupture of aortic aneurysms, high atmospheric pressure and low relative humidity were positive predictors. In multiple regression analysis, however, ambient temperature was the only significant predictor for both acute aortic dissections and ruptured aortic aneurysms.

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Conclusion: This is the first pan-territory study to show an attributable effect of ambient temperature on acute aortic events. This paper confirms that even in a subtropical country, meteorological variables were important factors influencing acute aortic events.

1. Introduction

Many studies have reported an association between cold weather and incidence rate of acute cardiovascular events such as myocardial infarction[1–14] or cerebrovascular accidents.[15–24] Several publications have demonstrated seasonal variation in acute aortic events such as aortic dissection[25–27] and rupture of aortic aneurysm.[28–32] However, these observatory studies were conducted almost exclusively in countries with severe winter conditions, and to date there are no such studies in countries with subtropical climates.

This study was based on a pan-territory survey conducted for a period of 10 years in Hong Kong, in a subtropical territory where summer and winter seasons are distinct. In the study setting, the use of household heater is not common and people are exposed to the true ambient atmospheric weather. Hong Kong is one of the most densely populated areas in Southeast Asia with 7.4 million people concentrated in 1104 km^2 (426 mi^2), equating to an overall population density of about 6300 people/km^2 of land, 93.6% of whom are ethnic Han Chinese.[33] There is usually little variation in meteorological factors across our small territory. Hong Kong has a world-renowned reliable and accurate observatory, established in 1883, which maintains well-documented, meticulous daily meteorological dataset.[34] Hong Kong also has in service a dedicated, reliable Pan-territory electronic registry containing data on patients' morbidity and mortality due to acute aortic events over a long period. The clinical management system (CMS) and electronic patient record (ePR), built in-house since 1991 in all the public hospitals, store essential clinical data of more than 7 million patients who attended our public hospitals.

This 10-year population-based longitudinal study is the first pan-territory survey to examine the influence of meteorological variables on acute aortic events (acute aortic dissection and ruptured aortic aneurysms) in a subtropical territory.

2. Methods

2.1. Collection of meteorological data

The Hong Kong Observatory has an accurate and reliable electronic meteorological database, which is readily available to the public through their website.[34] From this database, data on meteorological factors such as maximum ambient temperature (°C), mean temperature (°C), minimum temperature (°C), atmospheric pressure (hPa), mean relative humidity (%), mean amount of cloud (%), number of lightning strokes, typhoon signal warning (Yes or No), and thunderstorm signal warning (Yes or No) are available on a daily basis. Retrieved data were tabulated electronically onto an SPSS spreadsheet (IBM SPSS statistics, version 22.0) on a daily basis.

2.2. Collection of clinical data on acute aortic events

For the purpose of this study, we divided acute aortic events into either acute aortic dissections or ruptured aortic aneurysms. From a centralized public health care (computerized) database of Hong Kong public hospitals (the CMS and ePR, and data extracted from the Clinical Data Analysis and Reporting System), data on regional daily incidence of (1) aortic dissection, (2) aortic dissection with operation, (3) ruptured aortic aneurysm, and (4) ruptured aortic aneurysm with operation were retrieved. Search criteria were all emergency admissions with (1) primary discharge diagnosis of aortic dissection [9th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD9) 441.0], (2) diagnosis of aortic dissection and a procedure (ICD9 38.xx and 39.xx), (3) diagnosis of ruptured aortic aneurysm (ICD9 441.1, 441.3, 441.5, 441.6), and (4) diagnosis of ruptured aortic aneurysm and a procedure (ICD9 38.xx, 39.xx, 54.xx).

The precise number of events occurring each day was then entered electronically onto an electronic spreadsheet. Thus, we have data on both the meteorological factors and the incidence of acute aortic events within every single day in the study period.

2.3. Statistical analysis

Data were analyzed on a daily basis from 00:00 AM to 23:59 PM. Meteorological factors were used as predictors of acute aortic events. The incidences of aortic dissections and ruptured aortic aneurysms were regarded as event outcomes.

A linear regression model was built using mean ambient temperature, atmospheric pressure, relative humidity, amount of cloud, number of lightning strokes, and presence or absence of typhoon signal warning or thunderstorm signal warning as independent variable and incidence of acute aortic events as dependent variables. The correlation coefficient (R) indicated the direction of correlation (positive or negative) between the two variables; correlation of determination (R^2) measured the amount of variability in one variable that was shared by other; and the F ratio