Original Article

Seasonal Variation of Ventricular Tachycardia Assessed by 24-Hour Holter Monitoring

Maurício Pimentel, Letícia Grüdtner, Leandro I. Zimerman
Universidade Federal do Rio Grande do Sul - Porto Alegre, RS

Objective: To evaluate the seasonal variation of ventricular arrhythmias and its correlation with ambient temperature in patients submitted to 24-hour Holter monitoring in the city of Porto Alegre, southern Brazil.

Methods: Holter monitoring reports of 3,034 patients from 1996 to 2002 were analyzed. Ventricular tachycardia (VT) was defined as the presence of 3 or more consecutive ventricular beats, at a rate equal to or higher than 100 beats per minute. Percentage distribution of patients presenting VT by seasons and its correlation with ambient temperature were analyzed.

Results: Mean age was 59.2 ± 17.4 years, with a predominance of the female sex (61.9%). Patient distribution by season of the year was: 561 (18.5%) in summer, 756 (24.9%) in fall, 843 (27.8%) in winter and 874 (28.8%) in spring. Fifty-two patients (9.3%) presented VT episodes in summer, 39 (5.2%) in autumn, 56 (6.6%) in winter and 60 (6.9%) in spring ($p = 0.035$). There was a 40% relative increase in the proportion of patients presenting VT during summer in comparison to winter. There was a trend of increase in the proportion of patients presenting VT with rising temperatures ($r = 0.57$; $p = 0.052$).

Conclusion: The occurrence of VT presents seasonal variations in southern Brazil, with a higher proportion of episodes occurring in summer. There is an association trend between VT and temperature increase.

Key words: Ventricular tachycardia, seasons, Holter.

In the last years, several studies have demonstrated a seasonal variation in the incidence of cardiovascular events, such as myocardial infarction, sudden death, ventricular arrhythmias and stroke[1-4]. Most of these studies were carried out in the northern hemisphere and most of them disclosed an increase in the incidence of cardiovascular events during winter. However, in areas of the same hemisphere that presented differences of latitude and climate, some conflicting results were observed[5-7]. Heyer at al.[5] showed a higher incidence of myocardial infarction in summer in southern United States of America. In Brazil, in the city of São Paulo, two studies have consistently demonstrated an increase in mortality due to myocardial infarction during winter and its correlation with ambient temperature[8-9]. In comparison, the assessment of the seasonal variation of ventricular arrhythmias in the southern hemisphere has been hardly studied. The aim of this study was to evaluate the seasonal variation of ventricular arrhythmias observed in patients submitted to 24-hr Holter monitoring and its correlation with ambient temperature in the city of Porto Alegre, southern Brazil.

Methods

The results of 24-hr Holter monitoring, carried out in patients older than 18 yr of age, from 1996 to 2002, at the Cardiology Laboratory of Hospital Moinhos de Vento, Porto Alegre, Rio Grande do Sul, Brazil, were retrospectively analyzed. When the same patient underwent the examination in different periods, only the first one was included in the analysis. Holter reports did not bring systematic data on the presence or absence of cardiovascular disease, as well as the indication for the examination, thus such information was not assessed. Outpatient-based electrocardiographic evaluation was carried out for 24 hours, with a three-channel recording in a DMS 300-6 recorder (DMS, Escondido, California, USA). The recordings were evaluated through the CardioScan 8.0 program. Ventricular tachycardia (VT) was defined as the presence of three or more consecutive ventricular beats, with a frequency ≥ 100 bpm. All analyses were carried out by a cardiac electrophysiologist.

The city of Porto Alegre is situated at latitude 30 degrees south, in a temperate climate zone. The monthly mean ambient temperature in the period corresponding from 1996 to 2002 was obtained at the 8th District of Meteorology of the National Institute of Meteorology. For the study aim, the seasons of the year were defined as: summer (December to

Correspondência: Maurício Pimentel •
Rua La Plata, 980/601 – Porto Alegre, RS
E-mail: mauriciopimentel@cardiol.br
Recebido em 18/06/05 • Aceito em 08/12/05

February), autumn or fall (March to May), winter (June to August) and spring (September to November).

