

Long-Term Effect of Marathon to Cardiac Health- Potential Myocardial Fibrosis

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Abstract—towards the awareness of healthy living, people are likely to participate in long-distance running activities, for example, the marathon. Though, despite the helpful cardiovascular effect on marathon running, little is known about the negative effect of long-term recurring marathon running to the heart. Cardiac markers among marathoners show potential myocardial injury that is suspected because of prolonged hypoxemia during the long long-distance running which might predispose to myocardial fibrosis (MF). In spite of the concerns about the possible effect of MF among runners, studies found that the occurrence is variables. Considering the increasing participation of marathon among amateur as well as recreational athletes of the productive population, there is a need for awareness and also further evaluation on the possibility of MF among marathoners. A pre-participation examination among older age adults with the potential of underlying heart and coronary disease should be considered before marathon participation.

Keywords—endurance running, marathon, long-term effect, cardiac, myocardial fibrosis

I. INTRODUCTION

The World Health Organization recommends that adults aged eighteen-sixty-four to-do no less than 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic activity per week [1] Towards the awareness of healthy living, people have a tendency to participate in activities such as long-distance running to meet the recommended physical activity. Mass participation towards long-distance running events such as marathon and ultramarathon has increased since the late 70s, particularly among the productive population, between twenty to fifty years old [2, 3].

Marathon running is known to improve cardiovascular health and fitness.[3], [4] but, there are findings that indicate the possibility of long-term side effects.[5]–[7] This is explained by the exercise dose-response relationship that intense exercise training may cause pathologic cardiac remodeling. The duration for a person to finish a marathon is approximately four hours, which is a long duration for the heart to fulfill the oxygenation demand.[7] as a result of the high and long duration oxygen needs, researchers have found that an increased in the cardiac markers among endurance running just after the competition.[8]–[10]

Looking at the long high intensity running patterns performed by marathon runners, there is a risk of repetitive

micro-injury which may cause abnormalities in the hearts, such as the myocardial fibrosis (MF).[7], [9]–[13] The impact of increased cardiac biomarkers to the heart after endurance exercise is still not clear. Also, the correlation between the increased biomarker and the long-term effect which might be caused to MF needs more research since the effects only present in some of the runners.[6, 7] This review is to deal with the possible development of MF among marathon runners.

II. MF IN MARATHONERS

Myocardial fibrosis is described as a net accumulation of extracellular matrix proteins in the cardiac interstitium caused by hemodynamic stress, for example ischemia, inflammation and pressure overload which contributes to both systolic and diastolic dysfunction.[7, 14, 15] recently, myocardial fibrosis is detected by serum markers, cardiac magnetic resonance imaging (CMR) with late gadolinium enhancement (LGE), and endomyocardial biopsy. Though histology of endomyocardial biopsy is regarded as the gold standard, LGE is an established tool to assess the extent of myocardial fibrosis. [16] The main potential mechanism of MF among long long-distance athletes especially marathoners remains to be unknown since not all marathoners develop MF even after a lifelong participation.[6], [17]–[19] Schoor et al hypothesize four different pathways which may cause the development of MF among athletes [7].

- 1) Genetic predisposition – happens mostly among the young age with the manifestation of hypertrophic cardiomyopathy.
- 2) Silent myocarditis – the development of myocarditis is a non-viral because of exercise, which predominantly subclinical with minimal or no symptoms.
- 3) Pulmonary artery pressure overload – limited to the septum or even right ventricle insertion resulted from local mechanical stress in pulmonic systolic pressure produced during prolonged exercise.
- 4) Repetitive microdamage - related exercise intensity in marathon cause repetitive exercise-induced cardiac microdamage proved by minor troponin elevations.

