

# Evaluation of Cardiovascular System's Self-organizational Ability for Young and Elderly Normal Subjects

Wuon-Shik Kim\*, Seung-Hyun Jin\*, Young-Zoon Yoon\*, Jeong-Sang Lee\*\*

기립경사반응을 이용한 청년층과 노인층의 심혈관계 자기조직화 능력 평가

김원식\*, 진승현\*, 윤영준\*, 이정상\*\*

## 1. Introduction

Heart rate variability (HRV) is used as a clinical tool for diagnosing the cardiac autonomic function in both a healthy and diseased state<sup>(1)</sup>. A person's HRV becomes less random (or less chaotic) with aging<sup>(2)</sup>. The head-up tilting (HUT) test is a standardized physiological stimulus used to investigate the neurocardiogenic condition<sup>(3)</sup>. The test addresses the ability of the cardiovascular circulation to deal with a sudden change in posture rather than the ability to cope with a permanent orthostatic load.

Our aim is to investigate how the cardiac autonomic system adapts while the orthostatic defense is reacting to rapid tilting in a HUT test for young and elderly subjects.

## 2. Experimental Methods

Originally, 20 young subjects and 50 elderly subjects participated but we excluded six young subjects and 23 elderly subjects from the HRV analysis because they were smokers, took medication, or had clinical problems. We therefore ended up with 14 young subjects

(age:  $25 \pm 3$  years; eight males, six females) and 27 elderly subjects (age:  $75 \pm 6$  years; 15 males, 12 females).

After entering the experimental room, which was shielded from electromagnetic waves, each participant laid on the HUT test table in a supine posture ( $0^\circ$  from the horizontal line) and took a 10 min rest. We then used an electrocardiograph (Biopac MP-100 system, USA) to continuously record the ECG signal for 20 min: that is, for 10 min in a supine posture and for 10 min in a HUT posture ( $70^\circ$  from the horizontal line). Between supine posture and HUT posture, 1 min was spent for tilting.

We analyzed the linear and nonlinear characteristics of HRV for each 5 min period: that is, at the 5 min mark and 10 min mark for the supine posture, and at the 15 min mark and 20 min mark for the tilting posture.

## 3. Results and Discussion

When we compare the results taken at the 10 min mark of the supine posture with those taken at the 5 min mark of the supine posture, we can see no significant changes in the HRV variables both in the young group and in the elderly group.

\* 한국표준과학연구원

\*\* 서울대학교 보라매병원

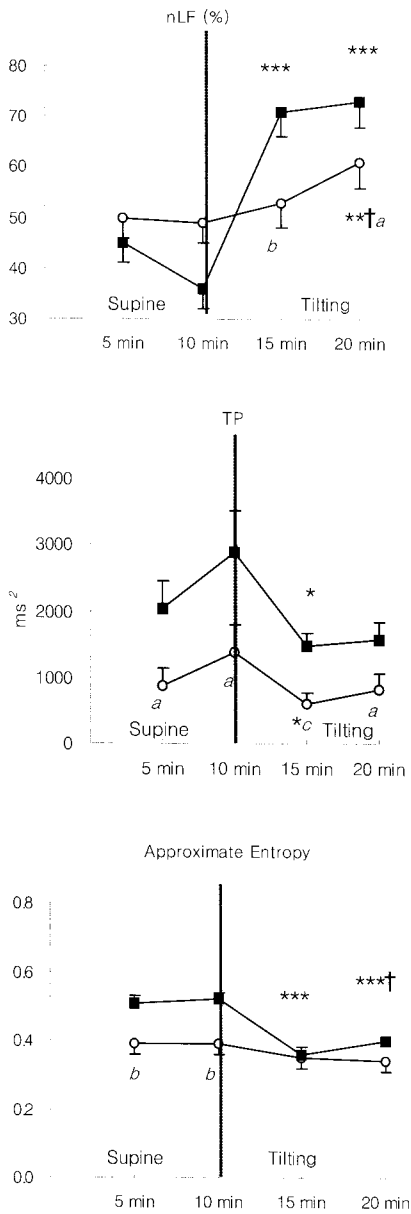


Fig. 1. The influence of HUT on linear and nonlinear measures of HRV in young subjects (■, n=14) and elderly subjects (○, n=27). Values are means  $\pm$  SE. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$  versus the 10 min of the supine posture; †  $p < 0.05$ , ††  $p < 0.01$  versus the 15 min of the tilting posture; a  $p < 0.05$ , b  $p < 0.01$ , c  $p < 0.001$  young subjects versus elderly subjects.

When we compare the results taken at the 15 min mark of the tilting posture with those taken at the 10 min mark of the supine posture, we can observe a significant increase in the normalized low-frequency power (nLF) in the young group ( $p < 0.01$ ). In contrast, we can see a significant decrease in the total power (TP) for both young and elderly groups ( $p < 0.05$ ) and approximate entropy (ApEn) in the young group ( $p < 0.001$ ) (Fig. 1).

#### 4. Conclusion

The way the cardiac compensation system reacts to sudden external force is more rapid and energetic in young people than in elderly people; the chaotic characteristics of the system are also more sensitive in young people. Nonlinear measures can reveal additional information on cardiac autonomic nervous system that linear measures fail to detect.

#### References

- (1) Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology, "Heart rate variability: Standards of measurement, physiological interpretation, and clinical use", *European Heart Journal*, 17, 354-381, 1996.
- (2) Acharaya U., Kannathal N., Sing O., Ping L., Chua T., "Heart rate analysis in normal subjects of various age groups", *Biomed. Eng. Online* 3(24), 2004.
- (3) Laitinen T., Niskanen L., Geelen G., Lansimies E., Hartikainen J., "Age dependency of cardiovascular autonomic responses to head-up tilt in healthy subjects", *J. Appl. Physiol.* 96, 2333-40, 2004.