Statistical Analysis - The evaluation of the percentage distribution of patients with VT among the four seasons of the year was carried out through the Chi-square test. The evaluation of seasonal distribution was also evaluated regarding age and gender. The correlation between the percentage of patients with VT and temperature was carried out through Pearson's correlation test.

Results

From 1996 to 2002, Holter monitoring was carried out in 3,034 patients, being 1,853 females (61.9%) and 1,181 males (38.1%). Mean age was 59.2 ± 17.4 yrs. Patient distribution by season of the year was: 561 (18.5%) in summer, 756 (24.9%) in autumn, 843 (27.8%) in winter and 874 (28.8%) in spring. The distribution of the proportion of patients with VT during the four seasons is shown in Figure 1. Fifty-two patients (9.3%) presented VT episodes in summer, 39 (5.2%) in autumn, 56 (6.6%) in winter and 60 (6.9%) in spring ($p = 0.035$ for the difference among seasons of the year). There was a relative increase of 40% in the proportion of patients with VT in summer in comparison to winter.

There was a higher proportion of male patients with VT in comparison to the females (10.7 vs. 4.4%, respectively; $p<0.001$). Regarding the seasonal variation of the proportion of patients with VT, it was significant among the female patients, but not among the males. Among the females, the incidence of VT was 7.2% in summer, 2.1% in fall, 4.9% in winter and 4.4% in spring ($p=0.004$). Among the male patients, the incidence was 12.5% in summer, 10.2% in fall, 9.3% in winter and 11.2% in spring ($p=0.656$) (Fig. 2).

Regarding age, in the group of patients younger than 65 years (n=1,704) the incidence was 5.6% in summer, 2.9% in fall, 3.3% in winter and 5.7% in spring ($p=0.078$). Among patients who were 65 years or older, (n=1,330), the incidence was 13.7% in summer, 8.0% in fall, 11.3% in winter and 8.4% in spring ($p=0.071$).

Mean temperatures during the four seasons in Porto Alegre in the period from 1996 to 2002 were: 24.1 ± 0.7° C in summer, 20.3 ± 3.4° C in fall, 14.7 ± 1.2° C in winter and 19.2 ± 2.4°C in spring ($p = 0.006$). The mean monthly temperature and the proportion of patients with VT are shown in Fig. 3. The correlation between the proportion of patients with VT and the temperature is shown in Fig. 4, disclosing a possible trend between the increase of the number of patients with VT and temperature rise ($r=0.57$; $p=0.052$).

Discussion

This study shows that, in the assessed group, there was a significant increase in the proportion of patients with VT in summer. There was also a possible correlation trend between temperature rise and increase of proportion of patients with VT.

The seasonal variation of ventricular arrhythmias has been assessed in studies with animal models and observational studies. In a canine model of myocardial infarction, there was a higher incidence of ventricular arrhythmias in winter[10]. Recent observational studies in the northern hemisphere conducted a follow-up of patients with an implantable cardioverter-defibrillator (ICD) and evaluated the seasonal distribution of shocks for the treatment of malignant ventricular arrhythmias. Müller et al.[4] demonstrated 27% of appropriate shocks in summer in ischemic patients, in comparison to 31% in winter. Nevertheless, these findings cannot be directly compared with the results of this study. Patients with an ICD generally present severe heart disease and represent a selected group of patients.

In this study, 3,034 patients were assessed and although they do not represent a population sample, they probably present a lower degree of selection than patients with an ICD. In studies with ICD, malignant arrhythmia episodes were considered only in accordance with detection criteria and utilization of shocks programmed at the ICD. These episodes include basically polymorphic and monomorphic sustained tachycardia, which can trigger sudden death. In the present study, all episodes of sustained or unsustained VT, whether symptomatic or not, were detected during a shorter period of observation (24 hours). No sudden death episodes were recorded.