Even though it has a evidence of the significant increase in cardiac injury biomarkers in most of the marathon runners after exercise, only 12 percent of apparently healthy 102 marathon runners aged fifty-72 years old who had completed a minimum of five marathons over the past three consecutive

years manifested with positive late gadolinium enhancement (LGE). From the twelve positive subjects, five had a coronary artery disease (CAD) pattern of LGE. When compared to the age-matched control, even though the marathoners were 3 times higher rate

Compared to control, the difference was not statistically significant.[17]

Though, in a smaller sized number of subjects (n=12) by Wilson et al[6] but similar age (50-sixty-seven) of lifelong, veteran endurance athletes, a subclinical evidence showed a high prevalence of myocardial fibrosis (50%), compared to age-matched control and young athletes. The difference subject criteria in this study when compared with the subjects of Breuckman et al, has a stronger dose-effect proof of association with the number of competitive marathons and the long-distance of the completed marathon.

Curiously, further research to the latter subjects with evidence of 50% MF among the marathoners found out that lifelong veteran endurance athletes with MF demonstrate larger cardiac dimension with larger end diastolic volume compared to athletes without MF. Despite the fact that there's evidence of structural differences between the 2 groups, echocardiography data showed that despite the presence of MF, though, didn't impact global systolic or diastolic function.[18]

Bohm et al had different more paradoxical finding when compared to studies mentioned above. Out of thirty-three healthy white competitive elite male master endurance athletes between 30–sixty years old with a training history of 29±8 years, only one (3%) pathological late improvement was detected. The study concluded that it is unlikely of cardiac damage in elite endurance master athletes with lifelong high training volumes [19].

Discussion

Long-term repeated impact of the marathon on cardiac damage has been a concern of late. The concern is based on the histories of sudden cardiac deaths among marathon runners with the first marathoner, Pheidippides who experienced sudden cardiac death after running.[3, 20]

The study by Breuckman et al[17] with the criteria of at least five marathons for the past three repeated years gives a result of the effect of repeated participation in a year. Taking into consideration that the age of the subjects of ≥50 year age, there's a high possibility of underlying a cardiac disease shown by the CAD pattern to five of the subjects. Although research classified the subjects to three repeated years with five participations in a year, there is no data of how many years of subjects' participation since their first marathon. As compared to the study done by Wilson et al[6], they took the data of years of training, and numbers of participants of the subjects since their first participation. Even though there is a chance of recall bias, this study could correlate between the diseases with the numbers of years participated before. With this data, the research may conclude the association between the disease as well as the dose effect of past training.

Although, the same study of Bohm et al[19] with younger age subjects with 29±8 years of training history shows only a 3% of a nonischemic pattern of pathological LGE which was most probably because of a previous asymptomatic

pericarditis. This is based on the finding from Wilson et al [6] which shows no prevalence of LGE among young endurance athletes. The possibility of marathoners who're involved in running in a later age has already likely predisposing factors in developing MF such as tobacco smoking when compared with the younger marathoners who had previously been having healthy lifestyle since a young age.

Although the hypothesis of possible myocardial fibrosis among marathoners, the fact that marathon can improve cardiovascular health with positive improvement can also be taken into account. This et al [19] had shown that despite the fact that there is the presence of MF among the lifelong endurance athletes, it didn't mediate global tissue velocities or even global longitudinal strain and strain rate during the echocardiogram. Their finding of athletes with MF has bigger hearts compared to the non-MF athletes, but the functional effect of the hearts is heterogeneous.

III. CONCLUSION

Chronic intense and sustained exercise of the marathon because of long-term repeating hypoxemia might predispose to myocardial fibrosis.

Younger age of participation of marathon without underlying genetic and cardiac diseases will not likely develop myocardial fibrosis when compared to the older age of participation. For that reason, a pre-participation examination among older age adults with possibilities of underlying heart and coronary disease should be considered before marathon participation.

A more detailed study with the considerations of control subjects, including other possible predisposing factors for instance running hours, years of participation, coronary artery imaging, likely underlying diseases, and drugs consumption is important to develop the hypothesis of potential myocardial fibrosis among marathoners

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