CHAPTER V

DISCUSSION

The purpose of this study was to evaluate the physiological responses during the 6MWT among the COPD patients with and without anemia and compare the result to those of normal subjects. The lowest 6MWD and the highest HRim were found in the anemic group. The resting SpO_2 was not different among the groups, but the lowest SpO_2im was found in the anemic group.

The control group had the longest walking distances among the groups. Additionally, the walking distances in the anemic group was lower than the non anemic group (300.12 ± 88.55 m. vs. 390.12 ± 50.75 m.; $p<0.05$). This result is comparable to a recently published study (265 ± 122 m. for the anemic group vs. 325 ± 124 m. for the non anemic group) (50). This implies that the functional capacity is reduced in the anemic group via the reduction in oxygen carrying capacity. Additionally, the difference of walking distance between the anemic and non anemic group was about 90 meters in our study. The evidence suggested that changing of the walking distances greater than 70 meters could alter the patient's clinical perception (10). Thus, the study related to clinical perception between the anemic and the non anemic group needs to be continued.

In this study, the highest resting heart rate was found in the anemic group compared with the others. Physical inactivity can increase resting heart rate (51). Also, dominant sympathetic outflow can increase heart rate and stroke volume in

patients with anemia (6). Thus, the anemic condition and the sedentary lifestyle, may affect their resting heart rate.

In this study, the HRim was not statistically significant difference among the three groups. However, the HRim trended to be higher in the pathologic group than the control group which may observe with large number of subjects. This may be due to the effect of increase WOB primarily from the airway obstruction in the pathologic group (1). Furthermore, the highest HRim was found in the anemic group. The anemic condition leads to an increase in blood plasma volume (6, 8). This consequently results in congestive heart failure leading to pulmonary hypertension and pulmonary edema, respectively (52). As a result, low lung compliance is occurred. Thus, the restrictive lung in the anemic group is possibly due to the low compliance. This restrictive type can increase the WOB and the heart rate, respectively.

The resting SpO_2 was over 95% in all groups. At rest, the oxygen availability can meet the basal metabolic rate. However, during the 6MWT the oxygen supply does not meet the oxygen demand due to high exercise intensity and gas exchange impairment in anemic and non anemic COPD.

It is known that the intensity of the 6MWT is comparable to the maximal exercise stress test in moderate to severe COPD patients (11). The range of exercise intensity in Turner's study was between 67 to 105 percent predicted maximal heart rate (11). In this study, the exercise intensity in the non anemic and the anemic groups was approximately 69.95 and 75.5 percent predicted maximal heart rate,

respectively. Thus, the test could elicit oxygen supply deprivation and sufficiently stress the cardiopulmonary system.

Previous study have reported that the SpO_2im is significantly lower in COPD patients compared to the healthy individuals (53), similar to this study. This study is the first to demonstrate that the SpO_2im in anemic patients is significantly lower than in non anemic patients. Additionally, greater deoxygenating and greater reduction of SpO_2im was found in the anemic group (from $95.65 \pm 2.31\%$ to $84.82 \pm 6.69\%$, Δ $SpO_2 \sim 10.82\%$) when compared to the non anemic group (from $96.35 \pm 2.31\%$ to $90.06 \pm 7.11\%$, $\Delta \sim 6.29\%$). This is because the higher the heart rate, the greater the reduction of transit time at the pulmonary capillaries. Thus, the severity of gas exchange impairment in the anemic group was greater than in the non anemic group.

Ozalevli et al (53) reported that SBP and DBP were not significantly different between COPD and healthy group at rest and immediately after the 6MWT. However, SBP and DBP at rest and immediately after exercise were slightly higher in healthy group. In the present study, sympathetic activity was greater in the anemic group than the non anemic group, even though this group tried to reduce the walking speed.

Pervious study have shown that dyspnea after the 6MWT in the anemic group is greater than in non anemic subjects (50). In this study, data on leg fatigue and the dyspnea before and after the test were obtained. The pathology group had greater mean leg fatigue and dyspnea than the control group before and after the 6MWT. Level of leg fatigue and the dyspnea were greater in the anemic group than in the counter part before and after the test.

Hypoxemia in patients with severe COPD stimulates EPO production in the kidneys, resulting in increased RBC production (5). Thus, polycythemia should be frequently seen in the patients with COPD. In fact, it is not always the case. In one epidemiological study, the anemic prevalence in COPD was 23.1% (5). Additionally, EPO resistance was found in the anemic group (31).

Both COPD and CHF are considered as systemic inflammatory diseases (2, 3). Various anemic mechanisms in CHF have been proposed. Firstly, the increased level of inflammatory cytokines may reduce red blood cell survival. Secondly, there is the inhibition of erythropoietin production in bone marrow. Lastly, iron utilization is inhibited. Currently, the mechanisms of anemia in COPD are unknown. These mechanisms may cause anemia in COPD patients. Thus, further study needs to be done on these issues.

There were several limitations in this study. Firstly, there was no physical examination for gastrointestinal (GI) bleeding or laboratory tests of iron deficiency. GI bleeding and iron deficiency commonly cause anemia in the elderly (30). Secondly, pulmonary artery and capillary pressure were not directly measured. Lastly, objective physical examinations on the heart issues need to be done. This is because cardiac disease is one of the most common co-morbidities in patients with COPD (52).

In conclusion, this study showed that the lowest mean 6MWD was found in the anemic group compared with the non anemic group and the control group. However, the HRim was not significantly different among three groups. Immediately after the 6MWT, the anemic group showed the lowest SpO_2 among the three groups.

Also, anemia seems to reduce functional capacity in moderate to very severe COPD patients.