18 Exercise and Immune Functions

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18.1. Introduction

The increasing popularity of regular exercise is probably the result of increased public awareness regarding the beneficial effects of exercise on physical and emotional well-being. The positive effects of regular exercise are obviously a complex interaction between physiological and psychological effects. For example, it has been shown that exercise can lower blood pressure, improve the lipid profile, and decrease sensitivity to pain (Thoren, Floras, Hoffmann, & Seals, 1990).

Many individuals claim that regular exercise increases resistance to infections such as the common cold (Fitzgerald, 1988; Nash, 1987). On the other hand, there have also been anecdotal reports from athletes and their coaches that hard training is associated with increased respiratory tract infections (Fitzgerald, 1988). There is epidemiological evidence supporting the anecdotal impression (Nieman & Henson, 1994), and it has become clear that the function of the immune system is enhanced by moderate physical activity and may be somewhat responsible for exercise-related reduction in illness. In contrast, it has been repeatedly shown that intense exercise causes inhibition of the function of the immune system in the recovery phase following intense exercise (Hoffman-Goetz & Pedersen, 1994).

Today much research in exercise immunology is stimulated by the acceptance of exercise as a tool to study the immune system. Exercise can be employed as a model for temporary immunosuppression occurring after severe physical stress. The exercise stress model can be easily manipulated experimentally, and allows for the study of interactions between the nervous system, the endocrine system, and the immune system. Furthermore, eccentric exercise that is associated with muscle damage may represent a model of the acute-phase response to local injury.

This chapter provides an overview of the effects of acute and chronic exercise on the immune system and discusses the clinical significance of these findings.

18.2. Acute Exercise and the Cellular Immune System

18.2.1. Leukocyte Subpopulations

There are several consistent patterns that emerge regarding leukocyte subpopulations in the blood. The neutrophil concentrations increase during exercise and continue to increase postexercise (McCarthy & Dale, 1988). The lymphocyte concentration increases during exercise and falls below prevalues following intense long-duration exercise (McCarthy & Dale, 1988). The increased lymphocyte concentration is related to recruitment of all lymphocyte subpopulations to the blood. Thus, CD4+ T cells, CD8+ T cells, CD19+ B cells, CD16+ natural killer (NK) cells, and CD56+ NK cells increase during exercise. Simultaneously, the CD4/CD8 ratio decreases, because the CD8 count increases more than the CD4 count. The percentage of CD4+ cells declines primarily because of the fact that NK cells increase more than any other lymphocyte subpopulation. Accordingly, the relative fraction of lymphocyte subpopulations changes.

18.2.2. NK Cells

NK cells are a heterogeneous population of cells (see Chapters 1 and 2). By definition, they are CD3- large granular lymphocytes that express characteristic NK cell markers such as CD16 and CD56.