Variation in Parasystolic Cycle Length
Observations of a Hypertensive Patient for Over Six Years
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SUMMARY
At the time of the first visit to our clinic, an electrocardiographic examination of a 73-year-old female patient revealed ventricular premature contractions (VPCs) with variable coupling intervals that were diagnosed as parasystole. Characteristically many of the parasystoles had no sinus contractions between two consecutive VPCs, which we referred to as pure parasystole. We first repeatedly examined variations in the length of the parasystolic cycles between January 6, 1997 and March 2, 2003 using electrocardiography. The time courses recorded over this period showed that the length of the parasystolic cycle did not remain constant, but varied irregularly within a relatively narrow range. We also recorded the length of the parasystolic cycles over 3 hours using Holter monitoring. The interectopic intervals plotted against mean sinus cycle length showed that the cycle length of pure parasystoles remained almost constant at about 1,300 ms over the 3 hours. We also examined the cycle length during exercise and found that it was slightly prolonged thereafter, while the sinus cycle length was clearly shortened after exercise. The average of six deep breathing tests showed that parasystolic cycle length did not significantly differ between deep inspiration and deep expiration, whereas the sinus cycle length during expiration was significantly longer than that during inspiration. These results indicate that the responses to both exercise and deep breathing obviously differed between the parasystolic and sinus cycle lengths. (Int Heart J 2006; 47: 153-158)

Key words: Parasystole, Cycle length, Deep breathing test, Exercise test, Holter electrocardiogram, Sinus, Long-term observation, Interectopic interval

VENTRICULAR parasystole is a rare ventricular arrhythmia. The ectopic parasystolic center, which is protected from the impulse originating in other parts of the heart, discharges regularly on its own rhythm. However, the cycle length of the rhythm is not always the same in the strict sense. The parasystolic cycle length is reportedly modulated by carotid sinus pressure, exercise, standing, and by the cycle length of the basic sinus rhythm.1,2)
The present report describes variations in the parasystolic cycle length in a hypertensive female patient during Holter monitoring for 3 hours, follow-up for over 6 years, and exercise and deep breathing stress tests. The patient had frequent pure parasystolic cycles without sinus contractions between two consecutive ectopic cycles. The pure parasystolic cycles were suitable for analyzing variations in cycle length because they were directly measurable.

**CASE REPORT**

A 73-year-old female patient with hypertension and palpitations visited our outpatient clinic on August 14, 1996 and has been treated with antihypertensive drugs since that time. Since 2001 she has been receiving nonsteroidal anti-inflammatory drugs at an orthopedic clinic to treat aseptic necrosis of the femoral head of the left hip joint, which has caused her difficulties with walking. At the first visit in 1996 her heart rate was 72 bpm with some irregularities and her blood pressure was 162/98 mmHg. No other abnormal physical findings were noted. Chest X-rays showed borderline cardiomegaly and laboratory analyses of blood and urine were unremarkable. Echocardiography demonstrated no significant abnormalities. Electrocardiography revealed ventricular premature contractions (VPCs) with variable coupling intervals. Figure 1 shows ventricular arrhythmia that was diagnosed as parasystole with the shortest cycle length being 1.44 seconds. Holter monitoring revealed 23,238 VPCs per 24 hours. Characteristically

![Figure 1. Electrocardiogram conducted in March, 1997.](image-url)
many of the parasystoles had no sinus contractions between two consecutive VPCs, which we referred to as pure parasystole. We exclusively measured the cycle length of pure parasystoles to determine variations in the parasystolic cycle.

We initially examined variations in the parasystolic cycle length from January 6, 1997 to March 2, 2003 (long-term) by repeated electrocardiography. Figure 2 shows examples of an electrocardiogram and parasystolic cycle length. Figure 3 presents the time course of the parasystolic cycle length during this period of over 6 years. The times when electrocardiograms were recorded are also indicated. The parasystolic cycle length did not remain constant, but irregularly varied within a relatively narrow range between 1.21 and 1.60 seconds, with an average of 1.40 seconds. The shortest and longest cycle lengths were 0.19 seconds (13%) less and 0.20 seconds (14%) more than the average. The antihyper-
tensive drugs administered to the patient were trichlormethiazide 2 mg in the morning and atenolol 25 mg bid (August 1996 to February 1997), and trichlormethiazide 2 mg in the morning and diltiazem 30 mg bid (March 1997 to present). She also intermittently received nonsteroidal anti-inflammatory drugs to treat her left hip joint.

We then recorded variations using Holter monitoring over 3 hours from 09:00 until 12:00 on October 10, 2003. Figure 4 plots the interectopic intervals against mean sinus cycle length. The cycle length of pure parasystoles (arrow) remained almost constant at the level of about 1,300 ms throughout the observation period. B: Histogram of VPC-VPC interval. C: Components of VPC interval histogram as shown in Panel B.

Finally, we examined variations during exercise and deep breathing. One minute after the Master's two-step test on May 7, 1999, the length of the parasystolic cycle was slightly prolonged from 1.44 to 1.50 seconds, while that of the sinus cycle was obviously shortened from 0.94 to 0.74 seconds. The parasystolic cycle length was prolonged for at least 3 minutes. The cycle length was calculated as the mean of 5 consecutive deep breaths in each deep breathing test. This test was repeated 6 times during the period from April 23, 2001 to May 2, 2003 to compare the lengths of the parasystolic and sinus cycles during deep inspiration.
and deep expiration. Figure 5 shows examples of an electrocardiogram and the lengths of the parasystolic and sinus cycles during deep inspiration and deep expiration. We calculated the averages of 6 tests. Parasystolic cycle length did not significantly differ between deep inspiration (1.34 ± 0.03 seconds) and deep expiration (1.33 ± 0.02 seconds), whereas sinus cycle length during expiration (1.02 ± 0.03 seconds) was significantly longer than that during inspiration (0.94 ± 0.02 seconds) ($P < 0.001$). These results showed that the parasystolic and sinus cycle lengths responded differently to both exercise and to deep breathing.

**DISCUSSION**

Both clinical and experimental studies have documented variations in ventricular, including parasystolic, ectopic foci. However, little is understood about long-term variations in parasystolic cycle length. We observed the time course of the cycle length for over 6 years in a female patient and found that it varied irregularly within a range of about 14% of the average. This range is close to that of the diurnal variation that was recently described by Takayanagi, et al.3,4) Their computer analysis demonstrated a small diurnal variation corresponding to about 15% of the average cycle length in 10 patients. Although the parasystolic cycle length in our patient remained almost constant for 3 hours in the morning, these findings do not exclude the possibility of diurnal variation.

The variations of the parasystolic cycle length are not only much smaller than those of the sinus cycle length, but are sometimes in the opposite direction. Exercise increases whereas standing decreases parasystolic cycle length, while both decrease that of the sinus cycle.2) We also observed an increase in the parasystolic cycle length and a decrease in the sinus cycle length after exercise in our
patient. Deep breathing induces powerful changes in the sinus cycle length,\(^5\)\(^-\)\(^7\) but an effect on the parasystolic cycle length has not been reported. We hypothesized that this maneuver would induce corresponding changes in the parasystolic cycle length. However, deep breathing did not significantly affect parasystolic cycle length, but induced an increase during expiration and a decrease during inspiration in the sinus cycle length in our patient. These results indicate that the parasystolic cycle length varies, at least partially, through a mechanism different from that of the sinus cycle length.

REFERENCES