Possible factors that can influence the seasonal variation of ventricular arrhythmias have not been fully established. Thermal stress, due to very low as well as very high temperatures, can trigger alterations in physiological processes, and maybe physiopathological ones, determining a seasonal variation in cardiovascular events[12-15]. Some observational studies have shown that the correlation between temperature and cardiovascular events, including ventricular arrhythmias, can be expressed by a U-shaped curve, with an increase of events at the highest as well as the lowest temperature extremes [16-18]. In the city of Sao Paulo, Sharovsky et al.[9] demonstrated a lower incidence of mortality due to myocardial infarction with temperatures ranging from 21.6 to 22.6°C. Lower temperatures than this range were associated with a significant increase of cardiovascular events. Higher temperatures, on the other hand, although also associated with a higher probability of events, presented a lower risk.

The city of Porto Alegre is located in a temperate climate zone, and it does not present an excessive variation between temperature extremes in summer and winter. In this study, a possible positive correlation trend between the rise of temperature and increase of proportion of patients with VT registered by Holter monitoring was demonstrated. It could be considered that, in this area, the temperature rise in summer influenced the occurrence of ventricular arrhythmias, whereas the magnitude of temperature decrease recorded in winter was not enough to determine a variation in the occurrence of ventricular arrhythmias. Additionally, one must consider the fact that the climate and temperature variations in the northern hemisphere are different from those observed in the studied area, as winters are more rigorous and summers are milder in most of the studies.

The increase in the proportion of patients with VT in summer can be related not only to alterations in the absolute temperature degree, but also to behavior alterations, which are characteristic of this season. During summer, longer exposure

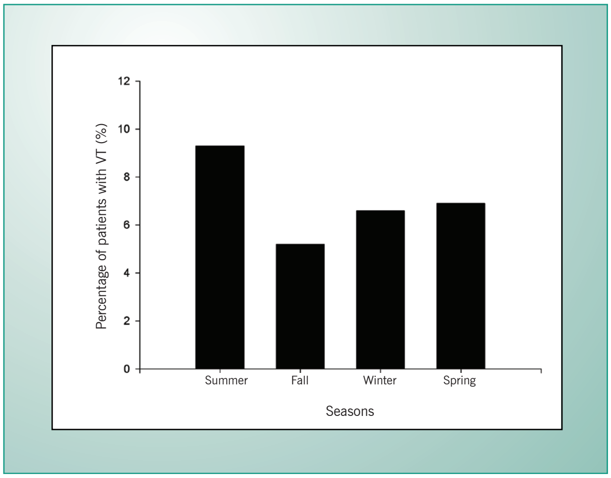

Fig. 1 – *Percentage of patients with ventricular tachycardia by season of the year (p = 0.035).*

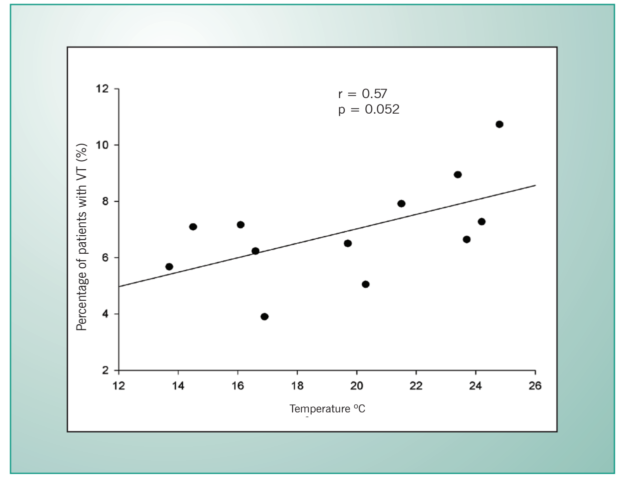

Fig. 4 – *Correlation between the percentage of patients with ventricular tachycardia (VT) and temperature.*

