FORMULATED COOL DOWN PHASE OF EXERCISE – EXERCISE MEDICINE

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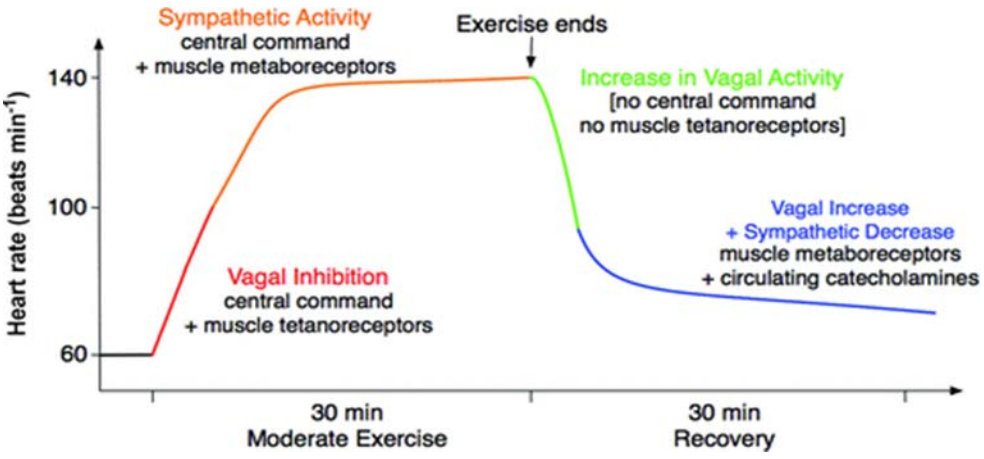
Introduction

Many research papers have proven the importance on the warming up phase gearing the body for an exercise routine for peak performances. There is no precise formulation or guideline as when do you cease to exercise; which is the cooldown phase. Sudden deaths though its remote, has been found only to occur during the cessation of the activity. Hence, this paper hypothetically draws a formulation based on the data collected on the cooling down phase crossing the 2 axis to coincide the time taken and the numbers of heart beat.

Recovery of the heart rate immediately after exercise is a deceleration mechanism of the vagal activation. Although attention has been given to the prognostic implications of changes in heart rate during exercise, (Ellestad & Wan, 1975; Sandvik, Erikssen, & Ellestad, 1995; Lauer, Okin, Larson, Evans, & Levy, 1996) the prognostic value of the rate of decline in heart rate after the cessation of exercise, the time taken and or the rate of the reduction of heart rate falls upon cessation of exercise has not been well characterized which could have led to the many unexplained sudden death in physical activities.



(Fig. 1) Changes in heart rate during and following exercise

The graph illustrates the change in heart rate from rest in a subject undergoing a 30 min period of moderate dynamic exercise followed by a 30 min recovery period. The timing of the

contribution from changes in cardiac vagal and cardiac sympathetic activity and their relation to central command and inputs from exercising muscle, as discussed in the text, are indicated schematically. Based on data from various sources.

Following moderate and longer periods of dynamic exercise, however, the sharp fall in heart rate does not reach the baseline (HR before exercise commence) value but continues to decrease slowly in an exponential manner over many minutes, and longer depending on the duration and intensity of the exercise (Carter III, Watenpaugh, Wasmund, Wasmund, & Smith, 1999; Takahashi, Okada, Saitoh, Hayano, & Miyamoto, 2000; Brown, Li, Chitwood, Anderson, & Boatwright, 1993; Miyamoto, et al., 1982; Takahashi, Okada, Hayano, Tamura, & Miyamoto, 2000; Hautala, et al., 2001; Murrell, et al., 2007) .

During this period, there is a co-ordinated cardiac vagal–sympathetic interaction, which ensures that there is sufficient cardiac output to prevent circulatory collapse whilst the dilated muscle vascular beds recover. This is probably enabled by slow reduction of sympathetic nerve activity, which is still being reflexed enhanced by muscle metaboreceptors as the muscles recover, and by the slow clearance of circulating catecholamines (Hart, et al., 2006).

