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Maximum phonation time in relation to disease severity in chronic heart failure male patients

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Maximum phonation time (MPT), which is related respiratory function, is widely used to evaluate maximum vocal capabilities because it is non-invasive, quick, and inexpensive (1,2).

Patients with chronic heart failure (CHF) have lower peak oxygen uptake ($\dot{V}O_2$) value (2,3). We previously found that MPT correlates positively with peak $\dot{V}O_2$, and Peak $\dot{V}O_2$ indices decreased with increases in New York Heart Association (NYHA) functional class in CHF patients (2). This cross sectional study aimed to determine the differences in MPT indices with disease severity in CHF patients. We selected 101 consecutive outpatients with stable male CHF who visited our university hospital for first-time evaluation of MPT and peak $\dot{V}O_2$ by cycle ergo meter. However, those classified as NYHA functional class IV, and those with neurological, peripheral vascular, orthopedic, or pulmonary disease, cancer, cirrhosis of the liver, nephrotic syndrome or advanced renal disease, or who were on dialysis were excluded. We evaluated participant characteristics including age, body mass index, left ventricular ejection fraction (LVEF), etiology, and medications. A cardiologist assessed LVEF as the index of cardiac function by echocardiography. NYHA classification was determined in all patients by an independent physician.

MPT was measured with a stopwatch with the patient in the seated position based on previous studies' methods. Patients were asked to produce a sustained vowel /a:/ for as long as possible and were verbally encouraged during this effort. The method, variability, and reliability of this measurement were previously described (1). Trials were assessed by a physical therapist. Three consecutive trials were allowed with a 15-second break between each trial. The highest value measured was considered the index of MPT (sec) in the present

study. All patients underwent symptom-limited CPX via a ramp protocol on a cycle ergometer during stable CHF. Testing consisted of an initial 3-minute rest on the cycle ergometer, 3 minutes of warm-up, and full exercise with linear load increased by 1 watt every 6 seconds. $\dot{V}O_2$ was measured throughout the exercise period with an aero monitor and calculated on a personal computer (2,3). The exercise testing endpoint was determined according to guidance from the American Heart Association and included leg fatigue, shortness of breath, or respiratory exchange ratio >1.10 (2,3). The present study was approved by our University Institutional Committee on Human Research. Informed consent was obtained from each participant.

Results are expressed as mean $\pm$ standard deviation (SD). Differences in clinical characteristics were analyzed by the Tukey test and chi-square test, and analysis of covariance (ANCOVA) was used to analyze MPT and Peak $\dot{V}O_2$ if there were significant differences in clinical characteristics between three groups. A p value of <0.05 was considered significant. Statistical analyses were performed with IBM SPSS 17.0 J statistical software.

No patient had chest pain, ischemic ST changes, or serious arrhythmia during CPX. The study comprised 101 CHF outpatients divided into three groups based on a NYHA functional classes. Participant clinical characteristics, Peak $\dot{V}O_2$ and MPT are shown in Table 1. Except for age, clinical characteristics were almost identical between groups. ANCOVA adjusted for age indicated that Peak $\dot{V}O_2$ and MPT indices significantly decreased with increases in NYHA class in CHF patients (Table 1). Also, MPT are shown as a Figure 1.

The present study is the first, to our knowledge, to evaluate a relation between MPT and disease severity in CHF patients.

Although age values were significantly different between the three groups, other patient

clinical characteristics were almost identical. After adjustment, significant differences were present in these values in relation to NYHA functional class, indicating that a high NYHA functional class, indicating lower peak $\dot{V}O_2$ in CHF patients. This finding is consistent with those of earlier study (3).

We previously reported positive correlation between MPT and peak $\dot{V}O_2$ in CHF patients (2). The results of the present study also show that in CHF patients, differences in MPT, relate to degree of illness as classified by NYHA functional class. The present study suggests that reduced Peak $\dot{V}O_2$ may reduce MPT levels in CHF patients too. However, we do not have enough data, and do not know in the relation of cause and effect in the present study.

With regard to normal subjects of MPT, Hirano et al. (4) suggested that normal subjects, and reported an average MPT of 34.6 sec in men. In the present study, MPT of NYHA I, NYHA II and III in our patients were inferior to previous Hirano's study (4).

The present study was limited by the absence of longitudinal data and female in these participants. The present study shows that in patients with CHF, NYHA functional class increased as MPT decreased as well as Peak $\dot{V}O_2$. In other words, NYHA functional class seems to be related to not only peak $\dot{V}O_2$ but MPT. The present study is an initial step in identifying factors associated with MPT in disease severity of CHF patients. MPT has also been used to objectively assess the degree of severity of dysphonia and to effects of voice therapy (5). Additional study is needed to evaluate the effect of MPT training in longitudinal settings and over longer periods in these patients.

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Figure legends

ANCOVA adjusted for age indicated that MPT indices significantly decreased with increases in NYHA class in CHF patients.