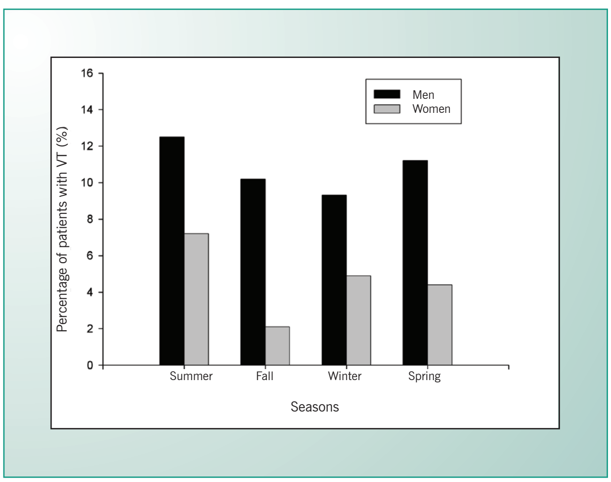

Fig. 2 – *Percentage of women and men with ventricular tachycardia by season of the year (p = 0.004 for women and p = 0.656 for men).*

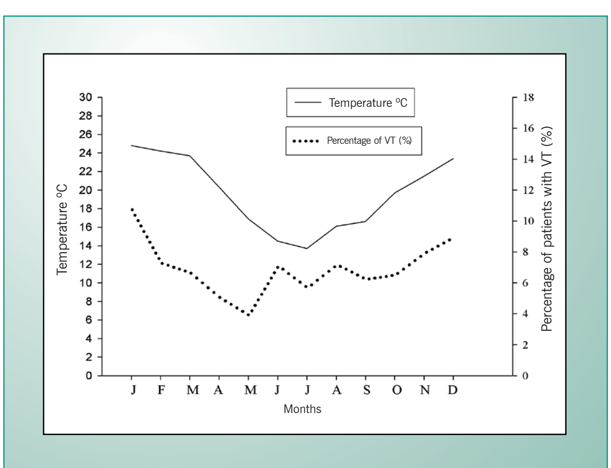

Fig. 3 – *Mean monthly temperature and percentage of patients with ventricular tachycardia (VT).*

to sunlight, increase of physical activities and uncontrolled weight-loss diets can lead to fluid and electrolyte loss through the skin, which can determine electrolyte imbalance, favoring the occurrence of ventricular arrhythmias. Similarly, the increased food and alcoholic beverage intake, which is characteristic of the vacation periods, can also contribute to an increase in the occurrence of ventricular arrhythmias.

The prevalence of structural heart disease, the substrate for the occurrence of VT episodes, is higher among men in comparison to women[19], which can explain the higher proportion of male patients with VT observed in this study. Regarding the influence of gender on the seasonal variation of VT, although a higher proportion of VT in summer was equally found in men, it was statistically significant only among women. The possible reason for this finding is that the study included more females than males, as previous studies did not demonstrate the influence of gender on the seasonal variation of cardiovascular events[20,21]. Age, however, has an effect on the seasonal variation of sudden death and myocardial infarction[3,17]. In this study, no effect of age on the seasonal variation of VT was observed. This was not an expected finding, as the thermoregulatory response seems to decrease with age[22].

Study limitations - The study presents some potential limitations. This is not a population-based study; it is a retrospective study, carried out from the analysis of the results of 24-hour Holter monitoring at a Cardiology Service in a general hospital, and accurate information on the presence or not of cardiovascular disease, other diseases and utilization of antiarrhythmic medication are not available. Thus, it is not possible to better categorize the studied group and the results cannot be generalized. The data were obtained from the medical reports, and the tracing review was not possible. Nevertheless, this was the first study to evaluate the seasonal variation of VT in the south of Brazil, and it cannot be considered a definitive study, but a hypothesis-generator.

Original Article

Conclusion

The occurrence of VT presents a seasonal variation in southern Brazil, with a higher proportion of episodes occurring in summer. There is a possible association trend between temperature increase and VT. These results must be confirmed by prospective future studies.

