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Modification of olmesartan on time-frequency distribution in QRS and expression of TIMP-1 mRNA in spontaneously hypertensive rat's heart

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Abstract

Aging changes of the time–frequency distribution (TFD) during QRS by use of continuous wavelet transform (CWT) observed at spontaneously hypertensive rats(SHR/Izm) hearts were studied with and without the administration of angiotensin II receptor blocker (ARB). The remodeling of the left ventricles was evaluated by histological and quantitative real-time RT-PCR analyses. The integrated time-frequency powers of ARB-treated SHR/IZM were less decreased over wide frequency range (180-500 Hz) but were tended to be increased in low frequency ranges (80 Hz or less) compared with those of control SHR/zm. The extracellular fibrous tissue was decreased in ARB-treated SHR/Izm than in control group. The present study provides the evidence that TFD of QRS complex partly reflects the suppressive action of ARB on age-dependent progression of cardiac remodeling in the heart.

1. Introduction

Recent reports indicate that CWT is an efficient tool with which to analyze non-stationary and transient changes in signal morphology[1]. we intended to quantitatively display CWT signals using the software[2-3], and compared them with histological findings and gene expression related to fibrosis. In this study, aging changes of TFD during QRS by use of CWT observed at spontaneously hypertensive rats (SHR/Izm) hearts were studied with and without the administration of angiotensin II receptor blocker (ARB).

2. Methods

SHR/Izm received oral ARB (olmesartan, 3mg/Kg) from 12 to 20 weeks of age. Systolic blood pressure (SBP) was slightly decreased in olmesartan-treated SHR/Izm(n=16) compared with age-matched control SHR/Izm (n=16). Continuous ECGs were recorded with the amplifier over 10 sec periods through a 1,000 Hz band-pass filter from all SHR/Izm at the age of 10ws and 20ws. Time-frequency power of the QRS complex was obtained in the frequency range of 70 to 500Hz with CWT applicating Morlet function. The integrated time-frequency powers (ITFPs) in QRS were calculated for every 40 frequency bands. The remodeling of the left ventricles was evaluated by histological and quantitative real-time RT-PCR analysis.

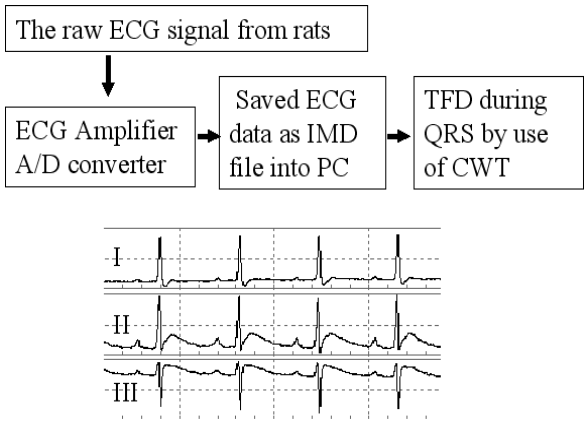

Figure 1. The outline of data acquisition and its analyzing systems and the representative limb leads ECGs.

3. Results

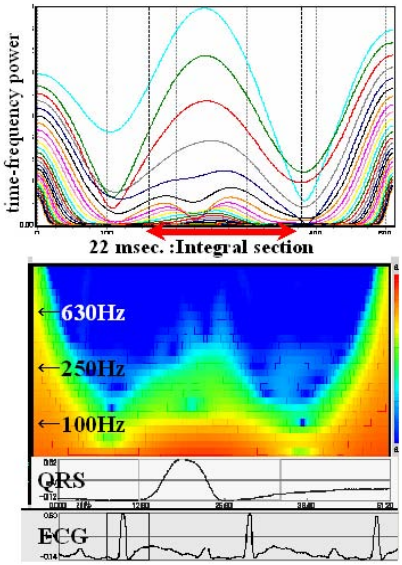

Figure 2. Representation of frequency power profile and wavelet signals of single QRS complex

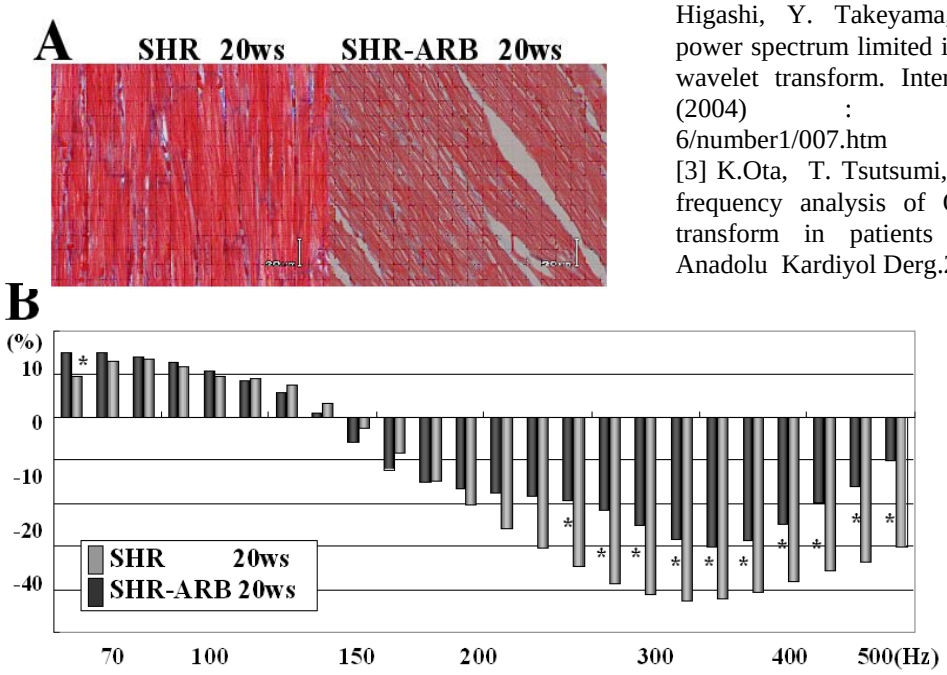

Figure 3. Histological detection of fibrous tissue and changing ratio of integrated time-frequency power in both SHR and ARB-treated SHR

In Figure 3A, the interstitial fibrosis and cardiac cell hypertrophy were more prominent in SHR than in olmesartan-treated SHR. As shown in Figure 3B, ITFPs of olmesartan-treated SHR/IZM were less decreased over wide frequency range (180-500 Hz) but were tended to be increased in low frequency ranges (80 Hz or less) compared with those of control SHR/zm. In addition, the extracellular fibrous tissue was decreased in olmesartan-treated SHR/Izm than in control group. The expression of TIMP-1 mRNA were also more prominent in control group.

4. Disccusions

The present study provides that CWT should become a useful method of detecting the the aging chang in TFD, and TFD in QRS complex partly reflects the suppressive action of olmesartan on age-dependent progression of cardiac remodeling in the rat heart.

5. References

[1] P.S. Addison, Wavelet transforms and the ECG: a review. Physiol. Meas. 26 (2005) R155-R199.
[2] T. Tsutsumi, D. Wakatsuki, H. Shimojima, Y. Higashi, Y. Takeyama, Analyzing time-frequency power spectrum limited in QRS complex based on the wavelet transform. Inter. J. of Bioelectromag. 6(1) (2004) : http;//www.ijbem.org/volume 6/number1/007.htm
[3] K.Ota, T. Tsutsumi, and Y.Okamoto,et al. Time-frequency analysis of QRS complex with wavelet transform in patients with triple-vessel disease, Anadolu Kardiyol Derg.2007 Jul;7 Suppl 1:133-4