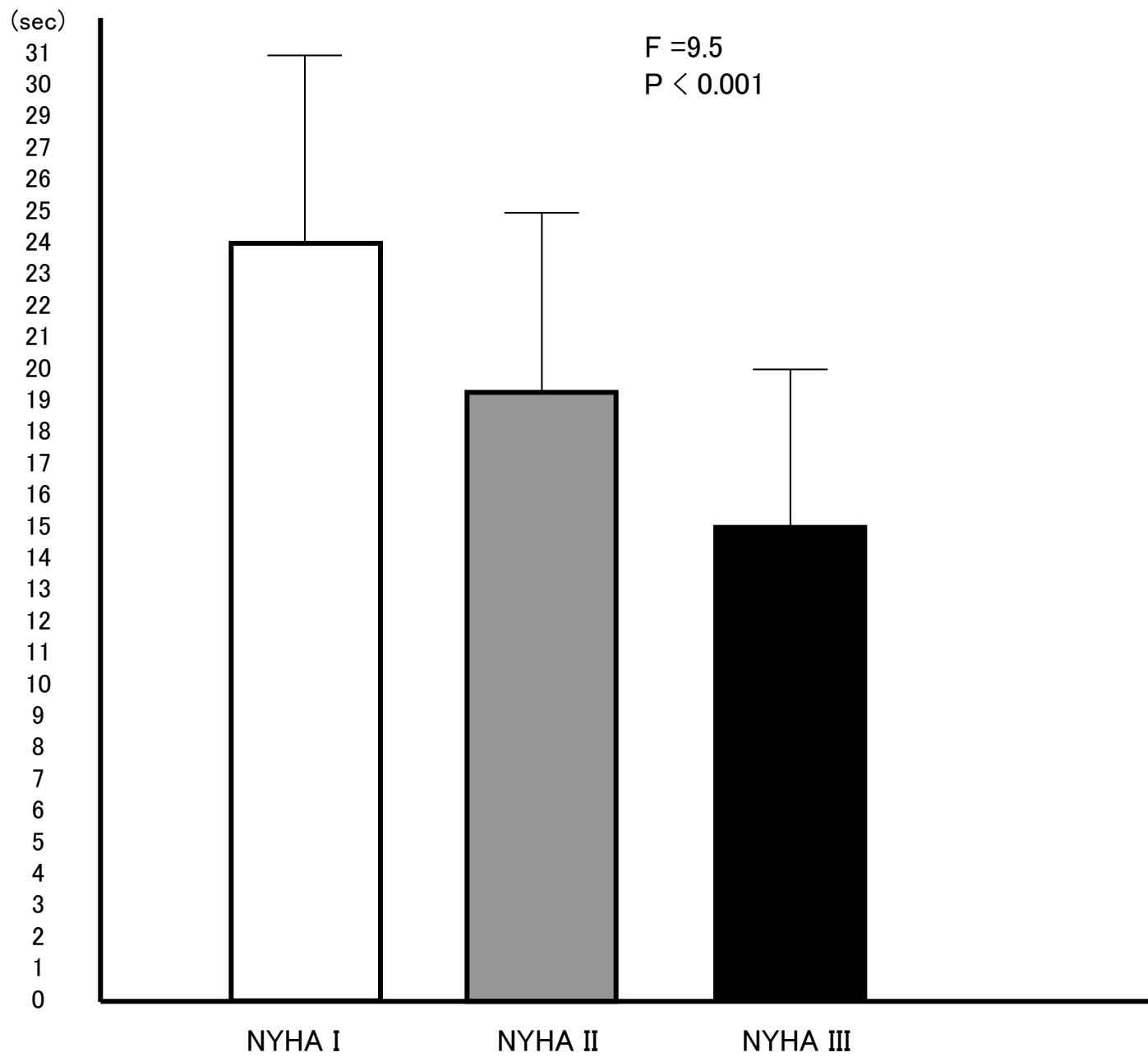


Fig. 1

Table 1.

Clinical characteristics of the patients.

Group	NYHA I	NYHA II	NYHA III	F or χ^2 value	p value
No. of patients	28	49	24		
Age (yrs)	48.9±8.4	56.1±9.3	56.0±11.7	5.65	0.005
BMI (kg/m ²)	23.6±3.1	23.1±5.8	22.9±3.9	0.28	0.75
LVEF (%)	31.9±15.5	33.9±7.5	32.0±15.1	0.36	0.69
Etiology (%)					
Cardiomyopathy	50.0	44.4	45.0	3.25*	0.77
Previous myocardial infarction	35.8	26.7	30.0	-	-
Arrhythmia	7.1	22.2	15.0	-	-
CABG/VR	7.1	6.7	10.0	-	-
Medications (%)					
Beta blockers	78.9	80.1	81.3	0.65*	0.31
ARB	42.3	46.9	48.3	0.53*	0.27
ACEI	48.2	43.2	45.2	0.45*	0.26
Diuretic	86.5	85.9	90.7	0.10*	0.51
Peak $\dot{V}O_2$ & MPT					
Peak $\dot{V}O_2^{**}$ (ml/kg/min)	24.2±7.4†‡	19.1±4.7*‡	13.1±3.3*†	16.1	<0.01
MPT** (sec)	24.0±6.9†‡	19.4±6.0*‡	15.2±5.6*†	9.5	<0.01

NYHA, New York Heart Association; BMI, body mass index; LVEF, left ventricular ejection fraction; CABG, coronary artery bypass grafting; VR, valve replacement; ARB, angiotensin receptor blocker; ACEI, angiotensin converting enzyme inhibitor; peak $\dot{V}O_2$, peak oxygen uptake; MPT, maximum phonation time. * χ^2 value. **Adjusted for age

* Significantly different compared with the NYHA I group.

† Significantly different compared with the NYHA II group.

‡ Significantly different compared with the NYHA III group.