Dr. Gary Mak, specialist in cardiology and President of the Hong Kong Association of Sports Medicine and Sports Science warned of stopping abruptly after running but should follow through a long and slow cool-down period with the concern of high risk of arrhythmia and vasovagal syncope. Abrupt stopping will put the heart under high stress as it will aggravate the imbalance between sympathetic nervous system and parasympathetic system, which are responsible for the exercise and cool-down of our bodies. Abrupt stopping might trigger either one of the following situations:

Sympathetic nervous system, which functions to increase heart rate to support the body for exercise, might become persistently hyperactivity and causes arrhythmia or even sudden death.

Parasympathetic system, which functions to restore normal heart rate after exercise, might act too quickly and causes low blood pressure and slow heart rate which in turn triggers vasovagal syncope.

The purpose of this study is to examine a formulated guideline to the post exercise recovery guide (called as ‘heart rate return’ [HRrtn]) to progressively cool down after a bout of exercise session to prevent post exercise arrhythmias which has been the leading cause of death.

It has been documented that upon cessation of exercise at any level of maximum heart rate (MHR), the elevated heart rate (HR) will not return to its baseline for many minutes.

During the first minute after cessation of exercise, the concentrations of both catecholamines increased still further while potassium decline rapidly have been termed the "vulnerable period" regarding the occurrence of lethal cardiac arrhythmias. The researchers propose that the rapid decline of potassium concentration while catecholamine levels are elevated to near maximal levels may contribute to the vulnerability of some individuals to post exercise arrhythmias (Young, Srivastava, Fitzovich, Kivlighn, & Hamaguchi, 1992).

According to the American Council on Exercise, if you suddenly stop after doing exercise that gets your heart rate up you can be at the risk of getting Blood Pooling Syndrome (BPS). During strenuous activity, your heart sends blood to the muscles because of their increased need for oxygen and nutrients. The blood vessels in your legs and feet expand causing more blood to flow into your lower extremities. BPS is when you suddenly stop without taking time to cool down causing your heart rate to drop abruptly. This can cause blood to stay and pool in your lower body instead of circulating back to the heart which can cause dizziness and fainting.

The risk is greater for serious athletes because their heart rate is slower and their veins can hold more blood than the average person. Those with heart disease are also at greater risk because blood vessels leading to the heart are narrowed making it harder for blood to get to the heart.

A cool down is the best way to avoid BPS. To determine the cool down phase based on the HR achieved or the time taken as cool down considering the variables of exercisers physical fitness status as the main component and taken into consideration that subjects are healthy with no cardiovascular diseases/complications.

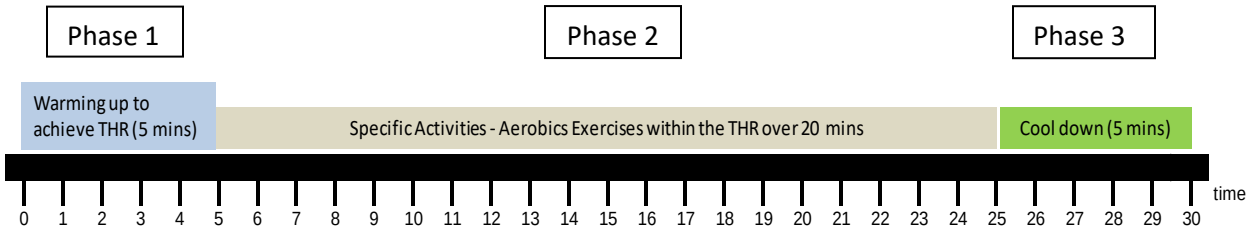
Objective

This paper is the first of 3 phases. The 1st phase is the data collection of how the heart rate decelerates with healthy subjects based on a hypothetical equation. The 2nd. phase will be comparison of healthy and subjects with cardiovascular conditions in their post exercise heart rate deceleration in time and the variables of the heart rate deceleration. The 3rd. phase will be

the meta-analysis of the deceleration variables to subjects with pathophysiology of the subjects' cardiovascular conditions.

