Diurnal Temperature Change is Associated with Testicular Torsion: A Nationwide, Population Based Study in Taiwan

Jeng-Sheng Chen, Yung-Ming Lin and Wen-Horng Yang*

From the Department of Urology, National Cheng Kung University College of Medicine, Tainan, Taiwan

Abbreviations and Acronyms

CWB = Central Weather Bureau

DTC = diurnal temperature change

LHID = Longitudinal Health Insurance Database

NHIRD = National Health Insurance Research Database

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* Correspondence: Department of Urology, National Cheng Kung University College of Medicine, 138 Sheng-Li Rd., Tainan 704, Taiwan (telephone: 886-6-235-3535, ext. 5251; FAX: 886-6-238-3678; e-mail: solarex333@gmail.com).

Purpose: We investigated the association between climatic variables and testicular torsion in Taiwanese males.

Materials and Methods: Using the Taiwan Longitudinal Health Insurance Database, we reviewed the files of patients who were diagnosed with testicular torsion and underwent orchiectomy or orchiopexy between January 1996 and December 2008. Children younger than 1 year were excluded from the study. Climatic data were provided by the Taiwan Central Weather Bureau and included ambient temperature, relative humidity, diurnal temperature change and barometric pressure. Patients with acute appendicitis who underwent appendectomy were chosen as the control group. Climatic variables in relation to testicular torsion were analyzed using the Mann-Whitney U test and chi-square test, and seasonal climatic variations using the Kruskal-Wallis H test. Relative risk was calculated to compare the incidence of testicular torsion for diurnal temperature changes.

Results: A total of 65 patients with a mean age of 16.2 years presented with testicular torsion and were treated surgically. Four children younger than 1 year were excluded, and thus the study population consisted of 61 patients. The estimated incidence of testicular torsion was 2.58 per 100,000 person-years. There were no special climatic conditions on days of admission. However, 73.7% of the patients had testicular torsion when the diurnal temperature change was 6C or greater. Compared to the torsion rate for diurnal temperature changes less than 6C, the relative risk of testicular torsion at 6C or greater was 1.8 ($p = 0.05$). Average seasonal diurnal temperature change in the 2 days before hospitalization showed increases in all seasons except spring, which fluctuated.

Conclusions: Diurnal temperature change was associated with testicular torsion and may be an etiological climatic factor affecting this condition. This is the first known study to demonstrate an association between diurnal temperature change and testicular torsion.

Key Words: climate, spermatic cord torsion, testis

TESTICULAR torsion is characterized by the acute onset of scrotal pain and swelling. An increased incidence of testicular torsion in male adolescents has been reported extensively.[1–5] Testicular torsion is an urgent urological condition that often requires surgical exploration. A significantly increased rate of orchiectomy has been reported in patients with late surgical exploration (56% at more than 6 hours after symptom onset vs 9.1% before 6 hours).[5] Based on time from symptom onset to surgery, testicular salvage rates are 90% if surgery is performed within 6 hours, 50% if performed within 12

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hours and less than 10% if performed after 24 hours.[6] Once a diagnosis of testicular torsion is suspected, surgical exploration should follow promptly.

While the management of testicular torsion is clear, the etiology of this condition remains uncertain. A growing body of literature attributes torsion to climatic factors. One study revealed that the incidence of testicular torsion increased when the ambient temperature was less than 2C.[7] The proposed theory is that torsion is caused by a more pronounced hyperactive cremasteric reflex during cold weather.

In Nigeria during November to February, when the ambient temperature and relative humidity are low, testicular torsion is almost 3 times as common as in other months.[8] A similar association between testicular torsion and climatic conditions was reported in a United States study.[9] A Japanese study showed that more than 75% of testicular torsion cases occurred when the ambient temperature was less than 15C, and that there was a correlation between temperature decrease and onset frequency.[10] Two recent epidemiological population based studies suggest that seasonal variations affect the incidence of testicular torsion, with a significant increase in events in winter (21,289 cases),[11] and a monthly incidence that is positively associated with seasonality and negatively associated with ambient temperature (1,782 cases).[12] Despite these reports, an association between testicular torsion and cold weather is not universally observed.[13–16] In addition, no study has explained why testicular torsion also occurs in warmer regions and seasons. One series suggests that the climate in the southern United States does not vary enough to influence the occurrence of testicular torsion,[15] although diurnal variation in temperature is a risk factor for asthma exacerbation, mortality, and cardiovascular and respiratory related hospitalizations.[17–19]

To our knowledge there has been no study on the association between testicular torsion and diurnal variation in temperature. According to the information from the CWB, Taiwan is in the subtropical zone with a mild climate. The average annual temperature is about 23C, and the average daily temperature variation is about 6C to 7C. We hypothesized that DTC is important in testicular torsion and conducted a nationwide, population based study to examine the association.

MATERIALS AND METHODS

Study Population

This retrospective, population based study was designed to analyze the association between testicular torsion and climatic factors in Taiwan between January 1, 1996 and December 31, 2008. We retrieved patient data from LHID 2000 and population data from the Taiwan Department of Household Registration (Ministry of the Interior). LHID 2000 was established by the National Health Research Institute and includes the original claims data of 1,000,000 patients randomly sampled from NHIRD in 2000. The National Health Research Institute determined that there were no significant gender or age distribution differences between LHID and NHIRD. From LHID 2000 we obtained records of clinic visits, hospitalizations and surgical procedures, as well as demographic information (including age, gender and residence). Personal information for each patient was encrypted and anonymized. Each record also contained diagnoses and procedures coded according to the ICD-9-CM.

Study Design

All males diagnosed with testicular torsion (ICD-9-CM code 608.2) and treated with orchiectomy (code 623) or orchiopexy (code 625) were included. Children younger than 1 year were excluded. We included males with acute appendicitis (ICD-9-CM code 540) who underwent appendectomy (code 470) as controls. The control group was matched by geographic distribution for climatic conditions similar to the torsion group. The case-to-control ratio was 1:10. Because testicular torsion and acute appendicitis were medically urgent events, we defined the admission day as the day of event onset. For accuracy we only included hospitalized patients who underwent surgery. According to the National Health Insurance policy in Taiwan, most patients diagnosed with torsion would be hospitalized and undergo surgery. We hypothesized that DTC might be a risk factor for testicular torsion. In addition, more testicular movement might increase the risk of testicular torsion in susceptible patients.

Climatic Data

All climatic information (ambient temperature, relative humidity, DTC and barometric pressure) was provided by the Taiwan CWB. Climatic information was collected by meteorological professionals working at each weather station who were blinded to our clinical data. There are 26 weather observation stations distributed on the main island. Data from 7 stations in mountainous areas with sparse populations were excluded, as were incomplete data from 3 stations. The total land area of Taiwan is approximately 36,200 km^2. Deducting the mountainous area, the area of the plains, where most Taiwanese live, is small. Climatic data were collected from weather observation stations nearest the hospitals to which patients were admitted.

Definitions

The seasons in Taiwan are defined by the CWB. Spring occurs from March through May, summer from June through August, autumn from September through November and winter from December through February. The CWB also divides Taiwan into 4 main climatic regions, ie north, central, south and east. Each region has different climatic features. The ambient temperature in the north is lower than that in the south.

Statistical Analysis

We used the Kruskal-Wallis H test to analyze seasonal climatic variations and the Mann-Whitney U test to com-