Potencial Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

01. Spencer FA, Goldberg RJ, Becker RC, Gore JM. Seasonal distribution of acute myocardial infarction in the Second National Registry of Myocardial Infarction. J Am Coll Cardiol 1998; 31: 1226-33.
02. Sheth T, Nair C, Muller J, Yusuf S. Increased winter mortality from acute myocardial infarction and stroke: the effect of age. J Am Coll Cardiol 1999; 33: 1916-19.
03. Arntz HR, Willich SN, Schreiber C, Brüggemann T, Stern R, Schultheib HP. Diurnal, weekly and seasonal variation of sudden death. Eur Heart J 2000; 21: 315-20.
04. Müller D, Lampe F, Wegscheider K, Schultheiss HP, Behrens S. Annual distribution of ventricular tachycardias and ventricular fibrillation. Am Heart J 2003; 146: 1061-65.
05. Heyer HE, Teng HC, Barris W. The increased frequency of acute myocardial infarction during summer months in a warm climate. Am Heart J 1953; 45: 741-46.
06. Beard CM, Fuster V, Elveback LR. Daily and seasonal variation in sudden cardiac death, Rochester, Minnesota, 1950-1975. Mayo Clin Proc 1982; 57: 704-6.
07. The Eurowinter Group. Cold exposure and winter mortality from ischaemic heart disease, cerebrovascular disease, respiratory disease, and all causes in warm and cold regions of Europe. Lancet 1997; 349: 1341-46.
08. Sharovsky R, César LAM. Increase in mortality due to myocardial infarction in the brazilian city of São Paulo during winter. Arq Bras Cardiol 2002; 78: 106-9.
09. Sharovsky R, César LAM, Ramires JAF. Temperature, air pollution, and mortality from myocardial infarction in São Paulo, Brazil. Braz J Med Biol Res 2004; 37: 1651-57.
10. Scherlag BJ, Patterson E, Lazzara R. Seasonal variation in sudden cardiac death after experimental myocardial infarction. J Electrocardiol 1990; 23: 223-30.
11. Mittleman RS, Zhang X, Stanek EJ, et al, for the Telectronics 4211/4215 Investigators. Ventricular tachyarrythmias occur more frequently in winter and less frequently in spring than in other seasons: report from a multicenter implantable cardioverter defibrillator database (abstract). J Am Coll Cardiol 1996; 27 (suppl 2): 97A.
12. Zipes D. Warning: the short days of winter may be hazardous to your health. Circulation 1999; 100: 1590-92.
13. Keatinge WR, Coleshaw SR, Easton JC, Cotter F, Mattock MB, Chel R. Increased platelet and red cell counts, blood viscosity, and plasma cholesterol levels during heat stress, and mortality from coronary and cerebral thrombosis. Am J Med 1986; 81: 795-800.
14. Gordon D, Trost D, Hyde J, et al. Seasonal cholesterol cycles: the Lipid Research Clinics Coronary Prevention Trial Placebo Group. Circulation 1987; 76: 1224-31.
15. Brennen PJ, Greenberg G, Miall WE, Thompson SG. Seasonal variation in arterial blood pressure. Br Med J 1982; 285: 919-23.
16. Fries RP, Heisel AG, Jung JK, Schieffer HJ. Circannual variation of malignant ventricular tachyarrhythmias in patients with implantable cardioverter-defibrillators an either coronary artery disease or idiopathic dilated cardiomyopathy. Am J Cardiol 1997; 79: 1194-97.
17. Pan WH, Li LA, Tsai MJ. Temperature extremes and mortality from coronary heart disease and cerebral infarction in elderly chinese. Lancet 1995; 345: 353-55.
18. Enqueselassie F, Dobson AJ, Alexander HM, Steele PL. Seasons, temperature and coronary disease. Int J Epidemiol 1993; 22: 632-36.
19. Lerner DJ, Kannel WB. Patterns of coronary heart disease morbidity and mortality in the sexes: a 26-year follow-up of the Framingham population. Am Heart J 1986; 111: 383-90.
20. Ornato JP, Peberdy MA, Chandra NC, Busch DE. Seasonal pattern of acute myocardial infarction in the National Registry of Myocardial Infarction. J Am Coll Cardiol 1996; 28: 1684-88.
21. Messner T, Lundberg V. Trends in sudden cardiac death in the northern Sweden MONICA area 1985-99. J Int Med 2003; 253: 320-28.
22. Ogawa NK, Sugenoya J, Ohnishi N, Imai K. Preferred ambient temperature for old and young men in summer and winter. Int J Biometeorol 1992; 36: 1-4.