The recommended elevation of HR during exercise

The 3 phases of exercise is as below:



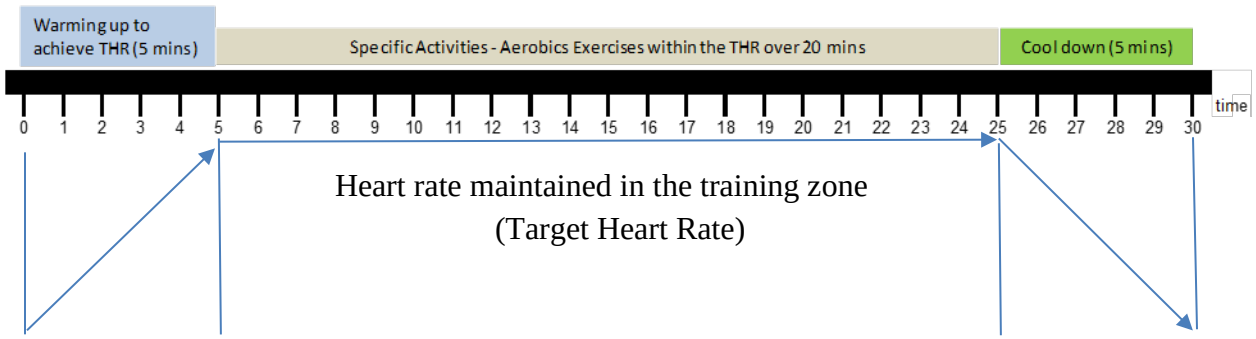
(Fig.2)

Phase 1: The specific warming up time is 5 mins before proceeding to the specific activity (aerobics exercises) ie the elevation of the resting heart rate (RHR) to the desired target heart rate training (THR) zones for specific adaptations.

Phase 2: Specific activities and its intensities– Specific activities relates to the specific types of exercises.

Phase 3: Cool down – There are no conclusive literature on this phase as compared to warming up. Looking at this cooling phase to be critical and it is important to formulate a guide to a proper regimented cooling down phase. Cooling down after a workout is seemed to be more critical than warming up as its relation to mortality. Sudden death is seen not only during exercise, but often immediately after cessation. The term "post-exercise peril" has been used to refer to the risk of cardiac arrhythmias during the first few minutes after cessation of strenuous exercise.

After physical activity, your heart is still beating faster than normal, your body temperature is higher and your blood vessels are dilated. Exercise-induced hypotension (EIH) also identifies subjects at increased risk for ventricular fibrillation in the exercise laboratory. This means if you stop too fast, you could pass out or feel sick.



HR increases from baseline (RHR)

HR do not return to baseline (RHR)

Therefore we are to determine the heart rate in an estimated time (5, 7 mins) upon cessation of exercise matches with the HRrtn formula.

Formulation – CP Method calculation for the cool down duration to cease exercising

Assuming the exerciser's THR is 130bpm (moderate level) and the RHR is 70bpm. The difference of the elevated numbers of heart beat (THR) from the baseline (RHR) is 60 beats (130bpm – 70bpm) then dividing to equal half (60bpm/2) gives the value of 30bpm. Add this value to the RHR, its gives a final value of 100bpm [30bpm + 70bpm] called as the heart rate return (HRrtn).

$$\left\{\frac{\text{THR-RHR}}{2} + \text{RHR} = \text{HRrtn}\right\}$$

The determined HRrtn as calculated from the formula will then be the crucial part of guide in the cool down phase but is also dependent on the time taken for each individual exerciser if they are able to acquire the numbers of HRrtn (bpm) in 5 to 7 minutes. As the heart rate recovery (HRrecovery) is determined in the 1st. and 2nd. minutes post exercise, we allowed the exerciser to cool down for 5-7 minutes and determine the HR at the end of 7 minutes.

With a constancy of time and HR of individual exerciser, we assumed that it would be safe for the exercise to completely stop their exercise session.

Discussion

With this guide of HRrtn, we are furthering our studies to:

a) Determine the time difference taken to arrive at the HRrtn for trained and untrained healthy subjects.
b) Determine the time taken to arrive at the RHR (pre-exercise level).
c) Cross examine the HR of the exercisers based on the variables of age factor and general cardiovascular fitness level.

Base on the similarity of the tabulation of exercisers' HR and the formulation value, we recommend that exercisers can cease their exercise session upon their HR reaches the HRrtn value as a guide.

Conclusion

The cooling down as part of the physical activity regime should be executed in a proper protocol to avoid discomfort and even sudden death though is remotely reported. This paper was not only benefits exercisers but through the fitness and health industry, the time taken was from warming up to end of exercise and cooling takes only 30 minutes which normally all exercisers are allowed to use the cardio machine. As we have demonstrated the entire exercise regimes takes no more than 30 minutes, it would be also justifiably to encourage busy individuals to exercise with a correct dosage and the right protocol.
Calculation of the HRrtn is simple and easily apprehensible.

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